Research Papers

The 20th EuroFM Research Symposium

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Online Conference

Editor:
Tuuli Jylhä

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▊Preface

I am very proud to present the proceedings of the 20th EuroFM Research Symposium! EuroFM is a network organisation missioned to promote 'advancement of knowledge in Facility Management in Europe and its application in business, education and research'. This open access publication and online research symposium present and discuss original, advanced FM research in the EuroFM network and beyond.

EuroFM Research Symposium is this year part of the 'Stay connect' sessions. The June series of 'Stay connected' sessions starts with education (9 June 2021), is followed by research (16-17 June 2021), and ends with business (30 June 2021). The online EuroFM Research Symposium is arranged 16-17 June 2021 in two afternoons. The first day reflects the new office landscape and is targeted at researchers, practitioners, educators and students. The second day of the symposium focuses on research developments in FM and CREM, and in FM education.

This conferences proceedings includes 12 papers. All accepted papers were double-blind peer reviewed. This year it was possible to choose to write either a full (max. 12 pages) or a short paper (max. 6 pages). From the 12 accepted papers, 10 are full papers and 2 are short papers. Approx. 70 % of submitted abstracts were developed and finally accepted in the peer-review process.

I would like to thank all the authors, the members of the scientific committee and the best paper committee, the speakers, the member of the EuroFM board, the EuroFM secretaries and my student assistant Danica Widarta for their contribution, commitment and flexibility in making this open access proceedings. It's a great, joint effort in the fantastic EuroFM network!

I look forward to our online symposium! May it offer us a possibility to greet old and new FM friends, provide advanced FM knowledge, and generate ideas for future EuroFM research initiations.

Tuuli Jylhä
Chair of the Scientific Committee
Research Chair of EuroFM

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The influence of the physical home work environment on perceived productivity during the COVID-19 pandemic

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ABSTRACT

Background and aim – Due to the COVID-19 crisis, Dutch employees were told to work from home as much as possible. Homeworking can have benefits both for employees and employers, as some experience a productivity increase and a better work-life balance. However, it is also harder for employers to measure and monitor employees' performance and for the employee it can cause social and professional isolation. Previous research studied homeworking from a voluntarily perspective assuming that the home work environment was suitable to conduct homeworking. Little is known about the experience of 'obliged' home working. In this research, the suitability of the home work environment is examined by looking at the relationship of physical aspects of the home work environment with perceived individual productivity.

Methods / Methodology – For this research the data at from an existing dataset (N = 36,102) was used, gathered by the research project "We Work from Home (WWH)". Data was collected, on a weekly basis, from Dutch office workers in (mainly) public organizations from April till December 2020. The following aspects were examined with regard to the room people used for their working activities: (1) the original function, (2) private vs shared use, (3) size, (4) ambient factors, and (5) outside view. Perceived individual productivity was measured on a ten-point scale. In this research descriptive and bivariate analyses (independent samples t-test or one-way anova) were conducted.

Results – Results showed that respondents who worked in a work room at home reported higher productivity (mean = 7.84, std. = 1.18) than respondents that worked in different types of rooms, especially those in the bedroom (mean = 7.45, std. = 1.38). In addition, respondents that did not have to share their workspace (mean = 7.83, std. = 1.19) reported higher productivity than those that (partly) did (mean shared = 7.57, std. = 1.34; mean both shared and private use = 7.52, std. = 1.34). Also, a higher productivity was found for respondents that indicated having ambient factors in their home work environment, like plants, art, and colour, and to have an outside view from their workplace.

Originality (if applicable) – The mass experiment of obliged homeworking provided a unique opportunity to study the relationship between physical aspects of the home work environment and perceived individual productivity.

Practical or social implications – It is expected that after the pandemic, employees will work from home more often than before. The ultimate goal of this study was to provide organisations and homeworkers with guidelines that can help them to enhance a suitable home work environment.

Type of paper – Research paper

KEYWORDS: Teleworking; Homeworking; Productivity; Home work environment; COVID-19

INTRODUCTION

Homeworking, also known as teleworking, is a phenomenon that has been studied since the 1980s.

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It was predicted that, partly due to the rise of information and communication technologies (ICTs), homeworking arrangements for employees would be implemented by many organizations. Especially so, because such research showed an expected increase in productivity of their employees; an essential benefit from an organizational perspective (Bloom et al., 2015). However, throughout the years homeworking arrangements were adopted less than predicted (Martin & MacDonnell, 2012), probably because it is harder for managers to monitor and measure the performance of their employees (Martin & MacDonnell, 2012; Steward, 2000). Furthermore, teleworking was also shown to potentially cause social or professional isolation because of less informal interaction with colleagues, and lower the career prospects of homeworkers as they are not seen (as often) at the office (Nakrošienė et al., 2019).

During the COVID-19 crisis, (Dutch) employees were suddenly told to work from home as much as possible, providing a unique opportunity to study the experiences of employees during this mass homeworking period. While homeworking influenced productivity of employees positively before COVID-19 (Bloom et al., 2015), recent research during COVID-19 showed various results (Mihai et al., 2020; Moretti et al., 2020; Toscano & Zappalà, 2020). In addition, not every home work environment is equally suitable for working from home. Employees do not always have a separate working room available and/or lack proper ICT facilities. Hence, the aim of this research was to determine what aspects of the physical home work environment influenced employees' productivity during this period.

LITERATURE STUDY

The emphasis in this study was on the productivity of knowledge workers in relation to their personal and home workplace characteristics. Because actual productivity is difficult to quantify (there are multiple ways of executing knowledge work and the outcomes of knowledge workers are mostly not comparable (Frankema, 2003)), we followed others in measuring perceived individual productivity instead (e.g. Bosch-Sijtsema et al., 2009). Throughout the years, research has shown that homeworking increases perceived productivity (Bloom et al., 2015; Giovanis, 2018; Martin & MacDonnell, 2012). However, homeworking is mostly studied as a phenomenon in itself, which means that no specific elements of homeworking were studied more in detail. An exception is Hoornweg et al. (2016), who discuss the impact that telework intensity (the number of hours working from home compared to total work hours) can have on productivity. When telework intensity is high (more than 8 hours per week), it was found that productivity decreased (Hoornweg et al., 2016). As the homeworker during COVID-19 is likely to work at home all the time, the telework intensity is very high. This implies that the productivity of the homeworker during COVID-19 might have decreased instead of increased. However, recent research on homeworking and productivity during COVID-19 showed various results. According to Moretti et al. (2020) respondents were less productive, although less stressed. On the contrary, Toscano and Zappalá (2020) record a high level of strain and, because of that, low productivity, whereas Mihai et al. (2020) showed higher productivity during COVID-19.

So far, studies on office employees' productivity focused on the office environment, such as the literature study by de Croon et al. (2005), instead of the home work environment. An exception is Ng (2010) who adjusted the conceptual framework of de Croon et al. (2005) to fit into the context of the home work environment. However, Ng (2010) did not study the effect that specific aspects of the home work environment have on productivity. A recent study by Nakrošienė et al. (2019) showed that the overall suitability of the working place at home has a positive effect on productivity, but the effect of specific aspects of the home are not addressed yet either.

So, a selection of relevant workplace design aspects must be drawn from office literature. According to de Croon et al. (2005), aspects of the office work environment that influence employee performance can be categorized by (1) office location, (2) office lay-out, and (3) office use. For the office location, a distinction is made between the conventional office and the telework office (this includes remote offices as well as the homework office) (de Croon et al., 2005). In the case of the COVID-19 situation, the office location is (mostly) the homework office, here referred to as home. The lay-out and use means whether the office uses an open plan or cellular offices, and if the workplaces are fixed or shared (de

Croon et al., 2005). The office lay-out in the home work environment can be interpreted as whether the room is used as a separate office or whether the employee works in a room with a different function (Ng, 2010), such as a living room or a bedroom, and should also include the size of this room. The office use means whether the room is shared or not. Usually, homeworkers prefer a private office, especially because of distraction issues (Ng, 2010). The current study looks at the function of the room (office layout) and whether the workplace is shared or used privately (office use).

Haynes (2008) found that besides a layout and use component (called behaviour by Haynes), there is also a component comfort of the physical environment that influences employees' productivity. He distinguished the indoor climate, such as temperature and ventilation, the lighting, both natural and artificial, décor, cleanliness, physical security, and the overall comfort. In addition to these attributes, the spatial requirements found by Ng (2010) are other ambient factors, such as the view from a workplace.

RESEARCH METHODOLOGY

This study is part of a Dutch research project called 'We Work from home' (WWH). WWH is a collaboration between the knowledge center 'Center for People and Buildings' (CfPB), consulting firm Aestate/Ontrafelexperts, Eindhoven University of Technology, and Delft University of Technology. The aim of the WWH project is to collect experiences with and insights in mass and obliged homeworking, to firstly offer organizations and employees practical tools on how to work from home, now and in the future, and secondly provide insights into starting points for policy and management after COVID-19. To gather the necessary data, weekly surveys were conducted over a period of nine weeks. For this short paper the data from the second week, with questions on the physical home work environment and productivity, was used (N = 36,102). Respondents with missing answers on at least one of the socio-demographic variables or with regard to productivity were omitted from the analyses, resulting in a sample 31,301 respondents. Most participating organisations belonged to the public sector.

The following aspects of the room in which the respondent worked most frequently (often to always) were available from this survey: for layout (1) the original function and (2) size, for use (3) private vs shared use and for comfort , (4) ambient factors, and (5) view. Table 1 shows the answer categories that respondents could pick from. Individual perceived productivity was measured on a 10-point scale. Descriptive and bivariate analyses (independent samples t-test and one-way anova) have been used to examine the relationship between the various physical aspects of the room and productivity.

RESULTS

The results of the analyses are provided in Table 1. Forty percent of respondents (mostly) worked in a work room (40%) and another 31% in the living room. Only 8% of respondents reported working often in multiple rooms in the home. Half of all respondents used the room they worked in privately and their workplace generally measured between $11 - 25$ m^2 (42%). A little less than half of the respondents reported to have ambient factors in their home work environment, like plants, art, and colours (other than neutral, light colours). The majority (89%) had an outside view from their workplace.

Table 1. Aspects of the physical home work environment and mean individual productivity

	n	%	Mean productivity (std)
Original function of the room (n = 31,301)**			
Work room	12,425	40%	7.84 (1.18)
Kitchen	1,763	6%	7.68 (1.32)
Living room	9,783	31%	7.68 (1.33)
Bedroom	1,973	6%	7.45 (1.38)
Other room	2,096	7%	7.57 (1.32)
Multiple rooms	2,518	8%	7.62 (1.34)
No type of room assigned / No response	743	2%	7.44 (1.60)

Size of the workplace (n = 31,301)**			
Small size workplace (1 – 10 m2)	8,059	26%	7.62 (1.32)
Medium size workplace (11 – 25 m2)	13,217	42%	7.70 (1.28)
Large size workplace (> 25 m2)	8,832	28%	7.80 (1.25)
No response	1,193	4%	7.78 (1.36)
Use of the room (n = 31,301)**			
Private use	16,091	51%	7.83 (1.19)
Shared use	7,391	24%	7.57 (1.34)
Both private and shared use	761	2%	7.52 (1.34)
No type of use assigned / No response	7,058	23%	7.60 (1.41)
Ambient factors			
Plants (n = 31,297)**			
Yes	14,610	47%	7.77 (1.27)
No / No response	16,687	53%	7.66 (1.30)
Art (n = 31,297)**			
Yes	12,686	41%	7.80 (1.25)
No / No response	18,611	59%	7.65 (1.31)
Colour (n = 31,297)**			
Yes	13,446	43%	7.82 (1.24)
No / No response	17,851	57%	7.63 (1.32)
View from workplace (n = 31,266)**			
Yes	27,690	89%	7.75 (1.26)
No / No response	3,576	11%	7.44 (1.45)

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** = mean individual productivity differs, with p < 0.001

The last column of Table 1 shows the mean productivity. A Welch test[5] showed that perceived productivity differed significantly (Welch's $F_{(6, 5146.87)}$ = 45.56, p <.001) between the various home work places. Post hoc comparisons using the Games-Howell test indicated that the mean productivity for respondents mainly working in a work room (7.84) was significantly higher than the productivity reported for all other rooms (7.44-7.68). Furthermore, the mean productivity reported by respondents working in the bedroom (7.45) was significantly lower than most other rooms, except 'Other room' (7.57) and 'No type of room assigned / No response' (7.44). These results show that productivity seems to be dependent upon the original function of the room in which respondents work; a dedicated work room seems to induce higher productivity whereas working in the bedroom appears to decrease productivity.

The mean productivity also differed significantly (Welch's $F_{(3, 5348.97)}$ = 29.465, p <.001) depending on the size of the workplace. The Games-Howell test showed that a small size workplace (7.62) scored significantly lower than all other size categories (7.70-7.80). And also the mean productivity reported for the medium-size workplace (7.70) again was also significantly lower than those in the large workplace (7.80), so, the larger the workplace, the higher the perceived productivity.

With regard to the use of the room, the results show that the mean productivity differs depending on whether the room is used privately, shared or both (Welch's $F_{(3, 3451.99)}$ = 100.97, p <.001). The post hoc Games-Howell test showed that only the mean productivity reported for private use (7.83) is significantly different (higher) than for all the other types of use (7.52-7.60). Respondents that worked both in private and shared environments were not more productive than respondents that only worked in a shared home work environment.

All ambient characteristics also showed higher productivity levels among the respondents. Those with plants in their home work environment reported a significantly higher mean productivity (7.77) than respondents without plants (7.66; $t_{(31295)}$ = 7.5, p < 0.001.) Respondents who indicated that they had

art or colour in their home work environment significantly differed with regard to mean productivity from respondents without art or colour in their room (for art t(31295) = 10.4, p < 0.001; for colour t(31295) = 12.8, p < 0.001). Lastly, respondents who reported to have a view from their workspace (7.75) significantly differed from respondents without (7.44) t(31299) = 13.6, p < 0.001). So, ambient factors in the home work environment and a view from the workspace seem to be favourable for productivity too.

DISCUSSION AND/OR CONCLUSIONS

The current study aimed to analyse the relationship between various physical aspects of the home work environment and perceived individual productivity. The results showed that those respondents with a dedicated work room at home, a place that does not have to be shared, which was relatively large (>25m^2), decorated with plants, art, and colour, and provided an outside view perceived higher productivity than those with inferior home workplace qualities. A future longer paper will also present data on the satisfaction with the physical home work environment and the socio-demographic characteristics of the respondents, and how all these subjects are related to each other in a more integrated analysis.

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Analysing perceived communication and productivity of different office workers while working fully from home due to COVID-19 restrictions

Minou Weijs-Perrée[1], Rianne Appel-Meulenbroek[1], Jeroen Looijen[1], Bartele S. Hoekstra[2], and Pity Jongens-van der Schaaf[3]

ABSTRACT

Background and aim – Due to the COVID-19 pandemic, people were forced to fully work from home under unique circumstances. Although working from home has several benefits, there are also many challenges regarding work-related communication, which are expected to have an impact on office worker's productivity. Therefore, this study is aimed to analyse how office workers perceived work-related communication while working from home during this pandemic, and how this related to their perceived individual productivity.

Methods / Methodology – The data are collected through a survey which was distributed between April and December 2020 among knowledge workers working at home due to the COVID-19 pandemic. The descriptive and bivariate analyses are based on data from 22.013 respondents.

Results – The results showed that generally people rate their productivity as positive. In addition, employees are positive about knowledge sharing and contact frequency while working from home. However, employees miss the spontaneous communication and people who are dependent on team work feel less productive, when working fully from home. In addition, people are moderately positive about the ease of communication with colleagues. People with (young) children and people who live alone perceived their productivity lower while working from home.

Practical or social implications – Since COVID-19, working from home has become more popular and is expected to stay more popular after this pandemic. This evoked reconsideration of workplace management strategies by many organisations. Insights in the perception of people regarding work-related communication while working fully from home, under unique circumstances, could help these organizations to improve communication facilities at home and at the office and eventually optimize work processes.

Type of paper – Research paper.

KEYWORDS

Teleworking; communication; productivity; COVID-19; office workers.

INTRODUCTION

Even though working from home (i.e. teleworking) is a hot topic at the moment, its origin dates back to the 1970s (Tavares, 2017). Telework can be defined as "*work that is performed from different locations (such as home) that enables workers to access to their labour activities by the use of information and communication technologies*"(Nakrošienė et al., 2019, p. 88). The term was first introduced by Nilles (1975) during the oil crisis in the 1970's, when it became clear that working from home could create work flexibility which in its own turn would create benefits for both organizations and employees. As a result, boundaries between working and non-working time become flexible while working from home. Over the last years, the popularity has risen even more since technological improvements created more possibilities to work remotely (Potter, 2003).

Throughout the last decades, the Netherlands has gained a leading position within the European Union on remote working, with 14 percent of the Dutch labour force working remotely within their organization in 2019 (European Commission, 2020). Since the COVID-19 pandemic in March 2020, there

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has been even a larger shift from working in conventional office environments to working fully from home, as the Dutch government requested to do so, when possible, in order to flatten the infection curve (Rijksoverheid, 2020).

Working (almost) fulltime at home and dealing with exceptional conditions (e.g. non-professional work spaces, lack of childcare, partner at home, social restrictions, and lack of ICT services) due to COVID-19, might also lead to many challenges related to perceived work-related communication and productivity. Therefore, it is interesting to investigate more in-depth how office workers perceived communication and productivity while working from home during the COVID-19 period. So far, research on the influence of (almost) fulltime working from home, under such unique circumstances, is still lacking. The main aim of this study was therefore to analyse people's perception of communication while working (almost) fully from home due to COVID-19 restrictions and investigate the possible relationships with perceived productivity. In addition, this study aimed to provide insight into personal differences regarding perceived productivity and work-related communication. The following section reviews the existing literature on perceived communication and productivity while working from home. Then, the data collection and methodology are described. In the fourth section the main results of the analyses are discussed. The final section contains the conclusion and discussion.

LITERATURE STUDY

Over the last years, the popularity of working from home has risen, even more since technological improvements created more possibilities to work remotely within organizations. However it most strongly increased recently due to COVID-19 restrictions (Guyot & Sawhill, 2020). Previous research showed that (part-time) working from home seems to have a positive relationship with productivity and work-life balance (Nakrošienė et al., 2019). For example, studies showed that working from home leads to positive changes in the daily schedule, such as a decreased commuting time and flexible working hours, which contributes to making knowledge workers feel more productive (e.g. Bosua et al., 2013; Raišienė et al., 2020). Another study showed that employees who regularly alternate their work environment between home and the office, reveal higher levels of well-being than the ones working primarily at the office or those working mainly from home (Beauregard et al., 2013). In addition, Butler et al. (2007) found that productivity of working from home employees did indeed rise compared to in-office workers, not only for a short term, but also over a period of three years. However, not all studies are very positive about productivity while working from home. For example, Lippe & Lippényi (2020) showed that individual and team performance decreased when more people worked from home. In addition, combining obligations from home and from work at the same time could also have a negative impact on people's productivity (Nakrošienė et al., 2019).

Besides productivity, working from home leads to many challenges related to communication. Communication is an activity that we humans perform every day, and is embedded in our interactions with other people (Marques, 2010). There are two different types of interaction at the work environment, namely work-related interactions (i.e. formal) and social interactions (i.e. informal) (Marouf, 2007). It is recognized that these social interactions (e.g. small talk) increases trust and support among office workers (Chevez & Aznavoorian, 2014), which eventually might lead to a higher productivity.

Communication can take place intentionally or unintentionally by exchanging thoughts and knowledge, and is not limited to verbal communication forms only (Mehrabian, 1972). It is recognized that verbal communication in combination with the presence of body language (i.e. face-to-face interaction) increases the impact of the message on the listener, enables direct feedback and improves the quality of information transferring (Zaremba, 2006). For example, Daim et al. (2012) suggested that absence of (non-verbal) communication can lead to anxiety, confusion and misunderstandings between employees. Therefore, more research is needed how people perceived communication opportunities, while working fully from home, under unique circumstances, due to COVID-19 restrictions.

An important form of work-related communication is knowledge sharing, which refers to providing know-

how and information on particular aspects in order to collaborate on solving problems, developing new ideas and implementing policies or procedures (Cummings, 2003; Pulakos et al., 2003). It is recognized that knowledge sharing is most effective through spontaneous face-to-face interactions at the office (Ngah & Jusoff, 2009; Wang & Noe, 2010), which is not possible when working fully from home. In addition, face-to-face interactions at work are important for sharing interests, rich information exchange and socializing (Sailer et al., 2016; Suckley & Dobson, 2014). If knowledge sharing is not possible (or optimal) due to COVID-19 restrictions, it is expected to affect individual productivity.

Besides proper communication, both individual and team productivity depend on ICT support while working from home (Bosua et al., 2013). Currently, a broad range of ICT communication tools are available for working from home, with the telephone as the oldest one. The advantage of phone contact is that a large exchange of (social) information can take place in a short time (Hinds & Kiesler, 1995). Another commonly used communication tool for working from home is e-mail (Smith et al., 2018). In addition, the use of instant messaging (e.g. WhatsApp, Messenger, chat MS Teams) for work-related communication is increasing, as it creates the opportunity for immediate feedback from colleagues and for multitasking (Wojcak et al., 2016; Zhang & Fjermestad, 2008). A communication tool, which has seen a big increase in users since the COVID-19 pandemic started, is the use of video communication. For example, the number of users of the video-call platform "Zoom" increased by 78% (Tilly, 2020). Despite this increased interest in (new) ICT communication tools, still little is known about the impact of using only ICT tools (instead of face-to-face communication) on an individual's productivity.

Furthermore, previous research showed that there are several personal differences with regard to productivity and communication. For example, it is recognized that women more frequently use, but also better understand, non-verbal communication, which is more difficult while working from home (Hall & Matsumoto, 2004). Another study suggested that women prefer face-to-face communication over technology-based communication (Mano, 2013). In addition, Zhiyu & Krishna (2020) showed that women perceived their productivity lower during the COVID-19 lockdown. Besides gender differences, younger workers probably use and learn new (online) communication tools faster than older workers (Dunaetz et al., 2015). Several studies on working from home before COVID-19 showed that the average teleworker has a high education level and a high income (e.g. Hjorthol, 2006; Peters et al., 2004). A higher education level is possibly related to the use of ICT tools and complex tasks while working from home. So, people with a higher education level probably are more productive as they have more experience with working from home (Sarbu, 2015). Neufeld and Fang (2005) showed that having (positive) social interactions with family members during the workday was related to a positive perception of working from home and subsequently related to productivity. Moreover, women are more likely to only work when children are not around (i.e. structure their workday) and that men are shown to be more resistant to interruptions by family members (Huws et al., 1996).

Overall, it is assumed that perceived productivity is thus related to people's personal characteristics and to how people experience work-related communication while working from home. Although working from home has several advantages regarding productivity, it is expected that communication (frequency, knowledge sharing and receiving support/ feedback from co-workers) is more difficult while working from home, due to the lack of face-to-face (informal) interactions and non-verbal communication. Therefore, this study aims to analyse how office workers perceived communication and productivity while working from home fulltime due to COVID-19 restrictions.

RESEARCH METHODOLOGY

Existing data was used, which was collected through a large survey-based Dutch collaboration project between 2 universities and 2 organisations from practice. The data was collected weekly in nine consecutive weeks among office workers of multiple organizations (i.e. mainly public organizations) in the Netherlands during the COVID-19 pandemic, starting in April 2020 up to the end of 2020. For the current study, a sub-survey from week 4 (22.013 respondents) was used, which specifically focused on communication. Data was collected on personal characteristics, perceived productivity and perceived

communication using an online survey. For data analysis only the cases that completed the full survey and reported their personal characteristics were taken into account.

First, respondents were asked to indicate the extent to which they are dependent on teamwork, followed by a question whereby respondents were asked to what extent they agreed with six items about sharing knowledge and experience, giving feedback and spontaneous knowledge sharing, based on a 6-point Likert scale, ranging from (1) disagree to (6) agree (see Table 2). Besides knowledge sharing, respondents were asked about the ease of communication, while working from home. They were asked to indicate to what extend they agreed with the following four items: "*I discuss problems in the progress of the work directly in team meetings*", "*I can easily approach colleagues with ad hoc questions*", "*I know what colleagues from my team are doing*" and "*We coordinate the progress of the work on a daily basis*".

With regard to contact frequency, respondents were asked to fill in how often they have digital meetings with their team and supervisor while working from home, ranging from (1) once a month to (5) daily. In addition, respondents were asked about the communication tools they used. They could indicate whether they used the following tools (yes/no): email, shared documents, shared server, groupware programs (e.g. MS Teams, Groupware, Wire, or Slack etc.), video conferencing systems (e.g. Skype, Zoom, or Facetime etc.), telephone, instant messaging (e.g. Messenger or WhatsApp) and social media (e.g. Facebook, Twitter or LinkedIn). Furthermore, they were asked to indicate which of these tools they preferred for specific activities, such as providing general and existing information, solving a joint problem together and planning and monitoring. In addition, respondents were asked to rate their perceived individual productivity on a scale from 1 (low productivity) to 10 (high productivity). Finally, respondents were asked about their age, gender, level of education, household composition and age of children living in the parental house.

RESULTS
Sample descriptives
Table 3 shows the sample characteristics. As can be seen, men and women are almost equally divided. This sample consists of a large number of people (37.4%) aged between 51-60 years and with a high education level (i.e. bachelor's and master's degree programmes at HBO or University) (73.8%). Most respondents live together with a partner without (37%) and with children (38.3%). Among the respondents that provided the age of their children (18.3%) in the survey, the youngest child in the household is aged between 4-11 years (27.5%), 12-17 years (24.1%) or 18-22 years (33.4%).

Table 3 Sample characteristics week 4 (n= 22013)

Gender	N	%
Male	10305	46.8
Female	11596	52.7
Other	112	0.5
Age	**N**	**%**
≤30 years	1797	8.2
31-40	3495	15.9
41-50	4968	22.6
51-60	8227	37.4
> 60 years	3526	16.0
Education level	**N**	**%**
Lower education level	1489	6.8
Medium education level (MBO)	4090	18.6
High education level (HBO/ University)	16248	73.8

Other	186	0.8
Household composition	**N**	**%**
Single-person household	3545	16.1
Single-parent household with children living at parental home	1312	6.0
Couple without children (living at parental home)	8154	37.0
Couple with children (living at parental home)	8426	38.3
Other	576	2.6

Figure 1 shows that people most often used e-mail (97.8%), video conferencing systems (e.g. Skype, Zoom, or Facetime etc.) (92.7%) and telephone (90.8%) as communication tools. Social media (e.g. Facebook, Twitter or LinkedIn) is used only by a few people (2.4%) in the sample for work. Among the respondents, e-mail contact is mainly preferred for providing (80.5%) and requesting (82.7%) general and existing information. Moreover, e-mail contact is also widely applied to exchange information about a common problem (77.2%) and for planning and monitoring (61.6%). Telephone contact is preferred when needing (75.8%) or offering (60.3%) help to solve a problem both individually and collaboratively. In those cases, the possibility to share a large amount of information in a short time is seen as an advantage. This is also applicable for video conferencing, although this communication tool is more preferred when discussing a problem together (71%). Moreover, this tool is commonly used for presenting results (53.4%). When instant messaging (e.g. WhatsApp) is used for work-related communication, it is primarily used for suggestions to help other colleagues (27.4%).
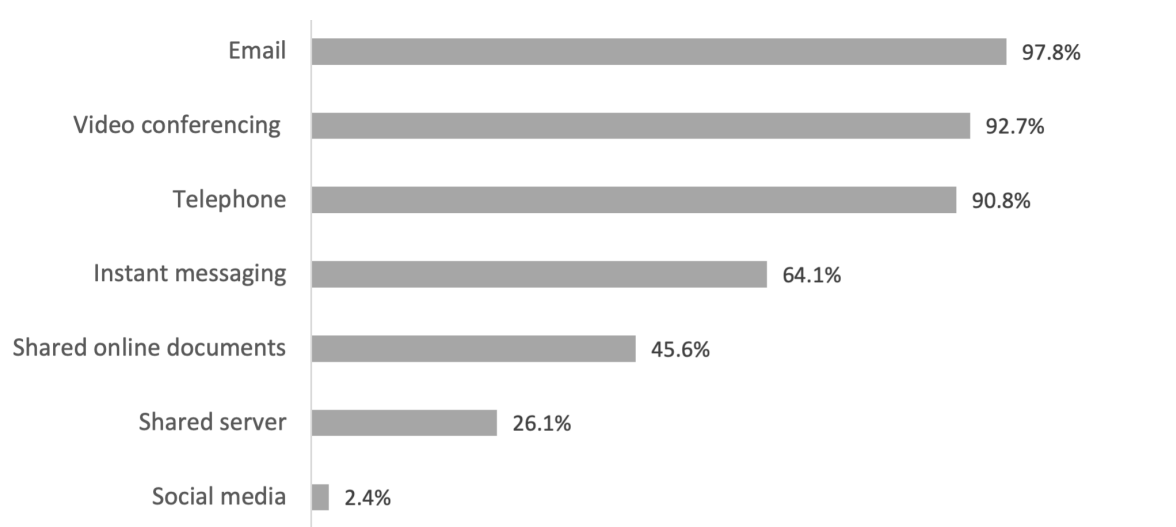
Respondents rated their individual productivity during COVID-19 with a mean of 7.7 (out of 10) and a standard deviation of 1.19. With regard to contact frequency, most respondents are in contact with their team members at least once a week (61%) and with their manager or supervisor at least once every two weeks (64%). With regard to the ease of communication, the Cronbach's Alpha value of 0.722 indicates that the sum score of these items can be used for the analyses. Respondents were moderately positive about the ease of communication, while working from home, with a mean of 3.1 (out of 5) with a standard deviation of 0.76.

A Cronbach's Alpha of 0.613 showed that internal consistency is too low to sum the scores on the knowledge sharing items for the analyses. Therefore, a principal component analysis was performed, using Varimax with Kaiser Normalization as rotation method (see Table 2). Two components were distracted, namely (1) '*Frequency of knowledge sharing*' and (2) '*Perceived absence of spontaneous*

knowledge sharing'. Concerning knowledge sharing, the respondents are moderately positive too. With a mean score of 3.86 (out of 5), respondents are positive about the frequency of knowledge sharing while working from home during COVID-19. Nevertheless, they also agree that spontaneous knowledge exchange at the office is lacking with a mean score of 4.04 (out of 5).

Table 2 Principal component analysis knowledge sharing

Knowledge sharing items	Frequency	Absence	Component
I regularly share my knowledge and experience with colleagues	0.765	0.058	1
I approach my colleagues to gain knowledge and experience	0.737	0.125	1
I provide timely feedback to my colleagues	0.811	-0.093	1
I receive timely feedback from my colleagues	0.738	-0.091	1
I miss the spontaneous knowledge sharing 'at the coffee machine'	0.009	0.946	2
I miss the spontaneous knowledge sharing 'at the desk'	-0.008	0.947	2
Initial eigenvalues	2.330	1.827	
Percentage of explained variance	38.8%	30.5%	

Explorative analyses

Data was analysed using explorative bivariate analyses (i.e. ANOVA (*F*), t-test (*t*), Spearman (**ρ**) and Pearson Correlation (*r*)). Table 4 shows the results of the explorative analyses of the relationships between work-related communication opportunities and people's perceived individual productivity. As can be seen, all work-related communication variables are highly related to an individual's productivity. The lack of spontaneous face-to-face knowledge sharing encounters due to working fully from home, is significantly negatively related to perceived individual productivity. Other work-related communication opportunities, namely frequency of knowledge sharing (sharing and receiving feedback and knowledge), the perceived ease of communication and contact frequency with the team and the supervisor are significant positively related to perceived individual productivity. The use of additional ICT tools such as instant messaging, shared documents and social media, besides the commonly used traditional tools (i.e. e-mail and telephone), is positively related to people's individual productivity as well, while working from home.

As can be seen in Table 5, all personal characteristics are significantly related to individual productivity too. Women felt more productive while working from home during COVID-19 compared to other genders. Also, age was significantly positive related to individual productivity. The results suggests that people who are older feel more productive. In addition, the results show for household composition that people who are living alone feel the least productive (M= 7.55, SD= 1.29) compared to other households (M= 7.65-7.76, SD= 1.17-1.21). Regarding children in the household, people who are living together with two or more children feel less productive (M=7.51, SD= 1.23) compared to people with only one child (M=7.65, SD= 1.20) or no children (M= 7.70, SD= 1.20). Moreover, people with a higher education level (i.e. HBO or university degree) felt the least productive (M=7.61, SD= 1.21) compared to low (M= 7.79, SD= 1.24) and medium education levels (M=7.92, SD= 1.13). Considering the significantly positive relation between age of the youngest child in a household and individual productivity level, the results suggest that a higher age of the child results in a higher perceived productivity of the respondents. Finally, people who are more dependent on teamwork felt less productive during the COVID-19 pandemic.

Table 4 Results explorative analyses between work-related communication opportunities and people's perceived individual productivity

Pearson Correlation (*r*)	Sample (N)	Individual productivity
Knowledge sharing		
Frequency knowledge + feedback	21248	*r*=0.22**
Lack of spontaneity	21528	*r*=-0.29**
Communication		
The ease of communication	19547	*r*=0.35**
Contact frequency		
With supervisor	18050	*r*=0.11**
With team	18404	*r*=0.03**

t-test (*t*)	Sample (N)	Mean	SD	Individual productivity
Communication tools (use yes/no)				
Instant messaging				*t*=-10.04**
No	8411	7.57	1.257	
Yes	15958	7.73	1.155	
Shared online documents				*t*=-8.57**
No	13091	7.62	1.221	
Yes	11278	7.75	1.157	
Shared server				*t*=-3.82**
No	18022	7.66	1.203	
Yes	6347	7.73	1.166	
Social media				*t*=-4.63**
No	23739	7.67	1.195	
Yes	630	7.89	1.125	

*** indicates that the coefficient is significant at the 0.01 level*

Table 5 Results explorative analyses between personal characteristics and people's perceived individual productivity

ANOVA (*F*)	Sample (N)	Mean	SD	Individual productivity
Gender	21826			*F*= 95.10**
Male		7.56	1.244	
Female		7.79	1.147	
Different		7.41	1.312	
Education level	21826			*F*= 79.27**
Lower education		7.79	1.236	
Medium education		7.92	1.132	
High education		7.61	1.205	
Other		7.81	1.114	
Household composition	21826			*F*= 24.51**
Single-person		7.55	1.291	
Single-parent with children		7.76	1.206	
Couple without children				
Couple with children		7.76	1.170	
Other		7.65	1.174	
Spearman (*ρ*)		7.52	1.274	

	Sample (N)			Individual productivity
Age				
Age youngest child	21826			*ρ*= 0.09**
Dependent on teamwork	3992			*ρ*= 0.07**
	21545			*ρ*=-.059**

*** indicates that the coefficient is significant at the 0.01 level*

DISCUSSION AND CONCLUSIONS

After COVID-19, it is expected that many office workers will continue working from home for a (larger) part of their work time (than before). The findings of this study show that people, under COVID-19 restrictions, still perceive their productivity as very positive (7.7 out of 10 on average). Although many people worked fully from home and did not have any face-to-face interactions with colleagues or managers, respondents were generally positive about the frequency of knowledge sharing (i.e. providing or receiving feedback/ knowledge). Further research is needed to analyse in more depth, whether people perceive their communication still positive when they work fully from home for a longer time.

On the other hand, many respondents agreed that they miss the spontaneous knowledge sharing at the office (i.e. desk or coffee corner). Previous research also showed that coffee areas and people's workstation are important for casual (informal) conversations (Hua et al., 2010). These conversations could lead to more trust among workers that eventually leads to more willingness to share knowledge (Chevez & Aznavoorian, 2014). Obviously, working fully from home makes it impossible to have casual and spontaneous face-to-face conversations, which in the long term could thus have an impact on productivity. For example, this could lead to misunderstanding, less trust and confusion among colleagues (Daim et al., 2012). The data analyses also showed that people were moderately positive about the ease of communication with colleagues while working from home. However, people who are dependent on teamwork were more likely to rate their productivity lower than people who are not dependent on teamwork. These findings suggest that working fully from home (i.e. no face-to-face communication) does not function that well for people who have to collaborate a lot with other team members. So, workplace managers should focus on creating workplaces at the office that enhance teamwork for these employees specifically.

