

# Spatial solutions supporting information exchange and knowledge creation

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## Abstract

Architectural practice is a creative, knowledge-based organization, and therefore information exchange and knowledge creation are essential components of architects' profession. However, these aspects of architectural practice are not studied widely. The objective of this study is to analyse how the mobility of the different types of workers' effects on the information exchange and knowledge creation in a team-based office layout. The research material was collected from a semi-large Finnish architecture office. The methods employed are qualitative: theme interviews with the employees and the executives of the office, together with the informal on-site observations.

The preliminary analysis of the research material indicates that the team-based office layout supported tacit knowledge exchange and creative group work. The team rooms, however, did not support the individual working preferences of the participants. Furthermore, the tacit knowledge remained inside the team and did not spread through the whole organization. Therefore, as a downside, the team-based working inhibited the information exchange and knowledge creation between different teams.

## Introduction

Knowledge in its various forms has become the most valuable asset in modern organizations and societies (Chatzkel, 2003; Brooking, 1996; Grant, 1996; Mclver

et al., 2013). The ability to mobilize and harness knowledge has been on the special agenda of researchers and practitioners from the late 20th throughout the 21st century, but it was already in 1939 when Robert S. Lynd, for instance, pointed out that people need to build their organisations so that knowledge flows freely to create opportunities and solve problems. Therefore, knowledge and its importance in work life is not a sudden insight, but a view that needs reconsideration time after time.

The study by Winch and Schneider (1993) defines architectural practice as a knowledge-based organisation. The distinctive characters of knowledge-based organisations are that they sell intangible service, which varies from client to client, and this service cannot be stored. In other words, the expertise of the staff, and their ability to provide promised service, is the main “product” to trade for knowledge-based organisation (Winch & Schneider, 1993).

Furthermore, architectural practice is a creative organisation. (Martens 2011; Winch and Schneider 1993) The creative process includes different stages and creative behaviour is also perceived in different ways (Martens, 2011). The possibility for interaction, the reflection of work, knowledge sharing and coordinating work are considered important for supporting creative interaction (Martens 2011). Hence, facilitating creativity in workplace requires various spatial configurations according to the activity, the stage of the creative process and personal preferences (Martens 2011, Gibson 2003) and knowledge worker type (Greene and Meyerson, 2011). Therefore, it is essential to identify different types of knowledge workers in the creative organization in order to respond to their spatial requirements.

Architects learn and transfer knowledge about their work procedures mainly by doing, because a great deal of architect’s profession includes tacit and “intuitive” knowledge. (Schön, 1983; Styhre, 2011) According to Schön (1983) this kind of knowledge reveals itself in actions, recognitions and judgments, which architects can carry out spontaneously. Furthermore, architects can rarely specify how they have learned to do certain things in their professional practice; they just simply do them (Schön, 1983). Moreover, the tacit components of the work are difficult to communicate to colleagues as well as external stakeholders (Styhre, 2011). In the process of design, an architect reflects the situation or the design problem, by exploring different solutions (Schön, 1983). In addition to visual aids, architects explain and discuss the design ideas and concepts with their colleagues. However, these discussions often derive from visual references, which support the verbal communication. (Schön, 1983; Styhre, 2011) Under these circumstances, face-to-face contacts in architects’ profession are important in considering the transfer of “intuitive” knowledge and tacit components of the works.

In other words, information exchange and transfer of tacit knowledge are essential components of architectural practice. Therefore, also the layout of the architectural office should support these different perspectives of work. This article focuses on architectural profession and work practices, and ponders on how the office layout of an architecture office supports information exchange and knowledge creation in relation to different types of knowledge workers.

The study aims to answer two following questions: RQ1) Which different mobility types of office workers can be identified among the participants? RQ2) How the mobility of the different types of workers affects on the information exchange and knowledge creation within the office?

The paper is structured as follows. First, drawing in relevant literature, the concepts of information and knowledge, more precisely the knowledge creation process and its relation to spatial solutions, are discussed. This is followed by literature on how different types of knowledge workers and their mobility effect on office layout and spatial solutions. Secondly, the detailed methodology of our study is presented. Thirdly, the results are discussed in relation to the theory: we

identify different types of knowledge workers and analyse how the case study office layout supports their mobility. Furthermore, we discuss what kind of impact the mobility of the workers has on the information exchange and knowledge creation. Finally, concluding remarks and recommendations for the further research are made.

