Spatial and Social Configurations in Offices

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Abstract
The strength of space syntax is the potential to describe the interplay between spatial configuration and social behaviour; however, there are some important differences between the space syntax found on the urban level and on the building level. In studies of offices, we have found that integration values do not explain the pattern of movements and the positions of interaction. The average interaction frequency is just the same for workstations in different positions and in different office concepts despite the fact that many “spontaneous” interactions occur when people pass workstations. Although there are some spatial explanations for this homogeneity (the studied offices are shallow systems both when it comes to cellular and to open plan offices), interaction follows organisational borders in an open plan office as these borders act as if they were walls: almost no interaction crosses the department borders in spite of some units being spatially well-integrated. Obviously, the spatial influence in these offices is weak when it comes to encouraging spontaneous interaction across organisational borders. In fact, much of the so-called spontaneous interaction is programmed, even if it is not scheduled. Clearly, visibility is important for social behaviour; we found that office workers have most frequent interaction with nearby and visible co-workers. To some extent, this is an effect of placing people according to the organisation scheme, but still - as we know that work processes in offices are largely formed by context, so this “use” of the neighbours is also an effect of seeing each other every day. We also noted that openness is more problematic when it comes to sound. Many people are disturbed by talking in open plan offices and one conclusion is that work dominated by “long questions” suffers from this conversational overhearing, while work dominated by “short questions” has the possibility to balance the negative effects. There is a need both for new office design and for management strategies that combine spatial and social configurations in a more conscious way. The findings presented in this paper are from studies of seven offices/companies with a total of about 1500 office workers.

Keywords: spatial analysis; spatial configuration; knowledge sharing; social configuration; office design; interaction

1. Introduction - the lack of knowledge
There is a lot of talk about the new age of office work and office design. Everybody seems to be afraid of being left behind when everything is supposed to relate to the new knowledge society. Consultants, producers, and researchers are in the middle of this discourse, using the same arguments and aiming at the same concepts, even if elements of pure fashion are sometimes striking. To this end, space syntax research has been challenged to understand how offices act as spatial configurations. Natu-
rally, researchers have been drawn to test whether the very fruitful results from urban studies correlat-
ing spatial properties with social behaviour are also applicable to buildings, especially office build-
ings, since they are supposed to act perhaps differently from more anonymous socio-spatial situa-
tions. This interest for movement and co-presence, creating a potential for encounters and interaction, and, in the longer term, a potential for knowledge sharing, is strongly connected with the efficiency of buildings with respect to human and economic life. Perhaps such knowledge will then lend itself to developing a more sustainable society.

The strategy characterizing space syntax is keeping the analysis on a principal level, looking for patterns without drowning in the details and specificity. On the other hand, the problem may be that the aggregation of data on average levels could hide strategic differences. After some years of trying to understand more about the spatial conditions interacting with social life in offices, we think it is possible to take a step further in revealing the processes within offices. Our conclusions from these studies must, however, depend on our capacity to formulate relevant theories and make relevant interpretations.

There are several important contributions to empirical knowledge, methodological develop-
ment, and the development of theory (Grajewski, 1993; Hillier, 1996; Penn, et al., 1999; Bafna and Ramash, 2007; Peponis, et al. 2007). These findings, however, do not always point in the same direc-
tion (see Sailer, 2007). Much work needs to be done to develop more solid knowledge of the spatial influence on the knowledge processes. This paper is about what can be revealed when we look at the social organisation as more than a bias to behaviour patterns when it comes to understanding offices (Markhede and Koch, 2007).

2. Research question
Our focus is on interaction between office workers in the same businesses, the interaction that moti-
vates a co-ordinated workplace. The main research question is how the spatial configuration of the office influences spontaneous interactions and planned interactions in meeting rooms or lunchrooms. Our next question is how social conditions, such as the organisational configuration and the type of work, influence the interaction. Do these conditions support or hinder the conditions created by the spatial form?