As expected, the results showed that telephone, email and videoconferencing are used the most when working from home. In addition, the results showed that for each activity, people prefer different communication tools. For example, when people are solving a problem together, people prefer to use videoconferencing and seeing each other. It is recognized by Waizenegger et al. (2020) that communication via video-conferencing, instead of meeting each other physically face-to-face, is more efficient, purpose-driven and focused. However, that study also found that many virtual meetings could lead to an increased number of people who are feeling fatigued, as these meetings are more attention-taxing compared to face-to-face meetings. Further research is also needed to analyse the effects of virtual meetings, due to working from home, on people's mental health conditions (e.g. sleep quality, mood or stress etc.). Overall, a good balance between efficient virtual meeting and face-to-face meetings is necessary to enhance the productivity and wellbeing of office workers. Therefore, workplace managers and facility managers should focus on creating and implementing (enough) hybrid meeting solutions at the office to optimize the balance between physical- and virtual meetings.

Results of this study also suggest that when people more frequently are in contact with and share knowledge with colleagues and their supervisor, they also feel more productive. Previous research also showed that not being present at the office creates a lack of visibility and difficulties of managers to assess their employees' productivity (Lippe & Lippényi, 2020). Thus, regular contact with colleagues and supervisors should be stimulated within an organization.

Last, several personal differences were found regarding perceived productivity. People who are living together with (young) children or are living alone perceive their productivity lower while working from home. Contradicting to previous studies, the results showed that women perceived that they were more productive compared to men. Although previous research showed that women prefer face-to-face communication over technology-based communication (Mano, 2013), they probably feel more productive, because of the decreased commuting time and flexible working hours (Raišienė et al., 2020).

Although this study showed interesting results with regard to perceived communication and productivity, there are still some limitations. The sample consists of a large number of older, public workers and

is focused on the situation in the Netherlands. In addition, data was collected during a very unique situation, whereby many people were non-voluntary working from home. Future research could increase the generalizability of the results by using a more heterogeneous sample among office workers from different countries. In addition, it would be interesting to find out if the results differ when people are working for a longer period (voluntary) from home.

Results of this study, with regard to people's perception of communication and productivity while working from home, could help organizations restructure their workplace management strategies. Another contribution of this study is that it uses a very large dataset gathered during the COVID-19 pandemic, which provides novel insights in current challenges in workplace management.

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Expected user needs towards the post-Covid office: better support of social interactions and concentration

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ABSTRACT

Background and aim – While remote working is not a new phenomenon, Covid-19 has forced many office workers to work from home for long consecutive periods. Recent research shows that while most of them say they can work productively from home, many feel less connected to their colleagues. This study explores how these experiences may influence employees' needs towards the office workplace.

Methods – Cross-sectional data were used from an online survey among four Dutch public sector organisations conducted between November 2020 and February 2021. These data include perceptions of 567 office workers regarding their workplace, both at home and at the office, and their motivations for working at the office.

Results – The survey data show that the main reason to (want to) work at the office has shifted from meeting expectations to the need for informal social interaction. On the other hand, many still need the office for doing concentration work. Although the home workplace feels more comfortable, ultimately it is not rated better than the office workplace. The respondents indicate several shortcomings of their current office regarding support of socializing, belongingness, and privacy.

Originality – While in the media different assumptions have been made about consequences of Covid-19 for future office use, few empirical studies have been conducted to substantiate these expectations.

Practical implications – This study shows that Covid-19 has increased the need for in-person interaction at the office without decreasing the need for silence, and indicates how offices could better support socializing balanced with concentration work.

Type of paper – Short research paper.

KEYWORDS

Office, user-needs, workplace design, Covid-19, working from home, social interaction, affordances.

INTRODUCTION

Shortly after the beginning of the Covid-19 pandemic, it seemed the end of the office age had arrived (Walsh, 2020). In April 2020, 59% of the current home-working office workers in the U.S. said they wanted to work remotely as much as possible once restrictions on businesses and school closures were lifted (Brenan, 2020). Companies already foresaw a reduction of costly office space as they would mainly hire remote workers (KPMG,2021). Prior to Covid-19, organizations were not very willing to embrace working from home, despite technological possibilities and many benefits for employee well-being, productivity, and the environment (Sander, Rafferty, & Jordan, 2021). Among the impediments were managerial concerns over employee supervision and social stigmatization of physical absent co-workers (Allen, Golden, & Shockley, 2015). Now these concerns were overruled by the emergency situation of the pandemic, it looked like the benefits could be cashed.

However, as the pandemic and the accompanying working from home continued, it became clear that there is no substitute for in-person collaboration and that the office workplace has a role in fulfilling the human need for connectedness. After all, face-to-face communication supports activities that are crucial for sustaining social relationships at work (Nardi & Whittaker, 2002). While the digital substitute of in-person meetings, video conferencing, is being experienced as particularly exhausting, possibly because of nonverbal overload (Bailenson, 2021). Already in May 2020, U.S. office workers ranked scheduled meetings, socializing with colleagues, impromptu face-to-face interaction and being part

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of the community as the most important reasons to want to come to the office, and 74% said what they missed most about the office were the people (Gensler Research Institute, 2020). A global survey showed that employees felt mentoring, collaboration, service to customers, and keeping aware of what is going on in the organization are considerably better at the office than from home (Kamouri & Lister, 2020). Currently, companies expect the 'new reality' will look much like the old, and most offices will keep their size (KPMG, 2021).

Hence, the office probably will survive the pandemic, but it may have to adapt to changed user needs. Several predictions regarding this change have been made by workplace experts so far. Kirkpatrick and Marinho (2020) assume that the post-Covid office will become purpose-driven, offering individuals the energy of being around colleagues as well as being able to work productively. Leesman (2021) states that the pandemic has changed workplace value ('home is the new benchmark') and intentions to return to the office depend on the home working experience and the workplace quality.

The purpose of this study is to gather scientific insights indicating which user needs the current and post-Covid office should support in particular. It therefore explores how employees' motivations for working at the office have changed during the pandemic, how their home workplace performs compared to their office workplace, and how the workplace design could be improved to fit their needs.

METHODS

Qualtrics survey software was used to create an online questionnaire including multiple choice questions about workplace characteristics and motivations, Likert scale items on satisfaction with the working environment, ratings of office characteristics, and questions about working situation, personal background and organizational context. Four organisations in the Dutch public sector (local and regional government and education) were recruited to participate in the survey. They distributed an anonymous link to the questionnaire among their employees. In this manner, data were collected during November 2020 and January to February 2021. During this whole period, working from home was strongly recommended, most shops were closed, and home visitors were restricted. After removing 22 cases because of respondent abandonment or misconduct, 567 valid questionnaires were included in the analysis; 42% of those were completed during Covid-19 primary school closure (Dec. 18 to Feb. 7).

RESULTS AND DISCUSSION

Sample characteristics
Most respondents (65%) were completely working from home when taking the survey, 32% had not been working at the office since the first lockdown, and only 8% continued working in the office regularly. Two third has a full-time job, 13% has a managerial position. At the office, 43% has an assigned desk. A minority (21%) usually works in an open workspace; most have small (up to three persons) or medium-sized rooms (four to six persons). Almost one third (31%) is younger than 40, 14% lives alone. A large group (47%) sees themselves as extrovert, 19% considers themselves reserved and quiet.

Changed reasons for working at the office
In the survey, the office workers were requested to mark the most important reasons for working at the office *before* the first lockdown (March 2020) and *at present* (eight to eleven months later), if going there would be possible. Their aggregated answers show a shift from feeling obligated towards the need for social interaction (Fig. 1). At the text entry some respondents explained this change out of culture ('it was normal [to work at the office]', 'I felt I was expected, but looking back maybe I wasn't') and availability of technology ('because the digitalisation was insufficient', 'we did not know that the necessary facilities were there'). Currently, only 6% feels their job requires their presence at the office.

Across the board, motivations for working at the office have significantly decreased (as shown in Fig. 1). Apparently, the respondents feel that many activities can be done from home as effectively as at the office, or even better. This change indicates that currently (and possibly after the pandemic) they would visit the office for different activities and less frequently, if they have a choice. Only the need for

diversity in working environments and being away from home have significantly *in*creased, which is not surprising considering the lockdowns and working from home for months on end. Being able after the pandemic to distribute working time between home, the office and elsewhere probably will meet these needs.
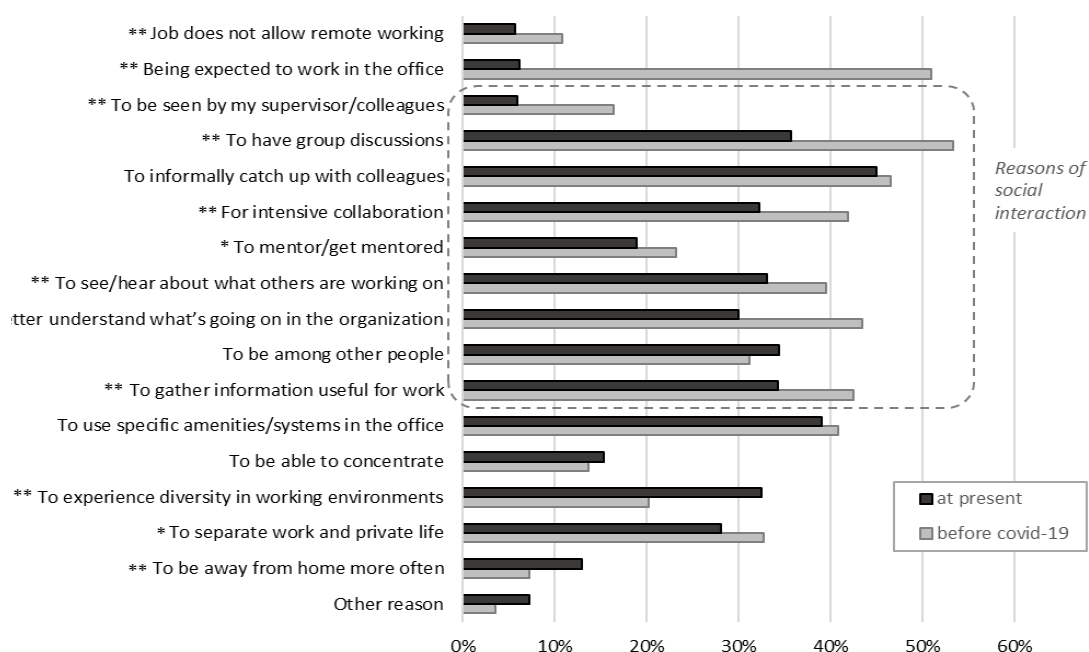

Figure 1 Main reasons for working at the office before COVID-19 and (wanting to work at the office) at present (*N*=540); * (p<.05) and ** (p<.01) mark significant differences between before and at present according to McNemar's symmetry test

In the current situation, informally catching up with colleagues is the most important motivation (marked by 45%) for the participants to go to the office if possible. Being among other people, having group discussions and intensive collaboration at the office are still important to a third of the office workers. Employees who were still or again completely working from home when taking the survey show a stronger need for being among others (X^2 (1, *N* = 488) = 14.916, *p* = .000) and other types of social interaction. Also younger employees, especially those under 30, more often indicate being among other people as an important reason for wanting to work at the office (X^2 (4, *N* = 499) = 16.252, *p* = .003). Living alone or with others does not play a role in these social needs. Extroverts more often want to go to the office for intensive collaboration (X^2 (1, *N* = 496) = 4.077, *p* = .043), but beyond this their motivations do not differ significantly from the others. Managers more often than others want to work at the office to mentor their team (X^2 (1, *N* = 499) = 18.840, *p* = .000).

However, in-person meetings are not the only reasons for currently wanting to work at the office. Second in the top-5 of most important reasons is using specific systems or amenities at the office, such as printers and ergonomic furniture. Furthermore, 15% still needs the office for doing concentration work ('my wife runs a day-care facility from home'), especially those who don't have a separate room serving as home office (X^2 (2, *N* = 548) = 14.767, *p* = .001) and young employees (X^2 (4, *N* = 499) = 32.342, *p* = .000). Working at the office to separate work from private life is especially important to managers (X^2 (1, *N* = 499) = 8.706, *p* = .003), young employees (X^2 (4, *N* = 499) = 44.547, *p* = .000), and to employees that are completely working from home (X^2 (1, *N* = 488) = 7.214, *p* = .007). Other reasons mentioned for wanting to work at the office include health (keeping a day-rhythm, getting outside, cycling to work), feeling part of the work community, and meeting with clients or students.

Comfort home workplace compared to office workplace
The reduced motivations for working at the office may be explained by adaptation to working from home and discovering its benefits. Our survey data show that on average the respondents' home

workplace clearly is perceived as more comfortable than the office workplace, except for the furniture and personal storage (Fig.2). The biggest differences are the ambiance and the amount of privacy and noise, which are all much better at home and important to concentration work. This better experience of comfort at home may increase expectations towards the office to offer a similar quality.
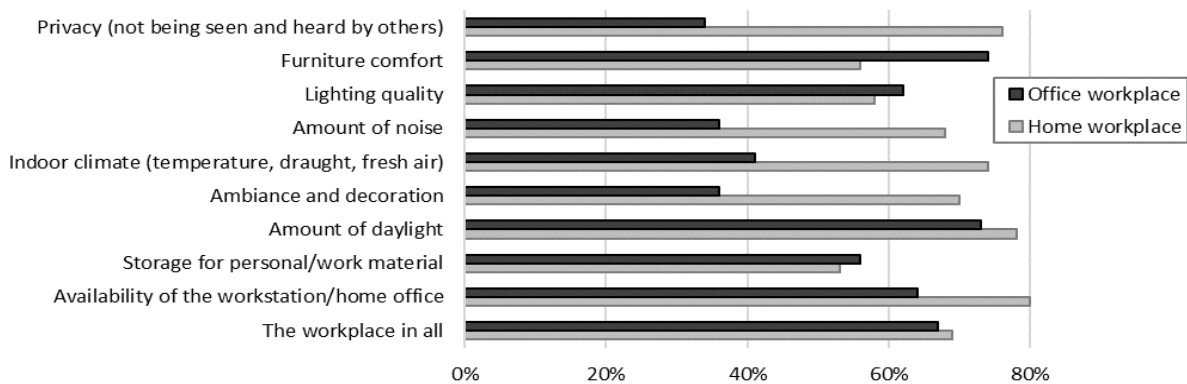

Figure 2 Total amount of respondents that answered 'satisfied' or 'very satisfied' at the question 'To what extent are you satisfied with the following features of your (home/office) workplace?' (Office workplace as remembered from last visit.)

Interestingly, satisfaction with the workplace *in all* does not significantly differ between home (*M* = 3.73) and office (*M* = 3.64), according to a Wilcoxon signed-rank test (*Z* = 1.403, *p* =.161). Apparently, other workplace characteristics are as important as comfort, so ultimately the quality at home and in the office on average is considered equal. Indeed, a multiple regression analysis shows that together the features listed in Figure 2 explain 70.8% of the variance of home workplace satisfaction (*F* (9) = 139.497, *p* = .000) and only 52.4% of office workplace satisfaction (*F* (9) = 55.143, *p* = .000).

Support of socializing and belonging
As shown in Figure 2 before, the current office workplace could better support concentration work, since for many respondents their needs regarding noise and privacy are not met. To explore how much their current office workplace supports informal social interaction, the employees were asked to rate their office on 12 *social affordances*, physical characteristics of the work environment that support socializing and belonging (Fayard & Weeks, 2007; Spreitzer, Bacevice, & Garrett, 2020). Over 70% of the respondents agree that their office supports spontaneous encounters and locating colleagues, but the other affordances are recognized by less than 50% (see Fig. 3 below). Their offices especially lack appropriate locations for having a telephone call (according to 61%), spots for personal expression (according to 48%), and places to chit-chat without disturbing others (according to 39%).
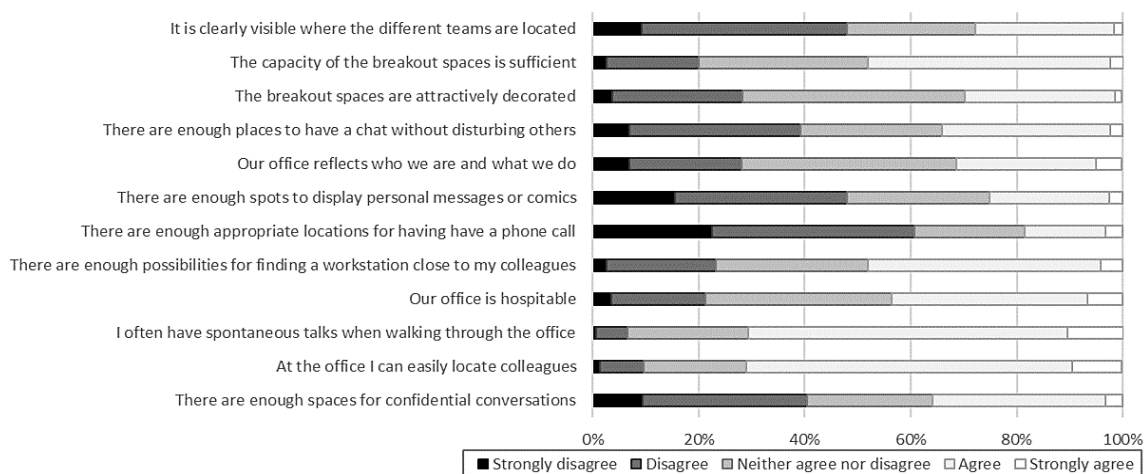

Figure 3 Social affordances of the respondent's office workplace supporting socializing and belongingness

Respondents without assigned desk (flex-office) rated their office workplace significantly *better* regarding hospitality (X^2 (4, N = 484) = 23.099, p = .000) and significantly *worse* regarding spaces for confidential conversations (X^2 (4, N = 483) = 17.992, p = .001) and spots for personal expression (X^2 (4, N = 484) = 69.654, p = .000). This may be explained by the usually more modern but standardized décor of flex-offices, their open spaces, and restrictions for personalizing such as a clean desk policy. Offices with assigned workstations and flex-offices equally lack appropriate phone call locations and equally provide (or lack) the other presented social affordances. Independent samples t-tests show that the opinions on social affordances do not significantly differ between younger and older employees. These results suggest that to support informal social interaction office workplaces should offer more private spaces and possibilities for customizing team spaces, especially flex-offices.

CONCLUSIONS

This study explored the influence of the Covid-19 situation on employee needs towards their office workplace. The participants report a shift in main reasons for working at the office from meeting expectations towards in-person interaction. Due to the forced working from home, many activities that previously were an important reason for coming to the office have shown to be possible online as well. However, unplanned interactions, socializing, and feeling part of a community are more difficult to substitute by online communication; informal social interaction and intensive collaboration remain important and now are the dominant reasons for wanting to work at the office.

On the other hand, many still need the office for specific amenities and to do concentration work. This indicates that to fit the user needs the post-Covid office should not be a 'giant coffee shop', but that it should still accommodate a variety of activities and needs. Ratings of social affordances show there is considerable room for improvement of workplace design in the participating offices, especially regarding visual identity, privacy, and noise reduction, and especially in flex-offices. Although the home workplace in general is rated more comfortable, the fact that it ultimately is not rated better than the office workplace may confirm the office's importance in supporting in-person interaction.

Future research could explain to what extent the current need for informal social interaction at the office has been amplified by the social restrictions and forced working from home during Covid-19. However, in-person interaction at the office will remain important to fulfil the human need for connectedness and to build trust for collaboration.

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Post-pandemic adaptive university campus management

Suvi Nenonen[1] and Vitalija Danviska[2]

ABSTRACT

Background and aim – The coronavirus situation provide an opportunity for bigger changes in the society, especially when considering Covid-related challenges in real estate sector. This paper aims to understand the trends, hindrances and enablers brought by coronavirus pandemic which need to be considered in managing the change in the context of university campus.

Methods / Methodology – The data was gathered by eight expert interviews in roundtables from Finland. The sample includes experts of real estate development (3), real estate economics (2), lifelong learning (1) and research about new ways of learning and working and research of finance (2). The interviews were analysed by content analysis. The outcome classifies the topics for strategic, financial, functional, and physical thematic campus management clusters.

Results – Five trends, applicable to Finland, were identified: changing ways of workings, changing ways in the use of space, digital culture, sustainable development, and changes in real estate markets. The hindrances include challenges with economy, flexibility, space use, demographic aspects, and urban development. However, the identified enablers include also urban development, increasing awareness of customer-centricity, service development, and sustainable real estate development and construction.

Originality – The paper provides data to the scholars who investigate the Covid-related challenges as a potential for developing conscious culture and ecosystems, limited to one country though.

Practical or social implications – The results contribute to university campus management responsibilities in the swing towards post-pandemic university campus as one of main contributors to the societal change.

Type of paper – Research Paper

KEYWORDS (4-7)

University campus management, systemic change, trends, hindrances, enablers, COVID19

1 INTRODUCTION

The post-pandemic era will see multiple challenges that require a better understanding of COVID-19 and its socioeconomic effects on society. In the context of university campus management, the short-term human and economic impact are undeniable as students and university staff stayed home and university campuses were closed. The COVID-19 challenged us to rethink buildings and facilities management to leverage sustainable solutions with win-win outcomes. A systemic change could transcend the "wait and see" paradigm into a more proactive approach that is imperative for creating an adaptive and resilient system.

To address the manifold challenges of COVID-19 crisis faced by universities now and in the future, campus managers need to acknowledge the interrelation of the multiple perspectives in campus management. The multi-perspective approach in university campus management proposed by den Heijer (2011) include the strategic, financial, functional, and physical perspectives to universities. What could the current transformation of the socioeconomic system towards post-pandemic era mean in university campus – can we already identify some signals towards the future?

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This paper addresses the trends, hindrances, and enablers for the future of university campus management in Finland discussed during the COVID-19 pandemic. This explorative study opens the discussion on the direction universities should take to address the future challenges in a pro-active manner.

2 SIGNALS TOWARDS FUTURE UNIVERSITY CAMPUS MANAGEMENT
2.1 Campus management perspectives

University campus management is a complex process that involves multiple stakeholders, requires dynamic alignment and understanding of both internal and external factors affecting campus environment (Rytkönen & Nenonen, 2014; Curvelo Magdaniel, Den Heijer, & Arkesteijn, 2019; Rytkönen, Heywood, & Nenonen, 2017).

To capture the complexity of campus management, den Heijer (2011) presented a model that distinguishes four main stakeholder perspectives that affect any campus decision:

1. Strategic (organisation)

> Strategic perspective focuses on the institution itself and the effects of campus decisions on the university's primary goals: education, research and innovation. It represents organisational interest as the quality of education, research and innovation determines university's ranking, identity and image, which are important to attract talented knowledge workers, students and staff.

2. Financial (resources)

> The financial perspective covers the effects of campus decisions on the financial sustainability and resources of universities. These consist of funding from national governments, national and EU research funds, contracts with third parties and tuition fees from students. In many European countries, these financial resources are under pressure (European University Association, 2018; Curvelo Magdaniel et al., 2019).

3. Functional (community)

> Functional perspective includes human resources, which are considered the most important resources of the university: students, professors, researchers and support staff that form a community. The extent to which campus decisions support their learning, teaching and working processes determines their productivity and well-being. Related to these human needs and resources is the importance of sociocultural and functional qualities (Richter et al., 2018)

4. Physical (sustainability)

> The physical perspective includes the effect of the campus on the environment, from the quality of place to their impact on natural resources. The ecological resources of universities include the land and buildings as well as technological aspects, such as software and hardware, of the university, and the materials and energy they consume. Natural resources such as water, soil, vegetation, and biodiversity should be considered (Richter et al., 2018).

2.2 Challenges brought by the global pandemic and impact to university campus management

The global COVID-19 pandemic has brought major changes in almost all industries worldwide. Here, major implications of the global pandemic to university campuses can be identified:

2.2.1 Global pandemic changed ways of working and learning

Traditionally, education worldwide has been based on the face-to-face instruction. The global pandemic forced educators and students of all ages to transition to online modes of teaching and learning in an unexpected speed. This has led to multiple challenges in terms of availability and management of technological infrastructure, adequate communication, capacity to adapt to changes and independent work (OECD,2020a; Daniel, 2020). Moreover, even though remote work capacity (especially in universities) has been high, remote work practices varied significantly among countries before the pandemic (del Rio-Chanona et al., 2020; OECD, 2020b).

Physical university campus infrastructure is challenged by the need for flexibility, collaboration, digitalisation, as well as health, sustainability, identity, and locational aspects. University campus needs to become a combination of traditional, networked, and virtual arrangements. Hybrid working and learning should be enhanced in all aspects of university operations. Conceptualizing and realizing physical infrastructures in parallel with virtual infrastructures without interlinking them, as well as adding more buildings on campus, completely stretches financial and human resources at universities (Ninneman et al. 2020) Based on the findings of Jansz et all (2020) the success factors of university campus are survey geographic proximity, cognitive proximity, scale, transitional spaces, comfort and experience, shared facilities and events, local buzz and networks were identified.

2.2.2 Global pandemic led to increased innovation

The COVID-19 pandemic has forced many industries towards rapid and innovative responses to crisis. This has been especially visible in the medical sciences (Farrugia & Plutowski, 2020). The innovation landscape changed significantly, leading towards a much more open innovation approach (Chesbrough, 2020). Open innovation means that organisations collaborate with external parties, share the knowledge and/or resources for a faster and more innovative response. Interestingly, organisational structures have effects on how fast organisations respond to changes in the markets. Start-ups seem to be the fastest to react to changed circumstances while universities fall in the same category as incumbents (Ebersberger & Kuckertz, 2021) mostly due to the understanding of time and the cyclical orientation that universities have.

According to Hopff et al. (2019), university campus can be considered as a testing ground for innovation within and outside the campus itself. Universities increasingly want to set an example for society, to practice what they preach in living labs on campus, to be responsible neighbours, to be energy-efficient, to cherish heritage buildings, and to responsibly spend taxpayers' money (Curvelo et al., 2019; Den Heijer, 2020). Additionally, universities emphasize the role of human health as one of the sustainability development goals. This can set an example from a conceptual perspective, adding human health as the fourth pillar to the overall definition of sustainability is a logical step (Hakovirta & Denuwara, 2020). Thus, universities can adopt more entrepreneurial approach and encourage innovation through less cyclical time orientation and creating living lab environments for open innovation. Universities can be role models to UN (United nations) or national sustainability goals. Already before the COVID-19pandemic one has been aware that the limitation of human, financial, ecological, and sociocultural resources force us to understand the university campus as a finite ecosystem that is not endlessly expandable (Ninneman et al., 2020).

2.2.3 Global pandemic affects real estate markets and layers of the built environment

The COVID-19 pandemic created major disruptions in all real estate markets. Due to severe lockdowns, people around the globe were forced to stay at home and in many countries all or most of semi-public or public buildings were closed. Social distancing requirement has affected the real estate sales processes. With many people losing their jobs or suffering from temporarily absences, many of them are not able to commit to their financial liabilities such as rent or loan payments (Nicola et al., 2020; Uchehara et al. ,2020). Remote work has also changed user behaviour and demand of real estate, increasing the role of public green spaces, larger houses, natural lighting, or smart solutions (De Toro, Nocca, & Buglione, 2021; Nanda et al., 2020). The possibility to work from home has led to more disperse in activities, thus, increase in the interest of periphery of cities and suburbs where more space can be acquired for a better price (Gupta et al., 2021; Carlock, 2020). The mobility of students has also changed due to the situation. Student fee as an income for the universities is also topical, however in the different ways in different countries.

Capacity building requires serious local and regional engagement (Avila et al., 2017). It is important to consider the location of the campus relative to the city, the importance of heritage – cultural, academic, and industrial – and how the campus adds to the aesthetics and identity of the city. As university campus is a city structure within the city, it can act as a ground for a bigger – urban – change, playing a role of a

knowledge and innovation hub for a creation of polycentric cities.

One positive impact of the current pandemic is the time it offers to the built environment professionals to reflect on past events and learn what can be improved for future responses (Goniewicz et al., 2020). To sum up, the campus management needs to consider university strategies towards hybrid ways of learning and working. The financial considerations need to emphasise the sustainable and regenerative solutions in the platforms which integrate both digital and physical platforms to serve the productivity, quality, and health of university community members from students to employees. Universities and university campuses play a strong role in the society by providing the new knowledge and skills needed to meet the challenges in the community. They lead the societal change and the development of the civic society (Sharma, 2015). According to s Diming et al. (2021) providers and landlords of real estate, two disparate, unconnected players find themselves in the same boat first time ever. Both parties who have never had to directly interact before now need to innovate and find a sensible way forward and step in a process is to seek fresh perspectives and fresh thinking.

3 RESEARCH DESIGN
The qualitative approach and interview-based research design was employed to have a transdisciplinary overview about signals for campus management change in Finland. There were eight participants in this sample. Participants first provided insights about the trends and COVID-19 pandemic has affected to them. Then the discussion continued to hindrances and enablers of campus management. The latter two interviews used already mentioned threats as starting point to the interview to decrease saturation. The sample strategy was to cover different perspectives of campus management to the discussion. To get insights of the financial perspective two real estate economic experts joined to interviews. The perspective of real estate development was represented by three persons. The university user expertise included three experts from the field of lifelong learning and research about new ways of learning and working as well as economic research tradition. All the experts worked in management positions in their background organisations. Three of them represented universities and four of them real estate markets either in private or public organisations. The quality could have been enhanced by providing additional data from university strategic management or city development, but in this phase of the study this limitation was accepted due to the potential Delphi-approach used in later stage.

The data was analysed by content analysis by using the step-by-step process. It included three interactive sub processes. The first data reduction phase consisted of generating initial codes identifying the trends from the data. During the second phase of the analysis, the themes were reshaped according to the identified under four thematic codes defined by den Heijer: Strategic, financial, functional, and physical perspectives of university campus management. The coding based on the descriptions of the themes presented in the theory. The comprised themes were reviewed against the themes of the first phase's initial codes. Finally, defining and naming the final themes based on their hindering or enabling expression provided us more in-depth approach to university campus management. The hindering and enabling clusters as final thematic themes were classified based on the contextual expressions, e.g., "is difficult" or "obstructs" (hindering) – "supports", "makes possible" – (enabling). The conclusions were drawn by reflecting the results to previous studies.

Results provide a good fit to the campus management framework. We compared the results of the two-separate analysis with the original data to ensure the reliability. The evaluation of the data presented in this work leads to identified changes which are relevant in national context. Because we were interested in a national perspective, we considered only national experts in this phase of the study.

4 RESULTS
4.1 Trends towards future university campus management
All eight participants agreed that COVID-19 pandemic has speeded up the existing trends in a way, which have consequences to university campus management. The interviewees agreed that a change towards a more strategic university campus management is the main trend that affects the future of the

university campus. Four trends can be placed under the strategic campus management trend: digital culture, real estate market changes, changing ways of working and changing ways of using the space. The reinforced digital culture is the main driver in strategic campus management. The culture of organisations will change dramatically since COVID-19 pandemic has forced organisations to perform in digital reality much more effectively than earlier.

The financial perspective is impacted in changes in real estate markets in general. The impact to housing and logistics facilities is weaker, but other sectors are transforming more. Additionally, the typical categories of real estate are changing towards mixed-use buildings. Moreover, real estate offerings are changing to include more services. This will have an impact to campus management when the local real estate offerings will transform, most likely with increase of unused facilities in cities and towns. The valuation of real estate is more difficult due to the lockdown.

The functional perspective has been affected by the holistic change towards new ways of working. It is obviously connected to a digital culture. However, the COVID-19 pandemic has not left any room for choice to work digitally or not. The identified trend has been reinforced dramatically with good and bad consequences. The change which has been ongoing step by step in different fields of industry occurred now rapidly in universities too. In practice, this has meant a huge change in capacity and competencies to perform work tasks differently among different users.

The physical perspective is impacted by the trend how to use the space. In general, the efficient use of space with efficient space measurement has turned opposite: the COVID-19 pandemic restricted the tight use of space and the efficiency changed to the measurements of providing enough room to perform in a safe way with restrictions of social distance. In short term, facilities are transformed to serve new safety regulations temporarily but there might be some long-term impacts for space planning. The space types and space concepts might be changing to serve more hybrid working in the future.

As the second most important but separate trend identified by all respondents was the sustainable development. The perspectives to the trend vary a bit, but the emphasis was in ecological sustainability concerning sustainable solutions in construction and real estate development. The construction of new buildings will still occur, but the solutions will be more environmentally friendly. The decrease of carbon footprint due to reduced travelling was noted. The COVID-19 pandemic has realized different ways to sustainable development also in economical approach: the local business is now considered differently. Additionally, the wellbeing issues were brought up in the discussions. The need for resilience and readiness for future pandemics was also mentioned as part of sustainable development. Figure 1 sums up the topics under the first thematic part of interviews.
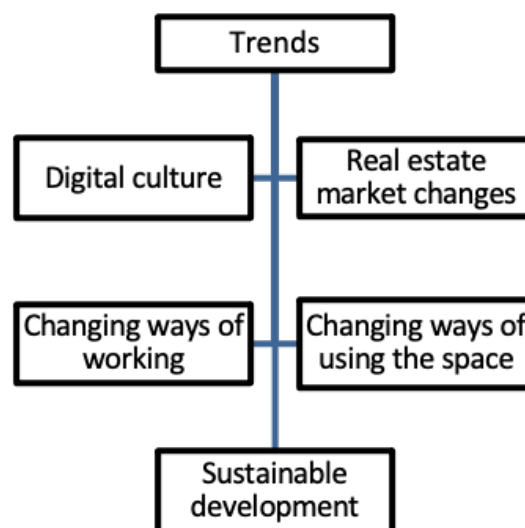

Figure 1 The trends effecting university campus management

The results of these roundtables were aligned with the general discussion in society and very few nationally significant issues were identified. Concerning digitalization, the strong technical infrastructure in Finland was used to explain the well managed and rapid change towards new ways of working. The digital culture has been already introduced in many organisations, universities and as a part of private life even before the pandemic. The welfare society with national awareness and locally different districts is somewhat different in Finland than e.g., in the southern part of Europe. This was pointed out also in the discussion about hindrances and enablers.

4.2 Hindrances of future university campus management

The hindrances of future university campus management caused by COVID-19 pandemic are interesting. Digitalization from strategic perspective can be a hindrance for university campus management for various reasons.

1. the digital solutions in teaching and learning, online courses, etc. can open new avenues for students to conduct their studies in a more efficient and easier way than traditional settings.

2. the universities might not be quick enough to offer hybrid solutions for learning.

3. the number of digital natives on demand side compared with the supply of university as a service -processes might be unbalanced if the significance of physical and digital platforms is underestimated. "*The demographic changes (statistical data indicates the decrease of potential university students) and the increasing digitalized learning procedures form together a wicked problem*" (quote from an interview)

Another potential hindrance can hide in urban development. The attractiveness of larger cities will continue, however, the significance of location for studying and working has decreased during the national lockdowns. The demographic changes (independent of COVID-19 pandemic) will have impact to the number of students in the future. This sets more requirements to internationalization of universities. Additionally, universities are in different regions in Finland which have responded to the current pandemic situation in diverse rhythm and intensity.

Economy in general will be suffering from the COVID-19 pandemic and the consequences will have impact on universities too. Despite the current situation, domestic and international investors continue to show interest in the Finnish property market, but it focusses on the capital region. The financial situation and conditions are challenging, and it was not stable before the COVID-19, especially in the public sector.

