WORK ACTIVITY PATTERN AND COLLABORATION NETWORK: NEW DRIVERS FOR WORKPLACE SPACE PLANNING AND DESIGN

Chiara Tagliaro, Ph.D., Politecnico di Milano, Italy
Yaoyi Zhou, Ph.D. (ID), Virginia Polytechnic Institute and State University, USA
Ying Hua, Ph.D., Cornell University, USA

ABSTRACT

Information about the users' work activity patterns is essential for office space planning and the design of organizations. However, it is not clear yet what factors can be used for predicting work activities, especially at the group level. In this study, we found that work activity patterns of groups are associated with the workgroup's job function and their location in the organizational collaboration networks. Two hypotheses were tested through a survey conducted on a sample of 188 managers from an Italian utility company. The participants were asked about (1) the percentage of time different groups (based on job function and demographic composition) spent doing individual, collaborative, and mobile work; and (2) how network connectivity affected individual versus group work. The results showed that workgroups with different job functions spent different percentages of time on individual, mobile, and teamwork. Communication network connectivity is not significantly correlated with the amount of time spent on individual work, but statistical evidence confirmed that it plays an essential role for the assessment of the amount of work time spent on teamwork, even more than job functions. By investigating the factors affecting collaborations between groups, we advanced the research on work activity in large companies in order to complement existing studies that mostly addressed work activity patterns at the individual level. How information about collaboration networks can be utilized for space planning and flexible work arrangement policy-making is also discussed, in light of the changes that the COVID-19 pandemic has triggered.

INTRODUCTION

The organization of office space for individual or teamwork is not a new theme for workplace design strategies. The concept of activity-based work (ABW) office design (Appel-Meulenbroek et al., 2011; Engelen et al., 2019) is mostly based on the assumption that work activity is varied, and employees will benefit when each activity is appropriately supported by different work settings (Babapour et al., 2018). The idea of multifaceted work activity is reflected in the growing arrays of furniture and layout assortments, aimed at better supporting both individual work and teamwork. Indeed, work processes, nature of work, and preference for mobility could strongly influence employee's adaptation to new office environments (Duffy et al., 2003; Greene & Myerson, 2011). In designing office buildings, the workers' activity patterns, including the complexity and interactivity of tasks, are considered a variable that influences the relationship between well-being and performance (Soriano et al., 2020). Moreover, they form the basis for the development of theories on how the design of office buildings can influence behaviors. Thus, studying work activity patterns is critical for workplace design and space planning.

Particularly in the wake of COVID-19, given the increasing adoption of flexible work arrangements (FWA), large companies are wondering whether they still need an office and determining the quantity and quality of space that will be necessary in the future. A survey conducted by Smith et al. (2021) and CoreNet Global highlighted that nearly three-fourths of large global occupiers expect employees to be in the office 2–4 days a week on average. Results from the PwC's U.S. Remote

Work Survey (2021) indicated that over half of the employees want to work remotely for 3 days a week or more, while 55% of companies are leaning toward remote work. New drivers will be beneficial to inform workplace design and allocation, in light of the increasing flexibility of the workforce. Typical workplace projects start with a discussion over the headcount and the available space (e.g., Kampschroer et al., 2007), but nowadays a successful space planning should be based on an accurate understanding of the activity patterns and job functions of the employees, so that optimal workplace settings could be conceived as a system where physical design factors influence work processed and at the same time are shaped by them (Becker, 1993). In previous research, work activity patterns were investigated through surveys, observations, and ethnographic studies on how individuals behave throughout their workday at the office. Only a few studies investigated how group dynamics affect work activity patterns, mainly by means of experiments (e.g., Zimmer, 1993).

The goal of the current study was to empirically explore which factors, irrespective from the behavior of individuals in the space, can explain the differences in work activity patterns at the workgroup level in a large organization. In particular, we were interested in determining if job function, demographic factors, and collaboration networks (i.e., connectivity in a work collaboration network) influenced work activity (i.e., individual, collaborative, and mobile work).

LITERATURE REVIEW

FLEXIBLE WORK ARRANGEMENT(S)

The increased flexibility in work arrangements makes the employees' work activity more diverse and difficult to evaluate. Organizational policies such as FWA have been cited among the key strategies to offer employees the increased schedule flexibility that allows them to better balance work, family, and life (Hirsch, 2012; Leonard, 2013). Two central FWA policies can be authorized by employers: flextime and flexiplace (H.R. 4219, 2017). *Flexitime arrangements* are when an employee's regular work schedule (scheduled starting and ending times) can be altered. *Flexiplace arrangements* allow eligible employees to work and perform some or all of their activities from a worksite other than the location from where the employee would otherwise work. Working from home or a telecenter are common examples of flexiplace arrangements.

> **The increased flexibility in work arrangements makes the employees' work activity more diverse and difficult to evaluate.**

The increasing adoption of FWA is reported by the Organization for Economic Co-operation and Development (OECD)[1], an international entity that monitors the state of the global economy and job market to support policy development in collaboration with the United Nations. Based on their studies, a significant fraction of employees used telework since 2015—that is, worked outside of the office, from home, or a public space—at least occasionally (OECD, 2020). Data from 2016 suggested that about 35% of the workforce in the 28 countries of the European Union (EU-28)[2] and 43% of the employees in North America are teleworking, and these numbers are forecasted to grow in the future as the COVID-19 pandemic encouraged most companies to transform telework and remote work policies into stable work modes for their staff ("What a way to make a living," 2020). In general, FWA policies are not mandated; therefore, they usually change from one organization to the other (Munsch, 2016). Companies are currently experimenting with pilot projects and workplace tests based on different hybrid work models (Smith et al., 2021); however, it is often unclear which drivers are shaping these new experimental models.

FWA policies have both positive and negative effects. On the one hand, they improve employee's work–life balance and job satisfaction, reduce levels of burnout and psychological stress (Hirsch, 2012; Levit, 2018), increase productivity (Hirsch, 2012; Leonard, 2013), lower commuting costs, and help companies attract and retain talent (Golden, 2009). On the other hand, studies also discovered a positive correlation between FWA and family–work interference; in other words, there is a higher degree of disturbance at work when FWA policies are adopted (Hammer et al., 2005; Shockley & Allen, 2010). Teleworking employees were found to work long hours and suffer from the perception of not belonging to an organization (Belle et al., 2015). Another major disadvantage of FWA is that flexiworking employees might be devalued in a performance

appraisal (Blair-Loy, 2009; Williams, 2001). Since FWA policies may have different effects on employees, identifying which jobs or group of workers are suitable for FWA is essential.

Despite the adoption of FWA policies in the past decade, the criteria upon which to determine which groups of employees are more suitable for FWA and the related impacts on office space allocation are not well defined and often do not take into consideration the type of work or the work activity patterns of employees. Understanding the work activity patterns can help managers establish a clear and comprehensive policy for a better implementation of FWA policies (Levit, 2018) and, consequently, can support workplace managers, facility managers, and interior designers in the implementation of the most appropriate spatial arrangement.