3. Research Strategy
To investigate our questions, we studied similar office activities/work in different office concepts and different activities/work in similar office concepts. In the first case, we studied a technical consultancy firm located in five buildings (Steen, 2001). In the second cases, we studied the headquarters of an insurance company with both individual rooms and landscapes and three tax offices with cellular offices, combined offices, and cubicles (Blombergsson and Wikander, 2006). In the third case, we studied a newspaper office with open plans, one for the editorial part and one for the administration (Markhede and Steen, 2006). In the fourth case, we studied the head office of the Swedish mail company, Posten, with three similar floor plans with some differences in work activities (Markhede
The idea has been to study what could be called normal office work; that is, we studied a relatively independent handling of a certain amount of tasks/commissions. The newspaper case was chosen because it was somewhat different.

Social data was collected through observations, logbooks, questionnaires, and interviews. In the final case, data was also gathered by asking office workers to map out their own face-to-face interactions. Spatial data was gathered using Space syntax methods (Grajewski, 1993; Hillier, 1996; Penn, et al., 1999). Initially, we used Axman-analysis, followed by DepthMap (in the later cases), and supplemented by other spatial values.

### 4. Initial findings

In our observations of spontaneous interaction, we found that on average nine out of ten interactions occur at workstations with one out of ten interactions occurring in common areas such as corridors or in the proximity of printers. We found a higher value of interaction (17%) in common areas in cellular offices compared to the top value (14%) in open plan solutions. In smaller and more enclosed systems - in systems where workers (for example, when walking to a printer) do not routinely come in contact with many other co-workers - there are about six movements for every interaction compared to three for larger and more open systems.

In our analysis using space syntax methods, we did not find any correlation between integration values and movements. Consequently, there was no correlation with the outcome of interaction. On the global level, there is more correlation with movement, but not with interaction. This is most likely an effect of the necessity for a building as a whole to form a tree-like structure and act accordingly. One explanation for the lack of correlation at the local level is the existence of common functions, which either act as attractors or assume the position of counteracting or supporting spatial properties. Obviously, this is not limited to the position of hard artefacts: managerial staff and experts are also attractors in the spatial system. Shallow spatial systems at the local level may provide a second explanation for the values in our analysis of the major differences encountered at each office included in the study. As almost every workstation is positioned one or two steps from the main passages, the spatial configuration will not create the differences in terms of use and usability that had been anticipated.
Figure 2. The newspaper company: workstations at the editorial floor

Figure 3. A VGA-model with the whole editorial floor divided into three separated parts showing the local visual integration

Figure 4. A VGA-model showing the local visual integration with observed interaction and the roles of the staff. The rings point out the positions for more than one interaction between colleagues during the twelve observation times. Red areas indicate the most visually integrated parts of the spatial system, yellow areas indicate the second most, green the third, and blue the least. Role of the staff: Yellow: top management; Red: middle management; Orange: editors; Green: journalists; Brown: graphics; Grey: photographers; Soft pink: chief editors; Pink: assistants.
So far, we have been discussing the general level. When we look closer at the individual level, we find more variation. On the general level, the observed interaction is the same for office workers sitting in cellular layouts as in open landscapes. Looking more in detail, we find that some people sitting in individual rooms are involved in more interaction at the workstations than others in the same concept. If we exclude those who have more interaction that depends on special work tasks, we find that persons sitting in more visible positions have more interaction than others. This indicates that the distribution of interaction in space is more a question of visibility than accessibility. Our interpretation is that the longer time a stationary and a moving person can see each other the greater potential for either of them to reflect over the potential of interaction and act accordingly before it is too late. To this we can add the conclusion that individuals who are seen more often than others are experienced as useful, and therefore are more recruited to interaction (Penn, et al., 1999).

Figure 5. A VGA-model showing the local visual integration with the group organisation marked. The red spots show the positions of the chief of the group. The black line shows the area where they decide where who sits where.

Figure 6. A Visual Graph Analysis (a VGA-model) for the whole editorial floor with roles in the organisation. Red areas indicate the most visually integrated parts of the spatial system, yellow areas indicate the second most, green the third, and blue the least. Top managers and their assistants are located within the black lines.
Another pattern we found that is strongly related to visibility is the positioning of managerial persons, who often have power or strong influence over the location of their workplace. Especially in open plan offices, we found that the normal pattern is that the head of a group has his/her workstation in the most integrated spot in relation to the others of the group. We find that the location of department managers follows local integration (VGA) and that the location of senior management follows global integration. This pattern is strong and, conscious or not, the role of management is without doubt connected to the quality of seeing others and being seen.