But more specifically the functional threat hides in the unwillingness to change within universities. The COVID-19 pandemic has been a demanding period and it is likely to get back to the 'comfort-zone' when there are too many changes happening simultaneously in a systematic way:

"*Well, it was not easy to organise an online hybrid course – it demanded resources in a different way*". One cannot yet estimate how much campus space use will decrease and what exactly the reasons causing that are, but most likely universities will consider the reduction of spaces or space types in the future both from learning and working environment perspective. To quote one interviewee:

"*The new realities (virtual, augmented) are emerging – we do not see clearly what the consequences to the built environment are.*"
The other response was:

"*There are spaces which might be unnecessary in the future, some spaces will be used more and new space types or new meanings for spaces will appear - how to convert the existing building stock?*"
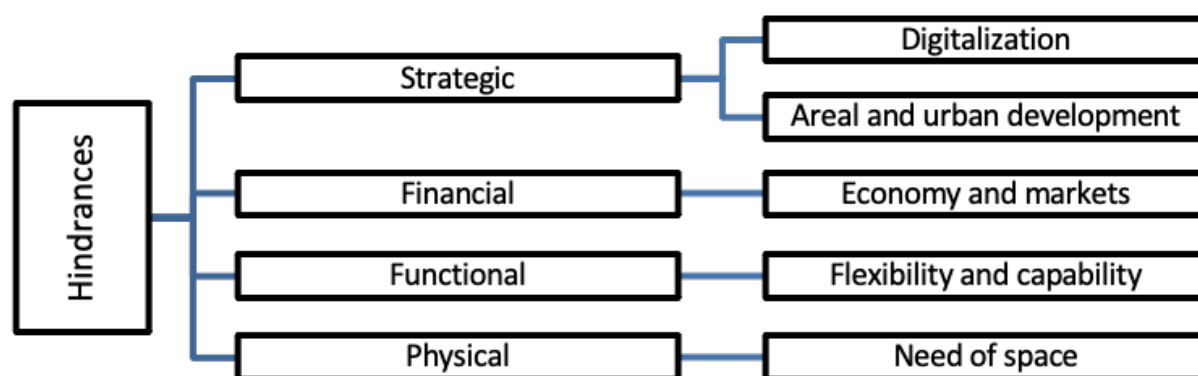The identified hindrances are summed up to Figure 2.

Figure 2 The hindrances effecting university campus management

Strategic hindrances for future university campus management are connected to digitalization: how the education will be organised in the future. What are the consequences of it for local ecosystem, where university plays an important role? However, the hindrance is also in the capability to agile changes. It is not very easy in university community; flexibility is not aligned through the organisation with long traditions like university. Additionally, the markets and financial structure in society seem to be hindering the development. The need of space will affect to the future university campus management, but it is still too early to foresee any ratios or patterns in it. The hindrances are crucial to identify when preparing to exit phase towards new normal, resilience and potential prevention of new similar kind of global crisis. Strategic, tactical, and operational university campus management can consider these hindrances in their long-term plan. The following chapter provides more perspectives in terms of enablers effecting university campus management.

4.3 Enablers of future university campus management

The content analysis provided insights to enablers of future university campus management and it is notable that many topics seemed to have both bright and dark side. Bright sides were found from urban development as much as it was mentioned to be a potential threat for future campus management. It was seen as a strategic issue for universities because all Finnish campuses have a close connection to the nature and provide empowering resources as granted for everyone after the lockdown. Additionally, the connectivity of campus is very advanced, which provides a good starting point for new hybrid practices. The urban structure makes it easy to connect locally with companies who also are on the way to develop new innovations. The network resources are available.

"The universities will provide new innovations for post pandemic era." (interviewee quote).

In long run, the portfolio of public buildings is an economical enabler from the financial perspective. There are different economical instruments to balance the value of public properties. The impact of sharing economy will also provide new economic potential. Additionally, the property was mentioned as a tool to improve customer centricity and service development as driver towards future campus management. The question is not anymore so much about the buildings but more about the experiences the buildings and services together provide. The experiences which cannot be achieved in working from home or working in digital realities mainly are the valuable assets for future campus management. Digital culture and fluent working digitally require new space types, which attract their users.

"It is important that the space can understand my needs and I can use it intuitively" (personal comment in the interview)

Smart services are essential part of digitalization and there are many opportunities to get best out of that potential. These enablers are important both for functional and physical perspectives.

"It might be tempting to continue working remotely after the pandemic passes, the campus might require fewer spaces – then we could recover these spaces for new use."

Additionally, the physical perspective needs to focus on delivering the sustainable solutions for campus users. The COVID-19 pandemic has increased the awareness of sustainable behaviour. Individuals are more aware of the environmentally friendly choices. It is important to increase the ecological solutions in the built environment, but one needs to be more aware of social sustainability of the university campus community in local, organisational, and individual level. The regenerative social elements of the campus are attractors which are making people to return to the campus. Something what has been self-evident before COVID-19 pandemic can now be used as a narrative, service, and ground for memorable experiences in the future. The significance of campus as a meeting point can be supported by smart and sustainable built environment.

"One needs to be optimistic and learn from the history. When the old factories were turned down and cities had lots of empty facilities, new use was invented e.g., in the form of sport facilities and flee markets. That was a blessing for many citizens in the area."

Figure 3 presents the summed overview of the discussed enablers. The enablers of the campus management of the future might serve both the academic community and the local ecosystem in the way which has not yet been experienced.
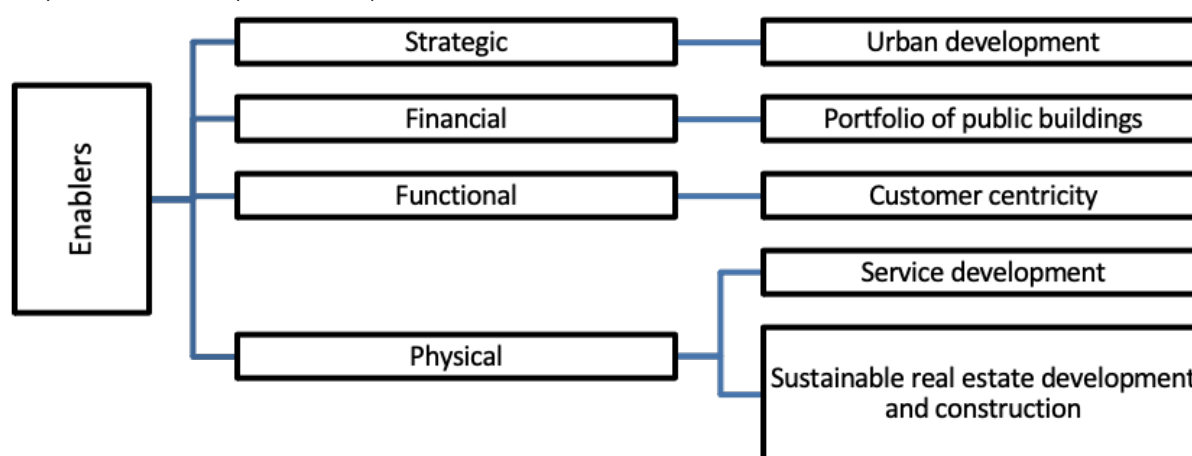

Figure 3 The enablers effecting university campus management

Strategic enablers for future university campus management are aligned with urban development. Especially the location of the campus in Finnish towns is in close connection to the nature. This is a strong profile in terms of healthy and empowering environment. Financial hindrances were connected to markets and economy in society; however, university portfolio includes public buildings, which is now safe target for investors. As a platform for community university management has its potential in customer centric approach even in changing landscape. The future enablers are also physical. As Richet et al. 2018) stated university has ecological resources: one can now focus both to service development and property development with the spirit of sustainability.

The results demonstrated in this chapter correspond to the effects of COVID-19 pandemic for real estate management generally and the role of universities in the societal change. The fundamental finding is that one needs to be able to identify the threat also as a potential strength. COVID-19 crisis is not making the universities return to the old but challenges them to face the future of resilient campus.

5 DISCUSSION AND/OR CONCLUSIONS

This paper discusses the trends, hindrances and enablers that were brought by COVID-19 to university campus management. By discussing changes happening in Finland, it concludes that future university campus management needs to value the social, digital, and physical layers in a new way. The connectivity to the people, nature and city can be physical while the digital connectivity brings whole world to experience it. The elements of resilience will steer the campus management.

Based on the results of this explorative study, strategic, financial, functional, and physical campus

management agenda can be developed towards post-pandemic era in a pro-active manner. Three challenges identified from the literature were the change in the ways of working and learning, increase of innovation and consequences to real estate markets and layers of the built environment. The findings of this study have been framed to face these challenges with strategic, financial, functional, and physical strengths as well as being aware of potential threats to manage the risks.

The results are however presenting signals of change from one country; thus, it is difficult to arrive at any generalisable conclusion. Nonetheless, the present research indicates that campus management needs to consider new perspectives and have a fresh scope to respond to the societal change. This conclusion can be adapted broader globally.

Future research in the field should consider the potential effects of COVID-19 pandemic more carefully, especially those to learning outcomes and staff performance. It is important to understand what requirements these effects set towards the future of university campus and generally to the built environment. Hybrid environment requires rethinking the social, digital, and physical services that support this new way of working and learning. For FM, this means that service offerings and delivery will move beyond physical building limits.

University campus management needs to adopt new tools and strategies to create a more flexible, responsive, and holistic environment. One need to keep in mind to work in all levels and scales from interior design to city planning are needed when pro-actively preparing for the future.

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Satisfaction with open plan offices: personality, age and gender as human factors

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ABSTRACT

Background and aim– The way users perceive the workplaces is known to be affected by multiple human factors (i.e. personality traits, age and gender). The relationship between these factors and workers' satisfaction, health and productivity need more research to contribute to a user-centred design.

Methods / Methodology – Data from a total of 389 SHE (Sustainable and Healthy Environments) Post Occupancy Evaluation surveys collected from five open-plan workplaces were analysed here. The dataset was analysed using descriptive statistics, correlation test, t-test, ANOVA and regression analysis.

Results – Extravert and agreeable workers were in general more satisfied, while workers with negative emotionality were less satisfied with the physical aspects of open-plan offices. Respondents who were considered more extravert, agreeable, conscientious, and open-minded rated their perceived health higher. Perceived productivity was found not be correlated with any of the five personality traits, while creativity was correlated with extraversion, agreeableness and negative emotionality. Male respondents showed significantly higher satisfaction with layout, and higher scores for health. Generation X had higher satisfaction, while generation Y showed higher health scores. Generation Z outperformed both Generation X and Y in satisfaction and health. There was also a match between sources of dissatisfaction for different personalities.

Originality – This paper expands knowledge in the field of corporate real estate by reporting findings on perceived health (such as sleep quality, physical and mental health, physical activity and overall health) and productivity (such as perceived productivity and creativity) reported by occupants of open plan-offices. Key relationships between human factors- age, gender, and specifically personality- with satisfaction with the physical environment, perceived health and perceived productivity in the context of open-plan offices have also been investigated.

Practical or social implications – Findings can be used as evidence for informing a user-centred design.

Type of paper – Research paper

KEYWORDS

Open-plan offices, personality traits, human factors, satisfaction, health, perceived productivity.

INTRODUCTION

Our personality makes us unique and defines our requirements, preferences and expectations from a physical environment, and influences how we perceive it. Perkins (2016) described personality as '*patterns of emotion, thought and behaviour that represent stable and lasting differences between individuals*' (Perkins, 2016). The Big Five personality traits (Soto and John, 2017) which comprise personality types such as extraversion, agreeableness, conscientiousness, negative emotionality, and open-mindedness have been used in a consensus among the organization behaviour researchers (Sharpe, Martin and Roth, 2011). These traits have been also studied in the area of corporate real estate to find relationships between the personality traits and how office workers perceive their work environment.

Research does not agree on the positive/negative relationships between work satisfaction and work performance with personality traits. Hartog et al. (2018) indicated that users who are more extraverted,

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open to new experiences and more agreeable were overall more satisfied with the multi-tenant office characteristics. They also reported that older and male users and users working in an open and flexible work environment were overall more satisfied with their work environment. Kallio et al. (2020), on the other hand, reported positive correlations between the personality trait extroversion and co-occurring stress and Indoor Environmental Quality (IEQ) problems, which shows more extroverted people are more likely to be stressed by poor IEQ conditions to be more sensitive to environmental factors when under stress. Seddigh et al., (2016) found positive associations between distraction and the personality traits of openness with higher levels of distraction among participants in open-plan offices compared to cell/private offices. Not surprisingly, Roskams and Haynes (2019) reported that more segregated workspaces tended to be preferred by employees who were more susceptible to distraction, more introverted, and male. Somewhat contradicting with these findings, Needle and Mallia (2020) found out that both personality types were feeling distracted in open plan offices and looking for personal spaces to perform their individual works. Looking at workstation types and personality, Lindberg et al. (2021) found that certain affordances of open bench seating are more beneficial to momentary focus and happiness for employees high in extraversion, while detrimental for those high on neuroticism. Beyond academia, there has also been a growing discussion in the industry on the suitability of open-plan offices for different personalities (Office principles, 2019).

The presumed unsuitability of the specific design aspects to some personality traits might be related to how people struggle and respond to some aspects such as amount and frequency of unwanted interactions and communications, distraction and interruptions and others. The needs and preference of some personality traits might be in favour of the interaction and collaboration opportunities provided by open-plan offices, while others might not receive this workplace layout very well as the some may shy away from too many interactions, preferring to work independently with minimum interactions.

The relationship between personality traits and open-plan office perception had been well documented. In addition, numerous studies are performed in open-plan offices exploring the impact of office layout (Maher and Von Hippel, 2005; Haynes, 2008; De Been and Beijer, 2014) and/or IEQ on perceived productivity (Appel-Meulenbroek et al., 2020), demographic characteristics such as age and gender (Kang et al., 2017; Haynes et al., 2017; Mesthrige and Chiang, 2019), organization type (Kok et al., 2015) and industry sectors (Candido et al., 2021). More studies are required to relate these aspects to people's perception of the work environment based on their personality traits.

This paper aims to contribute to this existing knowledge base by reporting findings aimed at providing further understanding around how open-plan offices fare against occupants' views from different personality traits, especially in terms of satisfaction, perceived health and productivity. For satisfaction with the physical environment, factors such as acoustic privacy, concentration, collaboration and key sources of dissatisfaction as reported by workers have been explored. Perceived health was investigated by sleep quality, mental and physical health, physical activity and overall health. In addition, productivity is explored by considering two aspects: perceived productivity and creativity. Analysis focusing on other human factors- age and gender- is also provided.

RESEARCH METHODOLOGY
Survey
Data from a total of 389 SHE (Sustainable and Healthy Environments) Post-Occupancy Evaluation surveys collected from five organizations were analysed in this study. Surveys were deployed between March and November 2020. Respondents were mostly working in their office at the time surveys were deployed (only 1.8% of the respondents indicated that they were working remotely, however they were asked to answer survey questions considering their experience at their workplace). The SHE online survey asks occupants to rate their satisfaction with key human, organisational/institutional and environmental-related aspects of environments. The questionnaire has specific versions designed for residential/student accommodation, workplaces and educational environments. For the purpose of this study, SHE workplaces is used. The survey has questions about occupants' sociodemographic, occupancy

and working arrangement, modes of transportation, IEQ, office layout, ergonomics and aesthetics, nutrition, sleep, workplace wellness and engagement. Further, the questionnaire also asks about overall physical and mental health, perceived productivity, and creativity. Finally, the survey also includes the short version of Big Five Personality test (Soto and John, 2017) to provide a concise measure of the five basic personality categories (extraversion, agreeableness, conscientiousness, negative emotionality, and open-mindedness). The SHE questionnaire uses seven-point Likert scale, multiple choice and open-ended questions along with five-point agree/disagree scale for personality questions. It also has a branch structure to allow dissatisfied occupants to provide their reason for dissatisfaction with different aspects of their workplace. The SHE questionnaire is an approved survey for use on WELL v2, Green Building Council of Australia's Green Star and NABERS Indoor Environment.

Surveyed organizations

Five organizations volunteered to take part in this study by reaching out to the researchers to use the survey tool for certification purposes. Table 1 shows basic information of the studied offices. All workplaces operated with open-plan configuration providing the infrastructure needed for traditional and Activity-Based Working (ABW). In this study type of open plan offices and organization were not taken into account. The main focus of this study is understanding the relationship of human related factors such as personality, age and gender and occupant satisfaction, perceived heath and perceived productivity.

Table 1 Basic information of the studied offices (n=389)

Office	Respondents	Response rate (%)	Intended certification	Industry
A	120	30	WELL	Construction
B	23	58	WELL	Consultancy
C	24	75	Green Star Interiors	Property
D	147	28	Not known	Government
E	75	48	WELL	Construction

Respondents

Out of the whole sample, 50.4% were females, 47.3% males, and 2.3% selected other or preferred not to respond. Around 40% of the respondents were born 1980-1994 (Generation Y), followed by 1965-1979 (Generation X) (36.5%), 1946-1964 (Generation Z) (12.5%), and 1995-2012 (8.5%). The majority of the respondents work between 31-50 hours per week (68.3%), mainly in managerial and administrative (32.6%) and professional (53.5) roles. Ninety-two percent of the respondents stated that they had been working full-time when the survey was conducted. Basic information about the respondents is shown in Table 2.

Table 2 Basic demographics and work-related characteristics (n=389)

Variable		Count	N%
Gender	Female	196	50.4
	Male	184	47.3
	Other and prefer not to respond	9	2.3
Age (birth date)	1946-1964	49	12.6
	1965-1979 (Generation X)	142	36.5
	1980-1994 (Generation Y)	155	39.8
	1995-2012 (Generation Z)	33	8.5
	Prefer not to respond	10	2.6
Hours worked	10 hours or less	8	2.1
average	11 to 30 hours	23	5.9
	31 – 40 hours	120	30.8
	41 – 50 hours	146	37.5
	51 – 60 hours	77	19.8
	More than 60 hours	15	3.9
Job type	Managers and administrators	127	32.6
	Professionals	208	53.5
	Tradespersons and related workers	1	.3
	Clerical	21	5.4
	Sales and service	2	.5
	Other	30	7.8

Analysis

Descriptive statistics is used to introduce the variables, their means and standard deviations. Pearson correlation tests are conducted to investigate if there are any negative or positive associations between the five personality traits and satisfaction, perceived productivity and perceived health. The reasons for dissatisfaction are also discussed. In addition, several multiple regression tests were conducted with five personality traits as independent variables and questions related to satisfaction, productivity and health as dependent variables to determine to what extent the personality traits are affecting the dependent variables. To further analyse if descriptive characteristics of the occupants are predictors of satisfaction, productivity and health, they were added to the multiple regression tests as independent variables along with personality traits. To investigate significant differences for different genders and generations, T-tests and ANOVA tests are performed. SPSS Statistics version 26 is used as the tools for data analysis of this paper.

RESULTS AND DISCUSSION

The respondents' personality traits in our dataset can be generally described as conscientious, agreeable, extravert, and open-minded with low negative emotionality scores. The respondents also stated that they are energetic, respectful, responsible, and creative with low scores for depression. As depicted in Table 3, there is low variation in personality differences for the whole dataset as the standard deviation is around 0.5 on a five-point Likers scale for all five traits.

Average scores for variables related to satisfaction with physical environment, perceived productivity and perceived health are depicted in Table 3. The importance of access to nature (M=5.60, SD=1.24), access to the outdoor environment (M=6.06, SD=1.03) and access to spaces for breaks (M=5.80, SD=0.98) gained the highest mean scores, while satisfaction with visual privacy (M=3.70, SD=0.51), satisfaction with distraction-free zones (M=3.57, SD=1.70), acoustics privacy (M=4.03, SD=1.58), mental health (M=3.61,SD=1.62) and physical health (M=3.34, SD=1.56) had the lowest mean scores.

Table 3 Descriptive statistics

	Variable	Mean (M)	Standard Deviation (SD)
Personality traits	Extraversion	3.16	0.56
	Agreeableness	3.77	0.52
	Conscientiousness	3.70	0.51
	Negative Emotionality	2.53	0.67
	Open-Mindedness	3.45	0.48
Satisfaction with the physical environment	Access to natural light	5.26	1.48
	Acoustic privacy	4.03	1.58
(1= Extremely dissatisfied ~ 7= Extremely satisfied) OR	Workspace layout supports way of working	5.28	1.24
	Workspace provides visual privacy	3.70	1.65
(1= Strongly disagree ~ 7= Strongly agree)	Workspace is free from distraction/ interruption	3.57	1.70
	Having access to spaces for breaks have positive impact on productivity/health	5.80	0.98
	Visual aesthetics	5.02	1.34
	Concentration***	4.27	1.55
	Collaboration**	4.91	1.37
	Aesthetics and enterprise culture*	5.03	1.26
	Workspace connectivity to outdoor environment	4.26	1.58
	Having visual and physical access to greenery**	5.60	1.24
	Having visual and physical access to outdoor environment**	6.06	1.03
Perceived health	Overall health (space)	5.04	1.23
	Mental health	3.61	1.62
	Physical health	3.34	1.56
	Ability to be physically active	4.42	1.45
	Sleep satisfaction	4.40	2.02
Perceived productivity	Perceived productivity	5.12	1.22
	Creativity	4.58	1.34

*Question: "All things considered, the workspace aesthetics communicates the enterprise culture and values".
**Question: "My workspace adequately supports collaborative activities.".
*** Question: "My workspace provides me with zones do develop focused work".

Occupants' satisfaction, productivity and health
Satisfaction with the physical environment
Table 4 shows the result of multiple regression analysis with personality traits as independent variables, and satisfaction, productivity and health as dependent variables. The results indicated that several satisfaction items are to some extent dependent on the big five personality traits. The adjusted R square varied between .035 for acoustic privacy to 0.133 for breaks impact productivity/health. This means that between 3.5% to 13.3% of variances can be explained by the personality traits for our dataset, and personality traits do not appear to have a high impact on user satisfaction in the studied workplaces.

When adding age and gender to the independent variables (Table 4), adjusted R^2 values for some of the dependent variables (i.e. access to natural light, visual privacy, connection to outdoor) showed a slight increase while a few other variables (i.e. acoustic privacy and distraction) showed a slight decrease.

Table 5 shows the correlation results for satisfaction, productivity and health with personality traits as independents variables. The personality trait extraversion was found to have significant positive correlations with layout, distraction, breaks, concentration, collaboration, enterprise aesthetics, health (overall, mental and physical), ability to be physically active, sleep satisfaction and creativity. The strongest association was seen between extraversion and mental health (correlation=-0.222), which is considered a weak Pearson correlation. No correlations were seen between extravert personality and Workspace connectivity to outdoor environment. However, this finding doesn't match with the findings of a study done by Needle and Mallia (2020). They found that extraverted people are desiring for flexibility in a variety of configurations within the office, and the opportunity to work outside it.

Studies indicate that extraverts are more social people and spend more time with friends (Judge et al., 2002), our findings on the significant correlation with spaces for breaks and overall satisfaction with the physical environment overlaps with this argument. The personality trait agreeableness showed weak positive correlations with access to daylight, layout, visual privacy, distraction, visual aesthetics, collaboration and aesthetics and enterprise culture. It also showed medium positive correlations with spaces for breaks, importance of access to nature and outdoor environment (Table 5).

For Conscientiousness, only three variables related to satisfaction with the physical environment are found to be weakly (Aesthetics and enterprise culture and importance of access to nature) and moderately (breaks) correlated with this personality trait. Conscientious people are described as careful, responsible and self-disciplined people (Borkenau and Ostendorf, 2008) who have higher job satisfactions (Furnham et al., 2009), and higher tendency to personalize the workplace (Wells and Thelen, 2002). Surprisingly, no correlations were found between this personality trait for our data set and well-known problematic aspects of open-plan offices such lack of or insufficient visual and acoustic privacy (Brand and Smith, 2005, Bodin Danielsson and Bodin, 2009; Candido et al., 2020), along with the workplace inability to provide people with an environment free of distraction and conducive to concentration (Candido et al., 2021). These results were aligned with a study by Hartog et al. (2017) which showed that personality trait conscientiousness did not significantly influence user satisfaction with the physical characteristic or the total user satisfaction.

Significant negative correlations were found between negative emotionality and all aspects of satisfaction except access to daylight, and importance of access to nature and outdoor environment. Negative emotionality refers to individuals' feeling or affective experience (Ashton and Lee, 2001), and their ability to handle stress (Bhatti et al., 2013). People with negative emotionality, unlike emotionally stable people, are more angry, depressed or anxious (Wolff and Kim, 2012). These people are found to be less satisfied with different aspects of the physical environment such as acoustic privacy, visual privacy, concentration, collaboration, distraction and connection to the outdoor environment. It is seen that this personality trait has become more sensitive about all aspects of physical environment since being under stress more than the others. The significancy value of perceived health, mental health for this personality is higher than the others and "sleep satisfaction" and "ability to be active" items are

indicating higher negative values when compared with others.

The personality trait open-mindedness found not to have significant correlations with aspects of satisfaction, except for breaks, importance and access to nature and outdoor environment. This personality trait is known to be more open to new experience and supposedly more satisfied with their environment. Our findings are to some extent conflicting with previous findings by Hartog et al. (2017) which reported open-minded people were more satisfied with the physical aspects of their workplace.

Key sources of dissatisfaction

Satisfaction scores for acoustic and visual privacy, distraction, concentration, collaboration, and outdoor connection were among the lowest out of all factors investigated here (Table 3). Respondents were asked about the key sources of dissatisfaction related to acoustics (Figure 2) and the general layout of their workplace (Figure 1) in two follow-up questions. Regarding acoustics, 83% of the respondents indicated that 'noise from people' is the main source of dissatisfaction, followed by having no space for a private conversation on the phone (62%) and with other colleagues (40%).

When looking at key dissatisfaction sources for office layout, the top five complaints are: insufficient concentration spaces (65%), insufficient meeting rooms (60%), insufficient spaces for private conversations (58%), insufficient break-out spaces (45%), insufficient collaborative spaces (43%). These sources of dissatisfaction are aligned with the satisfaction scores depicted in Table 3 Descriptive statistics. Combined, issues rose by occupants around amount of noise, unwanted distractions and lack of privacy aligns with findings from previous research (Brunia et al., 2016; de Been et al., 2015; Seddigh et al., 2014).

No significant differences were found in key sources of dissatisfaction for different personality traits. This means the general issues with open-plan offices seems to dissatisfy all respondents with different personality traits in almost a same level.
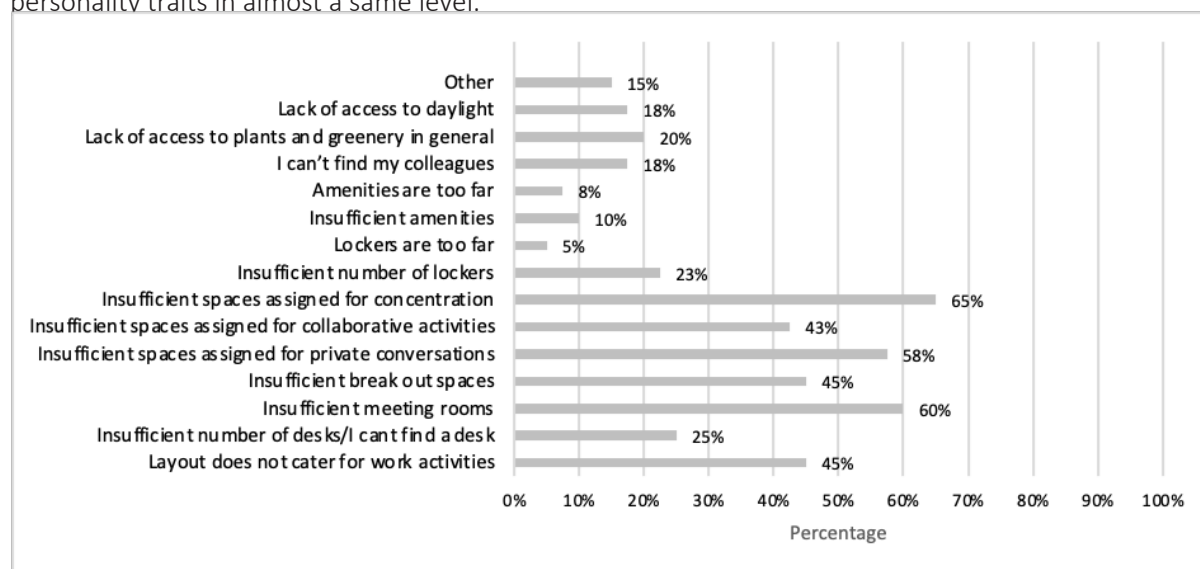

Figure 1. Key sources of dissatisfaction raised by respondents regarding office layout.

Perceived health and productivity

Based on the multiple regression analysis (Table 4), mental health, physical health, ability to do physical activity and sleep satisfaction are affected by the five big personality traits, however there is no significant effects on overall health by these personality traits. In terms of variable related to productivity (perceived productivity and creativity), there is no effect on respondents' productivity based on their personality, however creativity is found to be affected by personality in this study.

When adding gender and age as the independent variables to the multiple regression tests (Table 4), adjusted R^2 values for overall health, mental health, ability to do physical activity, and productivity

showed slight improvements. This means adding age and gender predict a higher portion of the variance, however not still a very strong predictor of productivity and health among the workers.

As depicted in Table 5, the personality trait extravert was the only trait to have weak to medium correlations with all variables related to perceived health (overall health, mental and physical health, physical activity and sleep satisfaction). Agreeableness and open-mindedness personality traits were found to have positive correlations with mental and physical health and sleep satisfaction. Conscientiousness had a positive correlation with mental and physical health, physical activity, and sleep satisfaction, while negative emotionality had a negative correlation with these variables. This means that people who were considered extravert, agreeable, conscientious, and open-minded rated their perceived health higher, while people with negative emotionality reported being less healthy.

Interestingly, perceived productivity was found not be correlated with any of the five personality traits, while correlations were found between creativity and extraversion (positive), agreeableness (positive) and negative emotionality (negative).

Table 4 Multiple regression results with satisfaction, productivity and health as dependent variables

	Variable	Personality traits as independent variables				Personality traits and demographics as independent variables			
		R	R Square	Adjusted R Square (Cohen's effect size)	Significance	R	R Square	Adjusted R Square (Cohen's effect size)	Significance
Satisfaction with the physical environment	Access to natural light	0.131	0.017	0.004	0.246	0.183	0.034	0.016	0.069
	Acoustic privacy	0.187	0.035	0.022	0.018*	0.188	0.036	0.018	0.053
	Workspace layout supports way of working	0.272	0.074	0.062	0.000*	0.280	0.078	0.061	0.000*
	Workspace provides visual privacy	0.200	0.040	0.028	0.088	0.217	0.047	0.029	0.010*
	Workspace is free from distraction/interruption	0.237	0.056	0.044	0.000*	0.242	.058	0.041	0.002*
	Having access to spaces for breaks have positive impact on productivity/health	0.365	0.133	0.117	0.000*	0.380	0.144	0.122	0.000*
	Visual aesthetics	0.175	0.031	0.018	0.034*	0.186	0.034	0.017	0.062
	Concentration	0.219	0.048	0.035	0.002*	0.220	0.049	0.031	0.008*
	Collaboration	0.175	0.030	0.018	0.036*	0.182	0.033	0.015	0.075
	Aesthetics and enterprise culture	0.216	0.047	0.034	0.002*	0.217	0.047	0.030	0.010*
	Workspace connectivity to outdoor environment	0.196	0.038	0.026	0.010*	0.216	0.047	0.029	0.010*
	Having visual and physical access to greenery	0.279	0.078	0.066	0.000*	0.141	0.020	0.002	0.373
	Having visual and physical access to outdoor environment	0.376	0.142	0.114	0.000*	0.291	.084	.068	0.000*
Perceived health	Overall health (space)	0.139	.019	0.007	0.183	0.183	0.033	0.016	0.072
	Mental health	0.469	.220	0.209	0.000*	0.486	0.236	.222	0.000*
	Physical health	0.291	.085	0.073	0.000*	0.296	0.088	.0071	0.000*
	Ability to be physically active	0.240	.058	0.045	0.000*	0.261	0.068	0.051	0.000*
	Sleep satisfaction	0.334	.111	0.100	0.000*	0.339	0.115	0.099	0.000
Perceived productivity	Perceived productivity	0.114	.013	0.000	0.414	0.148	0.022	0.004	0.291
	Creativity	0.345	.119	0.108	0.000*	0.244	0.060	0.042	0.001*
	*Statistically significant								

Table 5 Pearson correlations results[4] for satisfaction, productivity and health with personality traits as independent variables

	Variable	Extraversion	Agreeableness	Conscientiousness	Negative Emotionality	Open-Mindedness
Satisfaction with the physical environment	Access to natural light	-0.03	0.10*	-0.01	-0.04	-0.00
	Acoustic privacy	0.07	0.07	0.01	-0.11*	-0.07
	Workspace layout supports way of working	0.13**	.19**	0.08	-0.21**	-0.00
	Workspace provides visual privacy	0.09	0.15**	0.04	-0.15**	0.07
	Workspace is free from distraction/interruption	0.14**	.10*	0.03	-0.16**	-0.04
	Having access to spaces for breaks have positive impact on productivity/health	0.15**	0.33**	0.22**	-0.22**	0.13*
	Visual aesthetics	0.07	.15**	0.02	-0.10*	0.04
	Concentration	0.14**	0.05	0.06	-0.13**	-0.07
	Collaboration	0.10*	0.127*	0.04	-0.12*	0.00
	Aesthetics and enterprise culture	0.12*	0.181**	0.13**	-0.14**	0.06
	Workspace connectivity to outdoor environment	0.07	0.09	-0.00	-0.17**	0.08
	Having visual and physical access to greenery	0.07	0.20**	0.11*	-0.02	0.21**
	Having visual and physical access to outdoor environment	-0.09	0.23**	0.13	0.07	0.22**
Perceived health	Overall health (space)	0.11*	0.07	0.05	-0.02	0.04
	Mental health***	-0.22**	-0.12*	-0.17**	0.46**	-0.14**
	Physical health***	-0.13**	-0.16**	-0.21**	0.23**	-0.17**
	Ability to be physically active	0.18**	0.07	0.11*	-0.19**	0.01
	Sleep satisfaction	0.19**	0.14**	0.10*	-0.32**	0.10*
Perceived productivity	Perceived productivity	0.08	0.06	0.00	-0.02	0.05
	Creativity	0.18**	0.11*	0.09	-0.19**	.07

*Correlation is significant at the 0.05 level (2-tailed).
**Correlation is significant at the 0.01 level (2-tailed).
*** The two questions related to mental and physical health convey a negative meaning and the correlations for these questions should be interpreted positive if it is negative and vice versa. Both questions are on a 7-point Liker scale)1=strongly disagree ~ 7=strongly agree) (Questions: "During the past 4 weeks, my ability to work and/or develop other activities has been negatively affected because of your mental and emotional health", and "During the past 4 weeks, my ability to work and/or develop other activities has been negatively affected because of your physical health").

Satisfaction, productivity and health per gender and generation

As gender and age were found to be influential on respondents' satisfaction, productivity and health, T-test (for gender) and ANOVA test (for generations) are conducted to find any significant differences among the groups. The t-test results (Figure 2 (left)) indicated that male respondents are significantly more satisfied with concentration spaces (mean difference=0.31, p-value<0.049) and how office layout support the way they work (mean difference=0.37, p-value<0.004), and their ability to be physically active (mean difference= 0.35, p-value<0.001). Female respondents on the other hand, cared about access to nature more than male respondents (mean difference= 0.50, p-value<0.006).
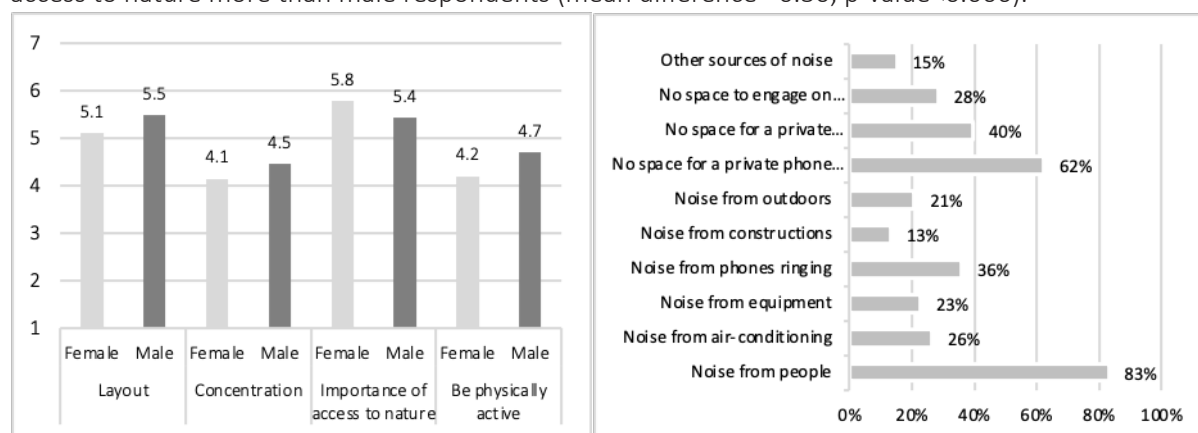

Figure 2 T-test results for satisfaction per gender (left) and key sources of dissatisfaction raised by all respondents regarding acoustics and noise (right).

