Spatiality and Transpatiality in Workplace Environments

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Abstract

It is widely considered that the physical layout of workplace environments has an influence on social interaction and therefore the social structure of an organisation. However, there is little accordance among scholars from different disciplines on exactly how the relationship between space and organisation is constituted. Empirical studies often come to different conclusions: for example, on the influence of an open-plan office on communication patterns among staff, as many studies report increases as report decreases or unchanged communication behaviours. This evidence-base is further confused since few studies make a link between a profound spatial and an organisational analysis.

We suggest that the inconsistency of results is for two main reasons: first, methodologies for operationalising variables differ significantly with each study tending to analyse a distinct notion of a phenomenon. This makes further comparative conclusions and predictive modelling problematic. Second, even where the same methods are used, contradictory evidence emerges, where one organisation reacts differently to another to similar spatial conditions. This suggests that, at the core of the problem, lies an apparent lack of understanding of the nature of the space-organisation relationship.

This paper explores these phenomena by drawing on the results of various case studies conducted over the last few years in diverse organisational settings (a university, a research institute, and in corporate media companies). Two main lines of argument will be developed: first we will show that some influences of space on organisational behaviour seem to be generic. Understanding of these generic influences may be used to design spaces enhancing interaction and knowledge flow for any type of organisation. Second, we outline how organisations depend on context, culture and character, and may react to similar spatial configurations in a unique way. We will suggest why this may be the case, referring to Hillier and Hanson´'s notion of spatial and transpatial modes of social cohesion.

The two underlying theoretical concepts, i.e. space as 'generic function' and spatial versus transpatial operations will be discussed concerning their application to, and meaningfulness for, workplace environments. Finally, inferences are drawn for the practice of evidence-based design.

1. Introduction

Scholars from backgrounds as diverse as psychology, sociology, organisation and management studies, architecture and design have analysed workplace environments, and have largely agreed on their contribution to the creation of organisational life. It has been argued that buildings

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"constitute the social organisation of everyday life as the spatial configurations of space in which we live and move" (Hillier 1996: 4), that space may be "comprehended as a vector of social interactions" (Fischer 1997: 3), and that "office buildings can play a pivotal role in business success" (Duffy 1997: 10). Management consultants have even called space the "most powerful tool for inducing culture change, speeding up innovation projects, and enhancing the learning process in far-flung organisations" (Peters 1992: 413). A variety of recent publications, including contributions from the Space Syntax community, have explored spatial configuration in its relation to different organisational outcomes, for instance collaboration, interaction and knowledge flow, but also innovation, creativity and performance (see for example: Heerwagen et al. 2004; Penn et al. 1999; Peponis et al. 2007; Sailer and Penn 2007; Toker and Gray 2008; Wineman et al. 2008). Hence it might be assumed that the question of how space shapes organisations in their behaviours is well researched and equally well understood. This is far from being the case, as the following quote from a UK policy report on office spaces exemplifies:

"*The ways in which office accommodation can create value for a business (…) are [still] inadequately understood. (…) The collective failure to understand the relationship between the working environment and business purpose puts us in the position of early 19th century physicians, with their limited and erroneous notions about the transmission of disease before the science of epidemiology had been firmly established.*" *(CABE 2005: 1f)*

On closer inspection, it seems that relatively few consolidated findings exist in the field. This paper explores the complex relationship between spatial configuration and organisational behaviours; it aims to uncover reasons for the apparent lack of understanding in the field by drawing on an extensive review of literature as well as some of our own empirical investigations. With this evidence at hand an explanatory framework for complex office buildings is developed based on Hillier's notion of 'generic function' (Hillier 1996) as well as the concept of 'spatiality' and 'transpatiality' (Hillier and Hanson 1984). The argument will be developed in three consecutive steps: a first section will review literature linking physical space and organisation in order to explore the existing knowledge base in the field more closely; the second section will briefly introduce the empirical case study material and the methodology underlying this paper; in the third section two distinct functions in workplace environments will be investigated: generic function and spatiality/transpatiality of organisations; before, finally, we draw conclusions.

