PAPER REF # 8146
Proceedings: Eighth International Space Syntax Symposium
Edited by M. Greene, J. Reyes and A. Castro. Santiago de Chile: PUC, 2012.

ANALYSIS OF STRONGLY PROGRAMMED WORKPLACE ENVIRONMENTS. Architectural configuration and time-space properties of hospital work

AUTHOR: **Daniel KOCH**
School of Architecture, KTH Royal Institute of Technology, Sweden
e-mail: daniel.koch@arch.kth.se

Jesper STEEN
School of Architecture, KTH Royal Institute of Technology, Sweden
e-mail: jesper.steen@arch.kth.se

KEYWORDS: *Building Morphology, Workplace Analysis, Spatial Practice; Strong Program, Architectural Configuration, Time-Space; Hospital Work*

THEME: Building Morphology and Usage

Abstract

Finding relations between configuration and activity of the level found in cities in strongly programmed buildings have challenged research for a long time. With increasing clarity, it has shown to have to do with how and where activity takes place. Compared to cities and large public complexes, workplaces are more centred around specific locations and the activities in them, whereas streets are more defined by movement between spaces exterior to the street system (i.e. between interior spaces). One reason for this difference is the time spent moving versus the time spent on specific locations, but also the way in which certain ranges of movement and activity is more programmed within workplaces than in cities. Most of this is well known within the field. What this paper adds to the discussion is a study of different spatializations of workflow of different roles and for different tasks. The paper does this through the concept of spatial practice, which is considered as the interplay between spatial configuration, organizational configuration, and the configuration of work processes and routines. In this way some conditions of workplace programs are brought to the forefront, and workplace distribution and organisation routines are discussed through direct and indirect benefits of different practices, as well as internal and external conditions of programs or tasks. The basis for the work is empirical studies of several hospital units within one large scale university hospital, offering a manageable variation of workflow and spatial configuration.

INTRODUCTION

Within space syntax research, workplace studies have had difficulties establishing consistent results when it comes to on the one hand correlations between configuration and movement, and on the other configuration and interaction. There are some results indicating that certain office structures have correlations between movement and integration, but these seem only vaguely related to face-to-face interaction. Other studies do not provide such correlations, but make other observations such as location strategies for certain roles (e.g. Markhede & Steen, 2006; Penn, Desyllas, & Vaughan, 1999) or study relations between organizational boundaries, space and interaction (e.g. Markhede 2010). Yet others have shown that degrees of configurative exposure seem to affect amount of face-to-face interaction at the workstation. This has lately led to the question being pushed further in various directions (e.g. Markhede, 2010; Sailer & Penn, 2010; Sailer & McCulloh, 2011). This paper constitutes one such effort in attempting to refocus from direct correlations between e.g. generic movement and configurational properties such as has been found in cities (e.g. Hillier, 1996; Hillier & Iida, 2005) and in public buildings (e.g. Rohloff, Psarra & Wineman, 2009; Tzortzi, 2007; Choi, 1999; Peponis, Conroy Dalton, Wineman & Dalton, 2004; Koch, 2005, 2009), towards pattern emergence and pattern production.

The point of origin for this paper is that the influence of spatial configuration may not come in the form of correlations between movement flows and integration (as has been repeatedly stated elsewhere). Instead the position taken is that it comes through what spatial configuration *does* as it is made use of *through program,* where program is considered both in its functional sense and as daily routines and habits (following the argument of Sailer, 2007). One way to understand this is to shift from 'behaviour', or even 'experience', to *action*. Or, what we could call a shift from Lefebvre's (1991) triad of Lived-Perceived-Conceived space into the parallel triad Representational Space-Representations of Space-Spatial Practice. Of these, the key term is *spatial practice;* that is, how does the program and space interact to formulate a spatial practice, and what does this spatial practice (re)produce, what does it support, and what problems does it cause? As has been made quite apparent through the studies serving as basis for this paper, a working unit's spatial practice is one of the fundamental informants for what is expected, wished, or demanded in a redesign process. This interplay between configuration and practice thus appear important to understand better and describe with more precision.