[4] Pearson correlation ranges: Values lower than 0.1 are not correlated, 0.1 to 0.2 have weak correlation, 0.2 to 0.4 have moderate correlations, and higher than 0.5 have strong correlations.

Having generations as independent variable, results of the ANOVA tests showed that for the dependent variables concentration, outdoor connection, being physically active, mental health, the p-value is less than 0.05 which means there is at least two groups with significant mean differences. Generation X sounds to be more satisfied with workplace providing them with zones for focused work, workplace connectivity to the outdoor environment and ability to be physically active compared to Generation Y, while Generation Y showed higher scores for mental health. Interestingly, very young respondents who were born 1995-2012 (Generation Z) outperformed Generation X and Y for all the mentioned variables.

Personality traits and the covid-19 pandemic

Satisfaction, productivity and health scores presented in this study are related to the workplace, not working from home experience. Very different results might arise from the extension of this research when considering the work from home experience. The individuals who have different personality traits play key but distinct roles in workplace adjustments to the COVID-19 pandemic (Kniffin et al., 2021; Gubler et al., 2020). For instance, extraverts might be more affected from social distancing policy, while this policy might have helped the conscientious traits in solving visual and acoustic privacy issues. Furthermore, people with negative emotionality, might be negatively affected from the stressor factors of the novel situation. As the roll-out of the COVID-19 vaccines have been accelerated in the last few months, the idea of having a hybrid way of working in strengthening and coming to reality for many organizations around the world. Academic (Davis et al., 2020; Marzban et al., 2021; Majumdar et al., 2020) and industry (Colley and Williamson, 2020; Kniffin et al., 2020; Gensler, 2020) research are starting to capture the effects of COVID-19 pandemic on knowledge workers, however how different personality traits will receive and rate this hybrid way of working needs more research.

CONCLUSIONS

This paper analysed the relationships between human factors with a specific focus on personality on satisfaction, health, and productivity of the occupants in open-plan offices. Weak and moderate effects, along with weak negative/positive correlation were found on the scores for satisfaction, productivity, and health by personality. Age and gender were found to have an effect on respondents' satisfaction, productivity and health. There was a match between sources of dissatisfaction for different personalities, and respondents raised acoustics privacy, and insufficient spaces for concentration, collaboration, meetings, and break-out as the main issues.

As a growing interest is arising in the industry to investigate the suitability of open-plan office for different personality traits, and other human-related factors (such as age and gender) and as organizations endeavour to make the links between open-plan offices and workers' individual characteristics, the need to produce more evidence is felt. The evidence can be used to create workplaces that are shaped around an evidence-based and user-centred design. A design that can increase users' satisfaction and health, hence boosting their productivity and contributing to the financial benefits of the organizations. This research has highlighted that human factors might be correlated with perception of open-plan offices by the users, however by creating variety of different spaces, there is a greater chance of successful design in these types of offices.

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Distributed Academic Workplace and Community
- towards a coherent campus within a city

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ABSTRACT

Background and aim – The European third generation universities are distributed in multiple places within a city. This paper focuses on a case of a recent university organisation merger that combines three campuses within one city, each with their own organisational cultures and spatial structures. The challenge for the campus development is to enhance and support community creation within this diversity. This paper examines the distributed academic community through its mobile knowledge workers: the quality and needs for mobile workplace.

Methods – The workplace experiences of the mobile knowledge workers were collected in two phases in early summer 2020 executing first a survey followed by semi-structured interviews (N=23). The qualitative content analysis was conducted.

Results – The findings indicated mostly intra-organisational mobility due to 1. interaction within the academic community, 2. (missing) provision of the workspaces, and 3. issues concerning control over time and environment. Three interaction patterns were identified: between, 1. the team, 2. the university organisation units 3. university organisation and external actors. Each level consists of direct (planned) and indirect (co-presence) interaction. These set diverse requirements for campus development.

Originality – Extensive amount of research exists on multi-locational mobile knowledge workers in e.g., global context and corporations. However, less literature seems to be on mobility within a city or in academic work context.

Practical implications – The results benefit briefing and designing of campus environments for interaction and collaboration at different levels.

Type of paper – a research paper

KEYWORDS

academic workplace, interaction, distributed teams, community, mobile knowledge work, campus development

INTRODUCTION

One of the trends in higher education institutions in the past 20 years has been university organisation mergers and closer collaboration between institutions (SFC, 2006). These mergers create strategic implications for the locations of the campus facilities and academic personnel among others. These so-called third generation universities, the network universities, have premises located in multiple places within a city (den Heijer & Tzovlas, 2014). Secondly, along with the mergers, work habits and workplace needs of the academic community members have been changing due to the new ways of working and the mobility of the knowledge workers (Harrison & Hutton, 2014). As a result of these developments, the academic workplace can be seen as distributed and creates a challenge for the campus development: how to enhance and support community creation within this diverse organisation culture context?

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This paper focuses on a case of a recent organisation merger of two universities and a university of applied sciences in Tampere, Finland. These institutions function in three main campuses distributed across a city. Along the merger, the campuses are now part of one organisation, but each with different organisational cultures, traditions and spatial structures (typical to multi-campus universities e.g., Pinheiro and Berg, 2016). Campus development was created as a strategic project to support the merger by creating multi-purpose environments to the changing needs of the users, community, and society. The focus was also increasing the low utilisation rates of campus facilities, in identifying the efficient number of spaces for use as well as creating an impact on the carbon neutral goals of the university. Campus development supports the community's renewal by modernising the workplace: creating activity-based and better performing workplace solutions suitable for different work profiles, enhancing intra-community mobility and collaboration.

This study investigated the needs of multi-locational mobile knowledge workers in a specific campus context. This user group was found focal as they experience the distributed higher education institution and campuses on a daily basis. The key intention is to understand workplace needs of mobile knowledge workers in the context of a university merger and thus, to provide insight for the campus development and facility management.

The research questions are:
RQ 1. Who are the mobile workers in the academic community?
RQ 2. What are the key reasons for their mobility?
RQ 3. What are the interaction patterns in a distributed academic workplace?

LITERATURE STUDY

The university organisation mergers have been increasing in Finland and since 2010, the number of universities have dropped from 21 to 14 leading to multi-campus universities (Vartiainen, 2016). In multi-campus situations, the activities span across distributed locations that may increase the structural and cultural complexity enhanced by the mergers (Pinheiro, Nordstrand Berg, 2016). The merger may lead to 'inadvertent multi-campus situations' at regional levels that in turn, may result in a tendency of internal concentration process to the core urban campus at the expense of others (Zeeman & Benneworth, 2017). However, in the literature the multi-campus seems to refer mainly to regional level situations (e.g. Zeeman & Benneworth, 2017) and in terms of in-city university mergers, the studies focus on policy and change management (cf. Tienari, Aula and Aarrevaara, 2015).

There are studies about the identity and dynamics of integration in terms of human resources (Tienari & al., 2016). Due to the rapid development of digital technologies, modern knowledge work has become increasingly independent of place and time and, thus, it can be conducted from various different locations apart from the office (e.g. Vartiainen et al. 2007, Blakstad 2015). Some scholars have indicated that as the importance of location diminishes, the value the physical workplaces create becomes central (Tuomivaara et al. 2016, 60). However, Nordbäck et al. (2021) argue that places, social entities, and temporalities intertwine as sources of identity. For understanding academic identities it is useful to focus on how layers of place (spaces such as city neighborhoods, buildings and workspaces that are made meaningful by people) intertwine with social aspects of identity (such as academia, university, department, research group, and research collaborations) and different temporal orientations (past, present, and future).

As modern knowledge work highly relies on effective interaction, fostering community creation has become a core purpose of the workplace design (Heerwagen 2004). According to Haynes (2012) the interaction through presence in the physical spaces develops deeper social ties than at distance. Knowledge is more probable to flow fluently when there is trust among the work community. According to Heerwagen (2004), knowledge work is based on the creation, sharing and application of knowledge, which requires working together. A well-functioning work community can serve as the basis of social capital for an organisation (Becker 2007) and is crucial to organisational productivity,

as effective interaction is fundamental to the creation of innovation (Oseland 2009). Berhelsen et al. (2018) investigated the psychosocial work environment in academia and they found out that the social community at work had declined and social support from colleagues and supervisors was perceived to have decreased. On one hand Gerards et al (2018) identified three facets of new ways of working: management of output, access to organizational knowledge, and a freely accessible open workplace – positively affect employees' work engagement. The latter two facets appear to be fully mediated by social interaction and transformational leadership. Bosch-Sijtsema et al. (2009) highlight that as an effect of mobility, teams have become increasingly distributed. This creates unique challenges both for the interaction behaviours of the organisation and to the design of the workplace.

The office of an organisation is a social and experiential environment, where the culture of the working community and the organisation is built and maintained. To strengthen this sense of community, the facilities provided by the organisation should serve as relevant and attractive bases as part of the workers' work environment network. (Blakstad 2015) Some scholars focus on campuses as the compositions of different spaces. They identify different stakeholder groups that occupy the formal and informal spaces throughout the day. New learning and teaching approaches, space typologies for creative work, and globalisation have an impact on what kinds of spaces will be built and how existing property will be re-designed and retrofitted around emerging user needs (Jamieson, 2009; Neary and Saunders, 2011; Rytkönen, 2016). Furthermore, the modern workplace has changed into the nodes of the network in between one moves (Blakstad 2015).

Understanding various user groups is important, and Lilischkis (2003) argues that well-defined user typology is helpful for an analysis of the economic and societal implications of mobile work and such a typology is not straightforward. Her proposal about five types of work distinguished by an increasing level of detachedness of the workplace from a fixed place are: (1) "On-site movers": work requiring movement around a certain site. (2) "Yo-yos": occasionally working away from a fixed location. (3) "Pendulums": alternate working at two different fixed locations. (4) "Nomads": working at changing fixed locations. (5) "Carriers": working on the move transporting goods or people. Additionally, a well-known typology of user profiles in knowledge work is presented by Greene and Myerson (2011). They identified four typologies of knowledge workers: The Anchor is in one sense a throwback to the process-driven floor plans of the twentieth century office-factory; the Navigator, enabled by new communication technologies, anticipates a more flexible and non-territorial future. With most knowledge workers still operating as Anchors and Connectors within office buildings, Gatherers and Navigators point towards a new territory for design in which more occasional and random presence within the work environment must nevertheless be catered inclusively.

While the COVID-19 pandemic accelerated the remote team collaboration with the adoption of virtual tools, the extended length of the pandemic situation has also revealed the need for new profiles based on understanding the work behaviour when one of the work locations is at home. Mellner et al. (2013) identified different profiles according to boundary management preferences, perceived boundary control, and work-life balance among full-time employed professionals in knowledge intensive, flexible work. This profiling is clarifying the preferences also in terms of working from home. One profile is based on strong preference for segmentation, that is, separating work and personal life. The other profile integrators had higher working time per week, more often working evenings and weekends and at different places than the workplace, especially from home. These profiles provide more insights into the potential increase of working from home partly also after COVID-19 pandemic.

The multi-locational mobile knowledge work is extensively studied in terms of global context and corporations. In an academic work context, mobility issues seem to be scarcely studied. Furthermore, literature on the universities often focuses on the students rather than on the workplace needs and experiences of the university staff (Ruohomäki et al., 2014). After exploring the literature about mobile and multi-locational knowledge work as well as related workplace literature, we state that there is a lack of the literature on mobility within an in-city academic work context. The literature seems not

to address the impact of the mergers on the academic knowledge workers who are bound to move between the campuses.

RESEARCH METHODOLOGY AND/OR METHODS

This research inspects the aspects of the workplace in support of mobile work in a case of a distributed academic community by focusing on a case study. A case study is an empirical inquiry that investigates a contemporary phenomenon within a real-life context where the boundaries between phenomenon and context are not clearly evident, and in which multiple sources of evidence are used (Yin, 1984). We chose a case of recent organisation merger because it represents a purposefully selected case (Patton, 1990) to study mobility within academic context. Firstly, the merger created a situation of distributed campuses and secondly, it had a major impact on the organisational structure. In effect, both actions presumably increased the mobility of the employees of the formed organisation.

Data collection and analyses

The data was collected in two stages and with two methods. First, an online questionnaire in early May 2020 and in the second stage, semi-structured interviews a month later. Participants for the survey were recruited via the university community intranet, which reaches the entire staff (approx. 5,000). The survey call was directed to the employees of the academic community who identified themselves as mobile workers. The initial premise for the survey was that respondents had, to some extent, worked either at multiple campuses or at different locations. Hence, the respondents were purposefully selected (Patton, 1989). The intention of the survey was two-fold. First, to formulate a general understanding about mobile workers' activities, perceptions and experiences in connection with working in different places and on multiple campuses. Secondly, to find interviewees to formulate a more in-depth understanding about the matter.

By the time of the survey, the staff members were working fully remotely due to the government-ordered lock-down caused by COVID-19. During the interviews, the lockdown had ended but there continued to be a university-ordered restriction on the use of campus premises, and therefore, the majority of staff remained working remotely. At this point, the interviewees had been working remotely for about 2 months and the assumption was the restrictions would lift by the fall semester 2020. Due to the ever-changing circumstances, the interviewees were asked to reflect the questions prior, during and post the pandemic.

The questionnaire resulted in a total of N=91 respondents which is not representative of the whole staff (1,83%), but provides insights together with the interviews. The respondents who were interested in participating in the interviews, were asked to voluntarily provide their contact information. A total of 23 self-identified mobile workers were then interviewed through Zoom or Teams. Saturation of issues emerged during the interviewees. The work positions of the interviewees echo the survey respondents (see fig. 1), five persons were from teaching and research, 15 persons from university services, two from management and one from "other". The recordings were analysed with the qualitative content-driven analysis by two researchers independently and results were discussed jointly. The analysis was loosely driven by the theoretical understanding of mobile knowledge work by the researchers.

Case organisation

The case organisation, Tampere University Community, is an organisation merger of two Finnish universities and a university of applied sciences created at the beginning of 2019. It entails approximately 30,000 students and over 4,000 members of staff. The community consists of several campuses, of which the main ones are dispersed within the city of Tampere in southern Finland. The campuses comprise approximately a total of 270,000 m^2 of space where of 54 600 m^2 are offices and auxiliary facilities, with the majority of private office rooms. (Tampere University Campus development 2019).

This study focuses on three main campuses, 1. City centre, 2. Sub-urban, and 3. Eastern. In terms of their spatial configuration, the Sub-urban campus creates its own unity, and the buildings are all connected

with interior pathways. This campus has also been somewhat heavily developed in recent years in terms of offices as well as open access and shared learning spaces for all. Then again, the City centre campus forms a recognisable unity, but partially blends with the surrounding centre. It consists of buildings that are not connected but in close distance to one another. Both the working and learning environments are mainly dated representing the ideals of their time. The Eastern campus area is the home to both the university of applied sciences and the university with university hospital close-by. The buildings are in proximity to one another, with separate buildings with modern approaches to studying and working.

RESULTS

This section discusses the main results. We aim to define what is the character of a distributed academic workplace and community. For this, we first define who are the mobile workers within an academic community and what is mobility in this context. Next, we discuss the main reasons for mobility. The section ends with defining the levels of interaction and interaction patterns in a distributed academic community and their implications for the workplace. By mapping the work habits and workplace needs of this particular user group, we were able to define the interaction levels and patterns that contribute to the character of the distributed academic workplace and community.

The mobile workers within a distributed academic community

According to the survey, the mobile workers within the distributed academic community are mainly from the university services, while teachers and researchers were less represented (see fig. 1). 84 percent (N=76) of the respondents represent the university and only 16 percent (N=15) the university of applied sciences. The over-presentation of support services may be due to many reasons, for example, members of the administration identify as mobile more than academic staff because their work contracts define the limits to the mobility (e.g., number of remote work days per week), or they were interested to respond to the survey, or their job description actually is more mobile due to the new organisational structure. Most of the respondents (73%) were over 40 years old (see fig. 2), implying for long work experience.

The interviews, in turn, revealed that many of the interviewees worked as a part of teams that were distributed across campuses. Also, many of them had been re-allocated into other campuses than the one they had worked prior to the merger. Hence, they were able to reflect the different characters of the campuses (discussed later). This was somewhat applicable to both the representatives of university services and to the academic staff. What is noteworthy is that all the interviewed teachers represented cross-disciplinary fields, e.g., language learning, which implies that the study subject specific education is mainly organised in the same campuses as where each degree topic is located at. In other words, higher education itself does not seem to be distributed across campuses. For university services, there seems to be a strategic choice behind the distribution so that the services are located across campuses closer to the teaching and research activities.
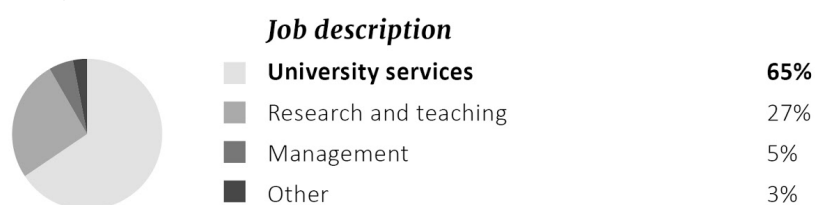
Job description

▨ **University services**	**65%**
▨ Research and teaching	27%
▨ Management	5%
■ Other	3%

Figure 1 Job description (N=91)

Age

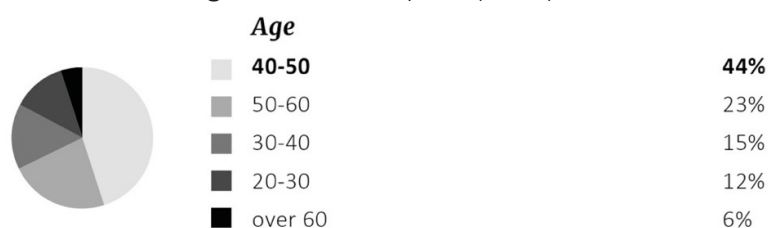|	
▨ **40-50**	**44%**
▨ 50-60	23%
▨ 30-40	15%
■ 20-30	12%
■ over 60	6%

Figure 2 Background factors of the respondents (N=91)

The locations of the mobile knowledge workers

According to the survey results, prior to the covid-forced remote work period over half of the respondents (52%) worked one to two times per week in another than their allocated campus, while approximately one in four works up to three to four times per week (see table 1). Furthermore, over half of the respondents (55%) work one to two times outside campuses per week, and then again 25% of the respondents work only one to two times outside campuses per month (see table 2). These indicate that their (allocated) primary workspaces were empty or underused at least half of the workdays prior to covid.

Table 1 Working on other campuses

Percentage of respondents (N=91)	Frequency
52%	1-2 times per week
23%	3-4 times per week
15%	1-2 times per month
7%	Every day or almost every day
3%	Rarely or never

Table 2 Working outside campus

Percentage of respondents (N=91)	Frequency
55%	1-2 times per week
25%	1-2 times per month
12%	Rarely or never
4%	3-4 times per week
4%	Every day or almost every day

Along the primary allocated space, the locations the survey respondents (N=91) indicated as workplaces prior to covid, were first-most 'the other campuses within the organisation' (98%) and secondly, their 'home' (85%) with one third working in 'the means of transport' (32%), while only one in fourth works occasionally in 'the facilities of an outside partner' (24%) or 'public facilities' (24%), and only 1% in 'coworking spaces'. According to these results, the mobility within an academic community is mainly intra-organisational and within the city. Working with external partners and in public facilities are part of the work patterns, but not in a significant role. Coworking spaces were heavily under-represented. However, this was in accordance with the pre-knowledge of the workplace statuses of the organisation and highlighted the importance of the intra-organisational provision.

The reasons for mobility

Both the survey and interview results highlight that the main reason for the mobility is the interaction and collaboration between different actors of the community within the multi-locational university organisation. Second reason for mobility was somewhat surprisingly the (missing) provision of the workspaces across campuses albeit in line with the motivation of this research. Related with the selection of the place for work, the third identified reason is the balance and control, which are allowed by the flexibility to work in suitable times and places. These three aspects are discussed below.

Interaction

Given the time of the data collection, the pandemic induced all-week full remote work was relatively recent for the interviewees. This was echoed in the interviews where the interviewees continuously reflected the on-going full remote mode to the previous situation and anticipated future directions. Thus, the selection of the place for work was emphasised and the results highlight that the location of the people with whom to interact is the main underlying reason for the selection. The main reason for mobility was the interaction and the internal collaboration within the organisation, between different members of the university community as previous practices required presence in various meetings face to face.

"A natural flow of information, which can also be described as common chatter, is what keeps an organisation running." Interviewee A

It is noteworthy that the interviewees highlighted the importance of co-presence in the workplace for information flow and communication. During the full remote period, the contacts with colleagues and other teams had significantly altered, and some found the virtual interaction limited and shallow in day-to-day practices. They found the remote mode supporting official meetings very well, but inadequate for creative collaboration and developing ideas together.

"What doesn't work remotely is when you should come up with ideas together, brainstorm new things and draw on a whiteboard. That would be better face-to-face. Traditional meetings, in turn, have been just as successful remotely." Interviewee B

In all, in the future, most of the interviewees wanted to plan their workday so that unnecessary mobility, such as participating face-to-face to a meeting where their role is not active, would be narrowed out, thus enabling them to control their way of working. In other words, their wish was to be able to stay in one location for the full workday and not to travel between campuses within a day. The workplace locations would vary between days, not within days. The remote working practices adopted during the pandemic will most likely allow such alterations in the future, where better workday planning and virtual or hybrid models of collaboration are enabled with the virtual collaboration tools.

Provision of spaces

Secondly, the results revealed the different characters of the campuses due to their workspaces, spatial structure and social culture. The character of the campuses was found to play a significant role on the respondents work habits and interaction. Many of the interviewees stated that prior to covid-induced full remote work, within one workday, they wanted to move back to their primary allocated workplace despite the extra travel. Three reasons were identified. First of all, the campus they had travelled to collaborate failed to provide adequate open access workspaces to use after the collaboration sessions. Secondly, they veered back for the comfort and familiarity their primary location provided. Many of the interviewees also felt the "other" campus was not as welcoming and would not provide similar freedom for them and their activities. The more familiar the environment, the more independence they seemed to feel. This was especially applicable to the City centre and the Eastern campuses. Then again, the Sub-urban campus was found in many ways affording many activities and better provision of collaborative workspaces. Thirdly, the interviewees returned to their primary workplace as they found important the presence of their own team and community. This partially "forced" mobility implies the inadequacy of the workplace provision on certain campuses for mobile workers, but it also implies a deficiency of digital work practices prior to the covid-forced remote work. On a positive side, this highlights the importance of the presence of colleagues. As stated, many of the interviewees work in distributed teams. However, it was found that the interviewees would prefer their teams to be in the same location for easy interaction and sharing of information. Thus, the colleagues can be seen as a part of the provision of the workplace as well.

"In terms of team spirit and overall communication between team members, it would be best for the team to be located in one place." Interviewee C

Balance

When comparing interviews with the survey results, the respondents originate from the extreme ends in terms of workplaces (see table 3). In other words, their workplaces, and thus most likely the related workplace cultures, differ from each other. The respondents were also asked to pinpoint the tasks they mainly conducted in their designated workplace prior to the covid-forced full remote work. Given the survey respondents (N=91) were self-defined mobile workers, it is noteworthy that the 'individual routine tasks' take up to 92%, and 72% of the 'demanding individual tasks' are conducted in the designated workplace. 'Informal group working' creates 41% of the tasks, while only 15% of the tasks are 'formal group working'. 'Breaks' compose 23%, 'other' (e.g. customer service) 7%, 'teaching' 3%, and 0% 'laboratory work' of respondents' tasks was performed in a designated workplace. These results are somewhat surprising as the ideals of mobility and activity-based working imply the possibility

to choose location for work according to the task at hand.

Then again, according to the interviewees, the concentrated work is conducted in an environment that provides self-control and comfort, and whether individual room or shared space with colleagues, this space feels as a haven for many. Furthermore, many of the interviewees were anxious to return to the campus after the covid restrictions were to be lifted. Instead of full-week remote work, many wished for partially on-campus, partially at home workweeks in the future.

Table 3 Designated workplace

% of the respondents (N=91)	Designated workplace
27%	Designated workstation in an open plan office area, over 8 pers.
24%	Private office room
24%	Designated workstation in a shared office room, 2 pers.
12%	Designated workstation in a shared office room, 3-5 pers.
7%	Designated workstation in an open plan office area, under 8 pers.
3%	A flexible/ non-designated workstation
3%	Other

The characters of interaction within the distributed academic workplace

This part discusses further in detail the identified levels of interaction, that in turn, are found to define the character of an academic community. The results also reveal the different characters of the main campuses and how those contribute to the workplace (as discussed above).

As stated, one of the main reasons for mobility was interaction and collaboration. We identified three levels of interaction, closely related with collaboration, and within each level two types of interaction patterns within the academic community (table 4). These levels and patterns were found to affect e.g., the workplace needs, social relations and work patterns. Both the physical campus environments and their different cultures play a major role in the creation of the academic community. Central to the campus experience are the encounters between stakeholders and the interaction that derives from the encounters.

Table 4 Interaction levels and patterns

	DIRECT *(i.e. active, purposeful, planned)*	INDIRECT *(i.e. co-presence, passive, ad hoc, serendipitous, spontaneous)*
between the team	active collaboration planned social session (e.g. lunch breaks)	co-presence availability of the colleagues
between the university organisation units	project work customer service	spontaneous encounters campus atmosphere
between university organisation and external actors	Creating and sustaining networks to external partners	community showcasing

Interaction between the team

Interaction between the team members and between the teams within the units is at the core of the work. Thus, a 'direct interaction' is active collaboration with colleagues. Whereas 'indirect interaction' is the co-presence with the team for easy information flow, the sharing of tacit knowledge and spontaneous request for help from a colleague. Both 'direct' and 'indirect interaction' are also closely related with social well-being, as many of the interviewees highlighted the importance of planned recurrent lunch breaks with the team, but also planned or spontaneous (virtual) coffee breaks missing during covid. Whether virtual or physical co-presence, it is important to know if the colleagues are available and when it is possible to interrupt, thereby sharing the joint rules for workplace culture.

In terms of workplace requirements, many of the interviewees highlighted the need for contemporary collaboration spaces for the new ways of working in teams. The basic meeting rooms were found to be inadequate in supporting collaboration. The contemporary spaces should accommodate the different ways of cooperation and be easily accessible and available. Along bookable spaces, also spontaneous ad-hoc meetings should be supported. Furthermore, interviewees found the workspaces in proximity to colleagues and key persons essential for the co-presence, transfer of tacit knowledge and support. Thus, emphasising the social well-being and creation of the community spirit, that in turn highlights the interlink of social (e.g. group cohesion) and physical aspects (e.g. spatial configuration) of a workplace. Here, the differences between campuses were evident. The Sub-urban campus was identified to provide a variety of workspaces, while the other two campuses inhibited the natural co-presence with the colleagues and the collaborative work styles (typical office corridor layout and meeting rooms, office location far from one's own team, or distributed location). Also, the equality issues were raised. For example, due to the distribution, interviewees found visits to meet the team members in other campuses necessary prior to covid, but the workspaces for the visiting team members were inadequate. In order to support the interaction within a distributed team, the workplace facilities should be equal across campuses.

Furthermore, the interviewees reflected how the covid-enhanced digital collaboration practices will alter their mobility and if the shared workspaces support that. For example, quite surprisingly, many of them state taking calls or participating in online meetings (e.g., Teams or Zoom) from their own desk prior to covid, thus disrupting colleagues as their workplaces lack isolated "withdrawal" spaces. Also, this indicates lack of joint rules as well. In terms of digital practices, the interviewees also pondered on the hybrid meetings for the future and how to enable the feeling of equal participation for online and face-to-face participants.

Interaction between the university organisation units

For mobile knowledge workers in an academic community, the work entails interaction between university organisation units. In this case, 'direct interaction' is project work between the actors from different units or direct customer service. Then again, at this level 'indirect interaction' is the spontaneous encounters, for example between the staff and the students or between different unit members. These encounters can either be active, i.e., benefitting or leading into collaboration, or they can be inactive, i.e., where co-presence with the community members takes place in shared (and social) facilities, such as corridors and restaurants. These encounters were found essential not only for the campus experience, but also for the creation of community spirit and the shared "story" between the members of the community and lacking during covid-induced remote work period.

"I travel around in my work because it is essential that I am reachable for the students." Interviewee D

Naturally, many issues have an effect on the campus spirit. Interviewees complimented the dynamic environment and the well-being that working on-location offers e.g. by variety for workplaces. Then again, the interviewees found clear differences and deficiency in joint workplace culture between the campuses. The Sub-urban campus was stated to afford serendipitous encounters. The other two campuses seem to inhibit the natural collaboration within teams and between units, but also chance encounters. For some interviewees, this changed the manner of collaboration and a need for intentional facilitation e.g. by announcements. The differences were traced to the spatial configurations. For example, in the Sub-urban campus the restaurants are centrally located, open in layout and along the main pathways. Secondly, the connecting pathways naturally collect people. In the other two campuses, both the buildings and the members are more separated and distributed.

Mobility was seen generating a comprehensive understanding about the organisation and its different cultures thus building trust between members. However, one shared location for teams was called for to harmonize team practices. When dispersed, cultural differences remain more easily maintained. In other words, interaction between units creates similar workplace needs to the team needs. Particularly

significant for inter-unit work is that each employee must be able to operate in various ways, despite their location. Interviewees emphasised the lack of official workspaces on the 'other' campuses and ambiguity if the provided spaces were allowed to use. Thus, a request was made for spaces that would be welcoming and create an experience of shared community.

"Allocated places for employees visiting from other campuses would create an atmosphere of belonging to the same work community. Now one feels left out as one works in the corner of a canteen." Interviewee E

Interaction between university organisation and external actors

The third identified level is the interaction between university organisation and external actors. As 'direct interaction' it may be about creating and sustaining networks to external partners, whereas 'indirect interaction' the community is showcased to external actors. This interface was found crucial to communicate the story and strategies of the academic community to the outsiders. In terms of workplace development, central locations are found natural for these types of interactions.

DISCUSSION AND CONCLUSIONS

The results presented here shed light on the quality of mobility in a dispersed academic community that is mainly intra-organisational and thus, the questions partially differ from general mobility studies. The reasons for mobility are 1. interaction and collaboration within the academic community, 2. provision and missing affordances of the workspaces, and 3. life-balance and control over work time and environment. This study also revealed that the encounters between stakeholders are central to the campus experience. Thus, different levels and patterns of interaction have a role in creating the character of the academic community.

This study contributes to the literature in at least two directions. The mobile multi-locational work and workplaces are mainly studied in the context of knowledge work in general, and scarcely in the academic context. So far the academic workplace research in the knowledge work context is leaning on quantitative data (e.g. Berhelsen et al. 2018). This study also provides qualitative perspectives to understand the phenomena more. The second contribution includes the mobility within a city focusing on campus context.

The results provide insights on how to enhance and support community creation within a diverse organisation culture context in general. The covid-enhanced remote work will likely alter the need from allocated spaces towards shared use of facilities. This is a new challenge for organisational culture. The innovative ways to use facilities require a new approach from facilities management: how to achieve the sufficient usage rate, how to support encounters, interaction and collaboration within the community. The results emphasize the importance of supporting intra-organisational mobile knowledge work with workplace design as well as sufficient campus management.

The results are reflected and implicated in the development project in the case study university. This study contributes to concept development in the university community after organisational merge. Future research is needed to follow up the impacts of new retrofitted concepts on the academic knowledge work and campus management.

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The use of Key Performance Indicators in Real Estate Management - A stocktaking along the CREM maturity level

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ABSTRACT

In the context of the increasing importance of the shaping of CREM within the organization and the implementation of increasing digitization, Key Performance Indicators (KPI) are becoming more and more important as a measure of efficiency and as an instrument for demonstrating support for competitiveness. Thus, not only the collection of the "right" KPI is more and more important, but also addresses the question of the required maturity level of CREM for the collection of such KPIs. Especially in a world of growing challenges (e.g., flexibility, measurement and implementation of ESG criteria), the importance of KPIs will tend to increase rather than decrease.

Background and aim – The aim of the student project is to describe the relevance and use of Key Performance Indicators in Real Estate Management and to classify them in the maturity level of the functional subsystem.

Methods / Methodology – Methodologically, the research followed a mixed method approach. In the context of a quantitative study, the description of the relevance and use of key indicators as well as a feature-based self-selection in the form of a maturity level was carried out. In the context of a qualitative study, an online workshop with experts was carried out to describe the connection between the key indicator structure and the maturity level.

Results – In the context of the (limited) study, a divergence between relevance/importance and the actual use of indicators seems to emerge. Basically, the KPIs are mostly attributed a higher relevance, whereby their actual use in practice lags behind. In the case of financial ratios, on the other hand, there is a corresponding correlation between relevance and use; it is precisely these ratios that are frequently used within CREM for performance measurement and in the context of reporting. In the qualitative part of the study, it becomes apparent that at a lower level of maturity, mainly financial indicators, that are easy to collect, are used and that the complexity of such indicators increases with increasing maturity.

Originality (if applicable) – As part of the research, the current key figure efforts of the ZIA (Zentraler Immobilienausschuss) were used and combined with the maturity system in CREM.

Practical or social implications – Based on the maturity model, it is possible to self-locate the CREM; moreover, the professionalization and use of indicators can be planned and systematized along the maturity level.

Type of paper – Research Paper

KEYWORDS

Use of key figures, CREM, maturity models.

INTRODUCTION

On the importance of Key Performance Indicators in CREM

Real estate management is undergoing fundamental change. Globalization, new technologies, changes in the procurement behavior of companies and, last but not least, the Corona pandemic are leading to a change in the core business. As a result, the rather "quiet heartbeat of real estate" has to be adapted

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to the "heartbeat of the core business" and will thus increasingly gain importance and, above all, dynamism; in order to support this adaptation and transformation process, the real estate portfolio has to become more flexible in three perspectives according to GIBSON: physically, financially and functionally (Gibson, 2000). Last but not least, the numerous articles regarding to "New Work" and "Workplace Management" as well as "Home Office/Work from Home" in the past "pandemic year" can be seen as an impressive evidence of this flexibility process. It is precisely these structural changes in the increasingly dynamic core business that pose a challenge to CREM for the efficient design and management of the real estate portfolio (*ZIA Cloud -,* 2021). The connection between real estate strategic orientation in the understanding of the support of competitiveness is already addressed numerous times in this context in literature (Barkley, 2001; Gibler & Black, 2004; Gibler & Lindholm, 2012; Kenley, 2008; Lindholm & Leväinen, 2006; Roulac et al., 2003). In the past few years, the measurement of added value in particular has increasingly found its way into the scientific literature (Bernhold et al., 2019; Jensen, 2012; Jensen & van der Voordt, 2017, 2021), where it is to be seen as a conglomerate (understood as a hypothetical construct) of different metrics in the understanding of a multidimensional form (Bernhold et al., 2019).

