SPATIAL POSITIONING - Method development for spatial analysis of interaction in buildings, by Henrik Markhede

Abstract

In offices, knowledge sharing largely depends on everyday face-to-face interaction patterns. These interaction patterns may depend on how employees move through the office space. This thesis explores how these spatial relations influence individual choices with respect to employee movements or routes. Space syntax related research has shown a strong relationship between spatial configuration and pedestrian movement in cities, yet field of space syntax has not applied spatial analysis to the office environment. Although several many space syntax researchers have suggested a connection between spatial configuration of offices and movement patterns of employees, no studies have developed methods to address this issue specifically. Our initial results suggest that organizational borders sometimes work as well as walls regarding movement related to face-to-face interaction in offices. This has led us to perform analysis using occupied spatial positions as a complement to the regular space syntax analysis. Using spatial positioning analysis, we incorporate organizational aspects into space syntax analysis and shift focus from analysis of movement to analysis of interaction. Our papers develop both observational methods and software for spatial modelling. We conclude that rational choice theory and actor network theory can provide useful conceptions and models for how to perform spatial analysis of interactions. Future research should focus on software development and new interpretations related to rational choice, actor networks, and symbolic interactionism.

Introduction

"Places don't make cities, cities makes places". (Hillier 1996)

Recently, space design has become a major tool for managers to boost the performance of their organisation; the concept behind this is the knowledge-society. Knowledge is the new means to compete with and focus is set on creativity and innovations. There is also a strong belief that innovation can be managed through designing organisations and workspaces. Office work often depends on a large amount of unplanned encounters, informal conversations, and informal meetings, all necessary communicative acts that help determine productivity. We believe that these informal encounters largely depend on how people move around in the office, where desks are situated, and who sits next to whom. Our hypothesis is that spatial layout and its configurative qualities affect these encounters and that spatial qualities can be used as a strategic design tool to support interactions.

Current trends strive to transform cell offices to open landscape offices. In part, this trend is motivated by a desire to reduce costs (more people per m^2) and to encourage

[1]

better contact between co-workers, a corollary benefit of spacing people closer together. In addition, new technology plays a major role as workspaces can be distributed both within the offices and on other sights such as when an employee is travelling or working at home. Regarding configuration of work processes, many concepts and developed strategies exist; however, when considering the configuration of space, there is a lack of useful theories. Concepts are often limited to the question of openness and the presumption that more openness will lead to more interaction or that the functionality of spaces is the major factor for how it is used (Duffy 1997, Becker and Steele 1995). Many architecture theorists have highlighted the interplay between spatial configuration and human behaviour. (Hillier and Hanson 1984, Peponis 1985, Hillier 1996, Penn et al. 1999, Hanson 1998, Marcus 2000). This new way of interpreting spatial relations provides an opportunity to re-think the interplay between spatial configuration, functions, and social configurations. For me, the overall research question is to understand how spatial relations affect knowledge sharing in offices. The investigation method is mainly quantitative and observational.

The methods used in this thesis originate from space syntax theory. Space syntax theory and methods differ from other spatial analysis as it focuses on spatial configurative aspects of built form. For many researchers in this area, the major focus of space syntax is on how internal configuration influences the way people move and behave in a spatial environment. Many correlation studies been made with respect to how people move through cities; studies from all over the world have shown correlations between spatial relations and movement of pedestrians (Hillier and Hanson 1986, Hillier 1996). This suggests that it is primarily the city structure in itself that affects pedestrian movement, whereas attractions only have a secondary effect on pedestrian movement. Hillier, one of the major theorists in space syntax, examines pedestrians' regularities for *natural movement* and argues that this is the foundation for a whole new way of interpreting architecture, namely a theory of architecture that discusses how architecture affects human behaviour. The technique used for analysis is through graph theoretical representations using computer programs to produce data sheets and graphs used for correlation studies. Within space syntax, integration is a key parameter: a more integrated place in a spatial system is relatively closer to other parts in the system in terms of configuration defined by angular turns or steps as opposed to distance. The analysis is performed in computer programs[1] and the output includes graphs and data tables.

---

[1] Depth map, Confeego (http://www.spacesyntax.org/software/index.asp), Place syntax tool (Ståhle, Marcus, Karlström 2005) These tools are just some examples and there is also an ongoing development of new software.

The research field can also be described as being a system of logical argumentation where the primary logical system is carrying a large explanatory scope. (Groat and Wang 2002) like the system described by Hillier and Hanson (1984). Space syntax research has been extensively used and applied to many different areas since then, e.g., housing, hospitals, green areas, shopping buildings, art galleries, and offices (Hillier 1996, Hansson 1998, Penn et al. 1999, Peponis et al. 2007, Koch 2007, Lu 2009, Sailer et al. 2009, Steen 2009, Ståhle et al. 2005). These areas of application are by Groat and Wang described as secondary application of the primary system also the research presented here can be described as a secondary application.

Papers

Our first step one has been to conduct field studies at office work places in order to gather data about encounters. Field studies were designed to grasp basic interaction patterns and understand where encounters are taking place. The first paper (Markhede and Steen 2006) is built around an observation study conducted at a newspaper's head office. The main aim was to understand how spatial characteristics affected face-to-face interaction. The observations were carried out with "snap shots": every second hour we walked a predefined path observing and mapping behaviours such as sitting working, standing working, interacting and walking. Four people made the observations on twelve occasions over two days. The data was layered digitally over the plan in order to easily grasp relations between observations and spatial relations. The initial discussion highlights that analysis of movement patterns in offices is important for cross group interaction within organisations and that on an overall level people tend to move along highly integrated routes when walking around the office. By observing the combination of movement and face-to-face interactions, we found that workstations are the most used spaces with respect to interaction, and this type of casual interaction is mainly done as people casually walk near a workstation. In the paper, we argue that visibility is a key mechanism for face-to-face interaction in offices, and high visibility is understood to give more face-to-face interaction because it makes it easy to know if people are available or not and the sight of another person can work as a reminder of tasks to perform. Examples are made through a virtual and one real case study, showing that visibility is a relevant spatial measure when analysing face-to-face interaction. In the virtual case, we show how narrative and characters are supported by their spatial positions, and this finding is also seen in the real case where managers often take advantage of strategic positions to encourage interaction. We also understood that face-to-face interaction patterns do not seem to be grasped through the usual space syntax analysis; although when analysing each department on its own, we could see a pattern of that face-to-face interaction was carried out in more visually central

positions. In addition, we noticed that some roles were more represented than others especially those with middle range tasks regarding graphics and text editing.