5. Further Findings
To understand more about the mechanism behind spontaneous interaction and the associated role of spatial properties, we used a new method to analyse the head office of the Swedish mail company Posten. Our problem had been a lack of knowledge about who was interacting with whom. This time we asked every office worker on the three floor plans (250 people) to map all their interactions over a two-day period. Each person's data is represented on a single layer in the computer and is tagged with the information of the applicable organisation (for departments consisting of 30 to 50 people).

![Figure 7. The same floor plan of Posten as in Figure 1 with organizational borders and dots for all self-reported interactions. The colour indicates the reporter's department.](image)

This new method made it possible for us to see that 95% or more of all reported interaction occurs within the same department. This is the case even in situations where two departments are closely integrated spatially. This means that spontaneous interaction is very much programmed: people talk to others who are appointed as their fellow-workers, people with whom they are supposed to cooperate and produce joint results. Perhaps we can say that people are not social in the sense of talking to just anybody: they economize their sociality. However, not every interaction must be of immediate importance and use. Some interactions seem to have as their primary role the maintenance of the social system at the individual level. Organisational belonging is the cause of interaction while also lending it legitimacy. With this in mind, we should perhaps avoid using the concept of spontaneous interaction. But if the interaction is programmed in the sense that it is related to work tasks and roles, we do not consider every interaction to be a necessity. As such, interactions range from interactions that are probably useful to those that are necessary. Almost all forms of interaction, however, do seem to be related to the formal organisation in ways that can seem surprising.
What about the spatial preconditions, do they play any role? If every realised interaction was necessary for the work, we think the spatial design should play a less important role. For example, working at home would not be a problem and contacts could be made on demand. It is, however, obvious that the interaction pattern to some extent is a result of each person moving around in the office, regardless of the original aim of the movement. We can also see that office workers moving around the office often do more than one activity on the same tour. To move toward the printer, the toilet, or a colleague will many times include talking to other persons who are passed. Looking at our floor plans in the Posten case with all interaction spots marked, we were at first surprised at the homogeneous distribution of interaction in space. Even in the more peripheral parts of the space, there is a lot of interaction. Looking closer, we can, however, see that there are differences: in the more central part of the space there is relatively more interaction. Some of this higher degree of interaction we understand as a consequence of more people passing by the centre. If a worker is based in a peripheral area and moves toward another person sitting in the opposite peripheral area, it is likely that the ambulatory worker will pass people in the centre. Similarly, an ambulatory worker moving from the peripheral to only the centre will not pass (and presumably not interact with) co-workers based in the other peripheral areas. That also means that persons whose workstations are in the centre have greater possibilities to interact with colleagues. We need to remember that this is the case in a very open plan office concept, but the mechanism should, however, be the same in less visible concepts.

To evaluate the interaction pattern, we conducted a social network analysis. In the questionnaire sent out to all office workers based on the three floor plans at Posten, we asked for the names of five people within the whole organisation with whom the person in question most frequently interacted in the following ways: a) face-to-face, b) by mail, and c) by phone. As we knew the names and positions both of the respondents and the people they named, it was possible for us to study the influence of physical distance as well as the configurational relations in space.

We divided the floor plan into squares of four or two workstations. If the respondent named a person sitting in the same square, the distance was 0. If the person was sitting in an adjacent square, either at a right angle or a diagonal, the distance was 1, and so on. Had space not played a part, face-to-face interaction would have resulted in a value of 5.9. Our questionnaire provided a result of 1.2. Through this investigation, we could conclude that 41% of all interactions of this kind occur within the same unit of workstations. We could also see that 76% of the respondents' five most regular face-to-face contacts sit within a distance of 1 and 88% within a distance of 2.

Furthermore, the existence of reciprocal connections are over represented compared to a random process. This supports the theory of balance: a friend's friend is also a friend. While the reciprocal connections count for 60% when it comes to face-to-face contacts, it is much lower for mail and telephone contacts. If we only look at these types of contacts on the same floor plan, we also find that they depend on physical distances: the average distance is 1.8 and 2.5, respectively. It is clear how e-mail functions both as a substitute and as a complement to face-to-face contacts.
We also found the distance effect to be strong in our early study of the technical consultancy firm, where almost everybody works in cellular offices. There we asked for the distance to the five most useful people. On average, we received responses to the effect that three of the five most useful people had workstations in the immediate proximity (Steen, 2001). Finally, when we analysed the spatial configuration (VGA) with the reports on the five most frequent contacts at Posten, we did not find any correlation, neither on the global nor the local level.