## THEORETICAL FRAMEWORK

### The knowledge creation process

The concepts of information and knowledge tend to mingle or be used as synonyms in colloquial language, whereas in academia they are distinguished and defined differently. One way to approach knowledge is to categorize it in a hierarchical relationship: data (unstructured data and figures), information (structured data), knowledge (integrated and interpreted ranges of information) and wisdom (the use of information and knowledge with sound judgement) (Ackoff, 1989; Thierauf, 1999; Rowley, 2007.) The hierarchical relationship intends to simplify that mere data possessed by a person is not useful without ability for interpretation.

The concept of knowledge can also be approached by the observability. Explicit knowledge refers to knowledge that can be codified in writing or some other form of systematic language or code being declarative by nature (Nonaka and Takeuchi, 1995). Tacit knowledge is something personal (Polanyi, 1966) context-specific, procedural and difficult to put into words (Nonaka and Takeuchi, 1995). Self-transcending knowledge is understood as tacit knowledge prior to its embodiment proposing a distinction between two types of tacit knowledge. It is precognition, or ability to sense and presence the emerging opportunities. To see the coming-into-being of the new is usually associated with artists (Scharmer, 2001).

The implicit goal of the information flow is that it becomes knowledge; knowledge that is valuable for the organization in concern. However, the information without considered actions may not result in desired outcomes if the process behind it is not understood properly. One of the most referred theories for the knowledge creation process is the SECI model developed by Nonaka and Takeuchi (1995). The model lays its foundations on the idea of knowledge conversion where knowledge is often considered being of two types – tacit and explicit - implying that collective learning process increases knowledge in the organizations, and that the SECI model is to produce a learning spiral by continuous knowledge conversion. The knowledge conversion takes place through four sequential modes of knowledge conversion: (1) Socialization, (2) Externalization, (3) Combination and (4) Internalization. The SECI model has been extended and two phases, potentialisation and visualisation, of knowledge conversion were added by Harmaakorpi and Melkas (2005) and Uotila et al. (2005). They incorporated self-transcending knowledge, because a need for dynamic capability that is to be able to plan for the future while taking into account the dependency of the past had been recognized (Uotila et al., 2005). The incorporation of self-transcending knowledge can be viewed also as “a gate to gaining new insights” that enhance the knowledge creation process. New and unorthodox ideas need to be allowed to join the knowledge creation process. Otherwise, there is a risk that circulating knowledge builds heavily upon previously created knowledge and becomes repetitious, conventional and exclusive (Salonius and Käpylä, 2013).

### Workplace for knowledge creation

Nonaka and Konno (1998) have elaborated the SECI model with the concept of “ba” that roughly translates into the English word “place”. “Ba” is a shared space for emerging relationships and therefore serves as a platform for knowledge creation. The space can be physical (e.g. office), virtual (e.g. e-mail, internet), mental (e.g. shared experiences, ideas) or combination of any.

According to Nenonen (2005, p. 56), four types of workplaces for knowledge creation can be identified: *connective*, *structural*, *formal* and *reflective*, with each

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supporting different phases of the knowledge creation process. However, not all of the workplaces should incorporate all of these different spaces, but instead some of them can be partly or fully virtual (Nenonen 2005).

*The connective place* brings people together and therefore, supports the first phase of knowledge creation, socialization, during which individual tacit knowledge is converted into group tacit knowledge (Nenonen 2005, p. 235). Then again, in *the structural place* tacit knowledge is converted into explicit knowledge. This place supports concentrated work and guided work processes by an atmosphere, which is task-oriented, and the focus is on tangible performance. Meeting rooms are examples of a structural place (Nenonen 2005, p. 58).

*The formal place* supports the phase of knowledge creation where separate explicit knowledge is converted into systemic explicit knowledge (Nenonen 2004, p. 235). This place offers room for privacy and repetitious routine tasks. Atmosphere is closed and silent and, on the contrary to the structural place, the formal place supports the role of the individual. Individual office rooms, for instance, can be seen as formal places.

During internalization, the last phase of knowledge creation, explicit knowledge is transformed back into tacit knowledge (Nonaka et al., 1995), which is supported by *the reflective place* hosting a relaxed and sometimes even lazy atmosphere. The sharing of knowledge and innovative spirit is essential part of this place. For example, coffee areas or informal meeting places with sofas can be identified as reflective places (Nenonen 2005).