2. Physical Space and Organisational Life

The discourse on space and organisations flourished during the 1970s and 1980s, based on two different approaches: on the one hand empirical studies were conducted, for example testing the influence of single spatial variables such as proximity on communication among co-workers. One of the milestones certainly was the finding that weekly communication of R&D engineers deteriorated significantly with increasing distance between their desks (Allen and Fustfeld 1975; Tomlin and Allen 1977). On the other hand, scholars from organisation studies as well as from environmental psychology (Becker 1981; Pfeffer 1982; Steele 1973; Sundstrom 1986) collated information on the relationship between physical space and organisational outcomes, drawing on a variety of sources: personal experience from consultancy, anecdotes, newspaper stories, but also early empirical psychological and sociological studies.[1] These authors underlined the significance of physical space for organisations and identified a variety of factors including proximity, density, visibility, office layout, and furniture arrangement, which were seen as offering crucial affordances to the way organisations behaved. Still it was widely agreed that the evidence-base was rather thin, that research efforts were limited and remained fragmentary, and that many relationships between space and organisations were based on speculation rather than on well-documented and rigorously researched evidence. At the same time, studies came up with ambiguous and partially contradictory findings, for example those analysing the changes in communication behaviour as an organisation moved from enclosed cellular office space to open plan offices. While some studies reported communication to increase (Allen and Gerstberger 1973; Brookes and Kaplan 1972; Hundert and Greenfield 1969; Ives and Ferdinands 1974), others found communication decreased (Clearwater 1980; Hanson 1978; Oldham and Brass 1979) and another set showed either ambiguous results or no changes at all (Boje 1971; Boyce 1974; Sloan n.d.;

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Sundstrom et al. 1982). This inconsistency may be grounded in significant differences in measuring variables and in setting up the studies, since they varied in data gathering procedures (self-rating, questionnaires, participant-kept diaries), the chosen research design (pre-post comparison, retrospective studies, comparison of different departments), physical settings (open plan offices can vary significantly concerning density, distances, barriers, etc.) and definition of variables (sociability, supervisor feedback, confidential conversation, interdepartmental communication, time involved in communicating, etc.).

It is clear that the lack of common measurements (among other shortcomings in the field such as the lack of rigorous studies and the tendency towards speculation or anecdotal evidence) inhibited the emergence of a strong and solid knowledge-base on the relationship between space and organisation, in the early years of the 1970s and 1980s.

After this first phase of interest in the subject, research on space and organisation stagnated during the following years until the mid 1990s. Even though research in the field became popular again around the turn of the century alongside the so called 'spatial turn' in the social sciences and humanities (Massey 1998; Soja 1996), and even though new insights were certainly generated by researchers on single aspects of the space-organisation relationship, the situation as a whole has not changed significantly ever since. As in the decades before, there has been little in the way of a unified effort by those disciplines interested in organisation and space; instead "the literature has discourses on organisations and workspaces whose proponents largely ignore each other." (Price 2007). Likewise, the more complex issues of collective organisational behaviours, for instance the impact of physical space on performance or innovation are unsolved riddles, as Peponis et al (2007) comment: "Measures of the impact of design on the productivity of the work process (…) [are] difficult (…) not least because it is not readily clear what measures of productivity are appropriate." Although some progress has been made regarding the refined operationalisation of variables for example by Space Syntax research that investigates detailed spatial properties based on configuration instead of generalised notions of space, it is still the case that findings from one setting cannot be easily replicated in subsequent studies.

From this review of literature it can be concluded that generally accepted knowledge of the influence of spatial settings on organisational outcomes still remains somewhat limited for a variety of reasons: the discourse on the subject is separated by disciplinary boundaries, the problem of adequate measurements has not yet been solved, research is sparse and where undertaken, at times lacks rigour, all of which results in an evidence base composed of incoherent findings across too few case studies.

3. Methodology and Research Design

This paper draws on a series of case studies of knowledge-intensive work environments in Germany and the UK, conducted between 2005 and 2008, comprising a university, a research institute and four media businesses. Apart from the research institute all organisations were studied both before and after a change to their spatial situation, so that in essence eleven distinct space-organisation relationships [2] were studied. In detail, spatial layouts were analysed with space syntax and ethnographic as well as targeted observations of space usage patterns. Short interviews with staff were conducted inquiring into work processes and organisational structures, while in-depth interviews with a sample of people helped elicit the organisational character, cultures and perceptions of the working atmosphere. Questionnaires captured patterns of interaction and collaboration among staff and were evaluated with the help of Social Network Analysis (SNA) (Wasserman and Faust 1994). Thus the collective behaviours of staff in workplace environments could be investigated in relation to the spatial environment in which they were enacted. Using a multi-layered methodological approach, our studies aimed at establishing case-specific insights into the relationship between organisational behaviours and spatial configuration. Additionally, by investigating a number of cases with a comparable setup, similarities and differences across the sample could be identified. This allowed us to test whether contradictory findings were due to the use of differing methods and measurements, or were a genuine property of the field. If the former was the case, it would mean that similar spatial constitutions analysed