In this paper, this will be studied through how the program distribution, workflow and syntactic structure interact to formulate spatial practices, and how these spatial practices each provide benefits and problems outside of the functional performance of the generative activity itself. They furthermore provide different characters to the workplace that can be further strengthened or altered through redistribution of functions, reconfiguration of the workflow, or reconfiguration of the workplace alike. In this way the paper aims to help to elucidate how come work places provide less statistical correlation between movement and configurational measures not because there is no relation, but because the relation is of a different kind; i.e. 'generic' movement patterns give way for movements between programmed working tasks that generate spatial practices. These practices include strategies and tactics that makes use of spatial configuration to negotiate between direct and indirect benefits, weighed differently for different roles in the workplace environment. In this way, the line of argument complements and develops on e.g. Sailer (2007), Heo, Choudhary, Bafna, Hendrich, and Chow (2009), and Lu, Peponis, and Zimring (2009), even if it comes from a somewhat different point of origin with a different aim. As these papers also provide more rigorous statistics they contribute to further anchor the discussion herein in empirical evidence.

Concretely, the study consists of a series of smaller studies at Huddinge University Hospital, south of Stockholm, and the focus is on the workflow and interaction of and between personnel. This study will go through a series of *dissimilarities* in workflow that leads to quite different spatial practices, shown through a selection of cases before a summarizing concluding discussion. This is preferred partially based on the form of the empirical material which is best presented either as generalized diagrams or particular cases. The argument will be presented through three specific examples from the study that serve to illustrate different programmatic effects of work task, time, and spatial distribution followed by a general conclusion. Before going in to these examples, however, we begin by giving a brief background description of the object and methods of the study.

THE KAROLINSKA UNIVERSITY HOSPITAL: BRIEF INTRODUCTION

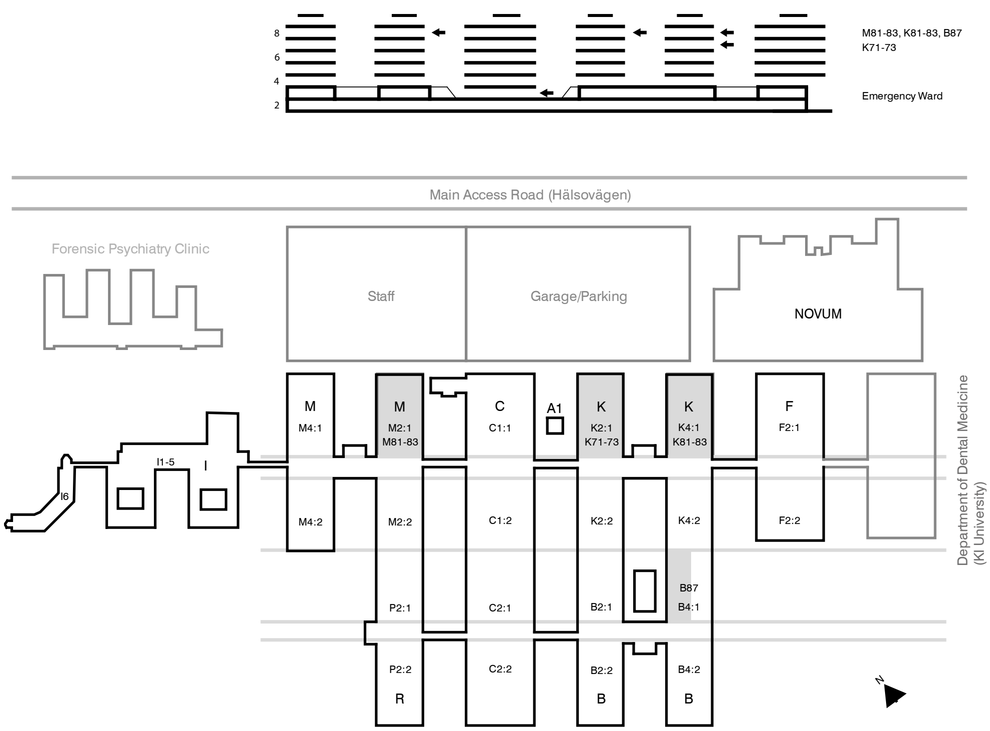

Figure 1. Overview over the Karolinska University Hospital and the module Grid (indicated in grey lines), as well as units of study (marked with gray in plan and arrows in section). Figure based on drawings from LOCUM.