The ZIA's set of Key Performance Indicators
The fundamental importance of Key Performance Indicators in CREM/FM should be undisputed (Barkley, 2001; Wills, 2008), however, a distinction between "importance/relevance/attitude" and actual "use" of the same is to be made. Moreover, some indicators are not standardized with regard to the exact description of "numerator" and "denominator" as components of the equation. In the case of different application of the same or different description of the input data, however, a cross-company application and its comparison is no longer ensured. To support transparency and create a uniform understanding of associated Key Performance Indicators, the ZIA in 2020 has written a policy paper with KPIs and their concretization, whereby the following table summarizes the essential allocation:

Table 1 Type-specific Key Performance Indicators in the ZIA Tableau (***ZIA Cloud -,* 2021**)

Cluster	Key Performance Indicators	Unit	Notes
Real Estate-KPIs	Depth of value added	%	
	Operating costs	EUR/m²	
	Production costs	EUR/m² BGF	m² BGF: According to (DIN 277-1)
	CO_2 intensity	$kgCO_2e/m^2a$	CO_2e = emitted CO_2
	Final energy consumption (EEV)	kwh/m²a	
	Vacancy rate	%	
	Maintenance expenditure	EUR/m²	
	Space volatility	% p.a.	
Finance-KPIs	Rental obligations	EUR	
	Real estate assets (RE assets)	EUR	
	Assets under management	EUR	
	Ownership rate	%	
User-KPIs	RE costs (occupancy costs)	EUR	
	Space efficiency	m²/employee	
	User satisfaction	1-10	

The ZIA Tableau was chosen for the project because of its recent publication and the resulting current awareness. Other sets of indicators can nevertheless also be used for an analogous study.

RESEARCH METHODOLOGY
In terms of methodology, the research approach followed a mixed-method approach, whereby a distinction can be made between a research part that tends to be deductively quantitative on the one hand and on the other hand one that is more inductively qualitative. The focus of the former was on

the research question of the fundamental application of KPIs in practice and the relationship between "attitude/relevance" and actual use. The hypothesis was that a positive attitude towards a KPI would also have a positive impact on its actual use in practice. This item based online study was conducted by students of the master's program in Real Estate and Facility Management in the winter semester 2020/21. In the second part of the questionnaire, feature-based questions were also asked to classify the maturity level of the CREM. Maturity models are to be classified as so-called "as-is" models, which allow a basic, feature-based classification (Becker et al., 2009). The aim of this structure and classification was to find out whether or not the use of certain Key Performance Indicators depends on the maturity of the organization. Although the focus of this paper is on the quantitative study, this aspect was addressed in particular in the qualitative part of the study, which was conducted online with experts. Participation in the quantitative study was possible between mid-November (18th) and mid-December (18th). To increase accessibility and awareness, participation in the study was called for via real estate-related German industry associations, such as GiF, as well as via LinkedIn and Xing. The total sample was 176 participants, but only 17 completed the entire questionnaire. This corresponds to a response rate of 9.66%. In summary, the methodological approach can be explained as follows:

Table 2 Methodical study design

Approach	Implementation in the study part	N
Quantitative	Questionnaire-based online implementation Part 1: Relationship between attitude and actual use of the ZIA metrics set. Part 2: Characteristic-based classification of participants' maturity levels.	17
Qualitative	Implementation within the framework of an (online) workshop with experts	10

The use of maturity models in the various scientific disciplines - especially in IT - is not new (Becker et al., 2009; Masalskyte et al., 2014); in CREM, there are already some basic considerations (Joroff, 1993; Masalskyte et al., 2014; Pfnür, 2014), the model used here is based primarily on the descriptions in the COBIT model (Heschl, 2005) and defines the following maturity levels:

Table 3 Characteristic-based expression of the maturity model in CREM

Maturity	Description	Essential features
1	CREM-Definition	• CREM target formation in coordination with core business not available • Reactive, non-modeled and unstructured processes • Transaction-oriented, decentralized procurement without standards • No recording of user needs and satisfactions • Asset information not available • No reporting system
2	CREM-Responsibility	• Operational, isolated and in many cases reactive target setting for CREM • No process visualizations, but structured and process-based way of working • Initial performance standards & multiple sourcing in operational implementation • Partial collection of customer and user satisfaction data • Asset information is partially available (without systematic IT management) • Reactive reporting

3	CREM-Target Planning	• Target formation by means of strategic maps for CREM • Process regulatory framework and accountability structure • Partial performance bundling & performance standards • Collection of customer and user satisfaction data • Asset information is available consistently available & supported by IT • Operational reporting
4	CREM-Control	• Management of the target system in alignment with the core business (alignment) • Process modeling and process management • Service bundling and supplier management • Management of customer and user satisfaction • System connectivity and mobile apps (mobile maintenance; CAFM etc.) • Information logistics (documentation, etc.) and integrated reporting (strategic and operational)
5	CREM-Optimization	• CREM as a potential system and hierarchical embedding as well as measurement of added value • Execution of process assessments and regular process adjustments • Cross-site package or system allocation in Strategic Partnerships • Optimization of customer and user satisfaction • Use of BIM and business analytics • Value chain oriented information logistics & KPI formation

Maturity models attempt to describe the "critical development path" of an organization and to determine a location along this path on the basis of characteristics. Without going into the existing critical comments on these models, this description in this study serves primarily to test a fundamentally assumed relationship between the "key figure" on the one hand and the "maturity level" on the other. Along the study preparation, it was thereby assumed - and other studies support this assumption (Bernhold & Wiesweg, 2020) - that the KPIs complexity increases with the maturity level. At the first maturity levels, it is assumed that primarily operational, monetarily driven indicators of low complexity are used, which can be easily mapped by the existing IT landscape (e.g., classic ERP systems) and above all provide an unidimensional insight into the implementation of day-to-day business (e.g., EUR/m²). With increasing professionalization of CREM- and thus its process management, strategy development, IT usage and databases, etc. - the key figures become more complex and multi-layered in terms of their usage, but also more suitable for transparent decision support. Meanwhile, the complex metrics provide an intimate, strategic insight into the real estate portfolio and thus have a real steering function. The characteristics shown in table 3 could be selected by the respondents themselves and thus served to standardize the model. These were then weighted and evaluated along the model and compiled or assigned to maturity levels.

RESULTS

Overall, there is a discrepancy between relevance/importance on the one hand and actual use of the ZIA set of indicators on the other. Thus, in the overwhelming majority of cases, there is a positive attitude toward the KPIs, but the actual collection and use in the context of substantiating and supporting real estate strategic decisions is lagging behind (see table 4).

Overall, the participants in the study (N=17) rated the ZIA indicators as tending toward high practical relevance. The mean value across all the metrics surveyed is 4.68 with an average standard deviation of 0.66. A six-point scale was used throughout, with the lowest rating described as "very low relevance"

and the highest rating as "very high relevance".

Table 4 Relevance and usage results overview.

Overview	mean relevance	mean usage	discrepancy[3]	standard deviation relevance	standard deviation usage
Real Estate-KPI	4,76	3,85	20%	0,63	0,74
Financial-KPI	4,24	3,56	16%	0,81	0,87
User-KPI	5,04	4,35	14%	0,53	0,77
Averaged	4,68	3,92	16%	0,66	0,79

In a direct comparison, the higher mean value of the user KPIs of 5.04 and its averaged, comparatively low, standard deviation are striking (0.53 to 0.81 (Financial) and 0.63 (Real Estate), respectively). User-related KPIs appear to be increasingly moving into the awareness and focus of CREM organizations and qualitatively supplementing a purely cost-focused measurement. Particularly in view of the fact that CREM organizations would be managed exclusively via financial ratios, the use of the ratios is surprising: A primarily financially driven management could also lead to alignment along these metrics within the organization, thus making costs the primacy of action, but the mean values show a different picture in this situation - here, financial KPIs take last place in usage, followed by real estate and user KPIs.

Table 5 Relevance and usage results for Real Estate-KPIs

Real Estate-KPI	mean relevance	mean usage	discrepancy[3]	standard deviation relevance	standard deviation usage
Depth of value added	4,76	3,00	37%	0,54	0,95
Operating costs	5,59	4,88	13%	0,39	0,69
Production costs	4,82	4,12	15%	0,52	0,69
CO_2 intensity	4,35	2,94	32%	0,72	0,76
Final energy consumption	4,53	3,94	13%	0,49	0,59
Vacancy rate	5,06	4,47	12%	1,19	0,80
Maintenance expenses	5,06	4,65	8%	0,58	0,71
Space volatility	3,88	2,76	29%	0,59	0,71
Averaged	4,76	3,85	20%	0,63	0,74

Beyond the group-averaged values, a differentiated picture emerges. In the real estate KPIs, the leading indicators in terms of relevance and utilization are rather easy to determine and in some cases have a strong financial focus: With a mean value of 5.59, operating costs are the most relevant and 4.88 the most utilized real estate KPIs, followed by maintenance expenses and vacancy rate. In sharp contrast, space volatility ranks last with a relevance of 3.88 and utilization of 2.76. The greatest discrepancy between relevance (4.76) and utilization (3.00) is shown by the depth of value added. In terms of relevance, it is almost on a par with manufacturing costs, but in terms of utilization, it is in one of the last places (see table 5). This observation is somewhat contrary to the trend noted above: User-KPIs that are presumably more complex to obtain are ahead of the Real Estate-KPIs both in terms of use and relevance; if further development took place in this direction, a corresponding focus on KPIs that are more complex to obtain and possibly more meaningful could also be assumed for the Real Estate-KPIs. However, this cannot be determined at this point. The three indicators CO2 intensity, final energy consumption and space volatility should be considered separately. Here, the higher discrepancy between

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[3] discrepancy = $\left| 1 - \left(\dfrac{mean\ usage}{mean\ relevance} \right) \right|$

relevance and utilization could be due to technical hurdles: The necessary sensors for recording are few or non-existent, and tracking changes in area, especially in a very lively portfolio, is correspondingly laborious and time-consuming.

Table 6 Relevance and utilization results for Financial-KPIs

Financial-KPI	mean relevance	mean usage	discrepancy[3]	standard deviation relevance	standard deviation usage
Rental obligations	4,12	3,41	17%	1,08	0,80
Real estate assets	4,65	3,88	16%	0,41	0,85
Assets under management	4,18	3,12	25%	0,85	0,95
Ownership ratio	4,00	3,82	4%	0,90	0,90
Averaged	4,24	3,56	16%	0,81	0,87

The spread of relevance within the financial indicators is less pronounced. What is striking here is the standard deviation in the comparison of the individual indicators. In the case of real estate assets, the participants seem to be relatively unanimous about the relevance of the indicators, as it has the second lowest deviation of 0.41 in the entire catalog of indicators (operating costs leads with 0.39). The participants are much less unanimous about the other three indicators: All of them have at least twice the standard deviation and thus, apart from the vacancy rate (1.19), form the set with the largest standard deviation in the entire test field. The rental obligations have the second highest deviation at 1.08, followed directly by the ownership ratio and assets under management at 0.90 and 0.85, respectively. Another special feature is the ownership rate: It is the key indicator with the smallest discrepancy between relevance and utilization (0.18/4%), with an identical standard deviation (0.90) (see table 6).

Table 7 Relevance and usage results for User-KPIs.

User-KPI	mean relevance	mean usage	discrepancy[3]	standard deviation relevance	standard deviation usage
Real Estate Costs	5,00	4,59	8%	0,47	0,66
Space efficiency	5,00	4,35	13%	0,59	0,83
User satisfaction	5,12	4,12	20%	0,55	0,81
Averaged	5,04	4,35	14%	0,53	0,77

As already indicated at the outset, the three User-KPIs are all among the top 5 indicators in the ZIA Indicator Tableau in terms of their relevance. The low standard deviations for relevance underpin this position: at 0.47, 0.59 and 0.55 (following the sequence in table 7), they are at a low level and thus form the most homogeneous group of indicators. The discrepancy between relevance and utilization shows a conspicuous feature: real estate costs are in the upper third at 8%, while user satisfaction occupies a place in the lower third at 20%.

If the discrepancy between relevance and utilization, the utilization as well as the standard deviation of the utilization are taken into account, an argument against the trend assumed at the beginning and for a more financially oriented control of CREM organizations can be seen here as well: The standard deviation of the real estate costs is with 0.66 on a, in relation to the whole set, very good level. User satisfaction has a standard deviation of 0.81, which is more than 20% higher, and thus occupies a position in the lower third of the overall set. If discrepancy and actual usage are added to the equation, this also results in a strong financial alignment in the case of the User-KPIs (see table 7).

The assessment of their own maturity level was carried out independently by the participants during the survey along the characteristics described in Table 3 (characteristics = response options). Based on

the descriptions of the characteristics, the participants were now allowed to select the characteristic that they felt best described their organization (where the characteristics are assigned to specific dimensions).

To determine a maturity level for the respective organization, the individual maturity levels within the various dimensions were subjected to internal weighting along the Analytical Hierarchy Process according to Saaty (1986). This allowed the maturity levels from the six dimensions to be combined into one. After homogenization, almost all companies are at maturity level two or higher. The majority are located between maturity levels two and four. One company is at level five or one (see Figure 1).
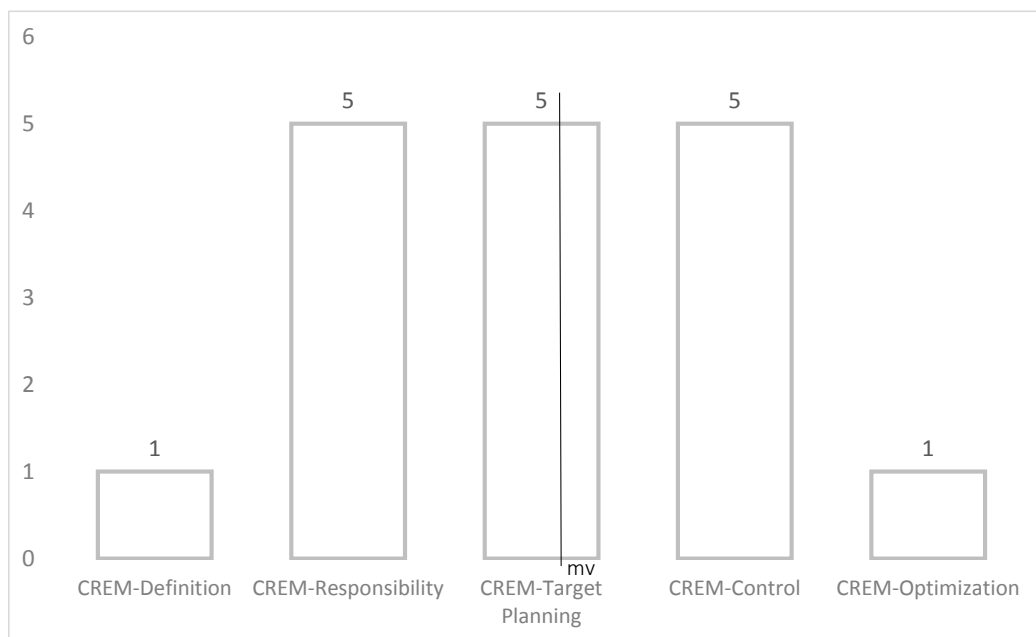
Figure 1 Observations along the ripening stage

If we take a more differentiated look at the results, we can see that many companies are on the threshold of the next stage or have just completed it. Figure 2 shows the individual companies according to their maturity level score. In Figure 1, for example, Companies with a score greater than 2 and less than 3 were assigned to level two. A slight tendency toward increasing professionalization of CREM organizations can be seen, not least because the majority of companies can be found on the right half of the pearl necklace.
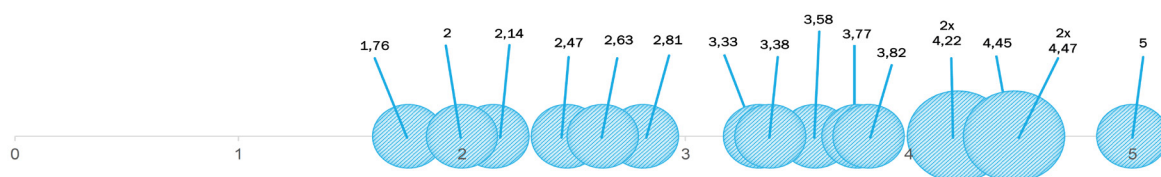

Figure 2 Maturity along the „string of pearls" from … to

This shift is an interesting observation, particularly against the backdrop of the KPI results, as no such statement can be derived due to the high discrepancy between relevance and utilization. During the workshop, the thesis that with increasing maturity, more intensive and professional use of KPIs would also occur was confirmed by all experts. However, the clear discrepancy already shown above in the case of the depth of value added, which can be assigned more to the area of the strategic KPI than to that of the operational KPI, now raises questions here. At the same time, the operating costs indicator, which is strongly operational focused, is by far the most frequently used indicator and was found to be clearly relevant.

DISCUSSION AND/OR CONCLUSIONS

The use of Key Performance Indicators is on everyone's lips, especially in view of increasing digitization. In many cases, however, the prerequisites for the use of such metrics, understood as professionalization along the critical development path, are not fully in place. Overall, this study can therefore be understood as a plea for two things: (1) further development of CREM competencies and (2) increasing use of more complex metrics. In particular, if one-dimensional input factors are no longer used and the efficiency of systems is to be measured from a diffuse conglomerate of input and output data, operational metrics and systems will no longer be suitable and will not provide any further benefit. Especially in view of the increasing challenges in the course of the ESG topic, the conceptualization as well as operationalization of these criteria and thus also their measurability will be given a significantly stronger form. The lower the CREM maturity level, the less these complex figures will be mastered and real estate systems will be optimized accordingly. Maturity models, when applied and used correctly, can be very powerful and useful tools for determining and developing organizational performance.

Especially by linking the maturity level with corresponding key performance indicators, a model can be created that focuses on the essentials: Real estate as a supporter of the core business. Here, the published ZIA metrics form a cornerstone for the future measurement and management of CREM organizations. A consistently high certified relevance suggests this conclusion. In the short to medium term, work will focus on the collection, processing and use of these figures, as in some cases large discrepancies between relevance and use have emerged. The ongoing technologization of CREM organizations will be able to make a major contribution to collection here. In this way, end-to-end IT systems will also make it possible to record the depth of value added and continuously recorded user satisfaction. Developments and the further spread of IoT offer an ideal starting point, especially for technically driven indicators such as CO_2 intensity or final energy consumption.

LIMITATIONS

The rather manageable number of study participants, which cannot reflect a population of all CREM departments, is of decisive relevance for the assessment of the results presented. This could be one of the reasons for the non-confirmation of the hypothesis established by the workshop experts, as the data material obtained for the key performance indicators and maturity levels are only related to a limited extent. In addition to this factor, the complexity of maturity models and the attempted simplified mapping within the questionnaire may have led to confusion among participants, despite pre-tests being conducted. Another cause can be assumed to be the harmonization of the maturity levels per dimension into one maturity level. This was done at a rather coarse level within the project, which may well have had an influence on the results. In general, it can be stated that the instrument of the maturity level has so far received little recognition and application in practice. Due to the low awareness of the topic and the choice of self-selection within the study, a subjective shift of the actual maturity of a company in a more positive direction definitely cannot be ruled out.

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Addressing the mismatch:
Promoting adaptability within the office real estate sector

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ABSTRACT

Background and aim – The purpose of this research is to investigate the importance of adaptability in the field of office real estate as a method of exploring the mismatch between the constant change of user demands and the static nature of the supply, assisting the transition towards a more sustainable and future-proof future.

Methods / Methodology – An empirical study was conducted, through literature review on the topics of adaptability and added value, constituting the basis for the second part of the paper where a research by design approach was adopted. Qualitative data were collected from a series of case studies – via documentary analysis and interviews- providing insights from practice which were then used to formulate findings.

Results – The findings collected are presented in categories based on the topics they address; exploring the impact of adaptability to firms' identity, the obstacles caused by developers and the financial aspects of adaptable constructions, the future of adaptability, the influence that determinant market parties can have on the transition towards futureproof buildings, the risks underlying this transition as well as the use of technology as a means to make building more responsive.

Originality (if applicable) – This paper addresses the shortage of future proof real estate, by presenting qualitative findings that can assist the development of adaptable buildings, something that according to Estaji (2007), and Gosling, Naim, Sassi, Iosif and Lark (2008) is still lacking.

Practical or social implications – This paper can assist actors such as real estate managers, developers and architects, into understanding the benefits of adaptability, and stimulate the shift towards a future-proof and sustainable environment where adaptability will become a standardised requirement. On the same line, the global pandemic crisis that we are currently facing, enhanced the significance and value of the research conducted.

Type of paper – Research paper

KEYWORDS

Adaptability, flexibility, real estate management, added value

INTRODUCTION

Living in an ever-evolving environment, where the pace of societal, economic, technological and environmental changes is rapidly increasing, has impacted the way people live and work (Remøy, Rovers & Nase, 2019). Such changes challenge corporations to find ways of adapting their businesses to the new environments in order to support their core objectives (Lindholm & Leväinen, 2006). As explained by Joroff (1993), real estate is one of the five resources that contribute to the goal fulfilment of companies, adding value and enhancing their competitive advantage (Jylhä, Remøy & Arkesteijn, 2019). The term 'added value' here means the alignment of real estate strategies with the core business and objectives of the corporation (Lindholm, Gibler & Leväinen 2006). Real estate is consequently regarded not as end but as mean, with the purpose of strengthening the performance of the corporation, by optimising the relationship between the users and the facilities provided (Blakstad, 2001).

Corporations constantly have to address exogenous (e.g. market trends and crises, technology advancements, new sustainability requirements) and endogenous demands (e.g. change in corporate

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& workplace strategy) leading to constant needs for changing their real estate portfolios (Schmidt III, Austin & Brown, 2009). Considering the strong relationship between work and context, office buildings are regarded products of their time (Blakstad, 2001). As a result, time constitutes a significant aspect of how corporations function and the way buildings accommodate their demands (Schmidt III, 2014). Therefore, corporations are challenged to increase the level of efficiency and adaptability in their portfolio management, and provide spaces that fit their demands, allowing them to work efficiently (Batbileg, Fritzsche & Lequeux, 2018). Hence, increasing adaptability is important for achieving an enhanced building-user relationship performance (Blakstad, 2001).

Inflexible buildings that do not support dynamic user demands, accommodate mainly short business cycles and have shorter functional than technical lifespans, resulting in vacancy and eventually obsolescence (Blakstad, 2001). Currently, such buildings represent the majority of the office real estate market (Manewa, 2012). Building incapacity to meet quantitative (e.g. available square meters) and qualitative (e.g. quality standards) user requirement has a negative impact on economic and environmental sustainability (Geraedts, 2008), as it leads to poor use of buildings despite high energy and material use for construction (Nakib, 2010).

Following the future's uncertainty and the changing user demands, it is expected that adaptable buildings will have a higher value for corporate portfolios (Arge, 2005; Wilkinson & Remøy, 2011; Remøy, de Jong & Schenk, 2011). However, the relevance and significance of adaptability for the construction sector are not clear to all actors involved. Many parties have short-term goals which contradict the long-term perspective of adaptability (Lindholm & Gibler, 2005). Therefore, not being able to identify the benefits and value of adaptability, such actors act as obstacles in shifting towards a future-proof environment.

Despite the significance of this the added value of adaptability for corporate real estate, according to many researchers, research is lacking (Estaji, 2017; Gosling, Naim, Sassi, Iosif & Lark 2008; Lindholm et. al, 2006). This research contributes to the body of knowledge on adaptable office buildings, and aims to provide a wider understanding of adaptable buildings from the perspective of corporate real estate management by answering the following question: **What is the importance of adaptability for decision making in the real estate market?**

The focus of this research is to explore the mismatch between constantly changing user preferences (demand) and the static nature of the built environment (supply), by presenting qualitative findings on the value of adaptability for the owners and users of office buildings as well as the importance of adaptability now and in the future, assisting in the transition towards a more sustainable and future-proof built environment. The results of this paper can provide input for future-proofing not only new developments but adapting existing buildings to present and future demands.

RESEARCH DESIGN

A comprehensive literature review was conducted on studies of adaptability and the added value of CRE, aiming to gain an overview of existing approaches and link the two topics (Gosling et al., 2008; Estaji, 2017). Studying multiple sources was key in order to gain a comprehensive overview of the present situation. The literature studied was conducted using the snowballing method (expanding literature from the available sources), in order to find the most relevant, recent and reliable sources (Manewa, 2012). From the approaches used to structure a literature review, a combination of "patchworking" and "finding intersection" was followed as they allow the identification of significant data in literature without focusing on a certain group of authors (Jylhä et al., 2019). The content analysis was conducted using Microsoft Excel where codes and labels were used to organise and identify links between the collected data.

In order to allow the triangulation of different data collection methods, following the literature review, a qualitative research approach was adopted, as this approach is more appropriate for addressing unexplored topics in literature and gaining deeper understanding from practice (Jylhä et al., 2019).

Triangulation is a technique used for assessing the credibility of findings in qualitative research, and constitutes an effective technique of gaining insights and results, assisting in the development of conclusions and strengthening the outcome of the research (Remøy, 2010; Manewa, 2012).

A qualitative approach allows the in-depth investigation of contemporary phenomena within a real-life context thorough the data collection and analysis in this case through case studies, the analysis of document data and interviews (Manewa, 2012; Bryman, 2012). Case studies allow the application of a holistic view by analysing realised projects as well as the identification of links and differences between them (Bryman, 2012). Therefore, the multiple-case design approach was selected, as it assists in identifying patterns and understanding the dynamics of the specific setting (Yin, 1989; Eisenhardt, 1989). The case-studies investigated are three Dutch adaptable projects, two new-built and a transformation of an existing buildings. The analysis is comprised of documentary data collection and a series of six interviews, with experts from the fields of architecture, real estate and development. The focus of this method was the collection of in-depth qualitative findings from different perspectives based on the experiences of the interviewees. The answers of the interviewees were then analysed and used to formulate findings categorized based on their topics they address.

Data collection methods:
Documentary data collection:
Data were collected by studying a range of documents, such as papers, articles and books. The purpose of this method is to gain general knowledge of the case, prepare for the interviews and identify the importance of adaptability in the built environment and its value for the users and owners of the space.

Interviews:
Semi-structured interviews were conducted, as they provide flexibility in the interviewees' responses, while being structured enough to guide the direction of the questions ensuring their relevance to the topic (Petrulaitiene & Jylhä, 2015). For all cases, the same interview protocol was used ensuring that the same topics would be covered. In all six interviews, 20 questions were asked in the span of one and a half hours providing time for further clarifications in the end – if required. Two sets of interviews were conducted for each case, one with an architect (focusing on adaptability) and the second with a corporate real estate manager (focussing on added value). The interviews were held face-to-face allowing direct contact and the ease of providing clarifications if required (Manewa, 2012; Petrulaitiene & Jylhä, 2015). The questions asked during the interviews were categorized in the following topics: "Drivers of adaptability", "Significance of adaptability", "Benefits of adaptability", "Value of adaptability" "Risks of adaptability" and "The future of adaptability".

Analysis:
A directed content analysis approach was adopted for the investigation of the qualitative data collected, using "atlas.ti" as the main tool, as it allowed the comparison of all cases. Implementing a directed approach, the analysis started by using the research findings as guidance for deriving the initial codes (Hsieh & Shannon, 2015). This analysis took place in three phases. In the first phase the interviews were analysed and related to the documentary data. The second phase focused on the comparing the findings across the cases and finally, the third phase entailed the formulation of findings.

LITERATURE STUDY
Adaptability
The uncertainty about future accommodation preferences and the rapid pace of changes has resulted in increased demand for adaptability (Geraedts, 2016). To understand how adaptability can be implemented in office building development, the meaning of the term must be comprehended. This research defines adaptability as: "The capacity to change the building in order to respond and fit to the evolving demands of its users/ environment maximizing value throughout its lifecycle" (Schmidt III et al., 2009). In literature, adaptability is often referred to as flexibility. However, flexibility refers to small scale changes that are usually initiated by bottom-up approaches, whereas adaptability entails buildings'

long-term capacity to react to large scale changes initiated not only by internal but also external factors (Gosling et al., 2008; Wilkinson & Remøy, 2011).

The adaptability potential of buildings defines their adaptive capacity, the ability to respond to changes in requirements and circumstances, in a sustainable and economic profitable manner (Manewa, 2012). Adaptive capacity influences the buildings' long-term utility value, allowing short and long-term changes (Geraedts, 2016). Due to longer functional lifecycles, adaptable buildings can respond to longer business cycles, reducing the mismatch between a building's technical and functional lifecycles (Remøy, 2010). Especially within the office sector where changes are frequent, the demand for adaptability has increased (Geraedts & Van der Voordt, 2003; Harris, 2015). Correspondingly, due to the environmental challenges of our era, sustainability and adaptability are becoming significant for assessing the value and future of buildings within corporations' real estate portfolio (Geraedts, 2016). On the other hand, characteristics such as high initial investments constrain actors with short-term perspectives from implementing adaptability in new projects. Therefore, when evaluating the implications of adaptability, the lifecycle costs should be considered, as in most cases after the first renovation cycle the adaptability costs are recouped (Geraedts, 2008). In addition, studies indicated that adaptable buildings are less than 3% more expensive compared to standard buildings (Remøy, de Jong, & Schenk, 2011).

To conclude, adaptable buildings provide the potential to create a balance in the relationship between users and space, in a sustainable and economic profitable manner, maximizing the building's value throughout its lifecycle. Acknowledging this potential, organisations gradually shift their preference towards adaptable buildings that allow them to manage their portfolio to accommodate changing user demands, maintaining their performance in a competitive market. Consequently, the office sector is transitioning towards not seeing buildings as static objects but as dynamic objects that can accommodate changes required by the users and the context.

Added value

To fully utilise the potential of real estate over time, contributing to their performance and supporting their core business, firms need to optimise the relationship between users and the buildings (Lindholm et al., 2006). Changes in organisations' demands and real estate deterioration, cause a mismatch between the supply (buildings) and demand (users) sides. Within the office sector, corporate real estate management addresses this mismatch, aiming to provide sufficient accommodation, at the required location, quality, time and cost (De Vries, de Jonge & van der Voordt, 2008). Real estate strategies must be aligned with business goals, providing environments that fit the needs of the occupiers, in order to create value for the firm (Lindholm et al., 2006; Lindholm & Leväinen, 2006).

Unlike real estate, organisations are dynamic entities that can evolve in response to the ever-changing environment (Gibson, 2001). Corporations' real estate portfolios are divided into two types, core and periphery, and for each part they have different demands. If the pace of change is high, to utilize the maximum potential of facilities and gain competitive advantage, core portfolios should have long-term value for organisations, stimulating the demand for efficient, innovative, productive and adaptable real estate (Gibson, 2001; Lindholm, 2008b; Remøy et al., 2019). Acknowledging the importance of real estate for their performance, corporations gradually shift their interest from cost reduction to value delivery (Jylhä et al., 2019).

Many studies have shown the value delivered by real estate. Eight forms of value were identified and are presented. First, buildings can be viewed as capital assets that can be managed to optimize the financial contribution to their organisations, increasing the portfolio value, defined as "increased real estate value" (Macmillan, 2006; Remøy et al., 2019). "Productivity" is another type of value, which is directly linked to performance, more precisely to user wellbeing and productivity. (Lindholm, 2008a; Petrulaitiene & Jylhä, 2015). Related to productivity, another major determinant of a firm's performance is "user satisfaction", which depends on the workplace design, quality and responsiveness, allowing the users to have control over it. Due to the competitive environment corporations operate in, in order for

them to survive and grow there is a rising need to "innovate" which can be stimulated through spatial design and location selection (Voordt & Jensen, 2018).

"Adaptability and flexibility" constitute another significant form of added value, allowing firms to continuously optimize their portfolio and respond to changes in their operations, image or management style (Lindholm, 2008a; Remøy et al., 2019). This form is directly linked to "environmental sustainability" as well as "social responsibility". Nowadays, sustainability has become a major concern for organisational image and identities, and a force for attracting talent and customers, having a direct impact in their performance and profit (Macmillan, 2006; Remøy et al., 2019). At the same time, real estate portfolios are a significant communication instrument of organisation "image and culture" and are dependent on physical design, site selection, workplace strategy and overall portfolio management, allowing organisations to reinforce their position within the competitive market (Singer, Bossink & Vande Putte, 2007).

The alignment of real estate strategies with corporations' business strategies and objectives, results in value delivery to firms. This is achieved by understanding and contributing optimally to the firm and user demands at a strategic, tactical and operational level (Lindholm, 2008b; Voordt & Jensen, 2018). However, the complexity of quantifying the effects of real estate strategies and isolating the impact from other resources as well as the lagged and long-term implications, make the measurement of indirect values hard for corporate real estate managers. Despite this, adding value is important to enhance the performance and competitive, allowing firms to achieve their primary goal, which is to increase shareholders wealth. In the context of adaptability, considering its long-term perspective, value delivery does not only comprise of solutions to current problems, but also ways to capture the added value of preventing future problems (Jylhä et al., 2019).

RESULTS

Three adaptable building projects were studied. The details of the cases are presented in table 1.

Table 1: Case study details

	Location	Type of project	Function	Client	Project ambition	Interviewees
Timmerhuis	Municipality of Rotterdam, NL	New development	Office & Residential	Public Project Municipality of Rotterdam	To create the Netherlands' most sustainable building, illustrating that adaptability does not have a negative impact on quality and price	Interviewee A, 2020 Interviewee B, 2020
Rijnstraat 8	The Hague, NL	Transformation of a 25 year old office building	Office	Public Project Central Government Real Estate Agency	Rijntraat 8 was designed with the capacity to remain responsive over short and long-term changes, setting an example of a highly sustainable and efficient building	Interviewee C, 2020 Interviewee D, 2020
The Edge	Amsterdam, NL	New development	Office	Private Project OVG Real Estate & Deloitte	Especially after 2008's financial crisis- the clients acknowledged the value of adaptability for their operation and companies' identities and decided to increase their investments, creating a building that can remain functional for the next 50-100 years	Interviewee E, 2020 Interviewee F, 2020

The findings from the expert interviews are presenting insights from the interviewees' perspectives and were categorized based on the shared topics identified through the content analysis conducted (Interviewees A-B: Timmerhuis, Interviewees C-D: Rijnstraat 8, Interviewees E-F: The Edge, Interviewee G: BREEAM expert). The findings address the following topics: the impact of adaptability on actors' identity, developer & investments, the future of adaptability, BREEAM & determinant parties, risks of

adaptability, technology & adaptability; along with some secondary findings: the impact of a crisis on adaptability, quality of buildings, and adaptability on an international context.

a) Identity

"If you imagine what it means to Deloitte to attract talent into their building, that is not even part of the equation, that it is 2-3-4 times as expensive and as valuable for a company like Deloitte than is the running costs of the building." (Bakker & Zwaan, 2015)

One of the main takeaways from all three cases is that the value of adaptability has for the identity of an organisation can be a significant driver for such developments. In all cases, whether the client was a public (Municipality of Rotterdam & Central Government) or a private party (OVG & Deloitte), having high ambitions contributed to the project's success. For public parties, the development of adaptable buildings aimed to illustrate the benefits and stimulate the market's shift towards such developments. On the other hand, for private parties (corporations, developers & architects) important drivers for implementing adaptability were: strengthening their identity, adding commercial value and attracting talent. Hence, the value delivered to actors from showcasing innovative and future-proof real estate can be a significant driver for them to proceed towards such solutions and overcome the risks that adaptability entails.

b) Developers & investments

Based on the cases investigated, public parties mainly focus on a vision whereas developers focus on costs and profit, constituting a major obstacle for the development of a sustainable and adaptable environment. Developers' short-term objectives and their goal to reduce costs, contradict the long-term perspective of adaptability, resulting in a large number of low quality and wrongly located buildings that have no value for the users and consequently require large renovations in order to remain functional, even within a small timeframe from their completion.

On the other hand, when creating adaptable projects actors need to be committed to their decision and invest efficiently and in smart ways without trying to cut down costs. Example of such perspective and contradicting the norm of "developers' short-term interests", is the Edge. OVG and Deloitte decided to increase their investments in order to make the building future-proof, acknowledging the direct (e.g. responsive to users' daily operations and demands) and indirect (e.g. reputation, image, increase productivity, efficiency) benefits that this would have for their companies.