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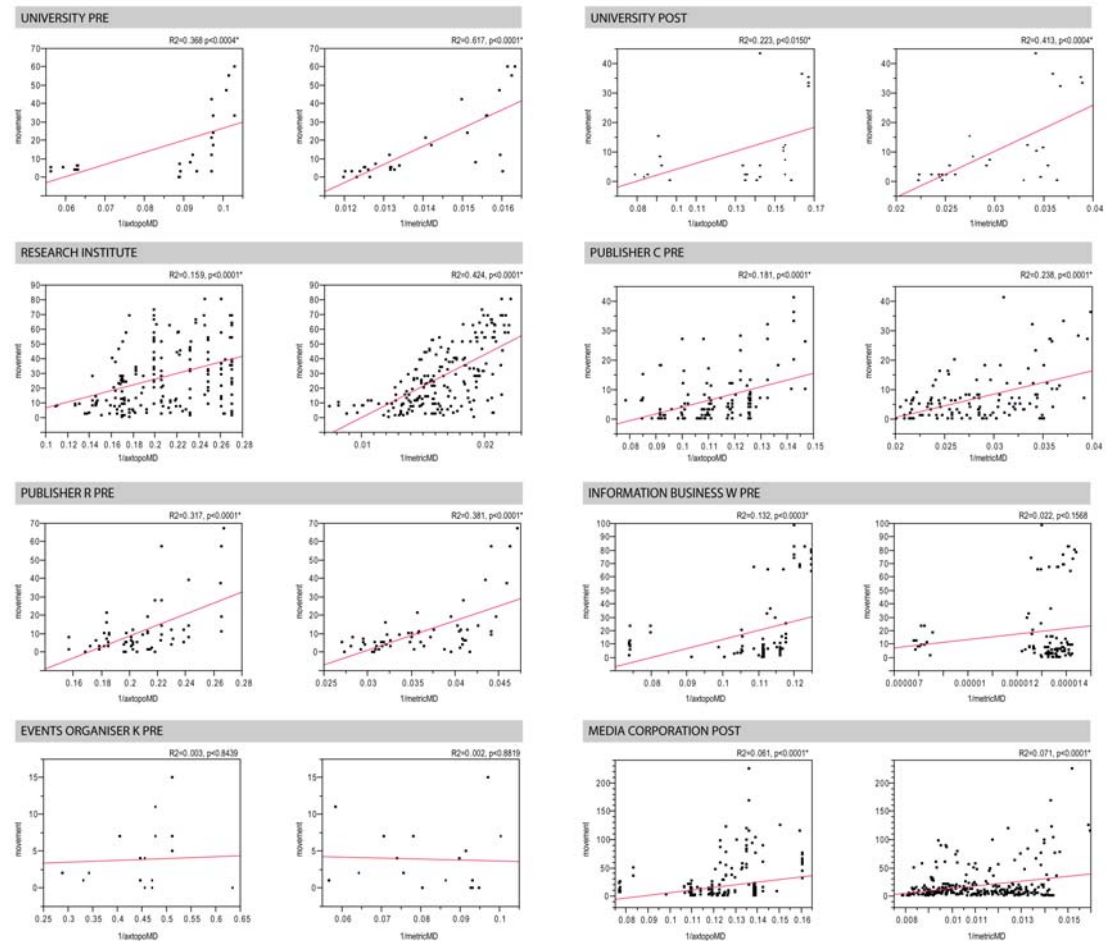
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with comparable methods across different organisations should result in similar responses of behaviour; therefore space could be argued to exert a generic effect on function. On the contrary, if contradictory findings emerged and organisations responded differently to similar spatial configurations, even though they were analysed with exactly the same methods, a new interpretation of the space-organisation relationship would be required based on the contingency of influences. In the following, evidence will be presented supporting both principles, thus giving rise to a combined conceptual framework for the nature of spatial influence in workplace environments.