DIVERSITY OF WORK ACTIVITY

Collaboration Versus Individual Work

Even though FWAs are becoming increasingly widespread, knowledge work is largely centered around meetings where individuals and groups of an organization gather information and share know-how (Kogut & Zander, 1992). During the pandemic, the organizations with the biggest productivity increases were those that supported coaching, mentorship, idea sharing, and co-working among their employees (Alexander et al., 2021). In recent years, studies about collaboration have constantly enriched management literature as the multiple benefits of collaboration are evident: "increased profit through sharing expertise across business units or companies; reduction in costs through sharing best practices; improved decision making through sharing insights and knowledge; innovation through sharing ideas; and an improved ability to pursue goals that involve distributed units or companies" (Patel et al., 2012, p. 1). Despite virtual collaboration gaining popularity, face-to-face (F2F) interactions that require meeting in real space and time are necessary (Augustin, 2014). F2F interactions can occur mainly in three modes: (1) meetings planned and scheduled in advance; (2) on-demand meetings between a few individuals; and (3) chance encounters (Brown, 2008).

> **Due to the pandemic, researchers suggest that remote work has led to gaps in collaboration, leadership, and managerial competencies, whereas experiencing the office physical environment provides a sense of community and belonging.**

Due to the pandemic, researchers suggest that remote work has led to gaps in collaboration, leadership, and managerial competencies, whereas experiencing the office physical environment provides a sense of community and belonging. The commercial real estate service company Jones Lang LaSalle (JLL, 2020a) surveyed more than 2000 office workers around the world and found that 70% of the participants believe the office environment promotes connection with teammates and helps them solve complex issues, manage direct reports, and connect with leadership. Gensler U.S. and U.K. Workplace Surveys during COVID revealed that people working full-time from the office spend nearly twice as much time collaborating compared with those full-time at home (Gensler, 2020a, 2020b).

Clearly, collaborative activities bring benefits to the workplace, but individual tasks are at the core of some job descriptions. Steelcase's (2022) report suggested that employees prefer to do diverse types of work at different locations. Home is preferred for focused work and rejuvenation, whereas the office is favored for meetings, collaboration, and socialization. Gensler (2013) reported an increase between 2008 and 2013 in the percentage of time knowledge workers dedicated to focused work (54% of their average workweek) compared with collaborative work (24% of their average workweek)—with the remaining percentage dedicated to learning, socializing, and other activities. Other studies found that, on a typical working day, the time employees spend fulfilling individual tasks approximately equals the time they are involved in collective activities (Gensler, 2019; Tagliaro & Ciaramella, 2016; Zimmer, 1993). These investigations seem practical to inform FWA policies, workplace strategies, and ABW space planning for more productive and happy employees.

Work Styles and Patterns

In addition to the plethora of literature on collaboration versus individual/focused work, diversity of working modalities has also been extensively covered. Hardy et al. (2008) built an

overview of several work activity patterns existing in most organizations, calling them "workstyles." They recognized three main employee categories: "residents," "internally mobile," and "externally mobile" workers. Each of them was split into further subcategories by different workstyle characteristics: use of owned vs. shared office desks; time in prime office, not at the desk; internal and external physical interaction; dependency on paper files or office systems; and need for mobile or fixed information communication and technology (ICT). Similarly, Greene and Myerson (2011) schematized four principal activity patterns for knowledge workers, from largely sedentary to more mobile: anchor, connector, gatherer, and navigator. They defined these patterns as "character types" and described them also based on networking habits. The characteristic way of working is also reflected in different workplace strategies and layout solutions to accommodate respective activity needs.

Leesman (2017) proposed a categorization of patterns focused on the work activities taking place within the office building. "Campers/squatters," "timid traveler," "intrepid explorers," and "true transients" vary by the number of different work settings and other locations used for work. Twenty-one kinds of activities that workers can engage in were recognized and grouped into five categories: (1) collaboration (collaborating on creative or focused work; informal social interaction or unplanned meetings; learning from others); (2) individual work (individual focused work, desk-based; individual focused work away from your desk; individual routine tasks; reading; thinking/creative thinking); (3) formal meetings (audio conferences; hosting visitors, clients or customers; larger group meetings or audiences; planned meetings; video conferences); (4) conversations (confidential business discussions; private conversations; telephone conversations); and (5) other (relaxing/taking break; spreading out paper or material; using technical/specialist equipment or materials).

Several studies have covered the relationship between work activity patterns and the worker's experience, sometimes with contradictory findings. Leesman (2017) affirmed that the less workers are mobile, the less likely they are to appreciate ABW office design. Indeed, ABW is supposed to serve the needs of flexible workers best. This result contrasts with previous studies, which suggested that the more mobile workers are, the less likely they are to be satisfied with their workspace (Greene & Myerson, 2011). Perhaps, mobile workers are expected to deal with a great variety of work activities, which causes increases in stress and less productivity (Leaman, 2003).

Demographic Factors and Workplace Culture

The information above illustrates the abundance of research focused on work activity patterns and styles at the individual level, yet attention to demographic factors and workplace culture seems to be missing. In particular, none of these investigations acknowledged any differences in work styles between women and men. Interestingly, some studies found that women and men tend to share different interaction patterns in organizations (Brass, 1985; Reskin, 2000), which is likely to affect their respective work activities and the benefit they receive from different workspace arrangements. For instance, women tend to avoid confrontation and disagreement more than men, which reduces their participation in collaborative work activities (Bodin Danielsson & Theorell, 2019). However, most studies on gender and workspace focus primarily on comfort (e.g., indoor environmental quality) and status perception (e.g., given different office layout), whereas specific enquiry on work activity patterns has been left aside (Migliore et al., 2022).

> **The information above illustrates the abundance of research focused on work activity patterns and styles at the individual level, yet attention to demographic factors and workplace culture seems to be missing.**

In addition to demographic factors such as gender, industry norms by business types vary significantly (i.e., workplace culture). Numerous researchers believe that organizational culture and office design are connected and can influence one another (Miller et al., 2014; Schneider & Warnvik, 2018; Turner & Myerson, 1998). However, little is known about how different factors might create a specific workplace culture and strategy. Practices and values are certainly dependent on several factors: supranational (i.e., regional, ethnic, religious, linguistic), national, professional, organizational, group, and individual (Karahanna et al., 2005). The impact of national

culture on workplace design has been addressed in some studies (e.g., Appel-Meulenbroek et al., 2014; Steelcase, 2012; van Meel, 2000). Research confirmed that it influences leadership style (Schein, 1990), personalization (Wells et al., 2007), employee attitudes (Gregory et al., 2008), and other elements that may affect several spatial features. Nevertheless, organizational culture remains an underdeveloped area of investigation for workplace design.

Justification for the Current Study

There are limitations in the investigations mentioned above. First, these work activity patterns define different ways in which employees use the office but do not explain why certain patterns occur. Second, the described models derived from previous observations of people's spatial behavior may have evolved throughout time, especially since the COVID-19 pandemic when many knowledge workers are working remotely. Thus, it is informative to examine work activities with new methods and indicators, such as data about collaboration networks, to better understand how workgroups in large organizations work together. Last, these models mainly illustrate individual work patterns but disregard potential group dynamics that might affect diverse ways of using space. Although both individuals and groups are relevant subjects in the work environment (Kämpf-Dern & Konkol, 2017), most studies have focused on individual work tasks rather than on groups. Work activity difference at the group level is largely unknown. Because knowledge work today is largely based on collaborations and team-oriented projects, exploring the activity patterns at the group level can help identify different groups' spatial needs and propose a space strategy accordingly. Thus, we addressed some of the most common factors related to work activity patterns and proposed two hypotheses to test if there are significant correlations between group job functions, demographics, collaboration networks, and work activity patterns.