6. Interpretation of the positive side of interaction

The impact of distance on interaction frequency is significant. This should not come as a surprise when one considers that it is normal management strategy to position people close to each other on the basis of their likelihood to cooperate. Members of a team obviously understand that their task is to cooperate for the common good. There are, however, reasons for questioning the way in which this positioning tallies with the organisation of work tasks into different roles, i.e., the social configuration. In interviews aimed at understanding existing work processes in terms of similarities and differences, we found that the level of cooperation between office workers in the same group/team is not at all as homogeneous as the results shown by the questionnaires. To some extent, these differences are hidden behind the method where the office workers are asked not to report degrees of interactions per se, but to name the “five people most contacted”. As this provides relative values, it provides very little information about the number of contacts per day behind “most”, which could vary dramatically between respondents.

One reasonable initial explanation for the importance of proximity relates to the level of confidence built up as a result of seeing a person regularly. It should perhaps also be noted that much weight seems to be given to relationships occurring at an equal level, i.e., a mutual relationship of giving and taking. The effect of proximity - talking more to people in one’s immediate vicinity - is reinforced by the tendency to regard people encountered regularly as more useful. It is our contention, however, that the phenomenon can be further explained by the content of the interaction. We know that it is extremely difficult to acquire information on an interacting pair’s verbal exchange without disturbing the situation. If, however, we could obtain concrete information about the interaction content, we would be forced to develop new theories to categorize the data in relevant ways.

Rather than drowning in a surplus of knowledge categories, we have identified a main level where differentiation occurs only between two categories of knowledge or knowledge-related interaction types: fact-related knowledge and judgement-related knowledge. For fact-related questions, people will carefully consider whom to ask on the basis of their expertise. If that person cannot provide an answer, he/she will say so, enabling the asker to either put the question to another expert or attempt to find the answer in written material. When it comes to judgement-related questions, anybody can ask a question and expect to receive an answer. As it is not a matter of right or wrong, everyone can understand the question to some extent and have an opinion. But as these kinds of questions depend so much on an understanding of the context, one must have confidence in the
other’s experiences and value systems. When it comes to matters of judgement, it is our view that people rely on those in their proximity, the people one sees often and knows as individuals to some extent. Furthermore, this interaction process will strengthen the ties to people in their immediate vicinity. In addition, face-to-face contact is often crucial in areas of judgement, as often a counterpart’s facial expression offers sufficient evidence of their opinion. Fact-related questions are easier to define and transmit via email or telephone.

7. The downside of interaction

So far, we have looked at interaction as a positive force in office lives, but even if interaction is necessary for businesses, there is also a negative side, which must be understood if we are to draw any conclusions about the design of office concepts. In most office work, workers are forced to work individually to achieve results, and there are limitations on the amount of time they can interact with others. Since we know that a normal work pattern for office workers involves interaction integrated into work tasks on an hourly basis (one of the reasons teleworking is not more widespread), handling the surplus of interaction is essential to minimise disturbances to work concentration. Exposure to movement is not a cause of disturbance; instead, problems arise through exposure to eyes and ears. In this regard, open plan offices pose problems of a degree not found in the cellular concept. The negative aspects of visibility, however, are easier to handle, as there are ways of not having to visually notice people passing by. But every action undertaken to make a visual situation calmer - such as erecting screens or turning one’s back on thoroughfares - will restrict the positive side: the ability to look others in the eye and engage in interaction.

It is, however, aural exposure in office landscapes that is the primary cause of real problems, judging from the answers to our questionnaire in the Posten case. First, we divided disturbances into two categories: a) Are you disturbed by others interrupting you? and b) Are you disturbed by other people chatting nearby? We also asked about having the opportunity to talk undisturbed to other people at one’s own workstation and the related feeling of disturbing others and perhaps restricting conversations. Looking at our VGA-analysis of the three floor plans at Posten, we do not find any correlation between spatial values and answers concerning disturbance through interruptions by other people talking or the possibility of talking at one’s own workstation.