### **Different types of knowledge workers and their mobility**

According to Fischer et al. (2004) three major aspects, which influence on workspace satisfaction, are individual differences, organizational context and environmental features. Individual differences consist of the role and responsibilities of the worker, the nature of the work tasks, individual wishes regarding the workspace type and level of satisfaction in general. Furthermore, according to Greene and Myerson (2011) organisations tend to perceive knowledge workers as a homogenous group supposing individual's work similar ways and have identical needs and due to this fail to provide the appropriate work environment. They suggest that better understanding about the movements and motivations of knowledge workers can inform office design towards increasing the productivity of knowledge work too (Greene and Myerson, 2011).

The mobility of the knowledge workers can be categorized several ways (Greene and Myerson, 2011; Schaffers et al., 2006; Vartiainen et al., 2007). In common for all of these categorizations are that they identify roughly four types of different knowledge workers based on the frequency of changes in location and the actual location. For example, Greene and Myerson (2011) call their four types of knowledge workers the Anchor, the Connector, the Gatherer and the Navigator. Anchors have the lowest mobility of all different types of knowledge workers. They come to the office everyday, working at their desks most of the time. According to Greene et al. (2011), anchors have the essential role in knowledge transfer within an office, because other employees go to them in order to get information. Connectors move around the office building and spend their working hours at meetings or talking to colleagues. Connectors interact a great deal with different people, but they stay within the office building. Then again, Gatherers spend half of their working hours away from the office at different meetings. At the office, Gatherers do not necessarily require their own office desk; instead they need different types of working stations, which offers space for concentration and collaboration. Navigators are key figures of the organization and their work is highly mobile including the global network. Most of the current knowledge workers fit to the types of Anchor and Connector, then again Gatherers and Navigators imply towards office design and work environment principles in which an infrequent presence of certain workers should be provided for in a comprehensive way (Greene and Myerson, 2011).

### Effects of workers' mobility on information exchange

As the categorization of different knowledge worker types indicates, the mobility of the workers can happen either within one location or between multiple locations. Traditionally, all kinds of work carried outside a main office are referred as "telework" or "remote work" (Vartianen et al., 2007). Pyöriä (2003) has analysed challenges to implement teleworking more widely among the knowledge workers in Finland. One of the most challenging problems is to establish the effective human communication in virtual environment. Even with the most advanced video-conferencing technology, it is difficult to express and respond to social clues, which are essential in human interaction, and therefore, the risk of misunderstandings increase. Furthermore, Pyöriä (2003) pointed out that the use of electronic interfaces restricts, and sometimes even inhibits, the transfer of tacit knowledge. Moreover, in the field of architecture, where the visual communication and conversations are essential part of the job description (Schön 1983), the physical presence is necessary (Pyöriä 2003).

The knowledge creation process has affected research on workplace design for the past two decades. The trends have been facilitating communication for information sharing, together with flexibility (Appel-Meulenbroek et al., 2011; Gibson, 2003; Peponis et al., 2007). Interaction and communication in offices are important for knowledge work and creativity. These are manifested usually in open and flexible layouts. However, openness has its disadvantages: for instance, talking in open-plan environment may disturb colleagues (Värlander, 2012). In order to address the problems related to open layout offices, the activity-based office concept was developed. That is, workers can choose an activity-based workstation that best suits the tasks in hand and supports also workers' personal preferences. Then again, activity-based offices have likewise drawbacks, for example, in the loss of identity and critical design failures such as lack of soundproofing (Appel-Meulenbroek et al., 2011).

According to Gibson (2003), in management of organisations the flexibility is acquired through project-based teamwork, where teams form and evolve constantly. Among other things, flexibility also derives from the changing working patterns to better suit individuals' and company's needs of time and place for work, i.e. from where and when people work.

Peponis, et al. (2007) proposed two models of workspace designs, which influence on information exchange and communication, thus improving productivity. The first, called "*the flow model*", argues "*communication is the most effective if the office layout directly reflects the required flow of information, such as by placing people who need to communicate near each other*" (p. 816). However, the problem of this model occurs if workers need to communicate with great number of colleagues or the patterns of interaction are irregular. The second called "*serendipitous model*" suggests "*providing informal nodes, such as cafes, helps to bring people together outside of normal workspaces*" (p. 816). This partially balances the problems of the first model and encourages unplanned interactions with various colleagues. In their work, Peponis et al. (2007) suggested that physical design of the workplace creates framework that supports distributed understanding in organizational setting. Thus, physical workplace can act as enabling and generative mechanism for information exchange (Peponis, et al., 2007).