> **Because knowledge work today is largely based on collaborations and team-oriented projects, exploring the activity patterns at the group level can help identify different groups' spatial needs and propose a space strategy accordingly.**

HYPOTHESES

JOB FUNCTION

Job function has been one of the most decisive factors to inform workplace design and space planning along with explaining the variance in work activities. The U.S. General Services Administration Office (GSA, 2012) defined specific benchmarks for different office configurations and usable square meters depending on the type of industry (e.g., business services/consulting, telecommunication, manufacturing, government organization, academic institution, manufacturer, media, and business services/consulting) and the job functions (e.g., manager, supervisor, technical, support staff, or clerical/junior staff). Bell and Anderson (1999) recognized 9 job function groups in a case company (e.g., administration, managers, analysts, developers, etc.), summing up to 5 work styles that required 10 different work settings.

However, the same authors also identified a high variance in work styles within a single job function and work settings suggesting that job function might present an over-simplification of how employees actually work. According to JLL's (2020b) research, the criteria to allocate specific workspace to the appropriate staff (i.e., space eligibility) are slowly prioritizing job title and function over band level (i.e., salary and compensation). Job function alone is adopted by only 2% of companies globally among the criteria to determine office eligibility. But together with job title, it is the second most important criterion (reported by 26% of companies), following band level (still reported by 43% of companies). Job title alone is adopted by 11% of companies, other criteria by 4%, whereas 15% of companies have no standards, which may be a consequence of the growing emphasis on productivity across the whole workforce without privileging those at the top of the organizational chart.

While job functions are evolving fast, little empirical research has been dedicated to understanding the composition of various activities in the daily work of different job functions, nor is it clear to what extent job functions predict work activity patterns. Therefore, we examined if there are any associations between job functions and the time spent on different work activities through the following hypotheses:

Hypothesis 1a *Groups in different job functions spend different percentages of time on individual work.*

Hypothesis 1b *Groups in different job functions spend different percentages of time on collaborative work.*

Hypothesis 1c *Groups in different job functions spend different percentages of time on mobile work.*

WORK COLLABORATION NETWORKS

Modern organizations have been encouraging interdisciplinary and inter-functional collaborations aimed at eradicating organizational silos, which can be handled either within the same organizational team (i.e., intra-teamwork) or across different teams (i.e., inter-teamwork). Collaboration and communication are so deeply embedded in contemporary jobs that the time devoted to collaboration between workgroups might not only be explained by job function but also by other structural or demographic factors.

> **Collaboration and communication are so deeply embedded in contemporary jobs that the time devoted to collaboration between workgroups might not only be explained by job function but also by other structural or demographic factors.**

Workgroups, or teams, are the critical relational building blocks of organizations, and how groups interact with each other has gained increasing attention in organizational behavior literature (Lazer & Katz, 2003). Studies have found that formal organization structure and spatial collocation have the most significant impact on the rate of communication at a dyad level (Kleinbaum et al., 2008, 2013). The communication frequency at the individual level was also found to be related to spatial proximity (Allen, 2007; Allen & Gerstberger, 1973; Kabo et al., 2014). Multiple management groups in the same functional unit still work differently based on other reasons such as positions in the whole communication network. It could be assumed that groups engaged in work that requires constant interactions with other groups might spend less time on individual work. However, the relationship between group networks and work activity has not been investigated extensively.

In this study, we examined whether the groups' work activity patterns are related to their connectivity in a work collaboration network (referred to as network connectivity, which is measured by the number of collaborators a group has). The structure of the work collaboration network might explain the involvement of workgroups in collaboration with other groups. This could affect workplace strategies as the need for collocation could determine the most appropriate layout solution rather than basing it merely on job function. Social network analysis, in this case, can support the mapping of collaborative relationships among the workgroups and offer evidence of the association with different work activity patterns. Therefore, we tested if there is a correlation between groups' network connectivity and the time spent on different work activities through the following hypotheses:

Hypothesis 2a *Groups with high network connectivity would be less likely to have a high percentage of individual work time.*

Hypothesis 2b *Groups with high network connectivity would be more likely to have a high percentage of teamwork time, especially for inter-teamwork.*

METHODS

SETTING AND SAMPLE

To explore the abovementioned hypotheses, we conducted a survey at an Italian company that in 2019 asked the authors for support in the definition of workplace requirements for their new headquarters (HQ). This utility company, founded in Milan, Italy, recently expanded in other

cities across Italy and Europe. Its administrative HQ is in Milan and hosts about 800 employees. At the time of this study, the work arrangement was traditional, with low adoption of FWA policies. Workspace layout was traditional as well, with enclosed single or multi-offices distributed along both sides of narrow and dark corridors. The workplace arrangement at the company resembled the characterization of Italian workplaces that Steelcase's (2012) report outlined, where hierarchy, seniority, individuality, and security prevail. However, given that the company was moving its HQ to a new building, their intention was to approach new ways of working by considering the opportunity for FWA and the reorganization of the workspace layout, taking inspiration from Anglo-Saxon and Nordic models of more open, flexible, and collaborative offices.

The company staff are organized into 13 main *Departments* (level 1), each department includes one or more *Groups* (level 2), and the groups are composed of one or more *Teams* (level 3). The size of teams, groups, and departments vary greatly. A sample of managers was selected thanks to the company's team responsible for the project of the new HQ and workplace strategy. The selection was based on a purposive sampling criterion; all managers of the groups and teams moving to the new HQ were included, for a total of 188 managers.

INSTRUMENT AND PROCEDURES

The survey, developed by the authors, consisted of a set of questions that asked for the percentage of time spent on different work activities at the team or group level (depending on the level of the manager). Inspired by Greene and Myerson's (2011) characterization, managers of each group/team were asked to indicate the percentage of time that the group members spent on the following four types of work: individual work, collaborative work performed within their team (intra-teamwork), collaborative work performed with other teams (inter-teamwork), and mobile work.

To collect data for collaboration relationships, the survey asked managers to identify the groups that they collaborate with during work (Krackhardt & Hanson, 1993). In particular, the managers were asked to list: (1) the 10 groups (at level 2) that they collaborated with more often in non-daily activities; and (2) the 4 groups (at level 2) that they undertook daily collaborative work activities with.

The completed questionnaire was initially tested on a group of three human resource managers to verify if any questions were ambiguous or could have been met with resistance (Krackhardt & Hanson, 1993). Only minor adjustments were made to rephrase some questions that could sound unclear to the reader (e.g., we clarified the difference between daily and non-daily collaborative activities). After the required amendments, the finalized questionnaire was distributed via email to the selected population of managers from levels 2 and 3. All 188 managers completed the questionnaire.

DATA ANALYSIS

With the insiders' help, the groups in this organization were categorized into four main job functions: administration, management, operation/IT, and service, following Bell and Anderson's (1999) study. To proceed with data analysis for this study, valid responses from managers at level 3 were aggregated to those from level 2 for a total of 68 groups (level 2). The gender composition of a group was measured in terms of percentage of female employees in a group.