![Figure 8. Visual integration (VGA) of the same floor plan as above, 1.8 meters from floor level.](image)
To further test the impact of spatial properties, we divided all workstations into two groups: workstations adjacent to main thoroughfares and those not adjacent. Of the respondents with workstations adjacent to main thoroughfares, 27% replied that they were disturbed several times per day. Fewer respondents in the second group, 23%, reported several daily disturbances. When asked whether they were disturbed by other people talking, the distribution among respondents was similar: 38% in the adjacent group were disturbed several times per day as opposed to 31% for the non-adjacent group. Regarding the possibility of being able to talk undisturbed at one's own workstation, the distribution of responses was somewhat surprising: 82% of people sitting adjacent to thoroughfares said "no" compared to 86% of people in deeper office positions. In conclusion, the division into two simple spatial dimensions did not produce the anticipated differences in an obvious way. However, when we cross-checked different data from the questionnaires about disturbances and work content, we found that disturbances are experienced most acutely by respondents, indicating a need to work undisturbed. The answers suggest that respondents experience disturbances to a greater extent when their work requires a high degree of concentration.

8. Interpretation of the downside

It is often said that the problems (some) people express regarding noise disturbance are an effect of individual characteristics. To some extent, this is of course true. We will, however, argue that work content is the key factor behind the experience of disturbance. To this end, we will return to the discussion of the two categories of knowledge.

In our opinion, it makes a lot of sense to describe work processes as consisting of tasks that deal with either long or short questions. Long questions pertain to tasks requiring consideration and are of the kind described above as judgement-related knowledge. Questions of this kind necessitate a juggling of ideas, either in one's own head or in league with others. This is because long questions must be understood in their context with implications changing as the context changes, a dynamic process that demands a focused chain of thought. Short questions are simpler to process: they consist of shorter chains of thought and more fact-related knowledge. We think it is reasonable to surmise that work processes of this kind are more predictable. Of course, both kinds of questions are in play in most offices. The point is that work dominated by long questions will have more negative interaction effects than work dominated by short questions that use the positive aspects of interaction to a greater degree. It is notable that half of Posten's office workers stated that they often received useful information through listening to other people's conversation.

According to our findings, the negative aspects of interaction result mainly from exposure to sound and will above all affect people with long questions. In aurally open spaces, there is a risk of lower efficiency both due to interruptions and restrictions on more complex conversation that could lead to others being disturbed. These problems can be hidden behind the fact that there are obvious
knowledge exchange processes at play in open plan offices, but perhaps this interaction over-stimulates the homogenizing of knowledge and the reproduction of social systems rather than enhancing the kind of knowledge development that will lead to strategic development for the organisation as a whole (Becker and Steele 1995, Duffy 1997).

Visual exposure seems to play a more positive role and perhaps a more relatively active role, as mentioned above. Seeing other people, seeing that they are available for interaction, and being reminded of the value of talking to a particular person are all positive qualities in terms of the efficiency of work processes. Indeed, this forms the backdrop to our development of the Spatial Positioning Tool (SPOT), which is intended to be both an analytical and a design tool (Markhede and Koch, 2007; Markhede and Miranda, 2007).

Conclusions
Let us summarize in four points:
- Office work is largely shaped in the ongoing work processes as a consequence of the combination of two types of knowledge in the work processes: fact-related and judgement-related knowledge. In spite of a wide range of activities in offices and of office concepts, the behaviour of office workers is relatively similar: the average frequency, for example, of face-to-face interaction is quite stable.
- Accessibility can be described in three dimensions: for movement, which is fundamental to letting people pass each other creating the potential for face-to-face interaction; for sight, which enhances the amount of interaction; and for hearing, which is both a carrier of information and a disturbance. Office design with a new balance between visual and auditory accessibility is of great interest.
- All interaction seems to be more or less programmed by the social configuration, but at the same time most interaction occurs at workstations and the distance to others plays an important role, especially for frequent contacts face-to-face. Spatial distance will in this way enhance or reduce the effects of organisational ideas of collaboration between office workers.
- There is a need to understand the difference between work conditions that support work dominated by long or short questions so that management can develop spatial strategies relevant for the aims of the organisation together with other applied strategies.

References


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