We conclude that we need to use roles and departments of the organisation in order to make a fair description of the social system as well as the spatial system. We also found that visibility plays an important role for face-to-face interaction in offices and isovists can be favourable when used as a basic parameter in our future analysis. We also concluded that we needed to develop new simulation tools to analyse properly face-to-face interactions in offices.

Paper two (Markhede and Koch 2007) mainly addresses the methods used in two cases. One is a survey regarding face-to-face interaction in an office and the other is a study of spaial relations between commodities in department stores. In the former study, the survey provides information regarding how organisational borders sometimes worked as if they were actual walls. Both cases forced us to consider the distribution in space rather than the distribution of space (Koch 2004). This line of investigation proved beneficial when making studies of face-to-face interactions in offices and when describing how commodities in department stores are distributed. We also understood that according to the office survey the employees within departments moved around the whole department, but seldom outside. The survey also implied that employees in a central position had more face-to-face interaction than those in the periphery. The later case study on department stores focuses on to how position goods with respect to spatial relationships to construct categories through and in spatial contexts. The interplay between the spatial relations and clusters of goods creates an intricate web of spaces where employees are moving or are static, teaching the costumers about what is exclusive, trendy, etc. Both phenomena need to be analysed using a spatial model drawn from positions defined by the spatially distributed entities, e.g., workstations or goods. We call this analysis positioning analysis and claim that it needs both a new kind of modelling and a different interpretive approach than the regular space syntax analysis uses.

In the conclusion we suggest using the positioning analysis as a complement to the regular space syntax analysis, combining the analysis of distribution in space with the distribution of space. We argue that when striving to make analysis of human interaction, one needs to look at it as a network of both artefacts and people (Latour 1998), and we suggest interpreting the analysis through symbolic interactionism as it is described by, e.g., Goffman (1959) and Giddens (1993).

The third paper (Markhede, Miranda Carranza 2007) is all about software development. The software – Spatial positioning tool (SPOT) –is a prototype developed to analyse the data collected in the former papers. The SPOT software is

[4]

written in Java and used for creating models of intervisibility using arbitrary locations for isovists. This paper describes an analysis of occupied spaces with respect to differences found in regular space syntax analysis, an analysis of occupiable spaces. The background section provides some results from case studies described explaining why the software is needed. The main argument is that the movement related to face-to-face interactions was primarily carried out within departments despite an open plan layout. We made the software to investigate how this behaviour can be described through spatial analysis. To build a graph, one has to prepare and import a Dxf file (Drawing exchange format) that defines the outline of the graph. The isovist are put within the line drawing by pointing and clicking on the spots of origin for the analysed entities. The isovist fields are transparent, but when they overlap, the layers created produce darker fields. There is also a circle and a value (Relative asymmetry) that change depending on the direct connections to other isovists centres. The isovists can be stored in different layers and turned on and off, creating different combinations of positions. The positions of the isovists can also be edited in real time, moved around within the line drawing.

The conclusion made in this paper is that the software is very use full for making graphs of overlapping isovist fields; however, as it does not contain any proper space syntax measures or data library, we cannot make a proper evaluation of the software. The future development of SPOT needs to fix this to be useful for correlation studies. In the conclusion we suggest that the graphs should be built up as sets, using sets and subsets to combine global and local analysis. The aim is to create data through multiplying sets and subsets into each other. It is also proposed that by implementing metric distance as an option rather than just turns and angular distance a stronger analysis will result. Later, we suggest that an editing option in the dxf line drawings in real time would make it possible to evaluate different design proposals. Our observed phenomena have also been highlighted by other researchers. I will give some examples of related research and results that may be needed for method development when applying space syntax analysis to buildings.

Problems and possibilities

When starting our research, the hypothesis was that *natural movement* (Hillier 1996) affects where and how encounters take place in offices. When applying the regular space syntax models in our studies, no strong relations were found although in two studies there was a correlation between movement and global spatial integration, but not with the observed encounters. We also established that this was a phenomenon mentioned in our reference literature (both within the space syntax related research and other workplace related research), but partly foreseen and not explored or integrated into the space syntax theory (Allen 1977, Gorawara-Bath 2000, Hillier

1996, Grajewski 1993, Penn et al. 1999). There are researchers within the field of space syntax who believe there is no correlation between movement and spatial layouts of offices. These researchers believe that movement to and from functions and within organisational borders is the main reason employees move through office space on particular routes (Wiklander, Blombergsson 2006, Sailer et al. 2007). Sailer also notes that this phenomenon has been neglected within space syntax and suggests that in order to create predictive models of movement patterns in offices one has to combine configurative models with attractor-based models and that movement in workplaces may best be reflected by metric analysis. In a more recent paper, Sailer et al. (2009) conclude that there is a need for researchers to integrate a level of programming of an organisation into the current space syntax models. Furthermore, Sailer noticed that the unique patterns of organisations affects complex behaviour like interaction, collaboration, and knowledge flow, where the spatial configuration is one factor among others that influences these behaviours. Sailer believes that there is a need to complement the regular space syntax analysis using organisational relations. Sailer's conclusions are similar to our conclusions regarding the need to create a complementary method to the space syntax analysis.

Other researchers have noticed similar observations as ours with respect to inter-departmental face-to-face interaction. Allen (1977) concluded that face-to-face interaction within departments (an office for engineering development) is twice as high than the cross departmental face-to-face interaction. In addition, Allen notes, face-to-face interaction decreases drastically 30m from the actor's workstation. These observations are similar to our result where face-to-face interactions primarily are a matter within departments and cross-departmental interactions are rare despite an open plan layout.