Huddinge Sjukhus, part of the Karolinska University Hospital, is located some 20 minutes south-southwest of Stockholm in Flemmingsberg, in the municipality of Huddinge. It was built as a response to an excessive need of health care buildings in the Stockholm Region in the late 1960s. Construction began in the early 1970s. The plan was founded on a range of investigations into proper measures and systems for modular construction of healthcare environments in the 1960s and 1970s (see e.g. Persson & Sjöqvist, 2010). Originally designed by Sven Lindholm and Karl-Åke Hellman at HLLS Arkitekter, the complex is constituted through an alteration between two-atrium and three-atrium modules interconnected by corridors and staircases [Figure 1 & 2]. On the entrance floor, the connections are even provided with 'street names' to facilitate wayfinding for visitors, although the main method of orientation is the modular system of grid positions (M, C, K, R, B) and floors (1-8). Cross-modular movement (i.e. between building volumes) is possible on all floors, whereas moving through modules is not always possible depending on what unit is housed in the module in question. The standard solution is that each unit has one module, but some units have only half a module (one side of the row of atriums). The hospital is continuously being rebuilt, unit per unit, with at least two modules free for reconstruction so as to not interrupt operations. In this way the interior configuration is continuously developed and refined, changing after concurrent healthcare ideals.

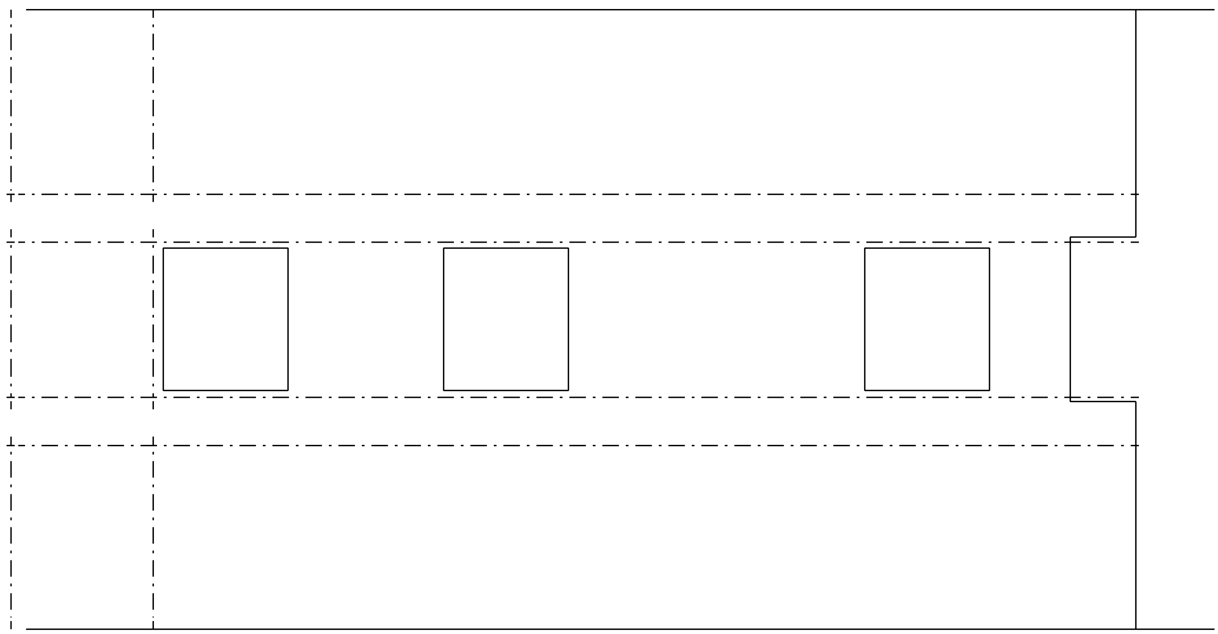

Figure 2. The module unit of Karolinska University Hospital, with indications of common partition principles (dash-dot) and atrium gardens. Worth noting is that modules in the center have two atriums whereas the ones in the ends have three per module.