> **With the insiders' help, the groups in this organization were categorized into four main job functions: administration, management, operation/IT, and service…**

The characteristics of the workgroups in the case organization were calculated using the average time spent on different activities, the average age of employees, and the gender composition of the group. Multivariate linear regression was performed to estimate the relationships between independent variables (i.e., job functions, gender, age, and network connectivity) and activity patterns. As a way to operationalize the groups' network connectivity, the groups' in-

Table 1. Characteristics of the groups by job functions ($n = 68$)

	Job functions				
	Administration	Management	Operation/IT	Service	Total
Number of groups	7	27	8	26	68
Average employee age	46.29 (SD = 3.77)	43.59 (5.87)	45.13 (3.64)	45.88 (6.91)	44.93 (5.93)
Female employee %	56.75 (13.32)	47.64 (24.32)	39.35 (26.60)	41.91 (27.35)	45.41 (24.96)
Work activity pattern					
Mobile work %	6.06 (6.67)	19.70 (19.08)	11.98 (11.56)	14.64 (8.40)	15.45 (14.27)
Individual work %	45.48 (6.55)	30.72 (13.62)	25.68 (11.56)	33.26 (17.94)	32.62 (15.32)
Teamwork %	48.46 (6.22)	49.58 (18.86)	62.34 (12.14)	52.10 (15.97)	51.93 (16.39)
Inter-team work %	27.90 (10.42)	25.24 (17.12)	21.93 (7.79)	27.15 (14.79)	26.08 (14.14)
Intra-team work %	20.55 (13.87)	24.34 (12.64)	40.42 (15.11)	24.96 (13.45)	25.85 (14.65)
Network variables					
In-degree (non-daily)	9.02 (7.70)	7.49 (4.40)	7.57 (2.38)	8.30 (4.45)	7.97 (4.59)
In-degree (daily)	4.28 (3.99)	2.57 (1.68)	2.97 (1.42)	3.01 (2.37)	3.01 (2.28)

In-degree centrality refers to how many times the group was nominated by the others in the survey results.

degree centrality was measured for both daily and non-daily collaboration networks. In-degree centrality refers to how many times the group was nominated by the others in the survey results. The in-degree centralities were calculated in software UCINET 6.463. Student's *t*-test was used to compare the time different groups spent on different types of work (individual, team, mobile work).

RESULTS

In total, there were 26 service groups, 27 management groups, 7 administration groups, and 8 operation/IT groups in this organization. Regarding the employee's average age, the four job functions (i.e., administration, management, operation/IT, and service) are homogenous, with ranges between 43 and 46 years old (see Table 1). However, there is a more evident difference in terms of gender composition: administration groups have the largest average percentage of female employees (56.75%), while the operation/IT groups have the least (39.35%).

As illustrated in Table 1, groups in different job functions have different work activity patterns based on the percentage of time spent on mobile, individual, and teamwork. On average, work-groups spent half of their work time (51.93%) on teamwork, whereas about one-third of their work time (32.62%) was devoted to individual work. However, groups belonging to different job functions showed relevant variations in the percentage of time spent on individual, team, and mobile work, which supports the assumption that each job function has a typical work activity pattern. In particular, people in administration stood out from others for the time they spent in individual work (45.48%), people in management for the time spent in mobile work (19.70%), and people in operation/IT for the time spent in teamwork (62.34%)—especially intra-teamwork (40.42%).

For network characteristics, administration groups have the highest in-degree centrality. This might be surprising considering that their job is relatively more individual than the others'; yet their time is mostly devoted to teamwork, especially inter-teamwork. On average, an administration group is nominated as a collaborator 4.28 times for daily work and 9.02 times for non-daily work. The management groups have the lowest in-degree centrality for both daily (2.57) and non-daily (7.49) work collaboration networks. This might be affected by the amount of mobile work, which keeps them physically away from collaborating with their colleagues in the office. The difference in network connectivity across job functions is not statistically significant.

Table 2. Regression models results, individual work % (n = 68)

	M1	M2	M3	M4	M5	M6	M7
Intercept	33.78**	20.25**	11.83	31.61**	34.09**	20.35**	16.34
Job function							
Management	−3.06		−3.02		−4.54		−4.27
Operation/IT	−8.10		−6.62		−8.52*		−6.77
Service	−0.53		0.49		−1.66		−0.41
Age			0.22				0.16
Female %		0.27**	0.26**			0.26**	0.24**
In-degree (non-daily)				0.83	1.14	0.51	0.78
In-degree (daily)				−1.72	−2.87*	−1.27	−2.18
R^2	.11	.20	.28	.03	.017	.21	.32

For job function, administration is set as the reference group. M refers to the regression models.
*$p < .05$.
**$p < .01$.

The results of multivariate linear regression are summarized in Tables 2–6. The administration group has been set as a reference for when the job function is regressed as a categorical variable.

For individual work time, there is a difference between groups in different job functions. On average, administration groups have the highest percentage of individual work time (45.48%), while the operation/IT groups have the least amount (25.68%), as shown in Table 1. Results of Student's t-test suggest that, on average, administration groups reported significantly more time spent on individual work than operative/IT groups $t(11) = 4.14$, $p < .05$, and management groups $t(20) = 4.09$, $p < .05$. Thus, we found significant statistical evidence to support Hypothesis 1a, namely that *groups in different job functions spend different percentages of time on individual work*.

However, the results of regression models in Table 2 indicated that job function is not a significant predictor for the percentage of individual work time. Instead, the results suggest that gender composition is the best predictor: groups with more female employees will spend more time on individual work. The network variables do not explain a significant amount of variance of the result ($R^2 = .03$ in M4) so that there is no statistical evidence supporting Hypothesis 2a, namely that *groups with high network connectivity would be less likely to have a high percentage of individual work time*. This is in fact demonstrated by the administration groups, which are more "individualistic" than others but strongly connected. This might depend on the fact that their job is in support for others (indeed, the inter-teamwork component is stronger than the intra-teamwork component), while still being mostly performed as solo-work. One might interpret this as a "one-direction" connectivity, meaning that collaboration in this case entails information sharing (e.g., learning from others) rather than co-creation of ideas and social interactions.

For the time dedicated to teamwork, there is a slight difference between groups in different job functions. On average, operation/IT groups have the highest percentage of teamwork time (62.34%), while the administration groups have the least amount (48.46%), as shown in Table 1. Results of Student's t-test suggest that there is no significant difference between each pair of job function groups regarding the percentage of time spent on teamwork. Thus, we did not find significant statistical evidence to support Hypothesis 1b, namely that *groups in different job functions spend a different percentage of time on collaborative work*.

The regression analysis results in Table 3 showed that its variance among the groups is highly correlated with network variables. In contrast, job function (M1) and gender composition

Table 3. Regression models results, teamwork % (n = 68)

	M1	M 2	M 3	M4	M 5	M6	M7
Intercept	53.12**	57.01**	71.45	54.67**	54.36**	58.12**	67.38**
Job function							
Management	−3.54		−3.91		−1.47		−1.90
Operation/IT	9.22		8.50		9.73		9.26*
Service	−1.02		−1.26		0.71		0.51
Age			−0.30				−0.23
Female %		−0.11	−0.10			−0.08	−0.06
In-degree (non-daily)				−1.78**	−1.90**	−1.67*	−1.81**
In-degree (daily)				3.80**	4.25**	3.65**	4.01**
R^2	.06	.03	.09	.13	.20	.14	.21

For job function, administration is set as the reference group. M refers to the regression models.
*$p < .05$.
**$p < .01$.

Table 4. Regression models results, inter-team work % (n = 68)

	M1	M 2	M 3	M4	M 5	M6	M7
Intercept	25.55**	28.19**	53.51**	24.65**	23.56**	26.20**	47.34**
Job function							
Management	−0.31		−1.12		1.39		0.49
Operation/IT	−3.63		−4.16		−3.08		−3.51
Service	1.59		1.65		2.76		2.77
Age			−0.55				−0.47
Female %		−0.05	−0.07			−0.04	−0.04
In-degree (non-daily)				−0.93	−1.01	−0.88	−0.95
In-degree (daily)				2.85*	3.07*	2.79*	2.76*
R^2	.01	.00	.07	.09	.10	.09	.14

For job function, administration is set as the reference group. M refers to the regression models.
*$p < .05$.
**$p < .01$.