Above mentioned references and our results suggest that the former mentioned space syntax hypothesis (Hillier 1996) regarding the relationship between spatial configuration and face-to-face interaction has to be re-interpreted. Our conclusion is that organisational settings have a major impact on face-to-face interaction and related research supports this conclusion.

Organisational aspects such as roles and assignments seem to have an impact on movement and face-to-face interaction. Other space syntax related research has discussed the organisational effects on movement. For example, nurses' movement patterns depend on spatial sub-areas related to their assignment rather than the spatial layout in total (Heo et al. 2009). Lu et al. (2009), commenting on the same theme in a study of nurses and doctors at a hospital, noticed that doctors move and interact in relation to more generic visibility patterns and nurses move in relation to targets, e.g., a patient's bed. Their speculation is that this is related to roles and

assignments; doctors have a more overall responsibility and need to cover a larger area and more people and the nurses are assigned to a more local area and spaces with patients. In paper one, we suggest that visibility affects face-to-face interaction. When using the space syntax analysis, visibility graph analysis[2], and organisational limitations together, we could see a tendency that face-to-face interactions are more frequent in central parts than in the periphery. Also in paper two, we note the same relationships: workers sitting in the visual centre of a department have more face-to-face interaction than those on the periphery.

Both in our software development and in related research (Yi Lu et al. 2009) visibility is used as basic parameter. We suggest that future investigations regarding spatial configuration in offices and face-to-face interaction use visibility as the main parameter. This way of performing analysis is also complementary to the space syntax visibility graph analysis.

The work processes are also influenced by visibility as well as variations in different spatial relations, variations that my influence how work is done. Rashid et al. (2009), in a study that looked at a government office that moved from one open landscape office to another, found that despite the fact the new landscape had a more accessible and visible plan layout, face-to-face interaction and co-presence was not linked to the spatial changes. Rashid et al. concluded that these behaviours are more connected to organisational relationships and location of common functions although they could see a relationship between higher accessibility and visibility and a higher frequency of movement (Rashid et al. 2009). Because employees with more experience were also seen as more useful, they were more often sought out by other employees for interaction (Penn, Desyllas and Vaughan 1999). This is also related to the discussion of how tasks are performed by office workers. Steen (2008) found it relevant to talk about working tasks as *long questions/problems* or *short questions/problems*. By long questions he means tasks that require longer chains of thought in the individual situation and more reasoning back and forwards (to understand the context, e.g.) in the interaction situation. By short questions he means tasks that require shorter chains of thought, where it is easy to ask people about the task, easy because there is a straight answer. All office workers can be said to work with both long and short questions, but the main point is that some office workers have a main emphasis on either long or short questions. Steen sees the issue of visibility of long questions as more related to judgments, so these questions are discussed with people employees trust, people that are frequently visible. Short questions, however, have

---

[2] The method involves taking a selection of points across a space and forming graph edges between those points if they are mutually visible, forming a *visibility graph* using the software Depth map (www.vr.ucl.ac.uk/research/vga/).

answers that are more related to a simple fact or facts than a matter of judgment, answers that specific experts, irrespective of the employee's personal relationship with the expert, can provide. What is important in this discussion is how visibility and knowledge sharing interact. Other recent research has highlighted the community as the core for knowledge creation, a view that stresses the importance of visibility in common spaces as the key to cross-departmental knowledge flow (Amin and Cohendet 2004). Visibility plays a key role on many levels of interaction, although, as Steen et al. (2008) highlights, open plans are not always an asset. Open plans might also be a problem as conversations and small chats disturb office workers occupied with complicated questions. When working with longer and complicated questions, quiet and less visible workspaces are beneficial.

Many of the references made here are written after the publication of the papers. Some of them are refer to our papers, elaborating similar problems, although the challenge is still there: When analysing offices with a focus on movement and face-to-face interaction, the space syntax analysis needs to be developed.

To prepare for future research, I will present a speculative discussion regarding three central issues that I found interesting. The first issue addresses the small-scale mechanisms giving rise to our observed large-scale behaviour. The second issue addresses knowledge sharing and spatial analysis. The third issue addresses spatial strategies and narratives with respect to roles and organisations.

Speculations

> "Boeing 747s do not fly, airline companies fly". (Latour 1998)

A city is filled with people moving around with assignments and personal goals hidden in the emergent swarm of everyday life. Space syntax theory has shown that generic behaviour follows patterns of behaviour: pedestrians move more along spaces that are most intelligible in the street network. These streets are often placed centrally in the street network and are long and have small angular changes as they stretch out in the city. These streets are good to use as they provide many options for walking. They are also easy to navigate as they do not demand decisions of orientation as they have a long continuity; that is, few decisions lead to an easy stroll (Hillier and Lida 2005). True or not, this is a central part when creating models in space syntax. One of the most common and basic models is the axial line model. The rules for drawing an axial map include using as few lines and as long a line as possible to cover all areas where it is possible to both see and walk. The model provides central and long lines as well as segments with few angular turns that are given high values. This corresponds to the behaviour of the generic average

pedestrian, a walker who seems to prefer to move along these central and long streets, taking few turns, making few decisions. Boiling it down, it seems that the assumption of a generic behaviour of the average pedestrian is very central for why the models can be predictive.

Rational choice[3] (RC) is a branch of social science with roots in game theory. It is primarily a normative theory that predicts what we ought to do in order to achieve our aims as well as possible, but it does not tell us what our aims ought to be. It is also a theory with focus on the individual actor, meaning that in order to describe macro state phenomena one has to describe mechanisms of the individuals involved in the macro state phenomena (Elster 1986). What differs RC from many other sociology methods is the strong focus on mechanisms. RC focuses on understanding an actor's interest, beliefs, and opportunities and how this is turned into choices of actions. This differs greatly from the casual sociology that works with classifications that depend on observations of the macro-level without trying to establish a theoretical micro-foundation for the analysis (Hedström and Swedberg 1996). Macro-level societal phenomena imply that individuals are always carried by the swarm of individual incentives and actions. RC has been used to investigate macro-level phenomena in a wide range of areas: juvenile crime explaining the behaviour of young criminals in relation to harder punishment, safety behaviour among prostitutes, sexual habits among teenagers, overcompensation for bosses, and the underrating of divorce (Harford 2008).