STUDY METHODS

The study serving as basis for this paper has been conducted over roughly one and a half years on a part-time basis, why data collection possibilities have been limited. The setup of the hospital offers a limited range variation of spatial configuration, and a limited range variation on the workflow. To make comparison possible and retain the possibility to make generalised conclusion, it was important to study as many different units as possible while retaining a reasonable precision in the data. The selection of units was based on reasonable similarity in terms of the healthcare taking place considered as patient flow and intensity, while providing a range of difference in spatial configuration. On this basis, the Centre for Gastronomy (K71-73), Surgical Transplantation (K87-89), Stem Cell Transplantation (B87), and the Medical Emergency Care (M81-83) units were selected in dialogue with the Hospital. As a complementary case the Emergency Ward unit was studied in order to provide further scrutiny of findings and analysis, and to increase possibilities of generalization.

The main method used to understand the workflow and practices of the different units was interviews followed by follow-up seminars. The interviews regularly lasted an hour each, and were conducted with a set of interviewees covering the three main roles of the hospital's healthcare work: doctors, nurses, and auxiliary nurses.[1] At least two representatives of each role in each of the units were interviewed, in some cases three. At the seminars, the work of the hospital was re-described so as to test our understanding of the organization and practice of the studied unit. A series of experiments with the plan of the unit was also prepared to test how certain configurative changes were received by the staff reflecting over their workflow and working conditions. These experiments were based on three different approaches: (1) expressed wishes from the personnel; (2) sub-optimization of potentials or problems identified through our analysis of the work practice; (3) 'maximum change' of spatial configuration, testing how it would affect workflow. In this way the seminars provided further information on the practices of the units, as the experiment brought up information that in regular interviews and discussions did not surface. These practices were almost exclusively of the kind heavily embedded in routine or tasks performed to support, enable, or facilitate what was considered as the actual working tasks.

The emergency ward was studied through a smaller set of interviews combined with observations, covering all of the divisions of the unit. This because the rhythm of the unit was such that it allowed observation studies within the time constraints of the project; the aggregation of activities and behaviour grows faster as the rhythm of work is higher. The subdivisions of the emergency ward was studied one day each, with the 'day' beginning between 8.30 and 9.30 depending on the division, and ending at roughly 15.30-16.

CASE 1: THE MEDICINE ROOM

The first case regards workflow-generative conditions which can be perceived as technical but also becomes socio-spatial. The units in question have *spatial conditions* that are comparatively similar, a general workflow principle that is similar, but where *workflow practice* turns out very dissimilar due to a single, ostensibly minute difference. Both MAVA (M81-83) and Stem Cell Transplantation (B87) works with teams of doctor, nurse, and auxiliary nurse, with a specialist doctor visiting select cases. Both as general practice begin the day by deciding the sequence in which patients are to be visited, after which patient visits take place.[2] Both also make use of a singular medicine station/room where nurses fetch medicines for treatment, and both have roughly the same amount of patients per team to cover. One unit has two parallel corridors whereas the other has a single corridor (as it is half the size). For the purpose of this particular discussion this is inconsequential, as each team were assigned patients in one corridor only, and the medicine room in the double-corridor unit had entrances from both corridors.

The *difference to be focused on here* is that in the larger the nurses use a wagon to transport the medicines for all patients under their care simultaneously, whereas in the smaller unit nurses return to the medicine room to gather and mix medicine for each patient one at a time. In the latter case, it is considered a safety precaution that medicines are mixed and brought to the each room one at a time. The back-and-forth was

---

[1] In some cases, the position of auxiliary nurse had been abolished, and the medical teams consisted of doctors and nurses only. In these cases, however, it was common to rotate the traditional tasks of nurses and auxiliary nurses among the nurses over the days. Note further that the translation is indirect, as the 'auxiliary nurse' here is his or her own professional category more focused on care, whereas the nurses are more focused on medicine.