4. Space as Generic Function

The notion of generic function of spatial configuration has been introduced by Hillier who argues that basic human principles of occupation and movement apply to every space and every building: "Generic function refers not to the different activities that people carry out in buildings or the different functional programmes that buildings of different kinds accommodate, but to aspects of human occupancy of buildings that are prior to any of these: that to occupy space means to be aware of the relationships of space to others, that to occupy a building means to move about in it, and to move about in a building depends on being able to retain an intelligible picture of it. Intelligibility and functionality defined as formal properties of spatial complexes are the key 'generic functions', and as such the key structures which restrict the field of combinatorial possibility and give rise to the architecturally real." (Hillier 1996: 282) Hence the effects of spatial configuration on movement and intelligibility shape organisations before any of the specific functional requirements such as task-structures, reporting lines, activities, organisational cultures etc. are brought to bear. To analyse the idea of generic function in more depth with respect to the character of workplace environments, an important limitation needs to be made. We shall not consider intelligibility in the following discussion, since we suggest that it only plays a minor role in organisational behaviour as office spaces are relatively small spatial systems and are used by the same people everyday; as such they may be considered well-known to their occupants. Apart from visitors and newly recruited staff, intelligibility is perhaps unimportant to an organisation and its collective behaviours such as interaction, communication, collaboration, or knowledge sharing.

So how is movement as the second main generic function reflected in the case studies? To start with, it seems that movement only partially follows the spatial configuration of an office building. Figure 1 shows the scattergrams of the correlation of spatial integration with observed movement flows.

In essence, for nearly all buildings (except for the spaces of events organiser K pre, which were very small) at least a positive trend can be observed, and for four of the buildings (university pre and post, research institute and publisher R pre) a significant and more or less strong positive correlation was found, ranging from R2=0.306 to R2=0.617. These results are perfectly in line with findings from studies as reported in the literature (for an overview see: Sailer 2007). It can be seen that spatial integration clearly limits the maximum movement flow, since in spaces hidden deep in the fabric of the building very little movement was found; in contrast a large variety of flows were observed in integrated spaces. Therefore, it can be concluded that movement partly followed the spatial configuration of the buildings since significant and strong correlations were obtained for some cases, and in those cases with weaker correlations, maximum movement flows were at least limited by the degree of integration of a space. Even though the organisations may all be considered weakly programmed, following the definition of strong and weak programmes of a building by Hillier and Penn (1991), which means an all-play-all interface with randomised and unconstrained, 'natural' movement is expected, clearly there are factors disturbing the relationship between configuration and movement. It has been argued elsewhere (Sailer 2007) that the predictive power of spatial configuration concerning the flow of movement is limited in workplace environments due to a two-fold constraint: on the one hand even weakly programmed buildings often show aspects of strong programming (for example in a university, teaching activities follow a strong schedule and thus a programme in time and space determining movement flows to some degree); on the other hand movement flows may be deflected by the placement of attractors, for example printers, photocopiers, kitchens, etc.

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Figure 1
Correlation of observed movement flows with spatial integration, i.e. axial mean depth (left images under each heading) and metric mean depth (right images under each heading) for all case studies

This means that movement in workplace environments actually evolves not only from spatial configuration, but also from levels of programming and strategic decisions on how to distribute functions and central resources taken by an organisation as it occupies its space. It is argued at this point that configuration-in-use, as it might be called, reflects both aspects of what drives movement flows: it underlines the importance of configuration as a foundation of movement and acknowledges routines and everyday work processes emerging from the placement of attractors. In summary, it was shown that the relationship between spatial configuration and movement patterns do indeed show regularity across a number of cases, pointing towards a generic function of space in workplace environments. However, a limitation of the universality of generic function of movement in office spaces needs to be acknowledged, since it was shown that it is not only configuration that drives movement flows, even in weakly programmed buildings, where natural movement was expected to occur; instead the placement of facilities and functions provides a second rationale for movement in offices and diverts flows towards attractors in space. Therefore movement flows do not satisfy Hillier's criterion of emerging prior to functional programmes. Instead, movement patterns in office buildings seem also to be tied to and determined by programmatic aspects of configuration-in-use.

5. Spatiality and Transpatiality

In contrast to the phenomenon of movement that was associated with generic function as outlined in the previous section, the majority of evidence – in the literature, as well as in the empirical studies presented in this paper – shows distinct organisational responses to similar spatial

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configurations. For example, no uniform relationship was found between proximity among co-workers or spatial integration of a building and potentially related behaviours such as increased face-to-face interaction.