(M2) alone do not explain much of the variance of teamwork time percentage between the groups. Daily collaboration in-degree centrality, in particular, is significantly correlated with the percentage of time spent on teamwork, as shown in M4. Non-daily collaboration in-degree centrality shows a negative correlation with teamwork.

When investigating teamwork in more detail, daily collaboration in-degree centrality significantly predicted the percentage of time spent on inter-teamwork, as shown in M7 of Table 4. Intra-teamwork time, instead, is significantly different between administration teams and operation/IT teams, as shown in Table 5. Indeed, intra-teamwork is the work activity that best characterized operation/IT work (see Table 1).

In summary, groups with higher daily collaboration in-degree centrality reported a larger percentage of time spent on both inter-teamwork and teamwork in general, supporting Hypothesis 2b, namely that *groups with high network connectivity would be more likely to have a high percentage of teamwork time, especially for inter-teamwork*.

Table 5. Regression models results, intra-team work % (n = 68)

	M1	M 2	M 3	M4	M 5	M6	M7
Intercept	27.57**	28.83**	17.94**	30.02**	30.80**	31.93**	20.04**
Job function							
Management	−3.22		−2.79		−2.86		−2.39
Operation/IT	12.85**		12.66**		12.80**		12.77**
Service	−2.61		−2.91		−2.0		−2.25
Age			0.24				0.24
Female %		−0.06	−0.03			−0.05	−0.01
In-degree (non-daily)				−0.85	−0.89	−0.79	−0.87
In-degree (daily)				0.94	1.19	0.86	1.25
R^2	.15	.001	.16	.04	.18	.04	.19

For job function, administration is set as the reference group. M refers to the regression models.
**p < .01.

Table 6. Regression models results, mobile work % (n = 68)

	M1	M 2	M 3	M4	M 5	M6	M7
Intercept	13.09**	22.73**	16.68	14.16**	11.54	21.52**	16.27
Job function							
Management	6.60*		6.93*		6.02*		6.17*
Operation/IT	−1.11		−2.23		−1.20		−2.50
Service	1.54		0.77		0.95		−0.11
Age			0.08				0.07
Female %		−0.16*	−0.16*			−0.18**	−0.18**
In-degree (non-daily)				0.94	0.76	1.16*	1.03
In-degree (daily)				−2.07	−1.38	−2.38*	−1.83
R^2	.09	.08	.17	.05	.11	.15	.21

For job function, administration is set as the reference group. M refers to the regression models.
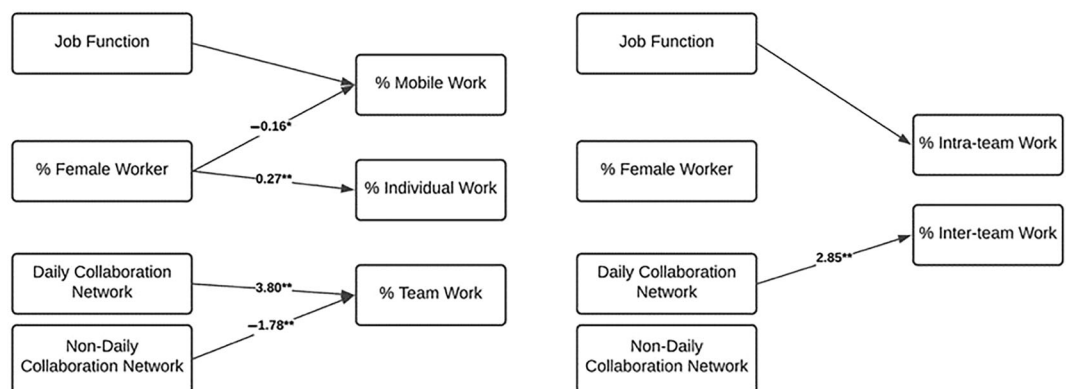*p < .05.
**p < .01.

FIGURE 1 Summary of findings.

Table 6 shows complex results about mobile work time. Results of the Student's t-test suggest that there is a significant difference between management groups (19.70%) and administration groups (6.06%) regarding the percentage of time spent on mobile work, $t(28) = 3.06$, $p < .05$.

Therefore, we found significant statistical evidence to support Hypothesis 1c, namely that *groups in different job functions spend different percentages of time on mobile work*. We also noticed that job function (in particular for management groups) and gender composition are significantly correlated with the groups' time spent on mobile work activity. First, management groups have a significantly higher percentage of time spent on mobile work than the administration groups. Second, groups that have more female employees have less percentage of time spent on mobile work. The in-degree centrality was not significantly correlated with the percentage of time spent on mobile work.

As summarized in Figure 1, these results showed that individual work is mostly predicted by gender, whereas teamwork is mostly predicted by collaboration networks. In particular, the group's connectivity in daily collaboration network is relevant to the percentage of time spent on inter-teamwork.

DISCUSSION

WORK ACTIVITY PATTERN BASED ON JOB FUNCTION

The results from this study are useful for informing and differentiating a number of workplace strategies and design solutions based on job functions and collaboration networks. Our data suggested that, on average, workgroups spent half of their work time on teamwork, and about one-third of their work time on individual work. These results indicated that teamwork was the major form of work activity for the employees in this organization before the pandemic, which seems different from what was found in other case studies where time spent on teamwork and individual work was approximately the same (Tagliaro & Ciaramella, 2016). This difference in the findings stresses the importance of a bespoke approach to work activity patterns, as generalizations might not be accurate.

> **Our data suggested that, on average, workgroups spent half of their work time on teamwork, and about one-third of their work time on individual work.**

The results also suggested that groups in different job functions tend to vary in the percentage of time spent on different work activities. To our knowledge, this study is the first in the field of workplace design and management to analyze in-depth job functions based on work activity patterns. On average, management groups spent significantly more time on mobile work and less time on individual work than the administration groups. The operation/IT groups spent significantly less time on individual work than the administration groups.

Thus, job function might indeed be a significant factor related to the difference in activity patterns, and therefore might help determine a group's space needs. As noted by JLL (2020b), job function provides information to determine space allocation standards and proves valuable to indicate ABW office design solutions. For example, if space is designed for a management group, it is likely that these employees will utilize that space with low frequency, given that they spend a percentage of time in mobile work. Even though managers are often assigned to proprietary desks and cubicles (GSA, 2012), hot-desking policies could be appropriate for such job functions. Perhaps the ratio between employees and desks can be smaller than 1:1, in favor of bookable spaces for particular needs (e.g., private or formal meetings).

WORK COLLABORATION NETWORKS: COLLABORATIVE SPACES AND TOOLS

The results also showed that groups with a high network connectivity are more likely to have a larger percentage of time spent on teamwork, especially for inter-teamwork. Thus, previous workspace arrangements based exclusively on job function may have limitations, as job function alone explains neither the amount of time spent on individual work nor the time spent on teamwork and its variety.

Understanding how much time groups spend on teamwork for daily and non-daily collaborations helps identify the user's needs for collaborative space, technology, and allocation of different functional zones. To illustrate, groups at the center of the collaboration network are likely to

need appropriate technology and physical space to facilitate teamwork, including meeting rooms, equipment for virtual collaboration, open meeting areas, and more. These groups might be less suitable than others for flexible work or hot-desking policies, as they would benefit from collocation with collaborators. Specific digital solutions might be needed to support the collaboration between on-site and off-site groups.