[2] In both cases the interviewees stressed that this is not 'rounds' in the traditional sense, but more involved from all sides including the patient.

argued for as a way to limit the risk of mistakes and undue access to medicine.[3] This has significant impact on the movement patterns, which for the nurses could be comparable to a *series* in one case, and a *tree* in the other (see Foucault, 1997). In one case the nurse goes from one room to next distributing medicines without returning to the medicine room [Figure 3], and in the other the nurse goes back and forth between the medicine room and the patients' rooms between each visit [Figure 4].

This produces a lot more movement in one case than the other to perform the same functional task of distributing medicine. This difference grows the closer to the ideal the workflow practice reaches. It should be acknowledged that also in M81-83 nurses have to go to the medicine room to fetch additional medicines or make changes to what has been prepared due to decisions made during the patient visit. That one case generates more movement than the other to perform the same task can initially seem impractical. However, it is important to note that the increased generation of movement, which also generate more time spent in the corridor, consequently produces social centrality to the medicine room. Comparatively, in the case of the series the medicine room is still central *for the work* (functional centrality), but not central *in the workflow* as it was realized in movement patterns and practices as performed (social centrality). If each case is treated in its typified ideal result this generates one corridor with a significantly higher movement flow than the other – especially closer to the medicine room. In one case the nurse passes by only two-three times during the patient visits, and in the other *at least* double the amount of patients they are to visit (i.e. between eight and twelve). It also means that, given the same timeframe to do the visits, the nurse would have more time to spend by each patient in one case than in the other, and again in the ideal case, the 'team' would be closer following each other as the nurse does not have to leave the team to fetch medicines.

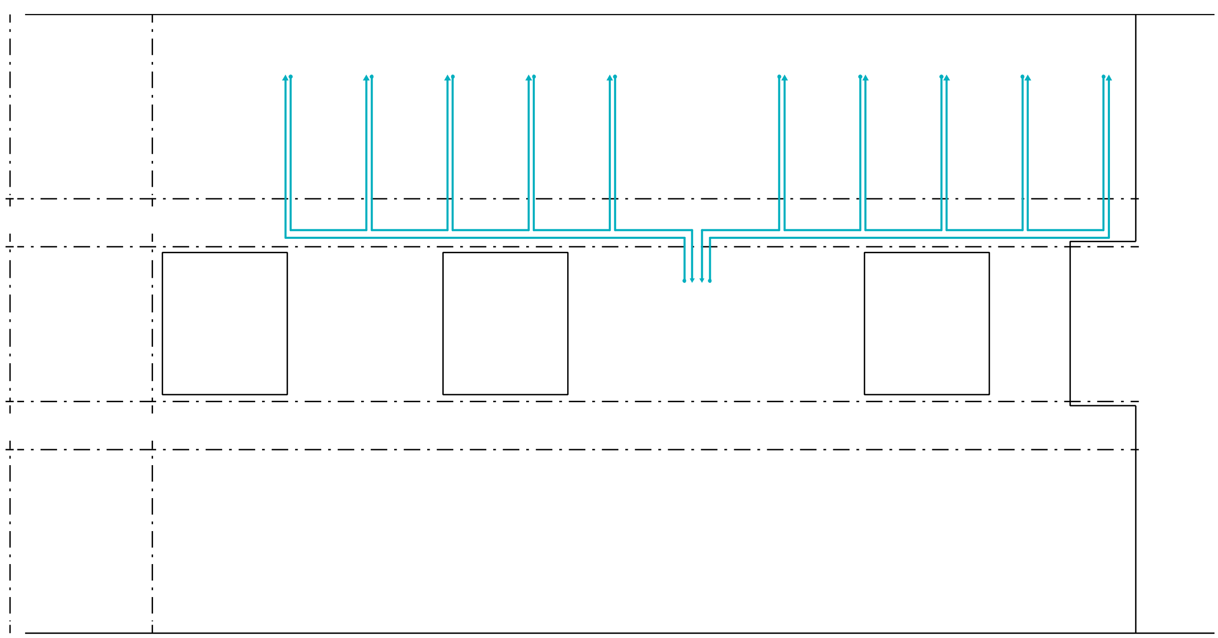

Figure 3. The minimal movement generation for the nurse in M81-83, where the nurse has a wagon which he or she brings from the medicine room with the medicine for all of the team's patients. The figure is conceptual and illustrates a case with two teams of five patients each.