To sum up, varying theories and research on office layouts impact on creativity, information exchange exists. Hence, creative organizations such as architecture offices need to consider their own office layout from different angles. For instance, it is important to consider how to facilitate the creative process and production of new knowledge, forms of information exchange and communication, as well as the mobility of different types of knowledge workers. In addition, the spatial configurations should support their organizational goals, working methods as well as employees' preferences.



## METHODOLOGY

### Research Context

This chapter describes the methodology of our study and provides an overview of the research context. The study focused on an architecture office that is a semi-large company and located in Tampere, one of the biggest cities in Finland. At the time of the study, there were 26 employees consisting mainly of architects. The office was established in 1982. The office is located in the city center and it had moved to the new premises in the spring of 2014.

The current office environment consists of a public lobby space and a kitchen area, meeting room facilities and small team rooms located along a circular corridor. Most of the employees are located in the shared rooms with approximately three people, based on team projects. The executives and a financial officer have individual offices. Glass walls separate the team rooms from the corridor. The combined lobby space and the kitchen area are mainly used for in-company and customer meetings, coffee breaks and breakfast events. The negotiation rooms are reserved for official and formal meetings.

According to the executives, the aim of the layout of the new premises is twofold. Firstly, the layout aims to support changing teamwork and enhance information exchange between people in the same room: project teams could be assembled flexibly in the need, and each employee could change the working station according to the project at hand. Like this, each project member could receive information easily from the other members of the project in the same room and, for example, overhear the phone calls related to the project. Another aim of the spatial organisation is a distribution of tacit knowledge among the employees. More experienced designers, could share their knowledge and expertise to younger designers by working in the same room with them. Therefore, an extra table was furnished in each of the rooms, so the more experienced designers, for example the executives, could change their workstation flexibly and guide the younger designers when needed.

The latter aim of the spatial organisation also supports the company's policy of working patterns: the employees are expected to be at workplace approximately during regular office hours, from about 7 to 9 until 4 to 6 pm, unless they need to participate in some work-related meetings outside the office. Furthermore, the technological resources limit the possibility for remote work, since almost all employees have desktop computers. However, company has a couple of shared laptop computers for the employees who occasionally work outside the office. In other words, excluding some occasional exceptions, the work patterns are relatively fixed on location.

### Participants

There were 18 voluntary participants in the study (F=8, M=10). The age-range of the participants was from 27 to 59, the average being 45 years. Most of the participants were architects, involving many roles: managers, financial control, senior architects, project architects and assistant architects. On average, the participants had worked in the office for 12 years, when the working experience in the office varies between 0,5 years and 22 years.

### Data Collecting Methods and Data Analysis

Semi-structured theme interviews (N=18) were conducted as a data collection method. Interviews lasted about one hour, and there was a moderator and an observer present in most of the sessions. The interview discussion framework consisted of the short background questionnaire, followed by three main themes 1) Job description in general, 2) Flow of information within the office (between employees), 3) Flow of information outside the office (between the architect and client). Each theme included approximately 10 questions, for example "Describe your typical workday and tasks" (theme 1), "Do you think that the layout of the office has an impact on the information sharing in the office? How?" (theme 2)

and “How do you gain essential information about the needs of the client or user during the project?” (theme 3). The interviews were tape-recorded and transcribed. The material analysis of the interview transcriptions was conducted with the qualitative content analysis method (Zhang and Wildemuth, 2009). First of all, the moderator and the observer of the interviews went through the material and discussed the emerging findings of the material. Then, the main author of this publication conducted the content analysis with the Atlas.ti programme, where the analysis unit was a part of a sentence.

As an additional and informal data collection method, the on-site visits to the architecture office allowed to conduct observations about the context. The observations and interviews were used to identify the workers' behavior in order to analyse the mobility of different types of office workers. The mobility analysis was based on the categories by Greene and Myerson (2011), Schaffers et al. (2006) and Vartiainen et al. (2007). Furthermore, the layout of the architecture office was analysed in order to examine the effects of workers' mobility on information exchange. In this preliminary analysis of the research material, we concentrate only on the physical facilities of the case study architecture office. We focused on the role of the main office facilities on the information exchange. Most of the participants worked at least sometimes out of the office, if they attended, for instance, meetings with clients in other places. The functional and spatial qualities of these other locations are not analysed here.