It could be argued now that in those cases space actually may not have shaped organisational behaviours at all, or at best, that the nature of the relationship between space and organisation remains unclear. Quite the contrary, it is argued at this point that space and organisation indeed do relate, yet in an intricate way, and that the nature of this relationship may be explained by the concept of spatiality and transpatiality as introduced by Hillier and Hanson in the Social Logic of Space (1984).

The authors argued that relations between individuals could be explained in a twofold way, either as a spatial function or as a social function of conceptual closeness:

"*In their elementary forms, in effect, buildings (…) can define a relation to others by conceptual analogy, rather than spatial relation. The inhabitant of a house in a village, say, is related to his neighbours spatially, in that he occupies a location in relation to them, but also he relates to them conceptually, in that his interior system of spatialised categories is similar or different from those of his neighbours. He relates, it might be said, transpatially as well as spatially. Now this distinction is very close to that between mechanical and organic solidarity. (…) Durkheim had distinguished between two fundamentally different principles of social solidarity or cohesion: an 'organic' solidarity based on interdependence through differences, such as those resulting from the division of labour; and a 'mechanical' solidarity based on integration through similarities of belief and group structure. This theory was profoundly spatial: organic solidarity required an integrated and dense space, whereas mechanical solidarity preferred a segregated and dispersed space.*" (Hillier and Hanson 1984: 18ff)

In essence, individuals may relate to each other in a dual way, i.e. either by means of spatial closeness (spatiality) or by means of conceptual closeness (transpatiality). Transpatial affinity however does not mean that relationships are non-spatial. Hillier and Hanson argued for the spatial contextuality of conceptual closeness, since homogeneity in values often came with the same preferences for spatial ordering. Hillier and Hanson's argument is well-grounded in the insight that space and society are inseparable and develop in unison, since every "society acquires a definite and recognisable spatial order. Spatial order is one of the most striking means by which we recognise the existence of the cultural differences between one social formation and another, that is, differences in the ways in which members of those societies live out and reproduce their social existence. (…) Different types of social formation, it would appear, require a characteristic spatial order, just as different types of spatial order require a particular social formation to sustain them." (Hillier and Hanson 1984: 26f) Still, they continue to argue, there is a degree of variation in societies concerning how prominently spatial ordering features in a culture:

"*Seen from a spatial point of view, societies vary, it seems, not only in the type of physical configuration, but also in the degree to which the ordering of space appears as a conspicuous dimension of culture.*" (Hillier and Hanson 1984: 4)

In summary, social formations were argued to require a characteristic spatial ordering and vice versa; affinity between individuals was considered to form spatially as well as transpatially; societies were seen to use one way of functioning more than another; and the ordering of space was deemed not of equal conspicuousness to every culture. Transferred to workplace environments this means that knowledge-intensive organisations require a characteristic spatial configuration, thus forming a distinct space-organisation relationship. Furthermore, some organisations may function in a distinctive spatial way, while others may be more driven transpatially, so that the ordering of space is less conspicuous and constitutive to their organisational culture. A good example to illustrate the spatial and transpatial modes of operation within organisations is the distance-dependency of interactions between people. Two aspects will be focused in this paper: first of all, distinct distance curves will be discussed for each case; they show the average distance between interaction partners depending on the frequency of their

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interactions. Secondly, frequency of contact between actors will be mapped in a so called 'Netgraph' (explained in more depth in: Allen and Henn 2006) exploring spatial locations and neighbourhoods in an office environment.

Generally, both aspects of the relationship between proximity and interaction show strong evidence of spatiality as well as interesting cases of transpatiality.