GENDER COMPOSITION: FWA AND SPACE LAYOUT

The results of this study found that gender composition is the best predictor for the percentage of individual work time, that is, groups with more female employees spend more time on individual work but less time on mobile work. This might indicate that FWA can be adopted to support female workers completing their individual work remotely if allowed by management policies. Indeed, individual work typically entails concentration, which can be achieved at home, and company reports suggest that employees prefer to do focused work there (Gensler, 2013; Steelcase, 2022). When in the office, concentrative work can be performed at best in sheltered places such as study rooms or private enclosed offices. Nevertheless, individual work entails distinct tasks, including desk-based focused work, focused work away from the desk, routine tasks, reading, and thinking/creative thinking (Leesman, 2017), each of which requires a different work environment. Therefore, workplace designers should consider the type of individual work performed and arrange enclosed spaces accordingly.

> **…additional data are needed to explain why groups with more female employees spend more time on individual work but less time on team and mobile work.**

Our data about work activity patterns before the pandemic also disclosed that mobile work did not constitute a significant percentage of work time for groups in this organization. It was a more common mode of work for groups in management, but the groups with a larger percentage of female workers had significantly less chance to work in this way. Flexibility in work can help alleviate work–life conflict (Kim & Gong, 2017), yet female workers in this organization do not seem to be reaping the benefit. This unequal application in groups with different gender compositions might suggest structural inequality in FWA policy design, especially before the pandemic, which could also depend on the hierarchy, seniority, individuality, and security attitudes that prevail in Italian workplaces, as highlighted by previous research (Steelcase, 2012). Clearly, additional data are needed to explain why groups with more female employees spend more time on individual work but less time on team and mobile work. According to some research, women tend to avoid confrontation and disagreement more than men, which may reduce their participation in collaborative work activities (Bodin Danielsson & Theorell, 2019). Encouraging FWA and sheltered spaces in the office might exacerbate this tendency. This finding calls for future studies about work activities and collaboration practices focusing on gender differences.

REFLECTIONS ON THE COVID-19 PANDEMIC

We acknowledge that by the time this manuscript is published, the COVID-pandemic may not have ended, and its impact on occupants' experience in a more flexible working environment such as ABW offices may still be unclear. Thus, comparing work experiences and how work time was distributed to different activities before and during the pandemic will be an interesting topic for future studies (e.g., Tagliaro & Migliore, 2021). Moreover, as remote working is likely to continue (Steelcase, 2022), expanding research on which type of workspace arrangement best suits each work style would be important, especially given the contrasting results reported in previous studies before the pandemic (e.g., Greene & Myerson, 2011; Leaman, 2003; Leesman, 2017).

Based on the current estimation that the pandemic will not end soon, managing space density in the physical workspace will continue to be important during the near- to medium-term stage of the post-pandemic era. If returning to office work is a major trend in the future, deciding which groups should have priority to work in the physical office space will be a critical question for organizations to answer. In this case, the necessity of a physical workspace to support work needs should be considered in the companies' office space restart plan. If the largest benefit of

F2F interaction is facilitating communication and collaboration, the groups that spend the most time working in a team might benefit from F2F interaction in a physical office environment. As per the present study, workgroups located more centrally in the collaboration network spent a significantly larger percentage of time on teamwork, making them more suitable for returning to the office space earlier. Tracing collaboration networks may prove a valuable alternative or complementary information to infer activity patterns, besides observing how people use the office through more traditional techniques such as those applied in previous studies (e.g., Greene & Myerson, 2011; Hardy et al., 2008; Leesman, 2017).

CONCLUSIONS

We discussed whether work activity patterns differ between groups, which factors at the group level are associated with this difference, and how to explain the variance in work activity patterns between groups in the same organization. The findings from our study on an Italian company suggest that work activity patterns differ not only at the individual employee level, as previous literature confirms, but also at the group level. The main factors associated with this difference are work collaboration network, gender composition, and job function. Groups tend to perform more individual work when they are composed of a larger percentage of women employees. Teamwork depends on the connectivity in the collaboration network of groups. The percentage of mobile work depends on job function (i.e., management groups) and non-daily collaboration network.

We also noticed that in our case organization, the percentage of time spent in teamwork exceeds the percentage of time spent in individual work. Groups in different job functions tend to spend a different percentage of time working on mobile and individual work. Groups' differences in work activity pattern are also related to the work collaboration network in the organization. For predicting teamwork, especially inter-teamwork, collaboration network connectivity plays a more important role instead of merely observing job function. Thus, in addition to the job function, collaboration networks among workgroups should also be considered for understanding different work activity patterns between groups, especially for teamwork.

> **…in addition to the job function, collaboration networks among workgroups should also be considered for understanding different work activity patterns between groups, especially for teamwork.**

This research is the first to identify work activity patterns at the group level and by job function in a quantitative way. This information is useful for determining hot-desking policies, needs for collaborative spaces and tools, FWA, and layout choices. In general, future programming and management of ABW design can be supported by our results, especially in the wake of the COVID-19 pandemic, for workplace policies are increasingly decided based on people's necessity to physically go to the office. We found that examining job function differences and work collaboration networks helps inform workplace policies, which still tend to rely on hierarchical criteria, headcount, and available space (JLL, 2020b). Finally, these findings stress the necessity of transdisciplinary collaborations in workplace design. Information typically retained by the human resources departments, such as collaboration networks, might be crucial for architects, interior designers, and facility managers to define design solutions.

LIMITATIONS AND FUTURE WORK

The generalizability of this study is limited by the relatively small sample size and that it represents one company. Moreover, the surveyed sample is based in Italy, which could reflect culture-specific approaches to work, including gender issues, that may be less common in other branches of the company abroad or in other international organizations. As Kampschroer et al. (2007) pointed out, findings should only be applied while considering each specific organizational context. We encourage further research to produce more generalizable data on this topic.

The information on the type of work performed by groups was self-reported by managers based on their perception of how people operate in their teams. While this offers aggregated

information, which is valuable to understand activity patterns at a group level, it may be slightly inaccurate. Ideally, this study could have been enriched with a second questionnaire administered to the individuals in each team. This would allow collection of other valuable insights: (1) to what extent work activities in a team are homogenous and (2) whether the perception of the team manager is accurate or distorted. In addition to survey-based collaboration network data, secondary datasets (such as emails or other records) might help identify whether a group locates at the center of the daily collaboration network.

It is also worthy to note that although statistically significant predictors were identified in the data analysis, the R^2 results are comparatively small in our regression models. To better understand the changes in work so that space design can adapt accordingly, we argue that more quantitative and qualitative results are necessary to verify and explain work character types. Future research can explore different regression models or other factors (such as industry, workplace culture, etc.) to explore which factor best predicts employees' work activity patterns.

Finally, a work collaboration network can inform new ways of categorizing workers. Cluster analyses could be performed to understand whether categories based on groups' in-degree centrality are more effective in predicting work activity patterns than more traditional categories based on job function. If offices are going to accommodate collaborative tasks in the post-pandemic era, how office space can support teamwork is a timely topic. Information about group work activity patterns with new indicators and techniques, in this case, can potentially contribute to future workplace design and management.

ENDNOTES

[1] https://www.oecd.org/about/.

[2] These also include the United Kingdom, as the study preceded Brexit. As of today, the European Union is made of the following 27 countries: Austria, Belgium, Bulgaria, Croatia, Republic of Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, and Sweden.