## **FINDINGS**

The preliminary results show how the current layout of the office has been experienced by the employees and the executives of the architecture office. The findings also present the different types of knowledge workers and their level of mobility. Furthermore, the results show how the mobility of the workers impact on the information exchange within the office.

### **Two types of mobility**

In general, the results indicate that the mobility can be seen happening not only physically but also mentally. That is, the mobility of the participants can be observed through the mobility of thoughts and mind-sets, for example the need to transfer between different projects. The interviewed participants told they were involved from 1 to up to 11 projects at the same time. On average, senior designers were in charge of 2 to 4 projects simultaneously. Obviously, these projects were in different phases and hence, the efforts needed from the individual worker varied. However, according to the participants, concentrating on multiple projects simultaneously takes time and sometimes causes stress. Based on the interviews, it seems that this mental mobility has actually more impact on the fluency of the work than physical mobility. The interviewed participants recognized that when concentrating on one project at the time, the work proceeds more smoothly.

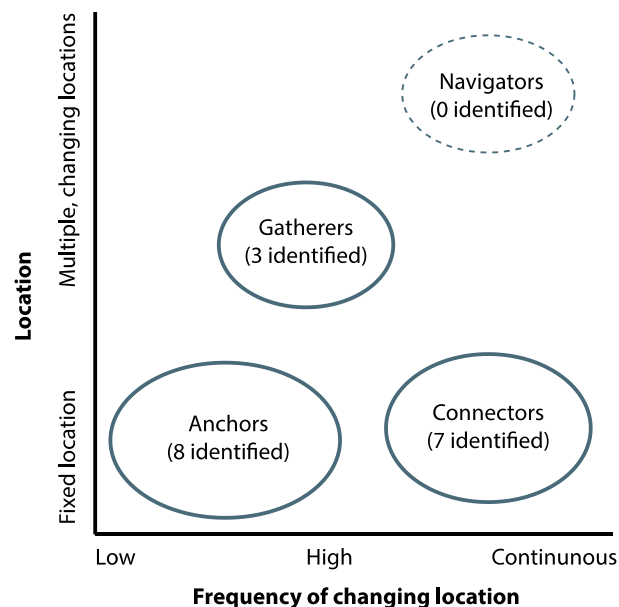
*“Of course sometimes you have to transfer from a project to another in the middle of your workday, if you receive some urgent e-mail or phone call. Nevertheless, sometimes you can concentrate on a specific project and that is nice, because then the work proceeds a lot more smoothly” (male)*

*“Unfortunately, you have multiple projects on-going, and you just have to choose the one that is the most urgent.” (male)*

All participants agreed that the physical mobility of work depends greatly on the phase of the project. Most of the participants worked 80-90% of their working hours at the office. The remaining 10-20% is spent at different appointments outside the office. However, in a few cases, the physical mobility of work increased momentarily, especially if the project involved a lot of meetings. Quite naturally, the senior and more experienced architects seemed to attend meetings more often than younger designers, as they were usually in charge of the projects.

*The tacit knowledge remained inside the team and did not spread through the whole organization.*

Based on the interviews, 3 out of 18 of the participants were identified as Gatherers (Greene and Myerson, 2011): they interacted mainly with people outside the office and brought back new business and relationships and they had a need to work in various locations, for example at the client or partners' offices. Then again, altogether seven Connectors (Greene and Myerson, 2011) were identified amongst the participants. They spent most of the day within the office, managing multiple projects, interacting with various people and advising younger designers. They also attended meetings outside the office regularly, but the main part of their work concentrated within the office. Furthermore, eight of the participants were identified as Anchors (Greene and Myerson, 2011). They worked normally within the office, concentrating only on one or two projects at the time. This group included mainly architecture students, younger designers and assisting architects, who were not in charge of the big projects. None of the interviewed participants were identified as Navigators (Greene and Myerson, 2011). Even though some of the participants used to spend major part of office hours outside the office, it still remained the focal point of their workweek. To summarize the categorization of the participants according to their physical mobility (Figure 1).



**Figure 1:** The categorization of the participants on four types of knowledge workers in relation to previous studies of Greene and Myerson 2011 and Schaffers et al. 2006.