In detail, the distance curves in figure 2 illustrate that in most organisations daily interaction took place within a reach of 10-22 metres, thus a characteristic distance of 18 metres for daily interaction was obtained.[3] In contrast, interaction on a weekly basis travelled a lot further with a characteristic distance of 34 metres. While most organisations may be argued to follow spatially induced interaction routines (overall low distances of daily interaction, and significantly longer distances for weekly or monthly contact), the research institute is a prime example for transpatial interaction patterns: daily interactions in this organisation were at a distance of more than 41 metres on average; 22% of daily interactions even were over more than 80 metres. Interactions between people obviously followed different rationales than physical proximity. Various reasons for this transpatiality can be found: first and foremost, theoretical physics as the main area of research of the institute is a highly specialised field, where individual expertise is very diverse. In effect, staff made contacts and established collaborations based on someone's specialist knowledge rather than group affiliation or office location. Since the institute suffered from a lack of space, newcomers had to be accommodated wherever an office was available. Additionally the majority of researchers only spent periods between 1 month and 2 years at the institute. All of this resulted in very specific, transpatially driven interaction behaviours, where spatial location and physical distance were rendered less relevant.
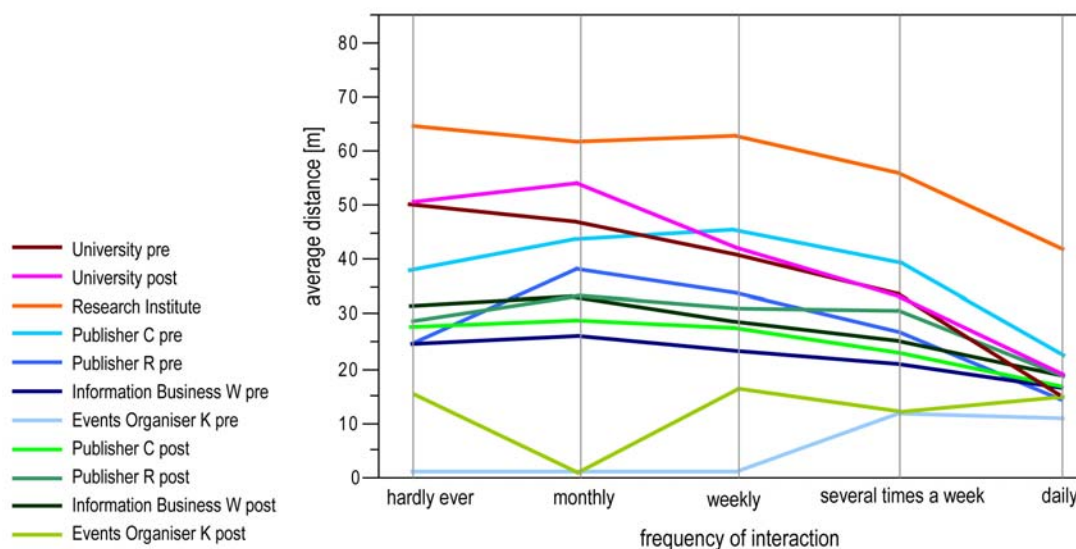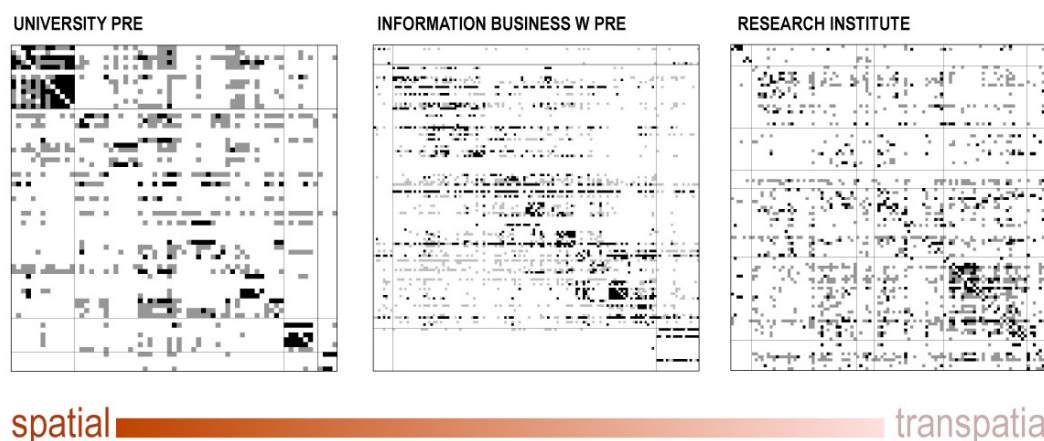

Figure 2

Characteristic distance curves for each organisation showing at which distance (on average) different intensities of interaction took place

The relationship between pair-wise interaction frequencies and office location of individuals can be further explored by analysing proximity-based Netgraphs, as shown in figure 3 at the example of three cases. While in the case of the university (pre) pronounced distance-based patterns emerge (evident from black clusters of intensive face-to-face contact in specific office 'neighbourhoods' and a well-defined diagonal showing frequent interactions in close vicinities), at the other end of the spectrum daily interactions (in black) are almost randomly scattered across office locations in the example of the research institute, pointing towards transpatial ways of operation, as already argued above. The case of information business W (pre) illustrates how both modes, i.e. spatiality

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and transpatiality may operate jointly, so that some proximity-based interaction patterns surface, but also a partial distribution of intensive interactions can be seen arising from conceptual closeness and transpatial affinity between people.