REFERENCES

Alexander, A., Cracknell, R., De Smet, A., Langstaff, M., Mysore, M., & Ravid, R. (2021). *What executives are saying about the future of hybrid work*. McKinsey & Company https://www.mckinsey.com/business-functions/people-and-organizational-performance/our-insights/what-executives-are-saying-about-the-future-of-hybrid-work

Allen, T. J. (2007). Architecture and communication among product development engineers. *California Management Review*, 49(2), 23–41. https://doi.org/10.2307/41166381

Allen, T. J., & Gerstberger, P. G. (1973). A field experiment to improve communications in a product engineering department: The non-territorial office. *Human Factors*, 5(5), 487–498. https://doi.org/10.1177/001872087301500505

Appel-Meulenbroek, R., Groenen, P., & Janssen, I. (2011). An end-user's perspective on activity-based office concepts. *Journal of Corporate Real Estate*, 13(2), 122–135. https://doi.org/10.1108/14630011111136830

Appel-Meulenbroek, R., Kemperman, A., Liebregts, M., & Oldman, T. (2014). Helping corporate real estate management with the implementation of a modern work environment that supports employees and their activities: An analysis of different preferences in 5 European countries. In *21st Congress of the European Real Estate Society* (ERES 2014), 25–28 June 2014 (pp. 1–24). Bucharest, Romania.

Augustin, S. (2014). Designing for collaboration and collaborating for design. *Journal of Interior Design*, 39(1), iv-xviii. https://doi.org/10.1111/joid.12020

Babapour, M., Karlsson, M., & Osvalder, A. L. (2018). Appropriation of an activity-based flexible office in daily work. *Nordic Journal of Working Life Studies*, 8(S3), 71–94. https://doi.org/10.18291/njwls.v8iS3.105277

Becker, F. (1993). Workscape 21: The ecology of new ways of working. *Journal of Interior Design*, 19(1), 43–46. https://doi.org/10.1111/j.1939-1668.1993.tb00152.x

Bell, S. M., & Anderson, M. (1999). Workplace solutions. *Journal of Corporate Real Estate*, 1(4), 349–360. https://doi.org/10.1108/14630019910811132

Belle, S. M., Burley, D. L., & Long, S. D. (2015). Where do I belong? High-intensity teleworkers' experience of organizational belonging. *Human Resource Development International*, 18(1), 76–96. https://doi.org/10.1080/13678868.2014.979006

Blair-Loy, M. (2009). *Competing devotions: Career and family among women executives*. Harvard University Press.

Bodin Danielsson, C., & Theorell, T. (2019). Office employees' perception of workspace contribution: A gender and office design perspective. *Environment and Behavior*, 51(9–10), 995–1026. https://doi.org/10.1177/0013916518759146

Brass, D. J. (1985). Men's and women's networks: A study of interaction patterns and influence in an organization. *The Academy of Management Journal*, 28(2), 327–343. https://doi.org/10.2307/256204

Brown, G. (2008). Proximity and collaboration: Measuring workplace configuration. *Journal of Corporate Real Estate*, 10(1), 5–26. https://doi.org/10.1108/14630010810881630

Duffy, F., Jaunzens, D., Laing, A., & Willis, S. (2003). *New environments for working*. Taylor & Francis.

Engelen, L., Chau, J., Young, S., Mackey, M., Jeyapalan, D., & Bauman, A. (2019). Is activity-based working impacting health, work performance and perceptions? A systematic review. *Building Research & Information*, 47(4), 468–479. https://doi.org/10.1080/09613218.2018.1440958

Gensler. (2013). *2013 U.S. workplace survey*. *Key findings*. https://www.gensler.com/uploads/document/337/file/2013_US_Workplace_Survey_07_15_2013.pdf.

Gensler. (2019). *Germany workplace survey* 2019. https://www.gensler.com/gri/germany-workplace-survey-2019.

Gensler. (2020a). *U.K. workplace survey*. https://www.gensler.com/uploads/document/739/file/Gensler-UK-Workplace%20Survey-2020.pdf.

Gensler. (2020b). *U.S. workplace survey*. https://www.gensler.com/uploads/document/740/file/Gensler-US-Workplace-Survey-Summer-Fall-2020.pdf.

Golden, T. D. (2009). Applying technology to work: Toward a better understanding of telework. *Organization Management Journal*, 6(4), 241–250. https://doi.org/10.1057/omj.2009.33

Greene, C., & Myerson, J. (2011). Space for thought: Designing for knowledge workers. *Facilities*, 29(1/2), 19–30. https://doi.org/10.1108/02632771111101304

Gregory, B. T., Harris, S. G., Armenakis, A. A., & Shook, C. L. (2008). Organizational culture and effectiveness: A study of values, attitudes, and organizational outcomes. *Journal of Business Research*, 62(7), 673–679. https://doi.org/10.1016/j.jbusres.2008.05.021

GSA. (2012). *Workspace utilization and allocation benchmark*. U.S. General Services Administration Office of Government wide Policy. https://www.gsa.gov/cdnstatic/Workspace_Utilization_Banchmark_July_2012_%281%29.pdf.

Hammer, L. B., Neal, M. B., Newsom, J. T., Brockwood, K. J., & Colton, C. L. (2005). A longitudinal study of the effects of dual-earner couples' utilization of family-friendly workplace supports on work and family outcomes. *Journal of Applied Psychology*, 90(4), 799–810. https://doi.org/10.1037/0021-9010.90.4.799

Hardy, B., Graham, R., Stansall, P., White, A., Harrison, A., Bell, A., & Hutton, L. (2008). *Working Beyond Walls: The Government Workplace as an Agent of Change*. Office of Government Commerce. http://www.placemaking.co.uk/wp-content/uploads/2020/03/workingbeyondwalls.pdf.

Hirsch, E. (2012). *Cultural change, technological advances aid telework*. SHRM. https://blog.shrm.org/workforce/cultural-change-technological-advances-aid-telework.

H.R. 4219. (2017). *Workflex in the 21st century act*. https://www.congress.gov/bill/115th-congress/house-bill/4219.

JLL. (2020a). *Reimagining human experience*. *How to embrace the new work-life priorities and expectations of a liquid workforce*. https://www.jll.co.uk/content/dam/jll-com/documents/pdf/research/jll-reimagining-human-experience-11-2020.pdf.

JLL. (2020b). *Space eligibility and standards*. https://images.hello.jll.com/Web/JLLAmericas/%7Ba0381bbc-1273-4efd-910b-d16bdbfdd7f0%7D_jll-global-2020-op-benchmarking-report-design-space-eligibility-and-standards.pdf.

Kabo, F. W., Cotton-Nessler, N., Hwang, Y., Levenstein, M. C., & Owen-Smith, J. (2014). Proximity effects on the dynamics and outcomes of scientific collaborations. *Research Policy*, 43(9), 1469–1485. https://doi.org/10.1016/j.respol.2014.04.007

Kampschroer, K., Heerwagen, J., & Powell, K. (2007). Creating and testing workplace strategy. *California Management Review*, 49(2), 119–137. 10.2307%2F41166386

Kämpf-Dern, A., & Konkol, J. (2017). Performance-oriented office environments—Framework for effective workspace design and the accompanying change processes. *Journal of Corporate*

Real Estate, 19(4), 208–238. https://doi.org/10.1108/JCRE-03-2017-0009

Karahanna, E., Evaristo, J. R., & Srite, M. (2005). Levels of culture and individual behavior: An integrative perspective. *Journal of Global Information Management*, 13(2), 1–20.