The RC applies to many areas within the field of architecture; e.g., in the design process there are many general assumptions made regarding how everyday behaviour is carried out in a building. The rational game played in the mind of the architect is probably reckoned by anyone who has designed an advanced plan layout. Emergent and unplanned behaviour in cities are also very interesting to investigate through RC, e.g., drug traffic at corners, burglaries, incentives for vehicle change from car to bicycle when going to work, or how spatial qualities interplay with gentrification. We are most interested in to how RC can help describe spatial behaviour in buildings. Within space syntax there has been some work with agent-based modelling. When Turner et al. (2003) programs agents to move in a visibility graph constructed in the space syntax related software Depth map, they program them to move around according to this hypothesis: *"When engaging in natural*

---

[3] The 'rationality' described by rational choice theory is different from the colloquial and most philosophical uses of rationality. 'Rationality' means in colloquial language 'sane' or 'in a thoughtful clear headed manner'. In Rational Choice Theory, 'rationality' simply means that a person acts *as if* balancing costs against benefits to arrive at action that maximizes advantage, be it kissing someone, cheating on a test or murdering an old man. In rational choice theory, all decisions, crazy or sane, are postulated as mimicking such a 'rational' process.

movement, a human will simply guide him or herself by moving towards further available walkable surface. The existence of walkable surface will be determined via the most easily accessed sense, typically his or her visual field".
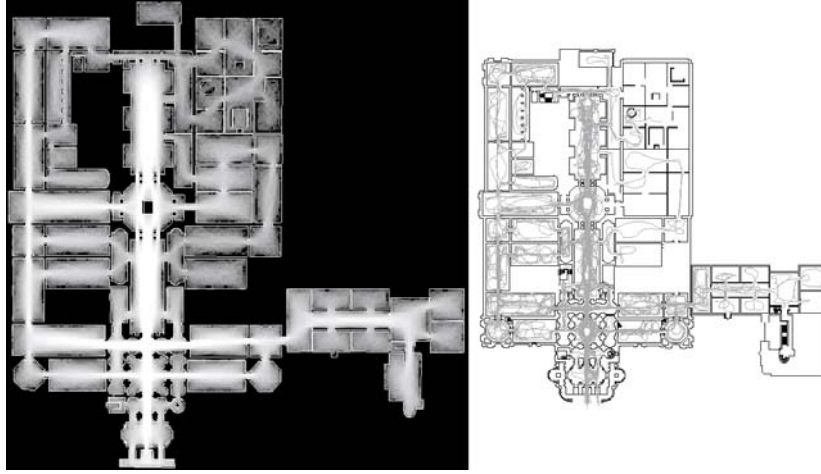

Figure 1. The left figure show, trails left by agents walking through the Tate Britain Gallery, Millbank. As each agent steps on a grid square it increments a counter. Black areas have low counts and white areas have high counts. The right figure show, actual movement traces for 19 people followed for the first ten minutes of their visit to the gallery (reproduced from Hillier et al., 1996).

The core space syntax phenomena fit into RC interpretations. Using the terminology of RC, it might look like this: the interest of the pedestrian is to get somewhere, the belief is to do it through the street network, and the opportunity is a walkable surface. This leads to individual actions that emerge into the swarm seen in the everyday life of the streets.

The amount of walkable surface affects pedestrians in different ways. Some researchers suggest that these mechanisms are related to the amount of opportunities for route choices (gaining options) or that through choosing the longer route one has to make fewer decisions (saving brain energy), or that it helps the pedestrian to develop and maintain efficient mental descriptions of environments, functionality, and intelligibility and these all seem to be closely interlinked (Penn 2003, Ingold 2005). When people ask for directions (e.g., to a museum or restaurant), it is much easier to describe it in as few steps as possible even if fewer directions means the pedestrian will have to walk a greater distance; that is, it is harder to explain short cuts through smaller streets. The mental maps have to be simple if they are to be successful (De Certeau 1984, Hillier and Hansson 1984).

The rationality of the positioning analysis regarding offices is different. As described in the introduction and in the papers, focus shifts from movement to interaction. In studies of offices (our studies and other studies), a different macro state phenomena than seen in cities is at work. When people are walking, they are primarily involved

in departmental activity. They are contacting relevant colleagues in order to solve their assignment. In the same way as nurses and doctors are using spaces related to their assignment, office people move in spaces so as to solve their assignments.

Using RC terminology, the difference will look like this: *the interest* of the office worker is to solve an assignment; *the belief* is to do it through relevant colleagues; and *the opportunity* is to do it with the ones visible within a reasonable distance. These individual actions lead to a macro-level where people not using walkable surfaces but using the occupied and visible surfaces occupied by co-workers are visible and useful for solving an assignment.

My assignment is carried out within the research group Spatial Analysis and Design at the School of Architecture situated in the Royal Institute of Technology in Stockholm. My workplace is in the corner in one of the three rooms belonging to our department. I have keys to all of the rooms, but only use two of the room in my daily routines. In my room there are three desks. We, two PhD students and one researcher, have our own desks. The big room in the middle is a meeting table and two workstations where the senior researchers are situated. The meeting table are used for seminars, lunch meetings, surface demanding projects, etc.
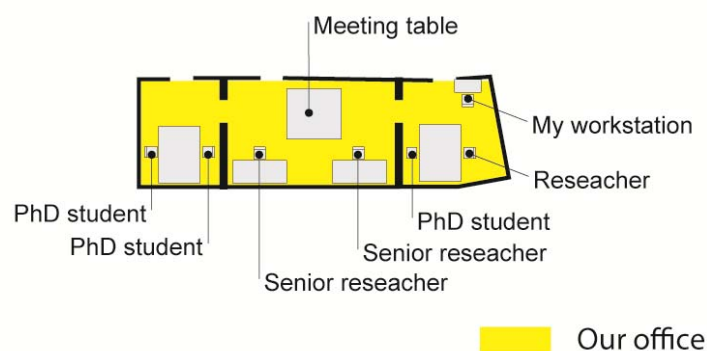

Figure 2. Our office.