Figure 3
Exemplary Netgraphs of the University pre, Information Business W pre and the Research Institute showing daily interaction (black), weekly interaction (grey) and infrequent interaction (white); each row and column in the square matrix represents one individual staff, rows and columns are ordered according to office location, so that people sitting next to each other will be displayed in adjacent rows and columns

Transpatial solidarity comes in a variety of forms and hence may differ significantly from case to case. For example, in the case of the research institute transpatial solidarity was predominantly maintained by homophily of expertise among scientists. Additionally, organised events, like a weekly research colloquium open to researchers from all groups, as well as ritualised behaviours and time-space routines (one of the research groups met for daily afternoon tea sessions, in another one people regularly went for lunch together) contributed to the formation of social cohesion. In other cases, for example the corporate media companies transpatial solidarity was informed by strong task-dependencies and roles (staff engaged in sales interacted intensively with the content teams of their product, but also with other sales staff), but also by strong team cultures enacted in space.

To summarise, we have outlined above how space and organisation may be interrelated in an intricate tangle of spatial as well as transpatial affordances of organisational behaviours. Whereas some organisations seem to be shaped in their behavioural world by spatial configuration, the social formation of other organisations was constituted transpatially. The interplay between spatial and transpatial modes of operation may work in a variety of ways, not limited exclusively to one mode or another.

6. Conclusions

Based on an extensive review of literature, this paper aimed to explain the nature of spatial influence on organisational behaviours in workplace environments. Evidence from empirical case studies suggested that basic anthropological behaviours like movement could be explained by spatial configuration-in-use, therefore describing a generic function applicable to every office building. However, the concept of generic function as introduced by Hillier was found not to be fully applicable, since generic function did not emerge prior to programming and usage of a building. Still the concept was confirmed as relevant for office spaces and its characteristic application to knowledge-intensive workplace environments was specified and detailed. This insight may be used for the practice of evidence-based design. Ahead of a design intervention, architects may draw on the modelling of potential movement flows based on the spatial

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configuration of their design solutions. Likely usage patterns given the organisational character, programme and task structures of a client should additionally be taken into account. Further research may be needed to integrate the level of programming of an organisation into the current Space Syntax models.

Beyond generic function it was shown how most collective behaviours in workplace environments emerge in patterns unique to the organisation, specifically the more complex behavioural responses like interaction, collaboration or knowledge flow may particularly depend on a tangle of differently formed influences. Therefore it was argued that spatial configuration formed only one affordance to complex behaviours among many others, like conceptual closeness or organisational culture and character.

Thus a conceptual framework for a renewed understanding of the space-organisation relationship in knowledge-intensive workplaces emerged, based on the idea of generic function as well as the theoretical concept of spatiality and transpatiality. A first interpretation is offered on the intricate nature of the relationship between space and organisation. In order to use this knowledge for evidence-based design further explorations of the matter will be needed, for example how the interplay between generic function on the one hand and spatiality/transpatiality on the other hand is governed, and how the degree of spatiality or transpatiality of an organisation may be identified other than by time-consuming in-depth studies.

Notes

1 For a more extensive discussion of the literature in the field compare the PhD dissertation of the lead author (Kerstin Sailer: "The Space-Organisation Relationship", to be submitted in 2009 at Technical University of Dresden/Germany).
2 In detail the cases are: University school pre and post (UK), Research Institute (Germany), Publisher C pre and post (UK), Publisher R pre and post (UK), Events Organiser K pre and post (UK), and Information Business W pre and post (UK). For some of the evaluations of this paper, the four media businesses, i.e. the two publishers, events organiser and information business, will be discussed together as one case in the post stage, since the businesses all belonged to the same corporation and had then been brought together in a single building. In this case, the study will be referred to as Media Corporation post.
3 This excludes the research institute (due to transpatial operation) and events organiser K (due to size).

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