Kim, H., & Gong, Y. (2017). Effects of work–family and family–work conflicts on flexible work arrangements demand: A gender role perspective. *The International Journal of Human Resource Management*, 28(20), 2936–2956. https://doi.org/10.1080/09585192.2016.1164217

Kleinbaum, A. M., Stuart, T., & Tushman, M. L. (2008). *Communication (and coordination?) in a modern*, *complex organization*. Harvard Business School.

Kleinbaum, A. M., Stuart, T. E., & Tushman, M. L. (2013). Discretion within constraint: Homophily and structure in a formal organization. *Organization Science*, 24(5), 1316–1336. https://doi.org/10.1287/orsc.1120.0804

Kogut, B., & Zander, U. (1992). Knowledge of the firm, combinative capabilities, and the replication of technology. *Organization Science*, 3(3), 301–441.

Krackhardt, D., & Hanson, J. R. (1993). Informal networks: The company behind the chart. *Harvard Business Review*, 71(4), 104–111.

Lazer, D., & Katz, N. (2003). *Building effective intra-organizational networks: The role of teams*. MIT Center for Public Leadership Working Paper Series, 3(3). https://dspace.mit.edu/handle/1721.1/55801.

Leaman, A. (2003). User needs and expectations. In R. J. Cole & R. Lorch (Eds.), *Buildings, culture and environment* (pp. 154–176). Blackwell.

Leesman. (2017). *The rise and rise of activity based working*. *Reshaping the physical, virtual and behavioural workspace*. http://www.leesmanindex.com/The_Rise_and_Rise_of_Activity_Based_Working_Research_book.pdf.

Leonard, B. (2013). *Study examines benefits of telework*. SHRM https://www.shrm.org/ResourcesAndTools/hr-topics/technology/Pages/Study-Examines-Benefits-of-Telework.aspx

Levit, A. (2018). *How to create and manage an effective flexwork policy*. SHRM https://www.shrm.org/resourcesandtools/hr-topics/benefits/pages/how-to-create-and-manage-an-effective-flexwork-policy.aspx

Miller, R., Casey, M., & Konchar, M. (2014). *Change your space, change your culture: How engaging workspaces lead to transformation and growth*. Wiley.

Migliore, A., Rossi-Lamastra, C., & Tagliaro, C. (2022). Are workspaces gender neutral? A literature review and a research agenda. *Building Research and Information*. https://doi.org/10.1080/09613218.2022.2087172

Munsch, C. L. (2016). Flexible work, flexible penalties: The effect of gender, childcare, and type of request on the flexibility bias. *Social Forces*, 94(4), 1567–1591. https://doi.org/10.1093/sf/sov122

OECD. (2020). *Productivity gains from teleworking in the post COVID-19 era: How can public policies make it happen?* https://www.oecd.org/coronavirus/policy-responses/productivity-gains-from-teleworking-in-the-post-covid-19-era-a5d52e99/.

Patel, H., Pettitt, M., & Wilson, J. R. (2012). Factors of collaborative working: A framework for a collaboration model. *Applied Ergonomics*, 43(1), 1–26. https://doi.org/10.1016/j.apergo.2011.04.009

PwC. (2021). *It's time to reimagine where and how work will get done*. PwC's US Remote Work Survey. https://www.pwc.com/us/en/library/covid-19/us-remote-work-survey.html.

Reskin, B. F. (2000). Getting it right: Sex and race inequality in work organizations. *Annual Review of Sociology*, 26(1), 707–709. https://doi.org/10.1146/annurev.soc.26.1.707

Schein, E. H. (1990). Organizational culture. *American Psychologist*, 45(2), 109–119.

Schneider, M., & Warnvik, L. (2018). *The impact of organizational culture and office design on innovation and motivation* [Master's thesis, Jönköping International Business School]. http://www.diva-portal.org/smash/get/diva2:1213436/FULLTEXT01.pdf

Shockley, K. M., & Allen, T. D. (2010). Investigating the missing link in flexible work arrangement utilization: An individual difference perspective. *Journal of Vocational Behavior*, 76(1), 131–142. https://doi.org/10.1016/j.jvb.2009.07.002

Smith, D. C., Bitner, D., & Thorpe, K. (2021). *U.S. office sector. FAQs: Has the tide turned yet?* Cushman & Wakefield https://cw-gbl-gws-prod.azureedge.net/-/media/cw/americas/united-states/insights/research-report-pdfs/2021/office-leasing-faq-final_1221.pdf?rev=7008b3cfcd874c56b283be2e6eed6ee9&hash=25F73F44B9B8BA853F20D40069BAA093

Soriano, A. W., Kozusznik, M., Peiró, J. M., & Mateo, C. (2020). The role of employees' work patterns and office type fit (and misfit) in the relationships between well-being and performance. *Environment and Behavior*, 52(2), 111–138. https://doi.org/10.1177/0013916518794260

Steelcase. (2012). *Culture code. Leveraging the workplace to meet today's global challenges* 360°, Issue 65. https://www.steelcase.com/

content/uploads/2014/03/360Magazine-Issue65.pdf.

Steelcase. (2022). *The new era of hybrid work: It's time to give people what they want*. https://www.steelcase.com/content/uploads/2022/03/2022_SC_GlobalReport_Final.pdf.

Tagliaro, C., & Ciaramella, A. (2016). Experiencing smart working: A case study on workplace change management in Italy. *Journal of Corporate Real Estate*, 18(3), 194–208. https://doi.org/10.1108/JCRE-10-2015-0034

Tagliaro, C., & Migliore, A. (2021). "Covid-working": What to keep and what to leave? Evidence from an Italian company. *Journal of Corporate Real Estate*, 24(2), 76–92. https://doi.org/10.1108/JCRE-10-2020-0053

Turner, G., & Myerson, J. (1998). *New workspace, new culture: Office design as a catalyst for change*. Gower Publishing.

van Meel, J. (2000). *The European office. Office design and national context*. 010 Publishers.

Wells, M. M., Thelen, L., & Ruark, J. (2007). Workspace personalization and organizational culture does your workspace reflect you or your company? *Environment and Behavior*, 39(5), 616–634. https://doi.org/10.1177/0013916506295602

What a way to make a living. (2020). *The Economist*, (pp. 18–20).

Williams, J. (2001). *Unbending gender: Why family and work conflict and what to do about it*. Oxford University Press.

Zimmer, L. (1993). POEs and prototypes: Post-occupancy evaluations comparing two prototypical flexible group work spaces in open office. *Journal of Interior Design, Education and Research*, 18(1&2), 25–33. https://doi.org/10.1111/j.1939-1668.1993.tb00069.x

BIOGRAPHIES

Chiara Tagliaro, Ph.D., is an architect by education and obtained her doctoral degree with a thesis on Key Performance Indicators for Strategic Design, Management, and use of the Workplace. She is now a researcher in the Real Estate Center (REC) of Politecnico di Milano. She investigates new ways of working and their impacts on people and the built environment with the aim to develop new strategies and innovative tools to drive workers, organizations, and cities toward a more sustainable future.

Yaoyi Zhou, Ph.D., is as an Assistant Professor of Interior Design in the School of Architecture + Design at Virginia Tech. His research focuses on the emerging design concepts and the impacts on the building occupants' social interaction and other behavioral outcomes. He also serves as a board member of the Transdisciplinary Workplace Research (TWR) network.

Ying Hua, Ph.D., is an Associate Professor in the Cornell Department of Design and Environmental Analysis and Director of the Cornell China Center. Dr. Hua leads the International Workplace Studies Program (IWSP) with both research and consulting work. Her research addresses design and management challenges across multiple phases of project life-cycle, with a particular interest in future work and workplace in the United States, Japan, and China.