Outside our department are circulation areas, a corridor, and beyond that an office landscape studio for the first year students. The circulation area is connected to two stairs, one leading directly to the schools restaurant and the other to an area shared with a large architect office that rents 1/4 of the building. This stair and circulation

area is also connected to the school restaurant where the main entrance also is situated, although the architect office has its own entrance and the employees are rarely seen using the restaurant or the school's main entrance.
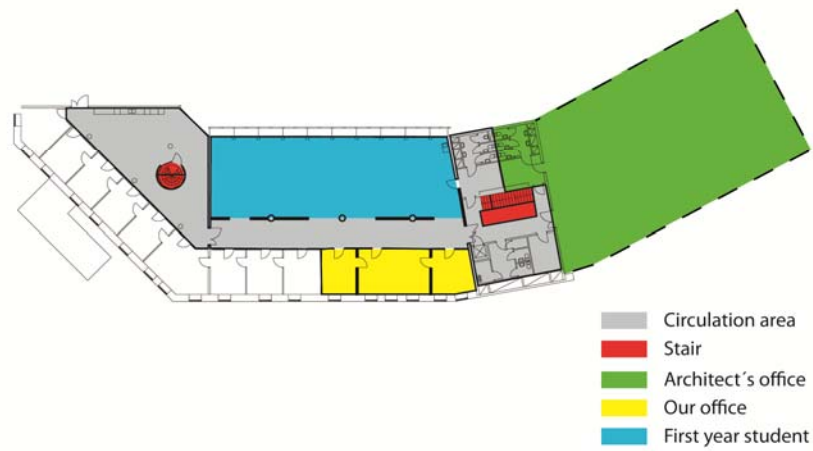

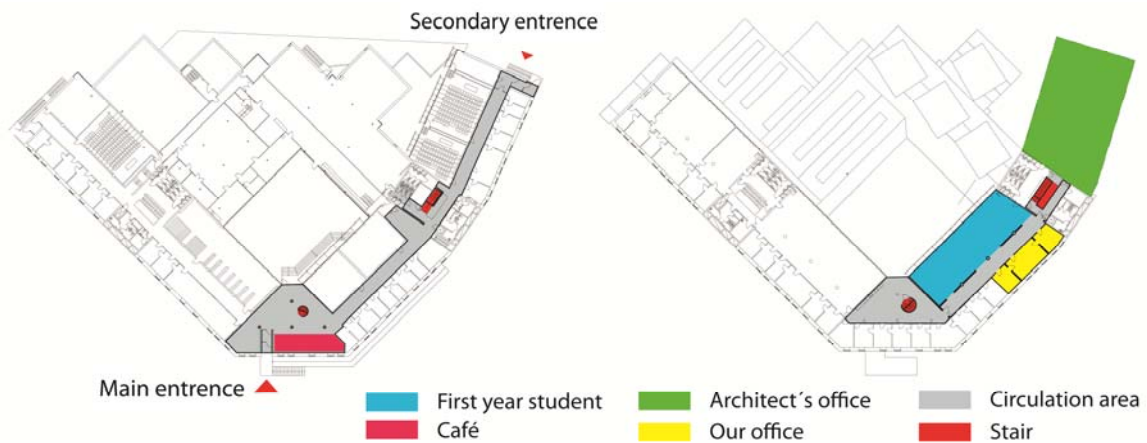*Figure 3. Floor one where our office is located.*

Figure 2. Entrance floor and floor one where our office is located. The gray area shows the spaces I use daily at the school of architecture, KTH.

This is the set up for my everyday work environment and I will give an example of how my assignment is carried out through this social and spatial network and in order to explore why this is an interesting way to examine how knowledge management is influenced by space.

[12]

I used to work at that architect office and I have a lot of friends working there, but none of my former colleagues drop by new work station informally. They will drop by if formally invited, although I often meet them informally in the common circulation area. When I meet the managers of the architect office, we often talk about future projects and how we might work together.

Our research group meets often, formally but mainly informally, to discuss research ideas, testing conceptions, arguments, or new ideas as well as to solve administrative issues. On the contrary I rarely talk to the first year students; no one in our research group does that despite their proxy location. We do not have anything in common with them except for the circulation space outside our office, although we have a lot of students from the master's program and diploma students visiting us for information or advice regarding their projects. This, of course, depends on the staff in our group who also works as teachers for these students.

I have done some extra work as teacher for third year students; they also sat in an open studio on the same floor though in the other end of the building. I felt very comfortable walking into their territory and supervising. I could always stay for a chat when meeting them in common areas. Since I stopped teaching them, I do not visit their studio, but I still stay for a chat when I meet them in the common areas. Of course, this has to do with the assignments. I had to go to their studio to perform my work as a teacher and now I do not.

Other staff – teachers, professors, and PhD students – sometimes stay to chat when they pass our office, although this does not happen very often, only a couple of times each week. I am not sure where they have their offices and due to the location of my office I am almost never pass any other offices. I casually meet these colleagues in the café at the main entrance where there are also people from other research groups present whom I chat with.

The mechanism of assignment is seen in my daily movement and encounters. There is an intricate interplay between my assignment and different groups, organisations, firms, etc. The most important interactions, due to my assignment, are carried out with my closest colleagues. I turn my chair and ask what they think about this text or step in to the senior researcher's office to get an opinion regarding something. Today we had a seminar where I talked about this text; we sat down at the large table in the middle room and the meeting went into lunch at the same table. This is a typical knowledge sharing situation within a community and very much related to the assignment. On the contrary is the contact with the first year students. I see them all day passing by my door in the circulation area and when I walk around talking on the cell phone outside my office, but I rarely interact with them. Some kind of

knowledge is created and obviously they affect me (enough to write about them), but not in the same way as colleagues inside our community.