Thus, ambitious developers and clients –whether these are private or public parties- that are committed to the project, can have a big impact on the project success and the creation of quality buildings that people will love and care about allowing the building to last longer . As described by Interviewee C: "*But if you do that, it only makes sense if you do that over a sort of "all the way" …. But then try to invest as much as possible in a smart way, in making this an office building for the next twenty-five years.*"

c) The future of adaptability

The rising importance of adaptability was a shared conclusion amongst all interviewees. This shift is stimulated by the pace in which the world is changing and the emergence of new patterns of work altering the current workplace demands and leading to a constant mismatch between supply and demand. The aforementioned were summarized by Interviewee D stating: "*There can be small to big changes, and therefore adaptability and flexibility are becoming much more important. The time we built for just one moment is over. Everything is changing faster and faster, and so I think that adaptability is part of the answer to this.*" Therefore, designing for adaptability is a concept that has attracted attention during the last two decades and has still a lot of room for experimentation and growth. On the same line, technology is regarded as a significant principle in the future of adaptability.

Contributing to a more sustainable and efficient world, adaptability is expected to follow the same pattern that sustainability did a decade ago. During that time banks shifted focus on financing

sustainable projects, municipalities began to impose new regulations and clients began to set sustainability requirements (OVG, 2014). As most of the interviewees discussed, the rising interest of office organisations for adaptability has started to impact the market, the financial value of real estate and consequently sparking developers' and investors' interest towards future-proof investments. Nevertheless, we are still in the very beginning of a long transition period, which at some point might lead to adaptability becoming a catalogue-requirement for buildings.

d) BREEAM & determinant parties

BREEAM certifications have stimulated the interest for sustainability, as actors have begun to understand the value underlying sustainable developments, especially for their company profile. Consequently, one can understand that leading organisations can have a large impact on market demands and the construction industry. On the other hand, some interviewees noted that quality or adaptability are not awarded and at the same time points can be deducted for supplying additional services and square metres for future needs – despite the significance of such measures for a building's adaptive capacity and the relation between adaptability and sustainability. In addition, it was indicated that certain criteria might be interesting only on paper while others can be just bought without having a real impact. Therefore, it was argued that there should be more focus on awarding quality and adaptability, factors that can have a significant impact on sustainability. "*… There is no BREEAM point for architectural quality and it's kind of weird cause if you make really good buildings that people like, people love, people will look after them better, they will last the test of time.*" (Bakker & Zwaan, 2015)

Following these remarks an interview was conducted with a BREEAM expert, who agreed that BREEAM awards could be more effective. The main issue resulting in adaptability not being awarded, is that its benefits are future-oriented and hard to quantify, whereas BREEAM focuses on direct environmental benefits. In addition, the expert discussed that after a grade is given there is no further control of how the building is operated, leading to potential unsustainable use. In conclusion, despite the benefits underlying BREEAM there is still room for improving the rating method and making it more comprehensive and future-oriented in order to stimulate the development of not only sustainable but also adaptable projects. On the same line, the impact that leading parties can have on market demands by stimulating and promoting innovative solutions is clear.

e) Risks

Despite the significance of adaptability, a number of risk factors were identified hindering the implementation of such measures. The main risk discussed is the higher initial investments required, which aligned with the pace the environment is evolving makes the future unpredictable, and therefore every investment made needs to be well considered. "*… Financially, it's always an investment and you have to have a reason to invest.*" (Interviewee E, 2020) On the same line, there is always the risk that the adaptive capacity of the measures invested in, will never be exploited. Therefore, actors need to make smart decisions on where to invest.

The second most discussed risk is the short-term objectives of actors, and especially developers and investors. Such parties mainly focus on profit and do not care about long-term benefits, contradicting adaptability which is future-oriented. On the other hand, considering the market's gradual shift towards adaptability and sustainability, according to the interviewees it is expected that adaptability will start to be reflected in property financial value, reducing the financial risks and stimulating actors into broadening their interest for more long-term objectives.

f) Technology, the ninth building layer

Considering the direction our world is moving towards and the rising interest for innovative solutions, technology constituted a significant aspect in the design, adaptive capacity and consequently the success of Edge. The implementation of adaptive measures resulted in a building which is highly responsive to users' daily demands, composing a healthy and productive environment, and adding a new layer to the building (Tilman, 2015). Such approach within the field of adaptability was unprecedented for the

time. As can be seen in this building, technology can be established as the ninth building layer, updating Schmidt's eight-layer model.

Technology entails a number of benefits for the users. However, similarly to any workplace related change, people require time to get used to innovative measures and fully utilize them. This constraint in addition to the higher financial investments required, can become discouraging factors for the implementation of technology related adaptability measures. Apart from the direct benefits that technology has for the owners and users of the building, indirect benefits in the form of data generated can contribute both to buildings' optimization, as well as to a bigger system, where buildings learn from each other (Zwaan, 2015). As explained by Interviewee E: *"...Building generates enormous amount of data and we are only really starting to understand how can these be used, and eventually create better workplaces".* Therefore, data constitute a valuable asset of nowadays, despite the uncertainty of how they can be fully exploited for the present and the future.

g) Crisis

Despite the rising demand for adaptability, there are still actors –such as developers and investors- who are not convinced about its importance and the benefits it brings about. Experiencing one more crisis with drastic impact on the real estate market could assist in stimulating the shift towards adaptable developments. As discussed by Interviewee G: "*I think we need one good crisis more to convince people that if you have properties that you can switch easily between function, if they are adaptable then it becomes handier.*" Living in 2020, the corona-virus could be the crisis that marks a turning point in the development of adaptable and flexible real estate. Changes such as the rising vacancy in the retail sector and mobile working were noted from early stages. Although the magnitude of this crisis cannot be predicted yet, one important take-away is that the built environment will need to be more flexible and adaptable in order to quickly respond to such situations and avoid repeating the impact of the "dot-com bubble" or the 2008's financial crisis on the office markets.

CONCLUSIONS

The purpose of this research was to explore the significance of adaptability in the real estate market for present and future developments considering the increasing pace at which the world is changing. As both the literature review and empirical research indicated, adaptability answers to this rising concern. As explained by all interviewees, buildings that have the inherent capacity to respond to short and long-term changes can withstand time and prolong their functional lifecycles, reducing the risk of obsolescence causing problems not only to their owners but to the general society as well. On the other hand -as it was highlighted in all cases- the higher initial investments, short-term perspectives, uncertainty about the future and most importantly the inability of actors involved to understand the short and long-term benefits of adaptability, constitute barriers for shifting towards more adaptable and sustainable constructions.

In order to address these boundaries, the literature review along with the case studies conducted showed that adaptability's strong relation with sustainability can have a significant impact not only for the owners and users of the buildings but also for the wider society (sustainable environment, preservation of existing setting). Depending on each actor's objectives and needs, adaptability can assist in the decision making design process, adding value to the owners and users of the space. In general, most parties focus on adaptability understanding its rising importance especially when it comes to their company identity. Though in order to develop responsive environments that can remain functional in time, actors need to be committed and have the will to invest in measures that can allow the building to withstand small- and large-scale changes. Leading organisation such as BREEAM, private parties (developers & investors) and other determinant actors can have a big impact on the transition towards a sustainable future.

The uncertainty of our environment, the increasing focus on embedded building emissions and the availability of resources, aligned with the environmental externalities caused by the construction

industry, have stimulated market interest for sustainable solutions. On the same line, the pandemic-crisis that we are currently experiencing and the post-pandemic uncertainty underlying the real estate market, enhance the significance of adaptability and eventually the research findings. Adopting a sustainable approach allows buildings to meet present demands without compromising the ability of future generations to meet their own demands. Using adaptability to address not only the present (short-term demands) but most importantly the future (long-term ambitions), results in more responsive real estate with longer functional lifecycles. This reduces vacancy rates, the need for demolishing and developing new buildings and the use of resources, consequently leading to a more sustainable future. The long term value of adaptable buildings - due to their capacity to respond to longer business cycles reducing the mismatch between functional and technical lifecycles- acts as an attractive force for actors and especially for corporations who require frequent changes in their portfolio.

Recommendations for further research

From the case studies conducted a number of qualitative insights were presented. These findings can be individually researched in order to explore them more thoroughly. From these findings, the relation between technology and adaptability was one of the research findings that was not addressed at all in literature. Considering the increasing significance and presence of technology in our world, this could be a very interesting topic to explore.

This paper presents the findings of an explorative study, based on which the topic will be further developed in order to formulate a tangible strategy that can be used by different market parties and assist them into creating more future-proof and adaptable real estate. This strategy can link the topics of adaptability and added value, presenting the impact that certain design tactics can have for a company's performance. On the same line, the analysis conducted could be further expanded by investigating the strategies implemented to enhance the buildings' adaptive capacity and added value. At the same time, comparing the strategies applied in each case could provide further findings. Overall, this paper shows that despite the large amount of research conducted in the field of adaptability, the rising importance of the topic and the pace at which our world is changing signals that there is room for further research on the concept of adaptability both for the present and especially for the future.

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Awareness and Use of BIM for FM: Empirical Evidence from Turkey

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ABSTRACT

Background and aim – Facility management (FM) practices play a crucial role in the efficient and effective operations of built environments. As a multidisciplinary profession, FM is closely related to the design and construction of buildings. For this very reason, the collaboration and information sharing between these disciplines should have the utmost priority. Despite building information modelling (BIM) offers a promising platform to create, store and manage building-related information, various reasons are hindering its utilization with FM purposes. This study aims to illustrate these reasons along with the level of BIM awareness and BIM-enabled FM practices within the industry.

Methods / Methodology – A questionnaire survey has been carried out to identify the existing awareness and utilization level of BIM within the FM industry in Turkey. Then, a series of semi-structured interviews have been conducted with FM professionals to discuss the reasons for low BIM adoption.

Results – Sceptical and short-term based approaches of building owners towards FM practices and discontinuity of the information throughout the building life cycle are the major challenges restraining BIM adoption within the industry. Although most facility managers are aware of the potentials of BIM, they are not satisfied with its promised benefits for FM.

Originality – This is the first empirical research in Turkey that identifies the industry's interest and motivation towards BIM.

Practical or social implications – Experienced challenges in the way of BIM-enabled FM practices and future insights regarding its penetration in the industry will guide the professionals to position themselves towards this emerging trend.

Type of paper – Research paper.

KEYWORDS

Facility management (FM), Building information modelling (BIM), Turkish FM industry, Awareness, Current practice, Future insights.

INTRODUCTION

In the 1970s, the cleaning of buildings and maintenance of equipment were the basis of facility management (FM) practice (Atkin and Brooks, 2021; FMA, 2012). Around the late 1980s and the early 1990s, FM has been recognized as a profession and since then it has been gaining great importance all over the world (Nor et al., 2014). In today's broad definition, the FM profession embraces multiple disciplines to ensure the functionality, comfort, safety, and efficiency of the built environment by integrating people, place, process and technology (IFMA, n.d.). To respond to the needs for efficient and effective operations of physical assets, FM embodies a wide spectrum of activities namely maintenance operations and repair works, workspace management, energy planning and management, renovation, refurbishment and retrofitting administrative and office services, emergency planning and management, financial management, FM personnel training, and so on (Atkin & Brooks, 2021; Chotipanich, 2004; Springer, 2001). Covering the longest duration in the building life cycle, the building operations phase

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surely depends upon the smooth operations of all these diverse disciplines.

Undoubtedly, rapid development in information and communications technology deeply influences the FM business (Bröchner et al., 2019). In line with the changing practices of the architecture, construction and engineering (AEC) industry from the paper-based 2D documentation to the computer-aided 3D applications, the FM industry has changed its practices from manual operations to computer integrated facility management (CIFM) environments (Yu et al., 2000). On top of the various CIFM environments, such as building automation system (BAS), computerized maintenance management system (CMMS), computer-aided facility management (CAFM), and integrated workplace management system (IWMS), the last decade has introduced building information modelling (BIM) as a promising platform for FM (Becerik-Gerber et al., 2012; Gao and Pishdad-Bozorgi, 2019). BIM is an IT-enabled approach that involves applying and maintaining an integral digital representation of all building information for different phases of the project life cycle in the form of a data repository (Gu and London, 2010). Although building owners are claimed to be the main beneficiaries of BIM (Eadie et al., 2013), currently design and construction professionals are taking the most advantages of it. Considering the application areas of BIM for FM such as creating and updating digital assets, visualizing and locating building components, accessing real-time facility data, checking maintainability, managing workspace, monitoring and controlling building performance and training FM personnel (Becerik-Gerber et al., 2012; Pärn et al., 2017), BIM implementation in FM practices is surprisingly low. Previous studies have highlighted the main challenges for the BIM and FM integration as lack of standards to define the information requirements for FM tasks, fragmented nature of FM data and interoperability problems between different systems, incomplete models and their maintenance issues, lack of owner demand, and inexperience of FM personnel in BIM (Becerik-Gerber et al., 2012; Korpela et al., 2015; Pärn et al. 2017; Patacas et al., 2015). Yet, there is a global interest in BIM-FM studies, especially since 2015 (Tezel and Giritli, 2021; Wong et al., 2018), and researchers anticipate further studies with the joint efforts of industry practitioners and academics to achieve BIM implementation in FM and overcome the existing barriers (Matarneh et al. 2019).

The present study prioritizes the need for a collaborative working environment between the academy and industry. The purpose of this study is to collect empirical data on the level of interest of FM professionals towards BIM in Turkey via measuring the BIM awareness and utilization levels among the FM companies and discussing the reasons behind low BIM adoption within the industry. The following sections of this paper summarize the existing studies in BIM and FM integration, describe the methodology of the research, illustrate the industry's perception regarding and adoption of BIM for FM purposes, and reveal the major challenges of BIM implementation in the FM business.

THE LINK BETWEEN BIM AND FM

Although BIM has already been adopted and actively used in the AEC industries, it has not been enduringly linked to FM practices. Design and construction phases generate a huge amount of information, much of which is useful for building operations (Yu et al., 2000). However, in most cases, FM teams are delivered unstructured and non-digital information of buildings that makes them spend additional time to transfer it into their FM systems (Patacas et al., 2015). The discontinuity of building information cause efficiency loss during the operations phase (Kasprak and Dubler, 2012). Besides, parallel to the rapid technological developments, not only buildings are becoming more sophisticated, but also their operational requirements along with the user need and expectations are getting complicated. Therefore, without a doubt, the future of FM is highly dependent on the integration of digitalization and intelligent data solutions (Bröchner et al., 2019). Many of the industry 4.0 technologies, such as artificial intelligence (AI), robotics, internet of things (IoT), augmented reality (AR) and virtual reality (VR) have promising potentials for FM. In all these systems, BIM is distinguishing itself because it provides a collaborative platform to create and coordinate building information in the early stages and stores the information available for all project stakeholders to manage it throughout the building lifecycle (Becerik-Gerber et al., 2012; Pärn et al. 2017). As a result, the integration of FM with BIM is one of the trends in the FM industry (IWFM, 2017).

The literature is full of various BIM definitions emphasizing its lifecycle potentials for buildings based on its information handling characteristics (Azhar, 2011; Gu and London, 2010; Love et al., 2013; Succar, 2009). Following its introduction to the AEC industry in the early 2000s (Penttilä et al., 2007), BIM has demonstrated numerous evidence for productivity improvements through enhancing communication and coordination between project stakeholders, reducing errors and omissions and reducing costs and durations (Azhar, 2011; Bryde et al., 2013; Ghaffarianhoseini et al., 2017; Love et al., 2013; Suermann and Issa, 2009; Zhou et al., 2017). Because of the information-intensive nature of the operations phase, BIM is argued to be an advantageous tool for FM (Becerik-Gerber et al., 2012; Dixit et al., 2019; Mayo and Issa, 2016; Wijekoon et al., 2018). This argument centres on the geometric and non-geometric information storage capability of BIM during the whole building lifecycle. With the help of BIM, geometric information of any building element such as shape, size or height and its various non-geometric features such as cost, manufacturer, installation date or warranty can be collected, maintained and transferred to other systems. The as-built 3D models of buildings involving all the mechanical, electrical and plumbing system components help FM personnel to directly detect the location of the component to diagnose the occurring problems. Also, inspection logs of the components facilitate efficient maintenance, repair or replacement actions to be taken. Embodied attributes of building spaces on 3D models assist FM personnel to allocate and manage the spaces regarding the needs of the occupants and business. Since BIM enables the creation of new assets or updates the existing ones, it can mimic reality. This feature streamlines FM personnel to get familiar with the building, execute training sessions and enable them to simulate various emergency scenarios to develop genuine emergency plans. A further advantage of BIM in FM is, when integrated with sensors, it captures and visualizes the indoor environmental conditions such as temperature, carbon dioxide, humidity and noise. Monitoring the real-time conditions of the built environment supports the efforts to ensure the comfort conditions and contributes the energy use control.

Together with the aforementioned benefits of BIM in FM, many challenges are restraining the widespread BIM adoption within the industry. Current literature identifies the most prominent BIM-FM integration barriers as limited BIM awareness and poorly defined BIM execution procedures, interoperability problems and data transfer between different software systems, incomplete and/or inappropriate BIM data for FM and data maintenance, lack of evidence quantifying efficiency gains using BIM for FM, and late involvement of FM discipline in projects (Dixit et al., 2019; Gao and Pishdad-Bozorgi, 2019; Korpela et al., 2015; Pärn et al. 2017). Also, a recent forum of the British Institute of Facilities Management (2018) declares the lack of cost-based benefit evidence of BIM in FM is the primary reason for the disconnectedness between expected and actual BIM integration into FM business and underlines the need for more real-life cases. More research should focus on the actual savings via BIM in place of the perceived ones to encourage the BIM adoption in FM (Wijekoon, 2018).

BIM implementation is an attractive subject for Turkey as well. Even though BIM is not mandatory in Turkey's AEC industry, many design and construction companies have already implemented BIM at Level-1 and Level-2, allowing them to create the 2D/3D models of projects and achieve multidisciplinary collaboration (Ozorhon and Karadag, 2017). Nonetheless, according to the most recent report of BIMgenius (2020) the use of BIM for FM purposes around 10%. It is a fact that Turkey has a relatively young FM industry. Even though numerous companies have been providing FM services for years, the establishment of professional associations aiming to develop the sector is considerably new. One comparative study shows how different regions perceive FM differently and claims that FM is considered according to the strategic goals of the facility in Turkey (Karaman et al., 2005). Apart from the recent and rare study that presents the BIM-FM integration at an international airport and points out technical challenges (Kula and Ergen, 2021), the number of BIM-FM studies in Turkey is scarce (Tezel and Giritli, 2019).

RESEARCH METHOD
Research Design
The present study aims to gather specific information on the current status of BIM-based FM practices

and their level of awareness in the Turkish FM industry. This study uses an explanatory sequential mixed method to understand how BIM is viewed by the industry, how much it is used and what are the discouraging explanations for its low acceptance. Due to its two-phase structure and the fact that only one type of data is collected at a time (Creswell, 2003; Subedi, 2016), collecting and analysing quantitative data were followed by the collecting and discussing of qualitative data.

Initially, an online questionnaire survey has been developed for quantitative data collection. Three key issues that the questionnaire focuses on are, (1) BIM awareness, (2) BIM utilization, and (3) the future of BIM in FM. Then, a set of semi-structured interview questions has been established to unveil the challenges of BIM implementation in FM practices.

Sampling Method

A sample is required to investigate explanations for context-specific issues in the field of BIM-based FM practices. Therefore, the participants were targeted towards organizations that could potentially provide insight on the use of BIM for FM. Turkish Facility Management Association (TRFMA), Professional Facility Managers Association (PTYD), Urban Facility Management Association (TRKTYD) and Turkey branches of three well-known international FM providing companies constitute the population for the study. The aforementioned associations house more than ninety member companies, among them are six international companies and two state-owned companies. We expect their responses to be representative of the industry because these are the largest societies in Turkey, comprised of professional facility managers and leading FM companies. Given the limited availability of these companies, our research is constrained by the number of people who participate in the study.

Then, the expert sampling (or judgment sampling) procedure has been used in selecting the target respondents because it is a strategy in which expert persons are chosen to provide valuable options or assessments on the subject of the study (Taherdoost, 2016; Thietart, 2001). We define the target of interview respondents as professionals with known or demonstrable experience and expertise in the BIM-based FM area. We invited these respondents to discuss the reason for low BIM utilization within the industry, as well as the benefits and drawbacks of BIM for FM.

Response Rate and Sample Characteristics

Quantitative data were collected by a self-administrated questionnaire which was distributed through the mentioned organizations via e-mail. The questionnaire survey was conducted from February 2021 to March 2021 with thirty-eight participants completing the survey. Using data screening, one submitted response is excluded because the missing information related to the respondent's professional background prevents the credibility of the answers. Consequently, the study population consists of thirty-seven respondents from thirty-five different FM services provider companies (see Table 1).

In the next step, qualitative data were collected by one-to-one interviews with experts from those who have prior BIM experience in FM. Although the use of BIM is more prevalent in the earlier phases of the building life cycle, it is merely adopted in the FM practices. In fact, among the respondents of this study, only four of them are actively using BIM for FM. To collect empirical evidence on the real-life barriers for BIM-based FM, we invited these four experts for the interview, however, due to their tight schedule, we could conduct only two interview sessions.

Table 1 Respondent characteristics

Variable	Categories	Number of response	Percentage
Position	Founder/General Manager	16	0.43
	Vice General Manager	6	0.16
	Director/Leader/Manager	9	0.24
	Consultant	2	0.05
	Specialist	2	0.05
	Other	2	0.05
	Total	**37**	

Experience in the FM profession	Less than 5 years	4	0.11
	6 to 10 years	11	0.30
	11 to 15 years	10	0.27
	16 to 20 years	5	0.14
	21 to 25 years	4	0.11
	26 years and more	3	0.08
	Total	**37**	
Years in the current company	Less than 5 years	14	0.38
	6 to 10 years	11	0.30
	11 to 15 years	5	0.14
	16 to 20 years	6	0.16
	21 to 25 years	1	0.03
	26 years and more	-	-
	Total	**37**	

Table 1 shows the distribution of the survey respondents. Founder/General manager is the largest job title of the respondents at 43%. The next category of job titles is in the Director/Leader/Manager category, which accounted for 24% of all job titles. Vice General Manager is a third-place respondent at 16%. It is worth noting that the survey drew a significant number of high-ranking respondents, including the company's founder, general manager, and vice general manager, highlighting BIM's growing significance in the FM business. The majority (60%) of the respondents have more than 10 years of experience in the facility management profession and 62% of them have been working in the same company for more than five years. This information indicates to an experienced and representative group of professionals.

FINDINGS

BIM Awareness

First of all, we aim to identify the BIM awareness of FM professionals by asking how familiar they are with the BIM concept and their responses are displayed in Figure 1. Overall, 86% of the respondents indicated that they heard of BIM before taking the survey. It can be seen that almost half of the respondents (49%) have a certain level of awareness about BIM but have not used it so far, whereas four respondents are actively using BIM and one respondent is planning to use it soon.
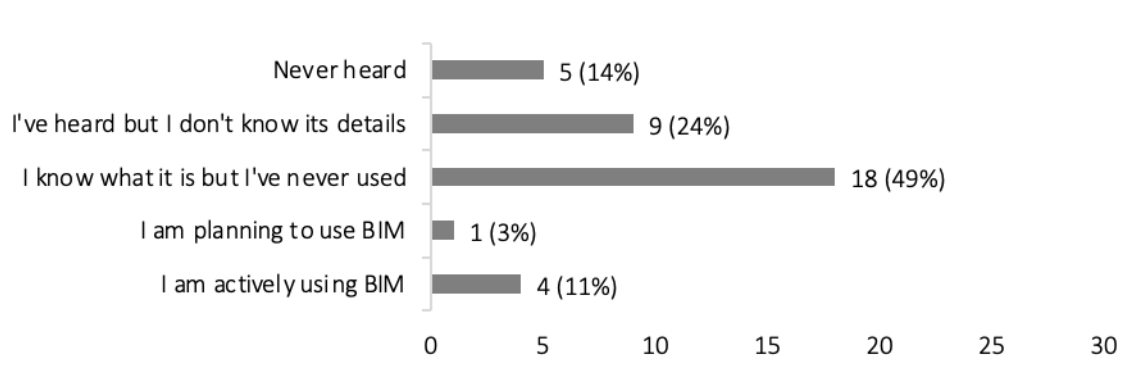

Figure 1 BIM familiarity of the respondents.

Excluding the small minority who heard BIM for the first time (14%), we can conclude from Figure 1 that there is a high level of awareness towards BIM within the industry. However, previous literature points out a low level of understanding regarding the potentials of BIM in FM and people are highly expected to recall different aspects when heard the BIM term. In fact, people treat BIM as a 3D modelling tool for architectural design or consider it as engineering software. To figure out what BIM means to the respondents, an additional question is included in the survey.
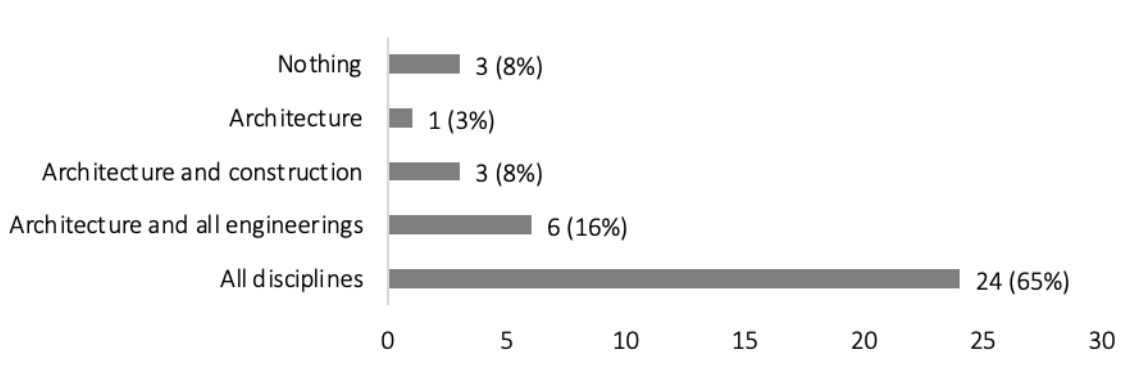
Figure 2 BIM understanding of the respondents.

With respect to the question "What does the BIM concept mean to you?", Figure 2 presents the perceptions of facility managers towards BIM. Approximately two-thirds of the respondents (65%) consider BIM as a platform that enables all disciplines to work on throughout the design, construction and operation phases. Remainings treat BIM either as an architectural platform (3%), a platform for architects and construction engineers (8%) or a platform for architects and all engineering disciplines (16%). There are only a few respondents (8%) who do not have any idea at all.

BIM Utilization
After finding out the high familiarity and awareness of FM professionals regarding BIM, we aim to detect how prevalent BIM within the FM industry. With this aim, respondents are asked to specify if they have ever used BIM and if they have ever heard of other companies using BIM. The responses to both questions are displayed in Figure 3 and Figure 4.
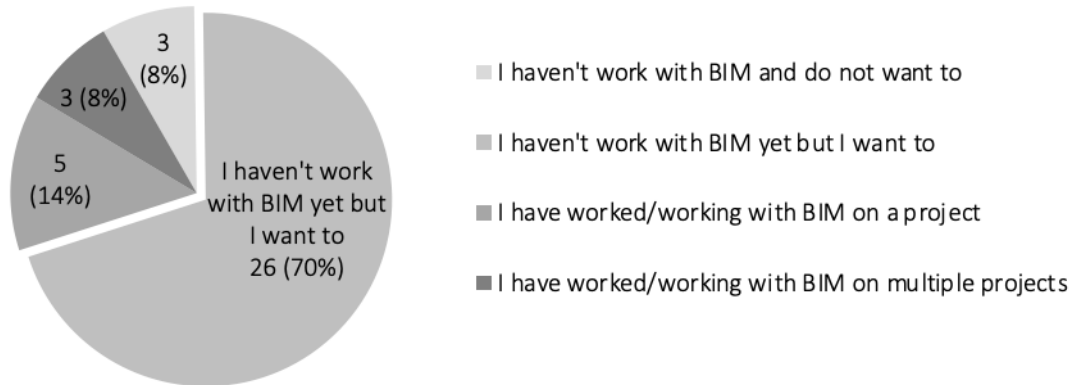
Figure 3 BIM use of the respondents.

As illustrated in Figure 3, a large number of the respondents (70%) have not worked with BIM but they are willing to. We can roughly conclude that one out of every five facility managers have used or are still using BIM in one or more of their projects. On the other hand, Figure4 shows the respondents' observations on other FM companies, where many of them (65%) have not heard others using BIM. Among those who already heard about the use of BIM by other companies, six received positive feedback, one received negative feedback and six solely heard without any additional impression on its benefits or handicaps.
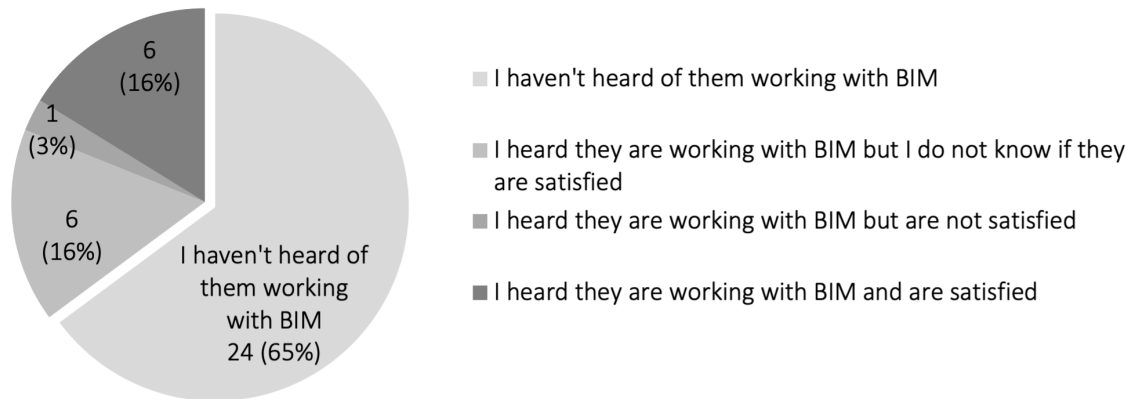
Figure 4 BIM use of other companies.

Future of BIM in FM

Following the BIM awareness and utilization measures, we aim to collect industry insights about the future of BIM use in the FM sector in Turkey.
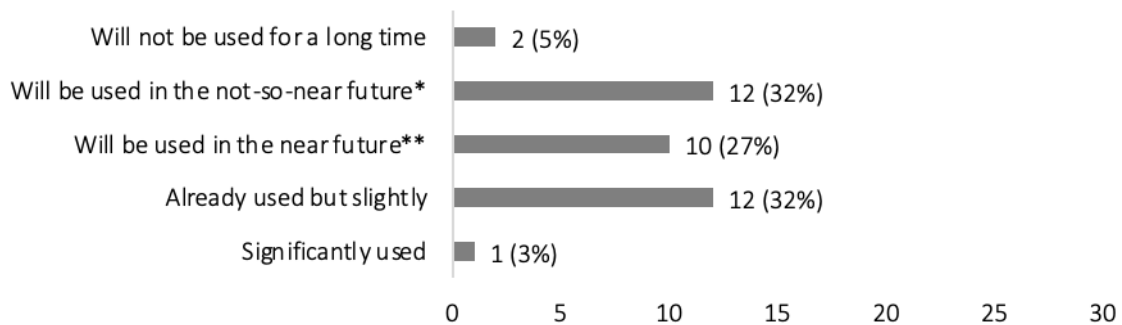

Figure 5 Future insights regarding BIM use in the Turkish FM sector (*Will be used in the not-so-near future*: i.e. within 3 to 5 years, Will be used in the near future**: i.e. within 2 years*).

Figure 5 highlights a clear difference among facility managers' points of view regarding the future of BIM in the industry. Even though one-third of the respondents believe that BIM is already used in the FM industry, the majority (59%) of the respondents seem to agree that it will be implemented in the next two to five years. Despite the fact that two respondents do not believe BIM would be widely used for a long time, Figure 5 shows that a pioneering community is benefiting from BIM to some degree, while the rest are waiting for it to become more widely used.

Challenges in BIM Implementation

The questionnaire survey empirically proves that the industry in Turkey fairly acknowledges BIM. However, compared to the industry's will to use BIM for FM purposes, its adoption is still lacking because of certain barriers. To unveil the factors hindering the industry to adopt BIM-based practices, this study applies a series of semi-structured interviews with FM professionals. This second part of the study aims to answer the question of how qualitative findings help to explain the initial quantitative results using data in in-depth semi-structured interviews. Each one-to-one conversation aims to discuss the expectations from BIM alongside its drawbacks in FM. Unfortunately, we could not be able to complete the interview process because of the overloaded schedules of the respondents. Yet, two of the survey participants who previously experienced BIM-based FM practice have responded to the interview.

The first interviewee is the technical service manager at the Turkey branch of a global company that provides integrated FM solutions. This company established its Turkey branch in the 1990s and has been serving in more than 60 countries around the world. The second interviewee is the general manager

at the Turkey branch of a global FM company. This company has been established in the 1930s with the initial aim of providing security services to local customers. Today, it has been offering cleaning, catering, security, support, technical and workplace services in more than 30 countries.

Each interview respondent has a different BIM-based FM experience. For example, the first interviewee involved in a project that aims to integrate the existing FM system of a healthcare facility with BIM. The two main objectives of the project were to improve the maintenance works of the mechanical systems and to monitor the changes occurring in the frequent renovation works. However, the project was not a success because of the time limitation. As noted by the respondent, the building has been handed over to the FM team when they had a very limited time to the opening and there was a lot of incomplete work, therefore they could not find time to integrate these systems. On the other hand, the second respondent and his team developed an in-house software system that provides a real-time illustration of various workspace management elements in a 3D environment. The software not only helps to control the indoor environment air conditions in terms of temperature, humidity and carbon dioxide levels but also visualize the user information in a particular workspace. Even though they could only use the software for their own office buildings so far, the respondent claims that they receive positive reactions to the system from their customers.

Regardless of the differences in their companies, positions, provided services or BIM-based FM experiences, interview respondents agree on the importance and potentials of BIM for FM. According to their responses, we can conclude that BIM can be a great help for predictive maintenance of the mechanical systems, energy monitoring and management and workspace management of large scale buildings. Still, BIM should not be considered as a single solution for all sorts of FM tasks. FM teams need to integrate BIM with other industry 4.0 technologies such as sensors, IoT infrastructure or AI to fully achieve these functions. This need for technology investment becomes the most explicit underlying reason for the low level of BIM adoption in FM. Today, the vast majority of the building stock is old where more often than not it is impossible to find the as-built drawings of them. Indeed, the recent technological developments can encounter problems related to information loss and enhance integration between different systems. However, in Turkey, most of the FM contracts covers short periods and prioritize the price rather than the continuity and value. When short term advantages are a major concern, conceiving the customer demand or reserving an additional budget for the technology investment is not an easy task. Another distinctive issue is finding an open-minded and technologically competitive human resource in the FM market. Excluding the professionals in managerial levels, most of the FM workforce are resisting the change due to the fear of losing their jobs. Overall, the FM market strives for more concrete evidence of real-life examples to demonstrate the benefits of BIM in FM.

CONCLUSIONS

This study empirically investigates the existing BIM awareness and BIM utilization among the FM professionals in Turkey and briefly discusses the reasons hindering the BIM implementation within the industry. To the best of the authors' knowledge, this is the first research in Turkey that aims to identify the industry's interest and motivation towards BIM. Therefore, its contributions can be addressed from two different perspectives. From one perspective, this study employs a questionnaire survey to analyse the industry, then conducts one-to-one interviews to unveil the BIM implementation barriers. With these efforts, the present study sets a concrete ground for further scientific studies in BIM and FM integration in Turkey. From the other perspective, this study helps facility managers to understand the current state of the industry and sheds light on the experienced problem areas in BIM implementation.

The survey results reveal a high level of BIM awareness but a low level of BIM utilization of the FM industry in Turkey. It is also important to note that the survey was mostly filled out by company founders and other senior level managers, demonstrating the level of importance that BIM is gaining in FM organizations. Despite the number of BIM users are scarce, there is a noticeable expectation of BIM penetration to the market in the upcoming two to five years. Also, the majority of the survey respondents are eager to use BIM in their business. Taking into account all these issues, the most remarkable finding of this research

can be said that the motivation and willingness to BIM-enabled FM practices of the industry. Yet, some major concerns, namely, limited budgets, short-term contracts, lack of client demand and FM personnel resistance are challenging facility managers to take pioneering actions.