However, noteworthy is, that identifying the participants as certain types of knowledge workers may vary greatly depending on the day. On one day, more experienced designers were Gatherers, spending their time in various meetings, and on the other day, they were Anchors, drawing up technical plans at their desk. This reveals a great deal about the varying nature of architects' job description.

According to the participants, information and communication technology have diminished the need to move physically from a place to another: most of the different design issues were handled with phone call or e-mail. In addition to this, several construction sites were located in another city and hence, due to the distance, the actual meetings were kept as minimum as possible. Major decisions and other complicated matters required face-to-face meetings with other designers or client(s). For example, site activities and supervision always required a visit to the construction site.



### **Layout to support information exchange**

The current office layout represented by our case study follows “the flow model” workspace design (Peponis, et al., 2007) as the layout supports team-based working (Figure 1). This followed two organizational goals of the architecture office that are enhancing information exchange and distributing tacit knowledge among employees. Based on the interviews, it seemed that the information exchange within the team room was excellent: when one person received project related information, he or she could pass it on immediately to the other members of the project. In addition to this, all the participants felt free to ask help from their colleagues in the same room. This implies that besides project related information, the tacit knowledge transferred well between the people in the same room. Furthermore, the team rooms were furnished by placing a low shelving unit in each room, which could be used as an extra table in order to support conversation and sketching within the room. The results indicate, that the team-based workspace supports especially the Anchor type workers, since they have low mobility during the workday. Each individual had his or her own desk, which was located in a team room with 2-3 other people. Based on the observations and the interviews, the participants worked mainly by their desk when being present at the office.

Employees, who participated in a project for a longer period of time and actually moved their workstation to another room, were quite happy about the arrangement. As said, passively gained information, such as overhearing the phone calls were considered a very efficient way to transfer information about the project. Those employees, who did not change their workstation and possibly participated the project only for the short period of time, were not happy about the information exchange within the project team, and felt stressed because they were thrown suddenly into a new project without any or with only a short introduction to the main features of the project. Especially these short-term project members would have benefit from the information exchange which happens between the team members within the same room. Often these short-term project members participated to the project during the busiest phase of the project and therefore, other team members had lack of time to familiarize the short-term members with the key features of the project.

On the other hand, it seemed that the layout did not support the mobility within the office, that is, Connector types of workers. Connectors were involved in multiple projects at the same time and therefore, they belonged multiple project teams as well. As a consequence, Connectors had a need to communicate and exchange information with several people during the day. Part of the Connectors required space to work more freely and talk to people. They wanted to work in even bigger rooms where they could interact more with the colleagues and talk more about design tasks in hand.

On the contrary, part of the Anchors expressed need for quieter working environment. These individuals had developed different kind of aids to concentrate on their work: some of them listened to music via headphones in order to tune down the distracting conversations. Some of them arrived early at work, because they felt they could focus better in the morning when it was quieter. If all the people in the same room wanted to work in silence, they would close the door to the corridor.

The Gatherer type of workers used mainly their own allocated desks in the office rooms. In addition to this, Gatherers frequently used meeting rooms. Gatherers were happy about the spaces provided for them, but in the terms of effective space utilization, having the separate office desks for Gatherers may not be the most efficient solution. Furthermore, two of the Gatherers had single offices, and this seemed to cause some problems on how to exchange information. The Gatherers participated the meetings outside the office and when being present at the office, they needed to share the gained information to the Anchors and Connectors. According to the participants, this caused some conflicts and frustration, since several people wanted to discuss with the Gatherers at the

same time. However, the same person could adopt very different roles depending on the urgency of the projects at hand. Hence, the categorization of the participants described before needs to be seen as suggestive.

Even though the spatial solution of the office seemed to enhance information exchange between the employees in the same room, the communication between people in different rooms was considered weak. Many of the participants claimed that they had only little or no idea what their colleagues were doing in other projects. The employees socialized during the lunch or coffee breaks and refrained discussion about work-related topics. Hence, it could be claimed that the office layout, in certain parts, limits the communication between teams.