Bruno Latour is a techno-sociologist who primarily has studied laboratory work. He believes that to develop a fair picture of the activities taking place in laboratories focus should be on the network of humans and non-humans. He emphasises that interactions are stored in artefacts as they hold interactions and are part of sequences or actions and keeps social relations in places when agents leave. In an office, the organisation of artefacts is very important for keeping the work going during the night and possibly to continue the work the next day. The organisation and its artefacts are interlinked and best described as a continuous network. Latour takes it further by arguing that the actors and their actions is a society and the only way to describe the society is through the interactions of the agents (1998).

Within the network of actors that I meet is a community of actors who I have closer contact with and use in the everyday performance of my assignment. Primarily these people consist of my research group but also a close friend working at the architect's office next door. There is also a PhD student from another research group whom I seek advice from regarding my work. These are people whom I trust and respect and we share values and cultural references. The rest of the network of actors (humans) to be found inside the spaces of the school (non-humans) is a mix of colleagues and actors with potential to be a part of the same community as mine, or the other way around.

In my everyday routines are the primary encounters regarding my assignment carried out within the research group, within the walls of our office or in other words within our community. According to Amin and Cohendet (2004), a community is the primary entity for knowledge development. They argue that ''the proper unit of analysis for knowledge formation in terms of knowing found in practice should be neither individuals nor organizations, but socially distributed activity systems, such as communities''. Communities are understood as ''active entities of knowing that make specific forms of knowledge through their daily practices''. According to them, organizational knowledge is better explained using cognitive variables and therefore should include ''consideration of the degree of knowledge intentionality and organization for it, the degree of variety and spontaneity in the community, incentives in place to favour experimental or procedural learning, accumulate experiences, achievements, and socio technological trajectories, and the organizational routines . . .''. Although they focus on communities, Amin and Cohendet promote interplay between management of knowledge through design and management of knowledge through communities as neither of them alone can cover all aspects that are needed to compete in the knowledge-based economy. Both Latour

and Amin and Cohendet interpret knowledge as something that circulates through the actor network and community and that this is very dynamic and an ever changing process as they expand and decrease in physical and virtual spaces.

Amin and Cohendet address the process saying that a community must somehow be governed to interact with other communities to help knowledge circulate in an organisation. They suggest that this can be made with relational proximity and through good technology, but crucial is the repeated interaction between actors from different communities. They suggest that the key management objective should be face-to-face interaction and maximization of benefits of co-presence and cross-community social events.

It is important that actor networks expand into the common spaces because these areas provide people the opportunity to interact, bringing in new knowledge to the community, knowledge that circulates through the network of humans and non-humans. The common spaces work as an interface between different communities, providing a platform where new contacts are made, where the communities can expand and contract. So how the common spaces interplay with departments and communities is a very important part of knowledge management. If the everyday encounters are encourage by the design of spaces, workers will more likely interact with people from other communities, sharing ideas and forming trusting relationships. This type of exchange is knowledge management through the use of spatial strategies.

Our office can be said to be an actor (non-human) holding our interactions through positions, books, computers, desks, stacks of papers, etc. How it is spatially structured and where we have chosen to position ourselves and our artefacts are crucial for our community's performance. If someone were to restructure the setting of the office, the disturbance would be total – even few or small changes would have an impact. The setting of an office carries a lot of knowledge through its configuration of stuff and people. As seen before, our office is structured as three rooms parallel to a circulation space. In the middle are the senior researchers and the meeting table and in the smaller room, on the sides, are PhD students and younger researchers. To interact face-to-face with the senior researchers one has to enter the centre of the office. The senior researchers act as a central role in the research group, both socially and spatially.

According to the sociologist Goffman (1959), the interaction between humans is the aspect to focus on in order to describe society; it is in the encounters where society is performed. Goffman builds a long argument around how the interplay between persons is built around a performance of different roles, formal and informal,

changing as the setting of artefacts and human's change. The visual relations are, as Goffman interprets them, the most basic form of interaction. He argues that the appearance of a role depends on the setting, e.g., clothes, furniture, etc. That is, the spatial position is part of the setting, giving a basic potential for the expression of a role. Despite whether a position is consciously chosen or given or unconsciously chosen, it will affect the way a role can be acted. In a Goffmanian sense, a person's spatial position is both a way of acting a role and reaching an audience.

As a bi-product of our observation studies, we have seen that managers of all sorts tend to position themselves strategically relative to their co-workers (Markhede and Steen 2006). This phenomenon was seen in several cases in landscape offices, most strikingly at a newspaper office where the chief editor unconsciously picked the most visible spot in the whole office although on a local scale the position was peripherally located. In addition, middle managers followed the same positioning on a local scale. What is striking about this is that the studied office landscapes were designed to be very non-hierarchical: everybody had the same number of square meters and same type of desk, chair, and file cabinet. Perhaps the use of these visually central positions is strategic, a strategy that seems to strengthen the role of the manager, to be seen and to see others. This kind of spatial strategy has intrigued me when summing up our studies. Taking a position is crucial for how we express ourselves and how we are influenced as roles change depending on the interaction. In a very basic sense, the manager is in a visually strategic position. The manager has chosen a spatial strategy to express a hierarchy of power. By using a basic spatial quality, he/she can use the building's shape to express power: "In space, relations of power are ever-present" (Markus 1993). Markus clearly sees how power is formalised through functional and spatial strategies. He notes that buildings are social objects in themselves carrying ideas of order and hierarchies.

In this text, spatial strategies are thought of as how a role uses a spatial position to interact with others and communicate itself. It is also how an organisation occupies spaces, the underlying strategy for how different roles in the organisation are positioned relative to each other. Spatial positions give different settings for different roles, as shown in the fictive example the office (see paper one). In fiction, spatial position is used to strengthen a character and perform a narrative; in reality, it is similar but also an instrument that manifests power. The setting and the roles acted in the settings seamlessly affect each other; the role acted needs a spatial position, a position rational for the actor's spatial strategy. It can be periphery or central depending on what seems feasible at the time. Here the choice of spatial strategies is about choosing spatial positions in order to achieve a specific interaction with others, as the manager does when positioning him or herself in a visible centre, using the position to solve an assignment.