The present study has certain limitations in terms of survey participants, survey responses and interview process. First of all, despite we invited the members of three major FM associations and some well-known international FM services providers in Turkey, there are other companies as well. Plus, the submitted responses are mainly from one of the three associations. Therefore, one cannot claim the results are completely reflecting the current status of BIM in the entire market. Nevertheless, the respondents are the foremost companies providing integrated FM services that are using BIM or have the potential to use BIM for FM purposes. Therefore, we can claim the results to be representative of the industry. Secondly, the number of BIM-experienced respondents are very limited compared to the inexperienced ones. Despite such a result is quite expected and somehow coherent with the previous studies, since there are other companies in the market, more response is needed for a complete understanding. Finally, we couldn't be able to complete the interview process because of the tight schedule. The initial plan was to separate the respondents based on their BIM experiences and discussing why and how they use or do not use BIM for FM purposes. Future works will concentrate on the strengths and shortcomings of BIM in FM and propose an agenda for efficient BIM implementation in the FM industry.

Acknowledgement

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Back to School – the Impact of Short Timeframe Student Case Studies on Projects and Educational Programs in the Context of Urban FM

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ABSTRACT

Background and Aim: This paper looks at the degree to which three student projects had an impact on the cases and educational programmes related to this summer school from both a practice and pedagogical perspective. The aim is to look at the degree to which a short-term workshop can create tangible and practical outcomes for a real case study in the context of Urban FM.

Methods/ Methodology: The data collection for this paper consists not just of preparatory desk research, but also a descriptive analysis of the case study outcomes of the students. This is done by looking at the outcome of the fieldwork and student presentations, and how they could potentially contribute to their projects in comparison to longer-term initiatives. This will also be supported by data in the form of survey and interviews with participating educators and students.

Results/ Outcomes: The study resulted in substantial outcomes from the students. This was not just in the form of data, but also in the form of materials for inclusive citizen participation as well as 3d models and conceptual outcomes. Whilst these outcomes impressed the educators in terms of their speed of completion, challenged with post-study engagement with the case study holders made the outcomes on cases themselves in the longer term difficult to implement.

Practical/ Social Implementation: This study has offered possible means by which to improve the involvement of citizens in these urban development projects using the mechanisms and materials created during the workshop. The data collected and conceptual aspects could also offer perspectives on urban development projects in the form of inspired reimagining.

Keywords: Urban facilities management, summer schools, EuroFM, case studies

Type of paper: Research paper

1. Introduction

The importance of workshops and summer schools in Facilities Management (FM) education at University level are vital in the acts of dissemination and advancement of the discipline. The two most crucial stakeholders, are those of students and their associated educators. Whilst the primary role of a student in a university context is that of being the receiving stakeholder of knowledge and skills, there is also the possibility to have them contribute to knowledge and skills advancement in educational programs, as well as through case study projects. In the case of educators, there are grounds to consider that contribution as being potentially more fragmented in the context of short time scales classes, particularly if these are not being held in their home institution. The purpose of this paper is the highlight not just the pedagogical possibilities offered by this and similar events, but also how they can be utilised to contribute to emerging fields.

Research Questions
This paper will answer the following research questions:
1) What was the impact of the summer school on the educator participants?
2) What was the impact of the summer school on the educators home institution study programs?
3) How successful was the summer school as a pedagogical exercise?

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This paper will consider each of these questions in turn, however firstly it will look into the theoretical framework behind the study, the methodological approach as well some of the outcomes from the summer school generated by the students.

2. Theoretical Framework

Before going into the core of the results of this paper, the context needs to establish basic theoretical definitions.

2.1. *Community-Based and Urban FM*

In terms of what FM can be considered to be it's in its most widely recognised form, it is "*the integration of processes within an organization to maintain and develop the agreed services which support the effectiveness of its primary activities*" ((CEN) 2006) according to the European of Standardization (CEN) and is a definition widely adopted by many FM organisations, such as the fore mentioned institution EuroFM. Whilst FM in this context is often considered to be related to activities ranging from maintenance to catering and cleaning, the definition of what constitutes Facilities Management is becoming as increasingly broad as it is complex.

Urban FM is a developing concept in FM, as urban areas are requiring more coordination across different sectors where supporting shared values can lead to opportunities that benefit the social, environmental and economic aspects of an area (Lindkvist et al., 2020; Temeljotov-Salaj et al., 2020). Community-based FM (CbFM) is a similar concept to Urban FM but is more entrenched at the community level. Alexander *et al.,* (2006) for example define CbFM as "*the management of facilities and the delivery of services to reflect the community and environment in which they reside and operate*" (Alexander et al., 2006, p. 263).

2.2. *Intensive Workshops in Educational Theory*

Intensive workshops and summer schools present an opportunity for educators to teach in a different way, and learn to be more independent and autonomous. Italian educational theorist Maria Montessori stated that in the case of educators and students, development takes the form of a striving for ever greater independence. Montessori therefore sees teachers as a guide in this process towards autonomy. She states that the teacher's goal is to teach students in such a way that they need them less and less, and are not so dependent on them (Montessori, 1912). To quote Montessori, "*the greatest sign of success for a teacher is to be able to say, the students are now working as if I don't exist*". This fits in with the concept of Trondheim Summer School more directly, where the students do not know each other and the educators have seldom worked together physically, meaning that a degree of functional autonomy is necessary due to the time restraints on developing a more traditional relationship between educators, students, and amongst themselves.

3. Research Methods

This study was conducted through a subjective evaluation of a Euro FM summer school which took place in 2019. Data collected includes a *questionnaire survey*, *interview* and *observations from* January to August 2020 along with supplementary data collected during the Summer school itself in September 2019. The participants were the students and educators from Netherlands and Norway attending a one-week summer school event in September 2019 at Trondheim, Norway. The aim of this to approach was to highlight the events contributes to pedagogy as well the field more widely. Underlying research methodology focuses on how these two factors can be extracted from a combination of the interviews and survey, as well as experience of the researchers who attended the summer school. With this in mind it can be considered to have a case study focus with a primarily cross section perspective.

3.1. *Summer School Preparation*

Lectures, reading and pre summer school summer school assignment submissions were done through a '*Collaborative Online International Learning*' tool (COIL) called 'Padlet'. This not only allowed for a 'one-stop' solution to combine all of these aspects, but also provided an opportunity for students to

ask questions to the educators that everyone could see, as well as allow students to co-organise travel arrangements and social event amongst each other. After the Summer school commenced, WhatsApp groups were also set up by individual groups to organise their project and social activities as well. As of March 2021, the students remain in touch in these groups.

3.1.2. Student Case studies Overviews

This summer school event was held in three different project sites representing the residential and non-residential area urban typologies in Trondheim. The areas were chosen based on NTNU's existing relationship with the cases, as well as their relevance as cases for the objectives of the summer school more broadly.
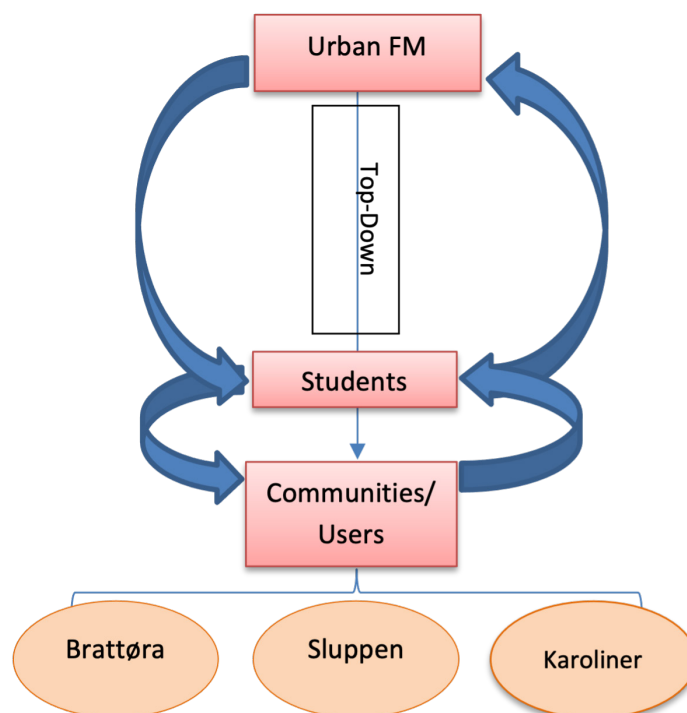

Fig 1. Co-creation and Intermediary model for the Summer school, Senior, 2019, p.3, Students can act as intermediate actors in the co-creation process towards more sustainable development.

Preparation and Induction

After the students went through the short educational program in Urban FM and CbFM, professional education gave the students a detailed briefing of the cases themselves, and the expectations of the students.

Brattøra area (office and leisure space)

Brattøra is a workplace area including the city harbour, hotels, museums, convention centre and sports facilities. Brattøra will undergo densification in the years to come through the construction of apartment buildings and the new Trondheim Station Centre, which combines public transport depots, offices and dwellings.

Sluppen (office spaces and residential)

Sluppen-Tempe is a major transformation area in Trondheim. It is focused on a sustainable urban development area including offices, public buildings and dwellings.

Karolinerveien Housing Cooperative (Exclusively residential)

Karolinerveien Housing cooperative is located in a residential area in Trondheim. The apartments in this zone (mainly built in 1967) are maitained by TOBB (Trondheim og Omegn Boligbyggelag), the regional branch of NBBL (Norske Bolibyggelags Landsforbund – English 'The Norwegian Housing and

Construction Association'), the co-operative housing federation of Norway

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3.2. Questionnaire survey

An online questionnaire survey was conducted on the students (but not educators) attending the summer school 2019 during summer 2020.

The survey was hosted by Google forms. This was done for a variety of reasons. Firstly, Google forms are optimised for smartphones as well as home computers, which provides increased ease of use for the respondents. Secondly, many of the analytics (such as pie charts and histograms) can be automatically generated by Google forms if required. Thirdly, Google Forms can easily export the data as .xlsx or .csv files that can be easily read by both Microsoft Excel, and SPSS.

Students were sourced for participation from the attendance list from the Summer school itself. They were contacted initially either through the still active WhatsApp group or through email addresses (where still active) from the initial enrolment. After approximately two weeks students were reminded to participate through the same contact means. Two weeks after that a final reminder was issued, but this time as individual messages with students who were still in the WhatsApp group.

Approximately 35 students attended the summer school, the majority of which were from Germany, the Netherlands or Switzerland. They were undergraduates along with three postgraduate students in Real Estate, Facilities Management and similar disciplines. A pilot test of the survey was conducted with three students in June 2020, with only one minor alteration to the wording of one question required before the survey proper was implemented. 10 students responded to the survey. Due to the minimal amount of changes required to the pilot test, the pilot test respondents are also included in the analysis creating a total of 13 respondents resulting in a 37.14% response rate.

The analysis was conducted primarily through SPSS for the quantitative elements, with provisional coding for the qualitative aspects.

3.2. Interview

The interview guide included 3 different sections including questions on:
1.   Before summer school and expectations
2.   During the summer school and the productivity
3.   After summer school reflections and achievements

In terms of analysis, this was primarily done through NVivo. As well as NVivo being a standard software for this type of analysis, the use of this software also allowed for easy recall of the data from the interview transcripts. The codes for analysis were taken from the elemental structures from the research questions, and consisted of- *International Experience, Pedagogy, Summer school Past Experiences, Role and Responsibilities, Mentorship, Teaching, Cases, Impact on Courses, Student Presentations, Social, Learning Something, New Study/ Working Life, Lectures, Field Work, Motivations, Positive Experiences, Challenging Experiences, Possibilities for Improvement.*

4. **Findings from the study**

4.1. *Expectations from students*

The weeks of the summer school embedded core concepts of Urban FM which the students were expected to work within the teams they were in. Such concepts were reflected in how their work should be valued and recognized, and communicated with the project stakeholders, the citizens and the university. They should reflect on the difference between a space and a place. The legal authorities are deciding what a space is or should be but a place is seen at eye level and experienced on a personal or community level. There is a difference between what you can measure (square meters, geographical location, market value) and what you cannot measure (sense of belonging, feelings, social value. They needed to compete to be the most innovative, visionary, playful that they possibly could.

The primary learning objectives of the summer school were to:

- understand environmental /economic/ social aspects in urban environment
- set demands for different stakeholder groups (emphasize is on citizen/community)
- identify needs which leads to sustainable communities
- measure interest-importance-impact
- set up additional responsibilities for Urban FM which differ from ordinary FM

The students were asked to think broadly and not only operate from a birds-eye view perspective but to consider at the city and urban level. They needed to open their minds as professionals and start involving people in their process as early as possible. Instead of working behind their desk and eventually parachute some revolutionary solution from top-down.

They needed to find new and playful ways to involve and interact with people. Adapting to a different scale than the one they were used to operate was crucial, both on the spatial aspect: from the building scale to the urban scale and the social aspect, and from working with stakeholders to making/being the bridge between stakeholder and users. Interacting with people will not be easy but they have to be creative and find new approaches. This challenge should be seen as an opportunity to do things differently and not as a barrier.

4.2. *Examples of Case Study Outcomes*

Students were divided into 3 groups and each group were allocated a location in Trondheim to work in – Sluppen, Brattøria and Karolinerveien.

Sluppen

The Sluppen group – upon completing their orientation and a site visit with one of the educators – considered the challenges of turning this business district into a socially attractive area to be of the most important for their study. They went on to turn this into the following research questions:

1. What is Sluppen going to look like in the future?
2. What are the already existing plans for the area?
3. What are our plans for the area?

To answer these questions, they viewed local residence and people who worked in the area to be the primary stakeholders for the study. They used Google Forms to develop a survey to gauge the needs of these stakeholders, and how these can be better capitalised to meet improve the social attractiveness of the area.

Their research approach was supported by a conceptual model they developed themselves to combine their theoretical knowledge from the induction, and the applied data they aimed to procure from the case study.

Along with the survey, they also interviewed a business manager from the property company Kjelsberg (the site owner) and conducted desk-based research.

Their outcome suggested that the community feeling in the area was minimal, hospitality services equally as lacking along with few cultural activities. Kjelsberg noted that they are attempting their efforts to improve these aspects, such as breakfast seminars, a business soccer tournament and a cultural festival.

In terms of the students' survey and interview outcomes, they were divided into topics related to '*mobility and infrastructure*', '*renewable energy'* and '*leisure and community*' in terms of improvements. These improvements in the first category involved a reduction in the use of cars, better pedestrian infrastructure, and more bus stops. Renewable energy was the focus of one of the more substantial overall recommendations, with the group recommending using the river for hydropower, solar panels

on the estate and the use of wind turbines if possible. In terms of leisure and community, children playgrounds, restaurants and more inclusive facilities came out of the research. The students produced a diagram that outlined this final category more boldly.

In concluding the results at Sluppen, the groups recommend a vast and dynamic reimagining of the business area into something more synonymous to an entertainment and retail community – all within the considerations of the project by Kjelsberg as it currently stands.

Karolinerveien
The student group using Karolinerveien as a case study operated under the logic that creating a stronger identity and empowering people is the project focus.
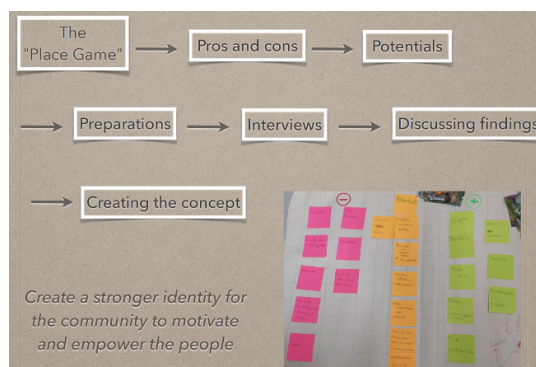
Methodological Approach – Karolineveien

In terms of a methodological approach, they chose to create a workshop that incorporated a 'Playbook' to help residence organise their thoughts in a manner that could be best to provide constructive solutions through play.
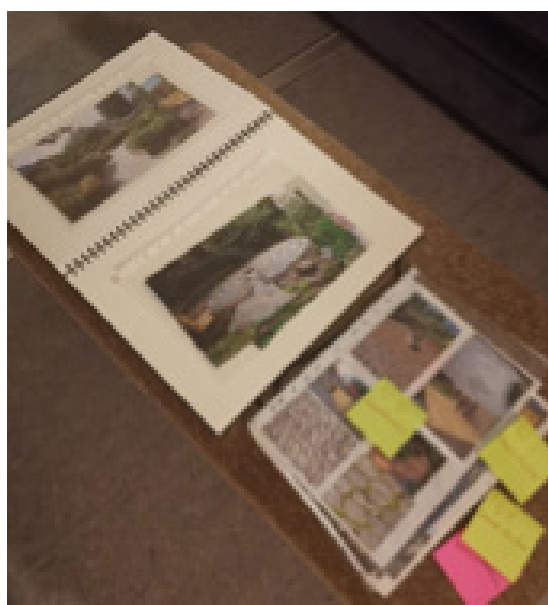

Figure 2. - Residents Playbook – Karolineveiein Figure 3. - Workshop Advertisement Karolineveiein

5. Analysis
5.1. Before the Summer school

The summer school featured a spread of educators (three from the host institution and two from the institutions from students' home institutions) all of whom had differing experiences concerning both their past experiences with Summer schools and their motivations for attending.

In terms of preparation of teaching materials and the programme, which was carried out almost exclusively by NTNU. The interviews yielded that the overall topic was decided more informally at an international level at a EuroFM meeting, however the more specific details, programme and cases were developed at NTNU. One of the Dutch educators stated that they did offer to become more involved in the preparation of the Summer school, however by that point much of the preparatory work had already been completed.

5.2. *During the Summer school*

The interviews also touched on the final student presentations. Whilst broadly considered a positive aspect of the summer school, it was the aspect of the interview that presented the most criticism. In terms of positive aspects, the educators were impressed by the technical elements and level of detail. With the presentations containing aspects such as computer-generated models and videos, they were impressed by what could be achieved in just one week. In terms of critical aspects, the lack of guidance meant that whilst in some groups, all of the students presented, in other cases, only one or a couple of students partook in the final presentation. One of the educators also said that the asymmetry of the type of presentations held might be a symptom of an overall lack of guidelines as to what was to be expected of the students.

5.3. *After the Summer school*

There were also some minor concerns over the time it took to prepare for the Summer school. In Norway, there was little to no activity in the University in July and early August, which heavily reduced the preparation time for teaching materials, recruitment and case study preparation. Although this did not have a detrimental impact on the Summer school during its commencement, the lack of activity at the University did create a time challenge.

6. *Discussion*

In this second the finding of the interviews and survey for each stakeholder will be presented within the context of three headlines corresponding to each of the research questions intended for answering in this paper.

6.1. *Impact of the Summer School on Educational Programmes*

In terms of the Summer School in Trondheim, the impact on educational programs was varied in scope. As noted in earlier sections of this paper, many of the educators (in particular those that were not from the host institution) felt that learning more about these new fields of Urban and Community FM made the educators more confident in teaching these subjects in their home institution. In the case of one of the Norwegian educators, the work of this summer school had a direct impact on the development of their own Urban FM specific course within a Civil Engineering Master programme. One of the educators was not teaching on an Urban FM relevant programme, however, after the completion of the Summer School intended to encourage other academics in their host institution to consider including it into their educational programme. One of the Norwegian educators also stated that the experience was so positive that should this be logistically feasible, they intend to try to include more short terms workshops as part of their formal study programme. It was also noted by more than one educator that the quality of the presentation material (despite the asymmetry of the participation of students during the presentation itself) inspired them to encourage similar impressive efforts from their students during semester-long engagements.

Educators were also keen to note that some of the gains were not specific to this Summer School but similar events more generally. The two Dutch educators stated that they regularly attend summer schools and similar events and find that learning from other educators and networking is a key selling point for them to attend in person. This, in turn, impacts the educational programs through collaboration, sharing the results from the event and even learning new educational techniques from other educators. Whilst the student survey didn't represent this, the educators have stated that the experience of students doing a case study in a different country has inspired students to work on Master

theses by not just offering them new insights into other countries way of working, but in many respects can offer potential to use these international cases as a part of their Master theses empirical work. A continued effort to encourage students to attend Summer Schools and other international events also strengthen the 'global citizenship' efforts of institutions to afford further internationalisation elements which strengthen the quality and credibility of the Master programmes.

6.2. *How Successful was the Summer school in achieving its aims?*

Earlier in this paper in the theoretical framework, Wayland *et al* (2000) note that success in Summer schools can be linked to five common success factors. Based on educator and student interviews along with the survey, these five success factors will be used to evaluate the success of the Summer school.

Wayland *et al's* first factor are '*presenting student purposes to enrol in the summer school*'. In the Summer school in Trondheim, this 'purpose' was developed on several levels. Firstly, the specific criteria for student enrolment. As mentioned earlier in this paper, Students had to be from EuroFM affiliated institutions and studying degrees in FM, Real Estate, Engineering or another relevant discipline. As the plans moved forward, however, this was slightly loosened allowing for the likes of the PhD students specialising in ICT to attend. This latter classification of student demonstrated the importance of good enrolment criteria as despite offering useful skills to the student teams, they at times felt like 'outsiders' within this group. Being specific on a relevant degree qualification also reinforced this purpose, it meant that the students could begin their casework having only a minimal level of foundation education earlier in the week. Considering this first factor concerning this summer school, it was successful.

The second factor from Wayland *et al* was '*determining if the expectations are different than a regular session*'. This factor is also addressed in the Trondheim Summer school on several levels. Firstly, the deliverables were bespoke for a short term workshop. The key deliverables came in the form of a pre-assignment essay and a student presentation at the end of the week. These deliverables were very much designed from the perspective of what could be achieved not just in a week (and the time leading up to it), but also the expectation of students unknown to the educators from a variety of institutions. As noted in the educator interviews, this resulted in exceeding the expectations of students present as the final presentations were for the most apart above and beyond what was considered possible within just a few days of work. The expectations of the students also reflected circumstances different from a regular session. As shown in the student survey and interview, the student looked forward to experiencing a different culture, improving their English and experiencing a foreign institution, aspects not possible in a semester-long course in their home Universities.

Wayland *et al's* third factor is '*determining if expectations of the summer are different from reality*'. If this can be given to mean that that the summer school can be seen to meet the expectations hope for by all involved, then this can be considered broadly successful. The educators stated that owing to their experiences in earlier Summer schools, their prior expectations were high. Upon the Summer school's completion, all of the educators claimed that the experiences exceeded their expectation and were keen to hold another such Summer school when circumstances allowed. From the perspective of the student experience, most of the students (with just one exception) felt that the Summer school either met or exceeded their expectations. As also noted earlier, the student interview yielded that the student had no real expectation of the Summer school except for it being a week-long workshop in Norway. In terms of reflecting on the experience, it met and exceeded the expectations that they did have.

The fourth success factor offered by Wayland *et al* is '*determining if differences are based on the session format*'. In the context of this paper, this can be considered to mean that the success of the Summer school was dependent on its inherent format. This Summer school was divided into foundation lectures, fieldwork and final presentations based upon their findings. Whilst this is inherently a difficult aspect to prove objectively, if taken into account the results then it can be considered successful. All of the students delivered their presentations as scheduled developed their research frameworks and carried out independent fieldwork. They also showed a knowledge of the subject matter (particularly community

and urban FM) that was based on the work conducted in their pre-assignment and the workshops conducted earlier in the week. When considering the possibilities of delivering similar presentations in a longer semester, the fact that students delivered to a high standard and even presents films and CG model is representative of the fact that although the format warranted an intensive level of work limited in terms of the scope possibilities of time, this was no detrimental to the quality of the work delivered at the end of the week.

The fifth and final of Wayland *et al*'s success factors is '*providing strategies or educational decision-making regarding summer schools*'. This can be considered in the context of the Summer school in Trondheim to have components before, during and after the Summer school and need consideration. The preparation for the summer school was conducted in a very different manner to that of a semester-long course. The EuroFM affiliation strengthened the support network, provided a sizable international component and connected the educators and students. During the Summer school, the student educators were very mixed on whether they significantly changed their styles to accommodate the summer school. This was not detrimental to the Summer school success owing to the positive feedback received, however, it cannot be considered to be a style bespoke for this event. Much of the aspects of this success factor were also mentioned in the previous section, as decisions on the educational program were made specifically for this summer school with the considerations of the time restraints, new students and cultural challenges along with the need to learn a new field all factored in. When considering the educator and student feedback, this can be considered to be successful. In terms of summer school decision making after completion of the summer school, students and educators all reflected on aspects for improvement. Better student guidance for the presentations and fieldwork would have been advantageous, as well as including more Norwegians.

7. Conclusion

In terms of how successful the Summer school was overall, both the students and educators agreed that the event was a success. Some aspects would need to be adjusted in the future such as including more students from the hosting institution and providing more structure to the student presentations, but these were minor criticisms overall.

The results of this project have also provided insight into the increasingly possibilities of summer school events from two very specific perspectives. Firstly, pedagogical. This summer school showed how educators can not just learn from the experience of attendance, but can take knowledge skills and materials to their own institutions and strengthen their educational programs. Secondly, field advancement. Whilst an emerging field can at times feel resource and literature lean, the possibilities of students to impart their knowledge on a blanker canvas provides an essential level of value in field development.

This research in a larger sample could also warrant research on how the challenges could be mitigated and opportunities strengthened. In terms of how this research would have been conducted different, the small and uneven sample size and response rate pose the biggest challenge to the legitimacy of this project. Whilst the results can be considered both useful and interesting, they are also none the less 'indicative' rather than 'definitive'. Whilst the resctrictions imposed by the papers format do not allow for the level of case study and theoretical probing this project deserves, the aim is spread this work over several more publications whilst it is also hoped that other educational institutions will move this work forward with their own summer school events.

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Problem-based learning for the teaching of FM skills: results of a practical use

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ABSTRACT

Digitalization and COVID-19 are not game changers, but accelerate several already existing trends. In the area of teaching e-learning and blended learning has always been a topic. Until the beginning of the COVID pandemic, most of the Facility and Real Estate (RE/FM) programs focused on classroom teaching. Only few already used digital learning concepts. Based on a literature review the paper gives an overview of the different possibilities of knowledge transfer and learning. Based on this overview two methods are analyzed in more detail.

- Blended learning
- Problem-based learning

Both approaches are not only described in theory but also shown in practical usage. The blended learning approach is demonstrated by the setup of an introduction course for FM provided by Springer and the problem-based learning approach by a cooperative lecture of TU Wien and Stanford Mechanical Engineering.

These case studies show that the approach of problem-based teaching combines several advantages. The students can learn when and wherever they like and optimize their own scheduling. They can select the relevant sessions they really need to attend. The lecturers act more as coaches. These two elements optimize the individual knowledge transfer. The practical application of the knowledge proves that the required competences and not only the theoretical knowledge is gained. The feedback of the students also proves the advantages of this method. Therefore, the problem-based teaching method is a very promising approach, which will change the way teaching and knowledge transfer in RE/FM will happen in the future.

KEYWORDS

e-learning, new teaching concepts, problem-based learning, blended learning, learning videos

BACKGROUND AND OBJECTIVES

The imparting of skills in the secondary and tertiary sectors has been influenced by digitization in recent years. Nevertheless, the focus was on face to face events for the transfer of knowledge and competence (Mmb Institut 2019, Scheidig 2020, p. 244, Huber 2016, p. 86, Blömer et al., 2020). The use of digital techniques and media has been researched and tested, but has not been implemented widely. COVID-19 has not really been a "game changer", but it has made the use of e-learning concepts almost a must. Due to the current situation, most universities have had almost no classroom teaching since March last year. Courses had to be adapted from physical to virtual teaching within a very short time. A lot of universities state they now make most of their offerings available digitally. In most cases, however, only digital tools for video conferencing were used instead of the physical classroom to convey the content. This means that instead of in the classroom or seminar room, the content was conveyed via Zoom or other videoconferencing software. This article deals with more advanced methods such as using the concept of blended learning and problem-based learning.

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LITERATURE REVIEW

According to the literature, there is a variety of teaching methods. The "mmb Institut für Medien- und Kompetenzforschung" (Institute for media and competence research) is a research organisation in the area of learning methods and competence transfer and publishes an overview of the status quo of digital teaching concepts and their use every year. The mmb differentiates between individual and collaborative as well as formal and informal methods.

On the one hand individual methods focus on the transfer of knowledge for a single individual. On the other hand, collaborative methods mainly use social cooperation e.g. team settings. (mmb Institut, 2019)

Informal learning encompasses all learning processes that take place without direct intent to learn. This is done, for example, through participation in forums and social networks, but also through work itself or through exchanges with colleagues. Formal learning, on the other hand, encompasses all ways of learning that provide knowledge in a planned manner. Examples are webinars, blended learning, courses, lectures and seminars. (de Witt, 2012). Figure 1 shows the main current teaching methods depending on these two classifications (mmb Institut, 2019).
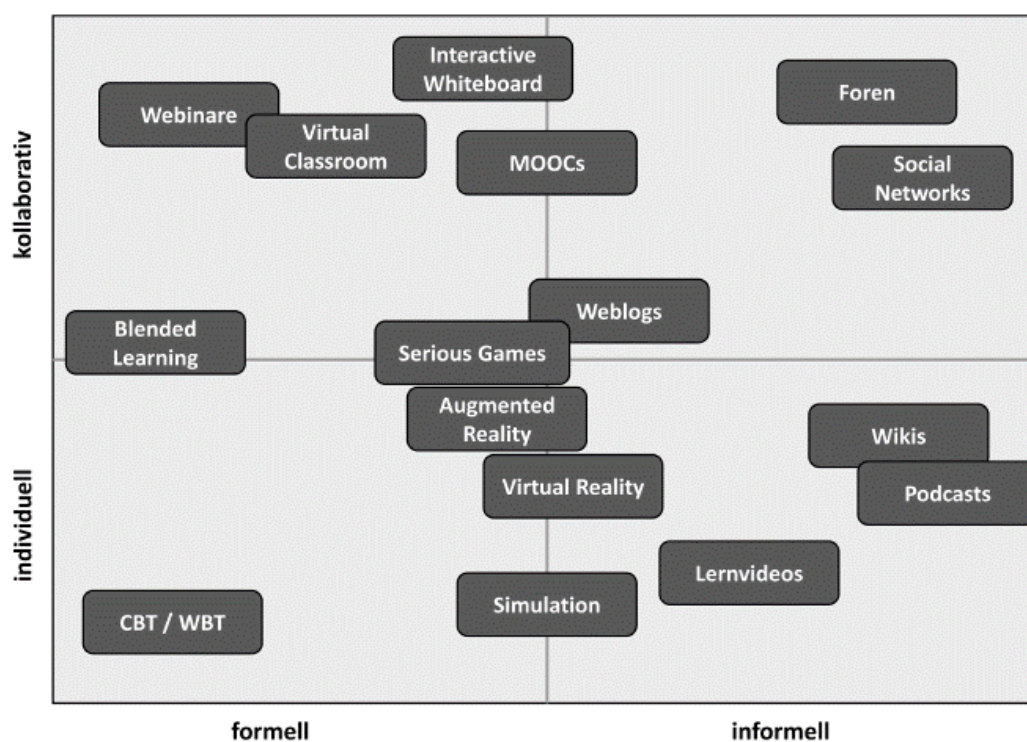

Figure 1: Learning methods according to mmb Institut 2019

Despite this diversity, however, most teachers still prefer formats based on face to face events, i.e. physical presence. These are, for example, lectures with attendance or workshops and seminars (mmb Institut 2019, Siepmann 2018, Poxleitner 2018). This is mainly due to the fact that in this way the interaction and motivation of the learners can be ensured easily. Also, the feedback can be collected by the participants the easiest (Gutbrod 2020, p. 48). Pure passive, digital learning methods such as learning videos have major weaknesses here (Modlinger 2020, p. 166, Kerres 2018, p. 118). But it is precisely the mix of using digital teaching methods with attendance times that activates extensive learning (Kerres 2018, p.105).

A middle way are so-called blended learning formats, in which different methods and media (face to face, readings, learning videos, etc.) are combined (Kerres 2018, p. 23, Erpenbeck et al., 2015, p.29,

Gabler 2021). The aim of this approach is to combine the advantages of face-to-face teaching with online teaching (Kraft 2003, p. 45). For example, classroom teaching is mixed with e-learning formats to ensure interaction, motivation and, above all, to guarantee the acquisition of competence (Kraft 2003, p. 43-44, p. 49). Presence formats and self-learning phases alternate. The presence phases ensure interaction, the possibility to eliminate ambiguities, ask questions and provide feedback (Kraft 2003, p. 49- 51). E-learning enables flexible time design (Erpenbeck et al., 2015, Feldmann & Wolff 2018, p. 200).

The possibility to select the relevant content yourself, if necessary to view content several times, supports individuality and flexibility (Feldmann & Wolff 2018, p. 215-216). The location independence that comes with e-learnings and that it can be accessed whenever and wherever, are additional advantages (Stock-Homburg & Groß 2019, Erpenbeck et al., 2015).

The tools in the field of e-learning are diverse. The simplest are digital papers or videos. But also animations, simulations, virtual and augmented reality technologies and gamification are to be mentioned here (Behrend & Gandomi 2019, Feldmann & Wolff 2018, p. 201- 210). In particular, the use of learning videos supports the self-confidence and independence of the learners. This leads to an increase in knowledge, which further contributes to the promotion of critical thinking and better self-reflection. (Mertens et al., 2019)

So far, these advanced methods have only been used in more specific, especially potentially risky scenarios (Arnold et al., 2018). However, the challenges of the past year have also increased the usage in higher education.

METHODOLOGY
In this paper, two approaches are used in practice to analyse the pros and cons of the methods.

1. Blended learning
2. Problem-based learning

Blended learning based on the Springer iversity platform
In every RE/FM program the different definitions of FM and their application in practice are included as a starting point. This content mainly consists of a description of the different definitions, their similarities and differences. In addition, the practical application of the definitions is to be taught. In times of COVID with a reduction of classroom teaching this content is perfectly eligible for the blended learning approach (Blömer, 2020). On the one hand e-learning videos can be used to convey the content. On the other hand feedback sessions can be used to answer questions and reflect the content with a special focus on the similarities and differences (Kerres, 2018). This allows a reflection of the strategic approach of the definitions.

In order to promote international knowledge about FM, an introductory course for FM was designed and implemented jointly by the IFM of the TU Vienna and Springer. For this purpose, the procedure model of Springer iversity was used to ensure interaction and knowledge transfer. The procedure model gives input on designing the learning videos with respect to (Kerres, 2018)
- duration (Modlinger 2020, p. 124, Lingenau & Ahel 2019, p. 27-28),
- content mixture (Lingenau & Ahel 2019, p. 27-28, Modlinger 2020, p. 121, Erpenbeck et al., 2015, p. 7),
- settings (Kerres 2018, p. 473 – 475, Modlinger 2020, p. 99 – 100, Modlinger 2020, p. 122 – 130),
- and cutting and finishing (Kerres 2018, p. 473 – 475, Modlinger 2020, p. 99 – 100, Modlinger 2020, p. 122 – 130).

Problem-based learning
The second lecture that is used as an example is a lecture on process modelling. The goal of the lecture is not only to present the content of the EN15221-5 but also to provide the practical competence to

model and optimise processes within RE/FM in practice. As the practical application of the competences are in the focus of the lecture the problem-based approach was selected for an optimal competence transfer.

As best practice example of setting up a hybrid course using the problem-based learning approach the ME310 of Stanford is used. Stanford University conducts the design thinking training ME310 as a problem-based learning course. This is done in partnership with other universities and industry partners. One of the partner-universities is the IFM of the TU Vienna. The industry partners provide real life use cases every year. The students use the design thinking methodology to "design" products to address the needs and pains of the personas (ME310 Stanford University 2018). In the second use case, the problem-based learning method and the experience of the ME310 course design are used to teach the students of the TU Vienna competences in the field of process management and IT support within RE/FM.

In this use case e-learning videos are used to pass on the content and the methodology of process modelling. The competences gained are applied by modelling the "failure handling" process, which is a very important process in the area of RE/FM.