[3] It can be noted that one of the reasons for this difference is that M81-83 had a machine delivering finished medicine bundles, whereas in B87 medicines were mixed by hand. It is expected to work similar to M81-83 if (when) such a machine installed.

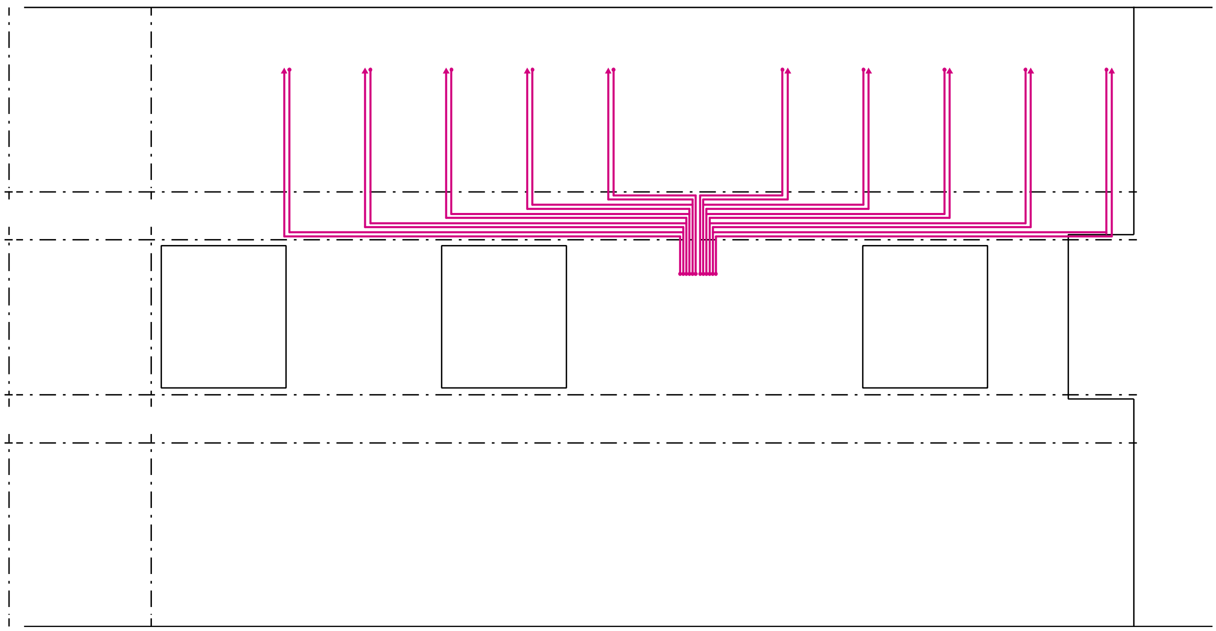

Figure 4. The minimal movement generation for the nurse in B87, where the nurse has to return to the medicine room for each patient. The figure is conceptual and illustrates a case with two teams of five patients each.

Another effect is for someone who is not a member of the team (another team, another doctor, the specialist doctor) who needs to find or communicate with the team. This can be the specialist doctor just trying to check if the planned visit to a patient is up. In this situation it would be more difficult to find the team following the series workflow as the team spends less time in the corridor. Considering that the one looking for the team or the nurse may not even know what rooms the team has assigned to them, it becomes even more difficult. In the 'tree' pattern the time spent in the corridor, and the constant return to the medicine room, provides more regular opportunity to find a nurse. It is also more likely that nurses from different teams have an overview of each other's location. The constant returns to the medicine room, together with the more time spent in the corridor, make it easier for teams and nurses to co-ordinate and keep track of each other. This is true even internally in teams when the workload is heavy and they have to split up (e.g. the auxiliary nurse having to take care of some tasks separately but keeping track of where her/his team is), similarly to the argument of Lu et al (2009). Perhaps counter-intuitively, a configuration spreading out the patients and to some extent maximizing movement distance would thus also (to a breaking point) maximize potential indirect communication in the course of patient visits.