Spatial strategies are not only performed individually. Goffman also describes the interplay between roles and teams; the team is defined as *a group in relation to an interaction or a series of interaction under which relevant definition of the situation is maintained*. For Goffman, interplay between teams is also a drama built on the conflict between roles played in the front regions and back regions. He defines it as an area defined by perception-barriers: the front region is for a more representative performance and the back regions are more for informal performance although they often support the front region

Goffman's definition of team is similar to how A and C defines communities: ''*active entities of knowing that make specific forms of knowledge through their daily practices*'' and I find it relevant to co-interpret them even if there are some differences. Community seems to be a broader social phenomenon than team, but since it is used for talking about interaction in offices, I will treat them as related.

A & C suggest that communities are the core aspects for knowledge management. There were also two different kinds of interactions defined as interesting, the inter-community and cross-community interaction, the former for knowledge creation and later for knowledge circulation. These take place in different kinds of physical spaces; the inter community is primarily within community specific spaces, as in our office, and the cross-community is primarily performed in common areas, as in the restaurant at our school.

The spaces are related to both different roles and assignments. Front regions focus on circulation of knowledge through formal roles related to the decorum of the situation. Back regions are more informal roles that focus more on performing assignments and knowledge creation. The sequence of back and front regions creates a continuous space where actors interact and roles change as the sequence unfolds. Seen from the Goffman dramatizing perspective, all good drama I driven by conflicts, and as he describes the drama is the conflict between different roles and regions. Fictive drama does not work without conflicts and in reality creative communities depend on how they confront and channel differences and disagreements. When actors are moving between back and front regions, different kinds of conflicts unfold depending on which interactions are taking place. The inter-community interaction engages in conflicts about everyday routines and negotiation roles within the community. The cross-community interaction is more about taking positions for recruiting or being recruited from and by other communities and/or transporting conceptions and routines between communities. Drama or not, the conclusion is that this can be an interesting interpretation when analysing socio-spatial relations in workplaces.

Knowledge management by spatial relations was at first thought of as something related to generic movement patterns. During our field studies, we noticed that organisational relations have a large impact. Input from A and C highlights that the community ought to be understood as the core for knowledge performance and the place where trust and differences are channelled into creativity. Furthermore, it is essential to manage for repeated face-to-face interaction between communities so that knowledge can circulate within the organisation. The interplay between social and spatial configuration creates crucial interaction patterns (Steen, Markhede 2008, and Steen 2009)

The analysis can be set to three different modes of operation: single actor interaction, inter-community interaction, and cross-community interactions. Primary is the different modes to be interpreted together although they can be said to work with knowledge circulation in different ways. The single actor mode tells something about how the most basic act of a role is carried out, how it stages itself. The inter-community mode focuses on internal interaction, inter-visibility within a community, who sees whom and who sits on the periphery and who sits in the centre. The cross-community addresses the common areas and how the interface between communities is brought together, defining spaces where cross-community interaction potential are high and low. Also the aspect of front and back regions will be used as the circulation patterns in front regions seem to be more of a natural movement and in back regions circulation patterns seem more due to assignments and functions.

One has also to take into account how roles and assignments are performed within communities and the socio-spatial network. Strategies for formalising power and narratives through spatial relations are seen in our studies as well as in our references and will be of substantial interest in future research. The choices of how to position oneself, others, and artefacts in a spatial position are both conscious and unconscious choices. In offices, positions of workstations depend on many different layers of choices, overall strategies combined with small-scale choices and individual initiatives, although there seems always be a spatial strategy.

Summing up

The effect of organisational borders is so strong that a correlation with traditional space syntax modelling does not appear with face-to-face encounters. Encounters are primarily performed between colleagues at workstations within departments or communities. Together with data from the studies that focused on department stores, we have understood that we can use space syntax analysis in a new way, focusing not only on movement but also on analysing interactions.

The discussions develop three lines of interest. First, the discussions examine space syntax from a rational choice perspective to develop novel models and investigate the assignment as the basic driving force when analysing face-to-face interaction in buildings occupied by an organisation. Second, the discussions argue for the use of socio-spatial definitions when setting the outline of the models. Departmental relations, communities, and spatial proximity seem to matter for interaction patterns. There is also a theoretical aspect to this theme that highlights the interaction interplay between humans and artefacts, the actor-network theory[4] (ANT), an approach that brings into relief interactions performed through a network of actors, human, and artefacts. The proposed theme to work with here is limitation of networks, both spatially and organisationally. Third, discussions highlight that roles, as described by Goffman, can be useful when interpreting some narrative behaviour seen in our field studies. It can be used to describe the interplay in a community by looking at how spatial positions express a role and/or an assignment. Goffman also highlights the interplay between back and front regions. This discussion looks at roles, both on an individual scale and on a group scale. In addition, this discussion examines the interplay between spatial positions and regions in the everyday drama. This interpretation complements both the assignment aspect and the socio-spatial aspect. A conclusion is to propose an interpretation of the interplay between spatial positions, both individuals and communities, to explore the knowledge flow in an organisation.

All the above speculations made me reconsider interaction as the core objective within positioning analysis and interpret visibility as the most basic form of interaction. Therefore, this study suggests a difference between the regular space syntax analysis and positioning analysis described in RC terminology. That is, space syntax analysis of pedestrian movement in cities requires examining *the interest* of the pedestrian to arrive at a predetermined destination, *the belief* that this goal can be attained through the street network, and *the opportunity* to use walkable surfaces. Taking these categories as a model, space syntax analysis of interaction in offices can use the same three categories with slightly different definitions: *the interest* of the office worker *is* to interact; *the belief* of the office worker is to do it through the assignment; and *the opportunity* of the office worker is to do it through visibility.

---

[4] ANT is an approach within sociology originating from science studies associated with its harsh critiques of conventional sociology.

References

Allen, T. 1977, *Managing the Flow of Technology*, MIT Press, Massachusetts.

Becker, F. and Steele, F. 1995, *Workplace by design: Mapping the High-performance Workplace*, Jossey-Bass, San Francisco, CA

Benedikt, M.L. 1979, *"To Take Hold of Space: Isovist and Isovist Fields"*, Environment and Planning B, vol. 6, no. 1, pp. 47-65.