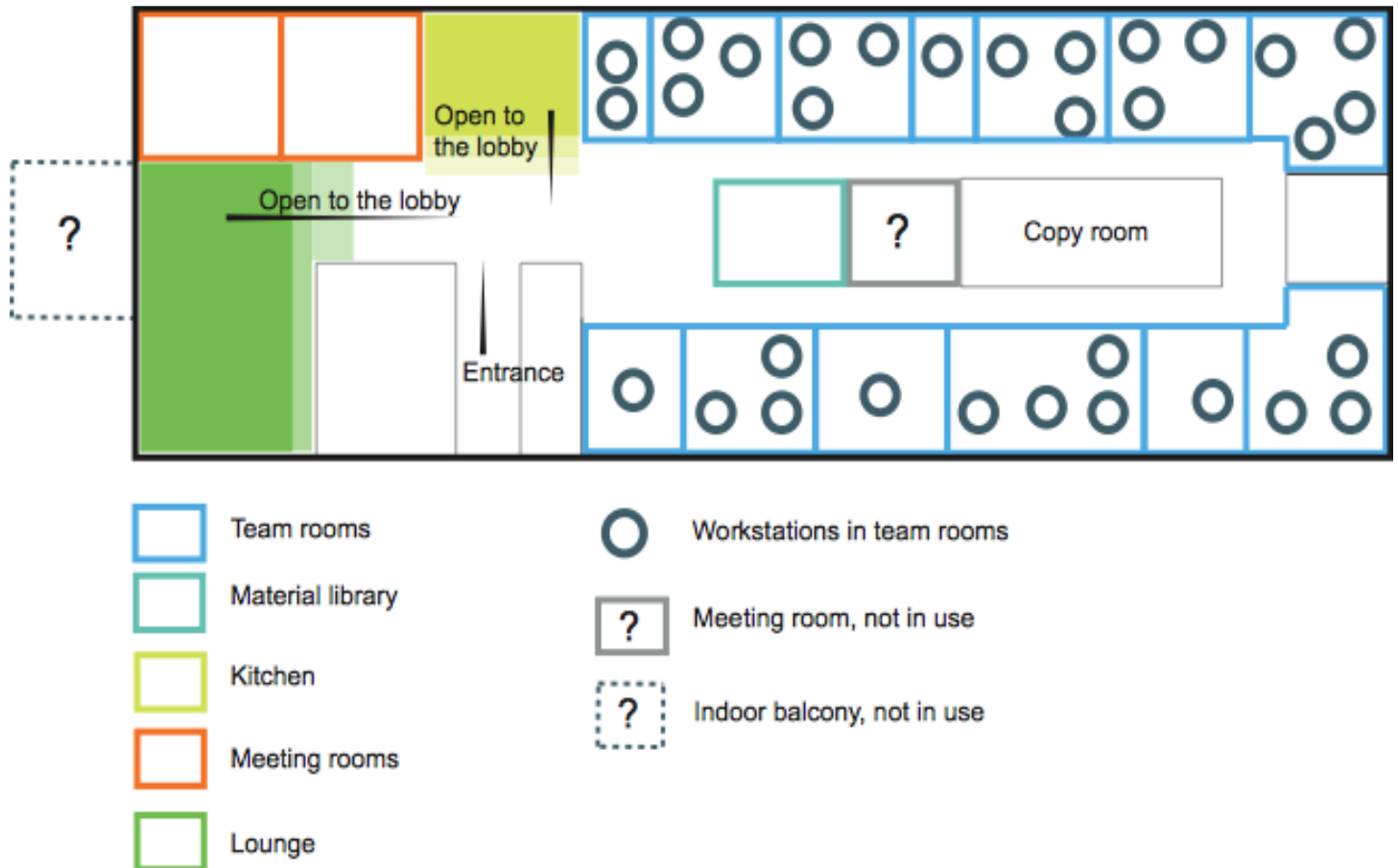


Figure 2: Layout of the case study office.

## DISCUSSION

### Team rooms support tacit knowledge exchange and creative group work

The tacit knowledge, gained little by little during the education and working life (Schön, 1983), seemed to transfer well between the employees within the team rooms. The organizational policy, the requirement of employees' presence during working hours, supports the reflective conversation (Schön, 1983), where the situation and the colleagues require almost invariably face-to-face contact. Furthermore, in design and planning processes the physical co-presence is necessary (Pyöriä, 2003), because drawings and other visual aids are essential part of communication (Schön 1983). Therefore, the team-based office layout together with the organizational policy supports the transfer of tacit knowledge and face-to-face contacts, and hence, should support creative work as well.