RESULTS
Blended Learning based on the Springer iversity platform
The experience and specifications of Springer iversity and the results of the literature research regarding blended learning led to a serious redesign of the lecture and the lecture documents that were used before in the classroom teaching setting. The advantage was that a textbook "Modern Facility and Workplace Management" (Redlein et al., 2020) was published by Springer Verlag in spring 2020. This was used as pre-reading, as a consolidation and deep dive into the topic.
Storytelling, the teaching of the content based on practical examples, was also included in the videos. Theoretical content is presented not only through the definition, but also using an example from a company (Kerres, 2018, p. 161).

The imparted knowledge is now provided with the help of the learning videos and can be accessed by the students independently. In addition, learning videos were also used to provide the topic in retrospect and then to repeat it. (Mertens et al., 2019) The creation of the learning videos themselves also turned out to be complex. One can assume that one hour of learning videos in total means two to three days of effort.

That learning videos can be produced successfully the learning objectives and the tasks should be defined in the first step. The learning objectives should be shown to the viewer at the beginning of the learning video. The tasks should be displayed at the appropriate points in the video (Lingenau & Ahel 2019, p. 27-28, Modlinger 2020, p. 121, Erpenbeck et al., 2015, p. 7). The learning content was divided into 5-minute units. This way, the concentration and communication of the content can be optimised. However, this is by no means in line with the classical transfer of knowledge at universities and colleges, which is always structured in 45-minute units. Therefore, the lecture has been revised completely in this regard.

Further tasks are the setting for the video recording (background, lighting, utensils, etc.), the filming, but also the post-processing of the videos above all to mention the partially repeated cutting and editing (Kerres 2018, p. 473 - 475, Modlinger 2020, p. 99 – 100, Modlinger 2020, p. 122 – 130). All these tasks to create high quality learning resources are very time consuming. Only if the material can be used several times the conversion pays off. Figure 2 shows an example of how the content is linked to the videos. They are grouped according to the chapters in playlists, so the students can watch the relevant ones easily until the next feedback session to learn the content and gain the competences.
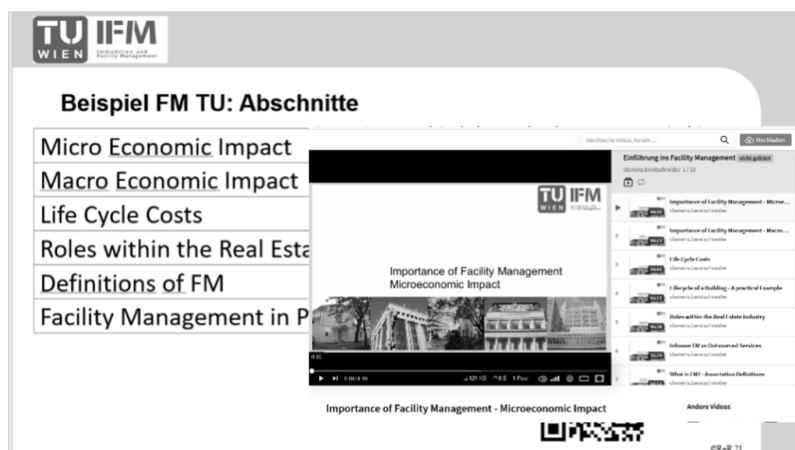
Figure 2: Screenshot of lecture 'Introduction into FM' TU Vienna Playlist Videos

Especially the tutorials of Springer iversity have given good support and a guidance here. They are much more detailed than the usual manuals at universities, but therefore support the work more comprehensively and ensure a higher quality (Springer, 2021). By using quiz formats, learners can also independently control their learning progress (Kerres, 2018). Another method is to design the execution of the tests based on each other. There is the possibility that after successfully completing one test the next one will be activated. (Feldmann & Wolff, 2018).

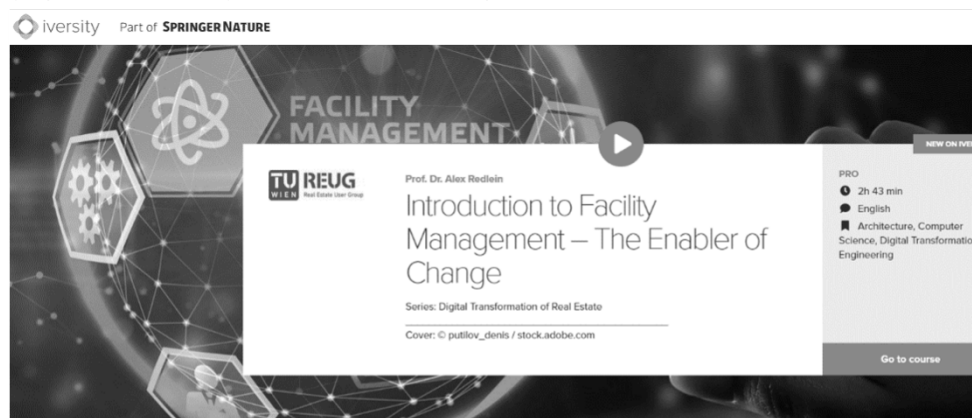The cover page of the iversity course is shown in figure 3.

Figure 3: Springer course cover page 'Introduction to FM'

The lecture is now structured in the following way (comp. figure 4):

1. In the kick-off session the competences gained, learning methods used and schedule, tasks/ submission of students and teaching staff, etc. are presented. This kick-off is a face to face session or held via ZOOM.
2. Self-learning unit about micro- and macro-economic impact of FM
3. Feedback session to answer questions, for a critical review of the learning videos and to show relationships between the topics. This session is again a face to face unit or held via ZOOM.
4. Self-learning unit about the different definitions
5. Feedback session to answer questions, for a critical review of the learning videos and to show relationships between the definitions. This session is a face to face unit or held via ZOOM.
6. Self-learning unit about the practical application of the definitions
7. Feedback session to answer questions, for a critical review of the learning videos and to make a deep dive into the possibilities of the application of the EN15221-1. This session is a face to face unit or held via ZOOM. It also sums up the whole content.

Figure 4: Content of Springer course and details of a chapter

The same concept is also used for the lecture "Introduction into FM" at the TU Vienna. Figure 5 shows the schedule and that the self-learning and the feedback sessions alternate.

Figure 5: Screenshot of lecture 'Introduction into FM' TU Vienna Content

This method and approach is also used by the IFM's teaching team when adapting five lectures at three universities. The feedback from the students from all five case studies was very good. Storytelling in particular is perceived as important because it establishes a connection to practice. The possibility of acquiring knowledge flexibly and regardless of location is also considered positive (Erpenbeck et al., 2015). However, the opportunity to receive sufficient personal feedback must remain in order to ensure long-term satisfaction and learning success (Kraft 2003, p. 49 – 51).

Problem-based learning
The second approach is based on the experiences of creating blended learning courses but incorporates the approach of problem-based learning. In this case, the learner should primarily use her/his acquired skills to solve a real problem of practice. This checks whether only knowledge or also the competence to apply the knowledge has been acquired. In a first step the students learn how to model processes based on the example of the "failure handling process". (Kerres 2018, p. 363 – 370) The first learning videos end with a submission order to the students. The next video starts with an example solution and the common shortcoming. Then the next step is described and another submission is requested. This process consists of six steps. In this way the students learn how to model and optimise processes. At the end of the last learning video, the students get another submission. They have to apply the methodology learned to optimise the preventive maintenance process.

The learning videos can be provided in advance and support the students during their self-study. Despite of the early provision, the videos can be used to call up the knowledge exactly when necessary. This

approach of learning on demand is mentioned by Claudia Bremer in the context of her scientific paper. (Bremer, 2017)

This approach is more likely to be used in small groups, as the learners usually acquire the knowledge in self-study and the teachers act primarily as coaches. Therefore, this method is very laborious for the teachers. Short response times and personal support are very important for the learning success and satisfaction of the learners. At TU Vienna, however, this method was used in an exercise with around 50 students.

Experience shows that European or students of an Austrian university have to familiarize themselves with the method first. The first feedback was from "You dare to do something" to "Super". The final feedback from the students confirms that they accept the method well and are enthusiastic about the flexibility of the learning method. There was actually no negative feedback. The analysis of the grading of the first two courses shows that the grading was analogous to the last semesters. There was even a slight tendency towards better grades, but this cannot yet be considered statistically relevant.

Again, it should be noted that the teaching team has spent a lot of time on feedback to ensure short response times. In addition to synchronous feedback methods such as Zoom meetings, asynchronous methods such as e-mail or even a ticket system were used. These tools were also extensively used by the students.

CONCLUSION

Overall, based on the case studies conducted, it can be said that blended learning and problem-based learning can be used well in hybrid or even purely virtual teaching. A mix between digital types of content mediation and personal feedback must be used. The cost of this changeover is considerable, but pays off. The results of the case studies show that student satisfaction and learning outcomes in terms of grading are very high.

However, it cannot be assumed that the number of lectures and tutors can be saved, as rapid response times to questions and feedback rounds in sufficient numbers are important for success. The IFM is currently working to test these methods for their suitability also in the field of secondary education, especially in the area of upper secondary education. The initial results show that feedback loops and teacher availability are even more important for success.

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Implementation of Digital and Physical Learning Environment to 21st Century Skills – Case Escape Room in the University of Eastern Finland

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ABSTRACT

Background and aim – Escape rooms are gaining popularity as learning environments from primary, secondary, and higher education to professional development programs. Escape room integrates 21st century skills in education, including programming, coding, technology education, and collaboration skills. This paper describes a case study of an escape room in one Finnish university: what it is, how it has been made, and experienced?

Methods / Methodology – The explorative research design is based on a case study. The escape room is built on the university campus and it comprises three escape rooms and one monitoring room. The data was gathered by a document analysis from co-creation process documents and observation. During Fall 2021-22, learning sessions have been conducted and about 350 visitors have shared their experiences. The qualitative data based on the experiences was analysed by content analysis.

Results – The co-creation process in developing the existing facilities to digital and physical learning environments had a significant impact on the final solution.

Originality – As a research object, escape room as a learning environment is unique. The user centricity both in the design process and experience mapping provides insights to the new learning environment.

Practical or social implications – The escape room can be modified for users of any age and discipline. The case study is a real-life example that can be scaled to different universities.

Type of paper – Research paper

KEYWORDS

learning environment, escape room, gamification, digital, physical, university, pedagogy

INTRODUCTION

Learning environments need to serve pedagogical purposes both digitally and physically (Sandström, 2020). Education is renewing itself, and this calls for new environments, methods, and devices. Gamification has become an essential part of teaching, and therefore it is necessary to develop related pedagogy. Skills that students associate with gameplay can be utilised in escape rooms, which are designed as learning environments (Karageorgio et al., 2019). Escape room methods can improve students' motivation to learn and result in higher learning outcomes (López-Pernas et al., 2019). There is a need to understand how pedagogic and space design can be integrated.

This paper aims to clarify escape room as a learning environment. The questions asked are:

1. How is space planning being conducted to support skill-based teaching and the implementation of curriculum?

2. How has the escape room been experienced?

The data is gathered from a case study conducted in the University of Eastern Finland in 2020. The explorative research approach provides insights both to the co-design process and user experiences of the solution named Sm4rt LOC, Learning Observation Classroom.

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After introduction, this paper presents a short review of the literature regarding the escape room pedagogy and hybrid learning environment. The third chapter presents the research design. The results in chapter four are two-fold: they analyse the process of co-creation and present the user experiences of the escape room. Discussion and conclusions include the practical and academic contributions, reliability and validity of the research, and finally propose topics for future studies.

ESCAPE ROOM PEDAGOGY AND HYBRID LEARNING ENVIRONMENTS

Escape rooms have existed as a form of entertainment since 2007 (Mayer and Toates, 2016). These experiences involve participants being introduced to the room and provided with a simple set of rules, including a time limit and a number of available clues, in order to solve the puzzle and "escape" or "complete" the room. Escape rooms present cooperative challenges that take place in the physical world; players must be active, and must work with each other directly (Nicholson, 2018). Educators are looking for new approaches and methods to meet new priorities in revised curriculums, and to expand the understanding of the use of escape rooms in education. The teachers within various fields of expertise and at various levels in the education system are implementing the idea of escape rooms as a didactic tool. It is used in higher education programmes, enhancing teamwork and leadership skills, integration of subjects and 21st-century skills (e.g., Adams et al. 2018; Aubeaux et al., 2020; Healy, 2019; López-Pernas et al, 2019). Escape rooms are rooted in gamification. The term gamification refers to the "use of game mechanics in non-gaming contexts" (Deterding et al., 2011) or, rather, to "the phenomenon of creating gameful experiences" (Koivisto & Hamari, 2014). It is used as a driver to promote fundamental things like learning and it is also rising in education (Domínguez, et al., 2013), due to the conviction that it supports and motivates students, and can thus lead to enhanced learning processes and outcomes (Kapp, 2012).

A gamified classroom is defined by a set of rules, usually created by the teacher, which leads to the achievement of learning objectives or goals. The gamified classroom is also a "flipped" classroom. It is a student-centred, as opposed to a teacher-centred process, providing opportunities for the performance of specific tasks that require propositional and functioning knowledge. It aims to enhance higher learning outcomes. It involves more freedom and is more playful, whilst also requiring hard work (Eaton, 2017). Gamification is relatively new to pedagogy, although "the use of game design elements in non-game contexts'' (Deterding et al., 2011) to improve processes is not a new idea. According to Landers (2015), gamification involves augmenting a pre-existing system, such as the classroom, with game elements, and the gamification of learning specifically includes game elements such as challenge, environment, game fiction, human interaction, immersion, and rules or goals which facilitate learning outcomes. Escape room pedagogy integrates gamification knowledge practices and learning. According to Sandström (2020) learning happens when people and groups of people work together – i.e., share intelligent activities whose aim is to create new understanding and knowledge. At the same time, the activities aim at re-construing the understanding and knowledge while also disseminating and communicating it to others. In this sense, when people share intelligent activities to learn and further their understanding of a learning task, object or phenomenon, they engage with new ways of thinking and new information while using or producing new kinds of skills (Sandström, 2020).

Escape room or game-based learning is a method and tool, which is supported by digital and physical environments (Veldkamp et al. 2020). Digital learning spaces include online and offline platforms, social media, virtual games, virtual worlds, and other kinds of spaces students and teachers learn and teach in (Harrison, 2018). Computer supported collaborative learning (CSCL) usually combines digital and physical spaces while students collaborate and it has become an established approach in most classroom practices where student collaboration and digital learning spaces are concerned (Jeong, Hmelo-Silver & Yu, 2014).

Furthermore, space is embedded with meaning as it is relational and filled with objects that people find important or meaningful (Harrison, 2018). She continues by stating that space sets boundaries for actions related to teaching and learning; the furniture and technology in the classroom can support

certain strategies and constrain what teachers and students want to do. However, the dimensions of the buildings we find on campuses today, are often based on the way we were learning, teaching, and working in the past. The promotion of e-learning and integration of ICT as well as virtual learning environments has not led to a rethinking of physical space on campus. Virtual and physical spaces are still produced separately and not in an integrated manner. (Ninnemann et al., 2021)

Some authors have driven the further development of hybrid learning environments (Hilli et a. 2019). According to Ninneman et al. (2020), hybrid environment is an approach to merge physical and virtual spaces as well as to integrate formal and informal spaces. It can also stress the need to overcome disciplinary and organizational boundaries. Hybrid learning suggests blurred boundaries between teacher and students. It is open to collaborative learning where student agency is important for the collective efforts of students to be beneficial. Digital spaces can support collaborative learning among students and foster a sense of community and shared knowledge (Harasim, 2012).

Escape rooms can have very different narratives and settings in time and place (Veldkamp et al. 2020). It is important to understand the knowledge practices, skills, and tools as well as places as an integrated entity in escape room pedagogy. Sandström (2020) proposes the diamond-shaped model of learning environments. It visualises a dynamic relationship between the actor (learner), tools and artefacts, knowledge practices, and the place (Sandström 2020). This framework is applied in this study focused on escape room pedagogy (Figure 1), because the original framework provides a way to integrate pedagogic aspects with digital and physical solutions. Additionally, it indicates how different narratives need to be brought together in the planning phase of the learning environments. He argues that it is common that the (project) management responsible for designing the facilities and campus retrofitting do not speak the same "language" as the ones who will use the spaces. It is essential to build common ground between the ones who deliver the space and the ones who use it (Sandstöm, 2020). Knowledge practices are based on collaborative processes among learners. Skills are developed by using narratives and tasks. The hybrid environment either as a digital or physical entity or both adapt to knowledge practices. Additionally, digital and physical places provide a platform for a learning experience for the students and teachers.
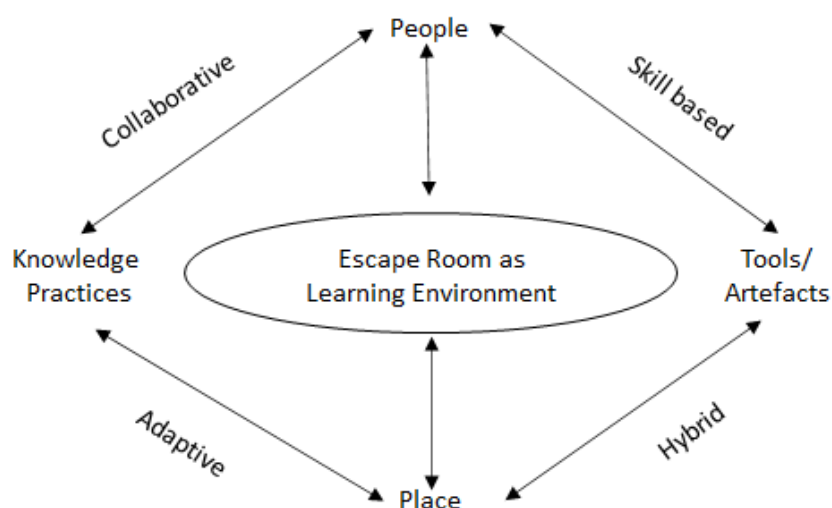
Figure 1 Escape room as a learning environment framework applied from Sandström 2020.

RESEARCH METHODOLOGY
Research approach, data collection and analysis
Because the innovative space is globally unique, it was considered essential to adopt an explorative case study approach. Case studies are frequently used to investigate complex and unexplained phenomena in a holistic way, focusing on understanding the dynamics present within single settings (Eisenhardt,

1989). Such a holistic view of dynamics in a single setting is mainly enabled through a use of multiple methods (e.g., interviews, archives, observations) (Eisenhardt, 1989; Yin, 2003). Further previous data on planning such an environment to integrate skill-based learning and research with gamification was not available. This study used different data collection methods. Document analysis included minutes from the meetings concerning the project management and pedagogical design team meetings, as well as layout plans from different phases of the co-design process.

The open answers were gathered anonymously to white boards during reflection discussions after the pilot escape game in October 2020. The participants told their ideas freely to the question: how would you use the space in your teaching or research purposes? The participants were in groups of 4-6 persons due to COVID19-restrictions. The participants consisted of university staff members who made online registration for the opening days of the Sm4rt LOC space. Due to registration, the groups were formed randomly consisting of teachers, research and administration staff members. The number of visitors in the opening week in the middle of October was 75 people and 30 of them wrote a note to the white board and these answers were analysed in the following Table 4. Additionally, the observation and user feedback data collected by open questions provided data about the user experience of the escape room. Collected data from participants of the design process groups and escape room users was analysed by content analysis.

Finnish National Agency for Education (FNAE) has set in 'The National Core of Curriculum for Basic Education' (2014) seven transversal competence targets. These targets integrate subject related content knowledge, skills, values, attitudes, and capabilities. First target (T1) is thinking and learning-to-learn skills, (T2) cultural competence, interaction and expression, (T3) taking care of oneself, (T4) multiliteracy, (T5) ICT competence, (T6) working life competence and entrepreneurship, (T7) participation, involvement, and building a sustainable future. Outcomes guide teachers to set up goals and assessment frames for each lesson and course. In the design process, these outcomes set the frames for educational and pedagogical goals for the project development. Further in this study, these outcomes were selected to categorize the open answers and integrate them to the curriculum.

Table 1 Research data.

Material	Pages	Main content
Project meeting minutes	103	7 meeting minutes between February and September 2020, layout and design documents, collaborative planning release
Pedagogical group meeting minutes	15	7 meeting minutes between November 2019 and August 2020, submitted application, pedagogical assessment analyses, plan of the functions, equipment listing, responsibility listing
The national core of curriculum	4	Transversal competences target descriptions for basic school education
Open questions	1	30 free answers on white boards
Visitor registration	2	Excel-file of registered visitors on Microsoft Forms

Case study Sm4rt LOC
Escape room Sm4rt LOC aims to gamify education and to develop students' collaborative problem-solving skills. LOC is abbreviated from Learning Observation Classroom to describe the main purpose of the space which is to monitor students. The escape room constitutes part of the Sm4rt LOC project, and is created in collaboration between the academic subjects of teacher education, computer science and physics. The escape room integrates 21st century skills in education, including programming, coding, technology education, and collaboration skills. The case also realizes new ways of learning and teaching, as well as research addressing gamification.

The escape room can be used in any subject, and teachers can design tasks for students to complete independently. When necessary, the design team can provide ideas for problem-solving tasks. The escape room can be modified for users of any age, making it suitable to be used in teaching university students as well as secondary level students in high schools. The rooms fit 20–25 people at a time, which means that an entire class of students can work there simultaneously. The escape room's problem-solving series and gamification motivate students to learn things in a new way. Different kinds of technology (e.g. VR goggles) support information retrieval. Escape room games can be recorded on video and audio. This function enables teachers or researchers to reflect and analyse the situations afterwards.

The escape room is unique nationally and according to the background studies also globally. Escape rooms have been used in education before, but they have been temporary and movable. The permanent facility has been built on the Joensuu Campus and it comprises several escape rooms. The facility was originally a self-studying space with computers and tables with low usage rate. Due to this rate, the university was willing to develop a new learning environment concept. The project involved different stakeholders like university facilities management, university teachers, design and project team, and university property owner. Figures 2 and 3 present the old and the new layout of the learning area and transformations of functions are presented in Table 2.
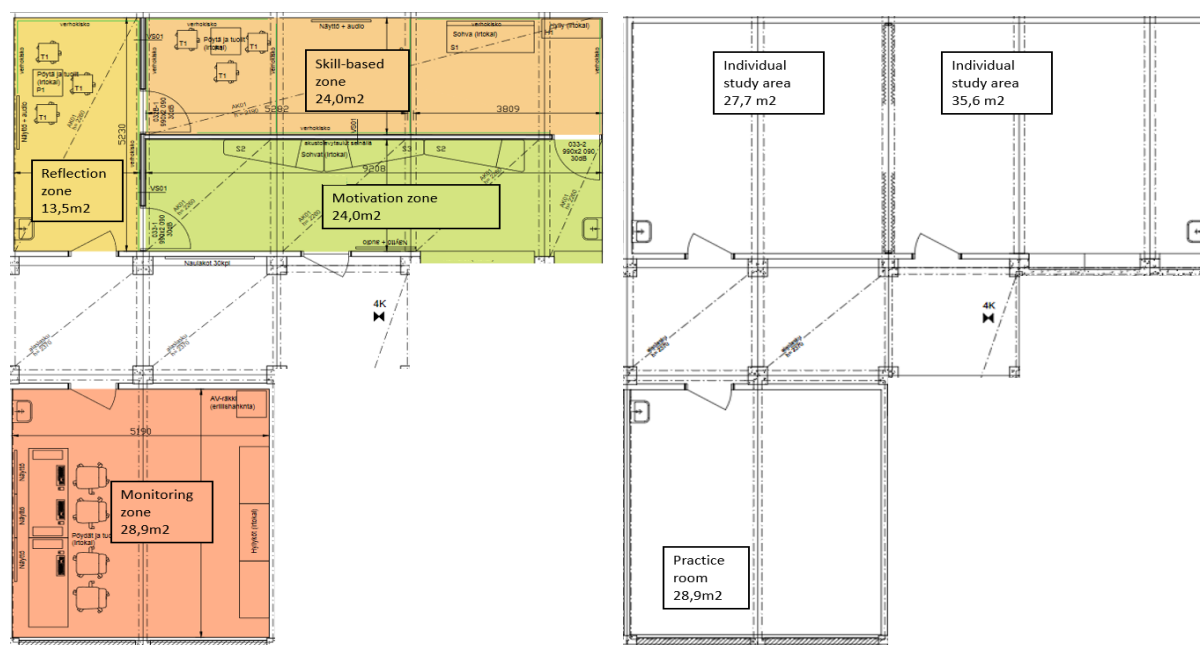

Figure 2 and 3 The layout of the escape room before and after with four zones.

Table 2 Room functionality descriptions.

Room	Function	Size (m²)
Room 1 (green)	Introduction space, eye-catching, promoting, motivation, reflection, escape room space, exit, waterpoint, lounge area	24,0
Room 2 (yellow)	Escape room, simulation and studying room, waterpoint, exit, small room, reflection space	13,5
Room 3 (orange)	Dead end space, escape room, simulation and independent studying room, divided ready space	24,0
Room 4 (pink)	Monitoring space, observation, analysing, collaboration space, storage	28,9

RESULTS

Based on the document analysis the diversity of participants in the co-design process was an essential

element for sustainable solution. The successful process began from the University Properties Ltd.'s open call to support development of learning and research environments by user-centred project proposals. So-called demo-projects culture is an annual way to interact with users of the facilities. The intention is to encourage users to explore new innovative ideas to university facilities. The projects are co-designed, co-financed and co-evaluated (Nenonen et al. 2016). The project focus was to design a learning and research environment with skill-based and gamification orientation. The group of academic educators formed a dynamic group for planning the project proposal. The group included teaching experts from diverse fields of science: mathematics, biology, geography, information, and communication technology. These educators had experience in giving teacher training from early childhood educators all the way up to the master students. Figure 4 is based on the analysis of the minutes of the meetings from both pedagogical and design and project groups. This figure illustrates the simultaneous process and interaction between these groups. Simultaneous processes played a crucial role in setting requirements for the redesign of the area. The shared understanding of the role of curriculum and methods impacted physical solutions too. Additionally, the integration of digital tools was steered by the pedagogical discussions.
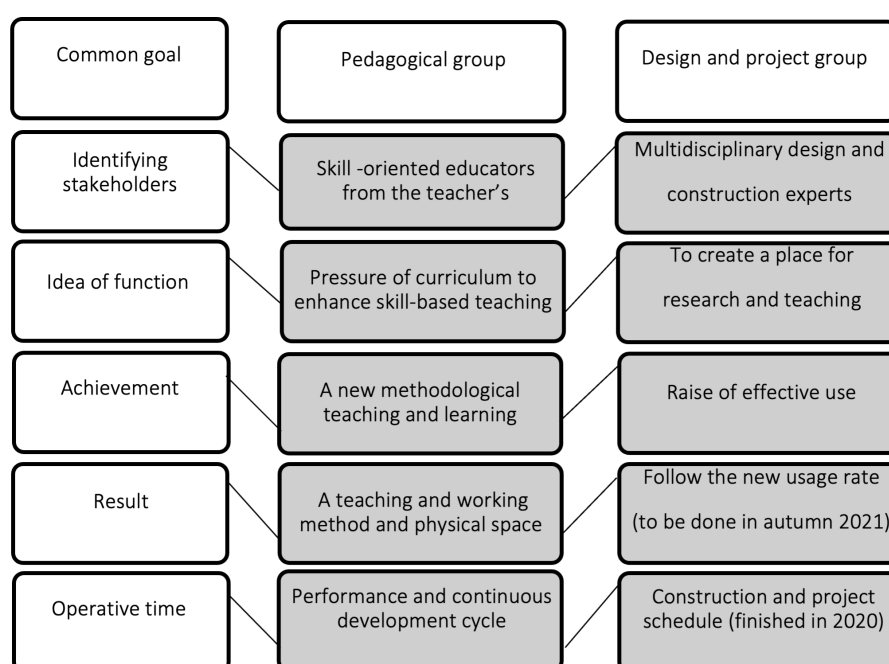
Common goal	Pedagogical group	Design and project group
Identifying stakeholders	Skill -oriented educators from the teacher's	Multidisciplinary design and construction experts
Idea of function	Pressure of curriculum to enhance skill-based teaching	To create a place for research and teaching
Achievement	A new methodological teaching and learning	Raise of effective use
Result	A teaching and working method and physical space	Follow the new usage rate (to be done in autumn 2021)
Operative time	Performance and continuous development cycle	Construction and project schedule (finished in 2020)

**Figure 4** Stakeholder processes compressed into figure model

The impact of the simultaneous processes is summarised in Figure 4 describing the transformation of the old space to a new learning environment, escape room. Further Table 3 compresses the main ideological and functional transformation of the space to follow the latest frames of curriculum.

Table 3 Comparing space before and after the project

Category	Previous	After
Knowledge practice	Individual learning	Collaborative and interactive space
	Knowledge supportive space	Skills-based space
Users	University students only	Teaching and research staff, students from various grades, external users
	Single use learning environment	Flexible and adaptive learning environment
Tools	Fixed computers	Bring your own device, fixed screens, audio and video recording, and monitoring equipment

Place	Uncomfortable interior design	Increased comfort
	Open area	Semi-open learning environment
	Fixed structures	Mobile, light structures

The following Figures 5 and 6 show the activities in the escape room. The first picture is about how the seventh graders learn how to collaborate and enhance their technology skills. The second presents how the teacher students use the monitoring technology to evaluate a group of pupils during the escape game.
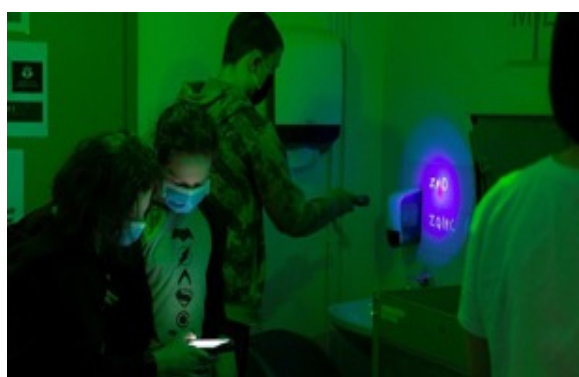
Figures 5 and 6 Sm4rt Lock in use.

The open answers were clustered into three categories in the content analysis:
1. Space and adapted skills related issues
2. Teaching methods related issues
3. Learning subject related issues

This finding through content analysis indicates that educators can implement their teaching in the Sm4rt LOC learning environment. All seven transversal outcome targets to implement curriculum were identified from the open answers (Table 4). Especially participation and sustainable future (T7) was highlighted with 11 responses. Cultural competence (T2) and working life and entrepreneurship competencies (T6) were mentioned eight times. Subject related contents indicated that the space can be used by various disciplines and for integrative teaching. Teaching methods emphasize collaborative learning. They also enable evaluation and reflection of the learning. The space itself has an obvious pedagogical function. Furthermore, 21st century skills have the main role in the skill category in Table 4. Without any great lead to the topic, the education professionals indicated in their answers that these skills are part of the designed space and pedagogical method. This result indicates that the project goals have been achieved both pedagogically and spatially.

Table 4 Categorization to questions: How could the space be implemented for your teaching?

(Theme) Category	Answers (N = 30)	Related subject	Related Transversal Competence Targets
Subject related contents	basics in problem solving in mathematic teaching	mathematics	T1
	in history time and map analysis	history	T4, T5
	practising treatment situations in health science	health science, biology	T6
	solving food chain in home economics and environmental studies	home economics, environmental science	T5, T7
	genetechnic and laboratory skill in nature sciences	biology, chemistry, physics	T5, T7
	recognizing species in varied environments	biology	T7
	material consciousness	hand crafts, geography	T7
	historical empathy	history	T2
	solving chains by the humans in the past	history, geography	T1
	using instincts in the physical education	physical education, biology	T3, T6, T7

Teaching methods	a group exam	various subjects	T6
	producing a play or a simulation situation	various subjects	T2, T7
	watching and analysing videos	various subjects	T4, T7
	recording a group interview	various subjects	T5
	experimental pedagogy and creating memory traces	various subjects	T1, T2
Space adapted skills	logical deduction	various subjects	T1
	grouping and group working skills	various subjects	T1, T2, T7
	problem solving	various subjects	T1, T6, T7
	practising different fields of interaction	various subjects	T2
	multidisciplinary collaboration	various subjects	T6
	facing and solving crises and conflicts	various subjects	T6, T7
	recognizing personal strengths and targets of development	various subjects	T1
	tutoring education	various subjects	T2
	reason and result practising	various subjects	T1
	perceiving space and draw	various subjects	T4
	hygiene and cleaning	various subjects	T6
	considering ethical problems	various subjects	T2
	emotional skills practising and controlling them	various subjects	T3
	leadership and time management	various subjects	T6, T7
	information and communication technology skills in daily life	various subjects	T3, T4, T5

Figure 7 summarises the results: Sm4rt LOC-concept is a tool which can be adapted to various disciplines and subject related contents. It is one way to realize the curriculum. The space itself is an inspirer for teaching and learning skills and competences.
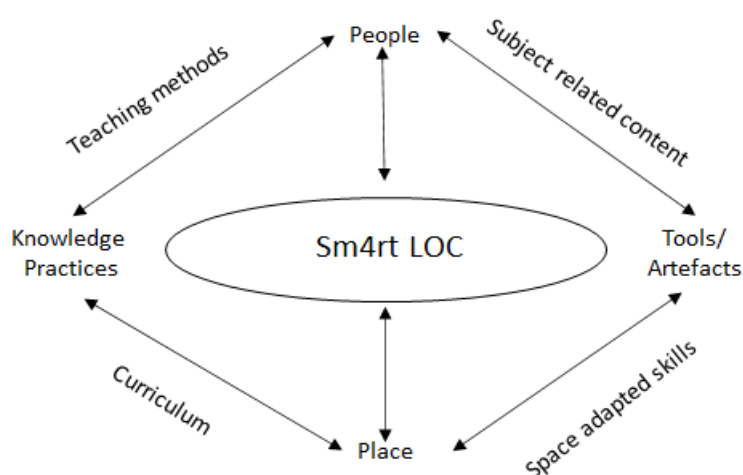

Figure 7 Sm4rt LOC-concept as a learning environment.

CONCLUSIONS

The goal of the paper was to find answers, at first, to the question about the space planning process of the new learning environment, escape room Sm4rt LOC. Additionally, the intention was to find out how the pilot of a pedagogical escape room has been experienced. In summary, this paper argued that it is important to clarify the escape room as a learning environment. We were interested in how space planning can support skill-based teaching and implement the curriculum. Additionally, we investigated the first expressions of the specific case. The integration of the space to the main frames of the curriculum was clearly confirmed by the users. Flexibility, multidisciplinary, skill-orientation, and content-related functions were also the main frames to define the escape pedagogy in theory. The findings contribute to escape room pedagogy literature by presenting the method and tool connected to the physical escape room solution.

This study provides a preliminary overview of the escape room experiences. The functionality of multidisciplinary, skill-based teaching and learning related to the recent curriculum can be identified from the data. For future improvement and research, the findings provide a seed to develop relevant methodology for analysing more data to increase the generalizability. Ideally, these findings should be replicated in a study where the concept is in use for a full academic year and learning impacts are also followed systematically.

Scalability and product development can enlarge the concept for external users. It is one way to enhance university-industry interaction. However, the pilot project indicated that the investment was high, 190 000 euros. One needs to also innovate cheaper solutions. Next to financial issues, one needs to be aware of time resources: the new teaching method adaptation takes time. However, it provides a great tool for new kinds of learning experiences. Further, the co-design process requires a tight collaboration between the pedagogical and design and project groups to perform efficiently. In this case study the students did not participate in the planning phase of the escape room, however their impact in the using phase has been valuable. In the future, more student involvement is needed. Covid19 situation has challenged the ideology of the learning environment development towards student-centred and open collaborative learning spaces. The use of space can be enlarged also by providing access to the students outside of the schedule. Bring your own device-principle is also vital to involve users among the pedagogical planning and functions.

Sm4rt LOC learning environment has created a vast field of research and is scalable in various contents and methods. Future technology could guide the learning and teaching analytics through eye recognition software. These technological solutions would support the teaching towards effective and individual learning paths. Future investigations are necessary to validate the conclusions that have been drawn from this study. The pilot case Sm4rt LOC provides a good starting point for discussion and further research in escape room pedagogy, space planning, and future skill-based teaching results.

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