Blombergsson, M, Wiklander, J. 2006, "Spatial support for key usability factors: spatial influence on interaction patterns for 800 office workers", Proceedings, CIB W70,

Blombergsson, M, Wiklander, J. 2010, Future coming licentiate thesis

De Certeau, M. 1984, *The practice of everyday life. Berkeley*, University of California Press

Duffy, F. (1997), *The New Office*, Conran Octopus Ltd, London,

Turner, A. 2003, *"Analysing the visual dynamics of spatial morphology"*. Environment and Planning B: Planning and Design **30**:657–676 (men citatet är från hemsidan http://www.vr.ucl.ac.uk/research/evas/)

Giddens, A. 1993, *Sociology,* Polity Press, Cambridge, UK.

Goffman, E. 1959, *The Presentation of Self in Everyday Life*, Penguin Books, London, UK

Gorawara-Bhat, R. 2000, *The Social and Spatial Ecology of Work,* Kluwer Academics/Plenum Publishers, New York.

Grajewski, Tadeusz. 1993. *The SAS Head Office – Spatial Configuration and Interaction Patterns*. Nordic Journal of Architectural research, vol. 2, pp. 63-74.

Groat, L, Wang, D. 2002. *Architectural research methods,* John Wiley and sons, inc. pp. 304-305

Hanson, J. 1998, *Decoding Homes and Houses*, Cambridge University Press, Cambridge, UK.

[20]

Heo, Y. et al. 2009 *"A modelling approach for Estimating the impact of spatial configuration on nurses´ movement",* Ref 041 Proceedings, 7th International space syntax symposium, Stockholm, 2009

Hillier, B. 1996, *Space is the Machine*, Cambridge University Press, Cambridge, UK.

Hillier, B, Hanson, J. 1984, *The Social Logic of Space,* Cambridge University Press, Cambridge, UK.

Hillier, B, Lida, S. 2005, *"Network and Psychological Effects: A Theory of Urban Movement"*, A. Cohn, D. Mark (Eds) Spatial Information Theory, Lecture Notes in Computer Science 3603, Springer Verlag, pp.473-490.

Hillier, B, Major, M.D, Desyllas, J, Karimi, K., Campos, B, Stoner, T, 1996, *"Tate Gallery, Millbank: A Study of the Existing Layout and New Masterplan Proposal",* Technical Report, Bartlett School of Graduate Studies, University College London, London.

Ingold, T. 2005, *"Up, Across and Along"*, A. van Nes (Ed.), Proceedings, 5th International Symposium on Space Syntax, TU Delft, Delft, pp. 45–54.

Koch, D. 2004, *Spatial Systems as Producers of Meaning: The Idea of Knowledge in Three Public Libraries*, Licentiate Thesis, KTH

Koch, D. 2007, *Structuring Fashion: Department Stores as Situating Spatial Practice*, Doctoral Thesis, KTH, Axl Books, Stockholm.

Latour, B. 1998, *Artefaktens återkomst,* E. Wennerholm (trans.), Nerenius & Santerus Förlag AB, Stockholm.

Lu, Y. et al. (2009 *"Targeted visibility analysis in buildings: Correlating targeted visibility analysis with distribution of people and their interactions within an intensive care unit"* Ref 068 Proceedings, 7th International space syntax symposium, Stockholm, 2009

Markhede, H, Steen, J. 2006, *"Analysing Open Space Offices",* Proceedings, CIB W70 Changing user demands on buildings, Trondheim, pp. 533-541.

Markhede, H, Miranda Carranza, P. 2007, *"SPATIAL POSITIONING TOOL: a prototype software and some background correlation data "* Ref 102, Proceedings, 6th International space syntax symposium, Istanbul

Markhede, H. Koch, D. 2007, *"POSITIONING ANALYSIS: social structures in configurative modelling"* Ref 069, Proceedings, 6th International space syntax symposium, Istanbul

Marcus, L. 2000, *Architectural knowledge and urban form.* Doctoral Thesis, KTH Stockholm

Markus, T A. 1993, *Buildings and power: freedom and control in the origin of modern building types*, Routledge, London, UK

Penn, A. 2003, *SPACE SYNTAX AND SPATIAL COGNITION Or Why the Axial Line?* ENVIRONMENT AND BEHAVIOR, Vol. 35 No. 1, January 2003 30-65

Penn, A. Desyllas, J. Vaughan, L. 1999. *The Space of Innovation: Intertaction and Communication in the Work Environment*. Environment and Planning (B), vol. 26, No 2, pp. 193- 218.

Peponis J, 1985*, "The spatial culture of factories"*, *Human Relations*, v.38, April, New York, London, 357-390

Peponis, John, Sonit Bafna, Ritu Bjaj, Joyce Bromberg, Christine Congdom, Mahbub Rashid, Susan Warmels, Yan Zhang, Craig Zimring. 2007. *"Designing Space to Support Knowledge Work*. Environment and Behaviour*"*, vol. 39, No 6, pp. 815-840.

Sailer, K. et al. *2007 "Movement in workplace environments: configurational or programmed?"* Ref 068, Proceedings, 6th International space syntax symposium, Istanbul

Sailer, K. et al. *"Spatial and transpatiality in workplace environments"* Ref 095 Proceedings, 7th International space syntax symposium, Stockholm, 2009

Steen, J, Blombergsson, M, Wiklander, J. 2003, *"Useful Buildings for Office Activities"*, *Proceedings* European Facility Management Conference, vol. II*, Rotterdam, pp. 14-17.

Steen, J. 2009, *"Spatial and social configurations in offices"* Ref 107, Proceedings, 7th International space syntax symposium, Stockholm, 2009

[22]

Steen, J, Markhede, H. 2008. *"Creativity demands New Office Designs"*. Proceedings, CIB W70, European Facility Management Conference, Healthy and Creative Facilities, Edinburgh, pp. 313-320

Ståhle, A. Marcus, L. Karlström, A. 2005, "*Place Syntax – Geographical Accessibility with Axial Lines in GIS*", A. van Nes (Ed.), *Proceedings*, 5th International Space Syntax Symposium, vol. I, Techne Press, Delft, pp. 131-143.