The team-based office layout is not the most commonly used layout for a creative organization. Instead, the open-plan layouts are commonly used to facilitate collaboration and changing team compositions as well as peer-to-peer help (Martens, 2011). Open plan layouts are thought to increase spontaneous interactions and knowledge sharing between colleagues. However, open plan offices, while affording flexibility in general, may have unpredicted influence hindering the use of spaces, such as discussions, which disturb colleagues in the same space. (Värlander, 2012). Hence, if compared to open layout, our case study, on the other hand benefits from the smaller team rooms.

From the point of view of knowledge creation, it seems that the team rooms support at least first two phases of knowledge creation process that are the socialization and externalization (Nonaka and Takeuchi, 1995). The team rooms bring people together and hence, physical presence of the team members supports the socialization phase. Furthermore, team rooms offer a place for the team to process the design tasks together and therefore, the team room supports also the externalization phase of the knowledge creation.

The team rooms support only partially the combination phase of the knowledge creation. According to Nenonen (2004), the combination phase concentrates on the role of the individual and therefore, the space should also support privacy and silent routine tasks. However, based on the interviews, the team rooms did not support the individual working preferences and some the Anchor type workers expressed the need for quieter working environment.

Moreover, it seems that the team rooms did not support the internalization phase of the knowledge creation. The internalization phase requires informal, cozy and even lazy atmosphere (Nenonen 2005). However, these qualities do not describe the atmosphere of the team rooms, but rather the atmosphere in the kitchen area or lounge. The kitchen area and lounge are equipped with more informal and relaxed furniture, such as sofas. Hence, these spaces support better the internalization phase of the knowledge creation. (Figure 2).

Even though the team rooms seem to support knowledge creation process at least in two phases, the knowledge remains inside the team and does not spread through the whole organization. Therefore, as a downside, the team-based working inhibited the information exchange and knowledge creation between different teams. In order to support the information and knowledge exchange between project teams, the information and the creative work should step out of the team room. The sharing of ideas, communication and shared search for alternative solutions during the non-routine phases of knowledge work could even indirectly contribute to the productivity of the work (Peponis et al. 2007).

### **Flexibility of the layout could support different types of workers**

Even though the layout of the office appears to support organizational goals through certain flexibility, individual working preferences are somewhat unrecognised in the spatial organization. Different types of workers have different needs in terms of office layout. Even though the team-based working that seemed to support the low mobility of Anchors works quite well, it did not support the Connectors mobility within the office. In order to better support Connectors work, the office layout needs more flexibility. Essential for flexible working is to encourage staff to work in the most appropriate location, the place and space - whether in or out organisation- according to the activity on hand (Gibson 2003).

Obviously, there are possible downsides to increase the flexibility within the office. For example, if the Connector types of workers move between multiple team rooms, does the information exchange within the team interfere? On the other hand, the Connectors may transfer the tacit knowledge to the team rooms and as a result, for example, the knowledge about the best working methods spread throughout the office. Especially Connector and Gatherer types of

workers may benefit the activity-based office (see Appel-Meulenbroek et al. 2011). Offering different types of workers possibility to choose their workstation or adjust work environment according to their individual preferences could enhance their job satisfaction, as stated also by Värlander (2012).

#### **Limitation of the study and further research**

In order to provide a more comprehensive view, the data collection should be extended by collecting more systematic observations about the usage of the space. Furthermore, the intensive observation of one or two members of the organization could provide additional information about the work tasks conducted outside the main office and moreover, information about the mobile work and its effects on information exchange. Finally, further research should include the examination of virtual work environment and its impact on the mobility of work and information exchange.

## **CONCLUSIONS**

The team-based office layout is supported generally the Anchor type workers, since they had low mobility during the workday. Furthermore, the office layout supported organizational goals of the architecture office: enhancing information exchange and distributing tacit knowledge among the project team. Team rooms supported tacit knowledge exchange and creative group work by bringing team members together and offering them a space to process design tasks in-group. However, the team rooms did support neither individual working preferences of the Anchors nor the Connector type of workers, who would benefit from more flexible office layout and various workspace configurations. Furthermore, the tacit knowledge remained inside the team and did not spread through the whole organization. Therefore, as a downside, the team-based working inhibited the information exchange and knowledge creation between different teams. The office layout is not in causal-relation to the behaviour, but the work environment in its full meaning – together with the organizational aspects – affects the work practices. Therefore, more important than the physical environment itself, is how people utilize the space.

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**Architectural Research in Finland, Vol.1, no.1 (2017)**

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