Furthermore, the more the nurses move in the unit, the more exposure of the nurses for the patients will be generated. This can be important for patients, even if they wish to 'just see where the personnel are at'. The corridor is more likely to be 'lively', and if the patient looks out from his or her room, it is more likely that someone will pass by. Conversely, it also means that it is, in principle, easier to cast a glance at patients through moving around, whether just checking on them, or nodding a greeting or giving some sign of progress. Depending on the configuration and design of patient rooms, and location of nurses' stations, the benefits of this movement pattern can then be further capitalized on, or minimized. It can even be speculated that in the tree workflow, the patients can see the nurses *more often*, whereas in the series workflow, the patients can see the nurses *longer,* or for longer periods consecutively. Set in relation to Heo et al's (2009) studies of the impact of configuration on nurses' movement and frequency of visits to patients, this can be further developed as a discussion of *balance* between these direct and indirect benefits.

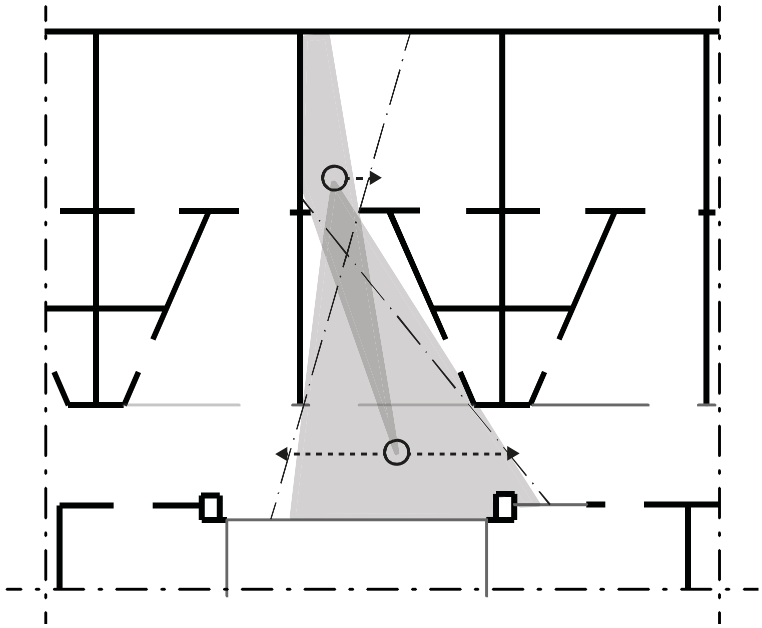

Figure 5. By widening the corridor end of the airlock, a significant increase in exposure of the corridor is created, while the window into the patients' rooms remain small. This way most of the corridor is exposed to patients' rooms, whereas most of the patients' rooms are hidden from the corridor. The control over the interface (visibility/exposure between patient and employee) is shifted towards the patient by means of spatial geometry recognising the character of visibility. Dash-dotted line in the figure showing the boundaries of possible visibility/exposure.

To investigate this further, one experiment was made to test the potential benefits under three conditions: (1) patients should be able to see staff as much as possible; (2) patients should be allowed privacy; (3) patients should have increased control over this interface. A further condition was that the means to achieve this should be spatial configuration. For this experiment, it is important to acknowledge time and directionality in relation to configuration. Simply put: in a reciprocally defined visibility relation between patient room and corridor, the control over visual contact sways in favour of the mobile person as a result of time-space constraints, and increasing the amount of reciprocally designed visibility keeps this imbalance of visibility conditions static. However, the expanding ('conical') character of visibility can be exploited to maximize the amount of exposed corridor, while maintaining a high degree of control in the patient room. As can be seen, this particular solution is dependent on *distance* between patient room and corridor provided by the airlock, as this increases the widening of the patient's field of vision. In [Figure 5] we illustrate how the control over the interface shifts as a result of such a layout.

Comparing to Lu et al (2009) an analysis can be made between indirect benefits of visual communication and direct benefit of targeted visibility distribution, setting work routines in relation to spatial configuration of both generic accessibility, generic visibility and targeted visibility. It can furthermore be set in relation to Positioning Analysis (Markhede & Koch, 2007) to see how movement patterns interact with stationary activity (e.g. patient views compared to staff movement, or static staff activity compared to movement). In the particular case, the medicine room is next to the singular nurse station, which provides a positional opportunity for those in the station and a targeted visibility opportunity for those moving to keep track of each other – even if the particular benefit is not maximized either in the case of the nurses' station or the patient rooms.

The extra amount of walking in the case of B87, naturally, is both cumbersome and provides less direct time with each patient per working hour, and is therefore less efficient under certain definitions of the term. As it can also be expected to affect frequency of patient visits (Heo et al, 2009), it has several impractical sides. Balance between direct and indirect benefits, if we consider the direct benefits to be more and less walking and longer or shorter spans of continuous time by the patient bed, and the indirect benefits being indirect communication and more opportunities for direct, 'spontaneous' interaction. In the cases above technical conditions and workflow routine may seem to have a larger effect on frequency of visits as well as movement flows than spatial configuration. While this is indeed the case, a more complex set of 'benefits' to optimize for makes the interaction between these routines, conditions and spatial configuration central, which adds a layer of complexity to the findings of Heo et al (2009).

This also points to that for once we can *actually* speak of benefits of 'attractor' locations used to draw people to different parts of a building; that is, specific functions and amenities can be so located as to either be easily accessible to facilitate functional efficiency, or to generate movement through the unit to generate indirect benefits of communication and co-ordination. The nature of architectural design, where something in the end *has* to be placed peripherally and other things central, also makes it a question not only if, but *what* should be placed in these locations. The intended flow of work thus provides fundamentally different implications for the design of the hospital units depending on the relative weight given to direct and indirect benefits of movement and occupation patterns.

CASE 2. NURSES' STATIONS

One of the most recent interventions in the spatial strategy for renewal of units in Hiddinge University Hospital is the breaking up of the nurses' station and doctors' offices into smaller team rooms (M81-83), series of 'documentation rooms' (K71-73), or a mix of documentation rooms and nurse expeditions (K87-89). The result has differed, in part due to differences in particular solutions and the degree to which the units have been rebuilt. K71-73 has seen a rather significant remake with specially designed and located glass rooms both as 'expeditions' and as rooms for documentation, whereas K87-89 has a layout that configuratively has been changed rather little. The latter instead house four of the six team rooms in old patient rooms or offices. Comparing the two, we can furthermore see a significant difference in visibility. In K71-73, one of the corridors has been dislocated, and in the other the space next to the rooms have been cleared, both to offer better visibility. This increases visibility whether measured generically (regular VGA; see e.g. Turner & Penn, 1999; Turner 2001), positional (Markhede & Koch, 2007) or targeted (Lu et al, 2009). The personnel reported it to be easier to find each other in K71-73, and also to keep an overview of what goes on. This conforms with the discussion of Lu et al (2009) and Markhede and Koch (2007). Practices ensuring that those in the room are not disturbed by other personnel make them function decently for concentrated work (as argued by Steen, 2009), but patients are less commonly able to read such symbolic constructions why they tend to disturb those working in these rooms.

Each unit was overall satisfied with their own solution with various minor objections that tended to be role-specific. The units with a central nurse station argued for keeping it for reasons reaching from practical to social, whereas those with distributed stations argued for that solution. It should be noted further, that doctors commonly propagate singular expeditions no matter solution, and that nurses and auxiliary nurses vary more in their opinion. To a fair extent, the varying opinions of nurses and auxiliary nurses correspond to the kind of work they were mostly doing and how flexible it is – i.e. nurses and auxiliary nurses working more with long questions (Steen, 2009) are more favourable of distributed stations and documentation rooms than nurses or auxiliary nurses working more with short questions. Reasonably, this is because of increased openness for disturbance or social conversation in the latter case, which benefits from a larger and more consistent presence of others. The reasons the doctors propagate the central expedition tend to be the ease of finding nurses. In this case, M81-83 has benefits as all stations are located close to one another, and that the two more centrally located team stations tend to be more frequently used by 'available' nurses and auxiliary nurses, whereas the more segregated stations were more commonly used by doctors at times when there was choice.

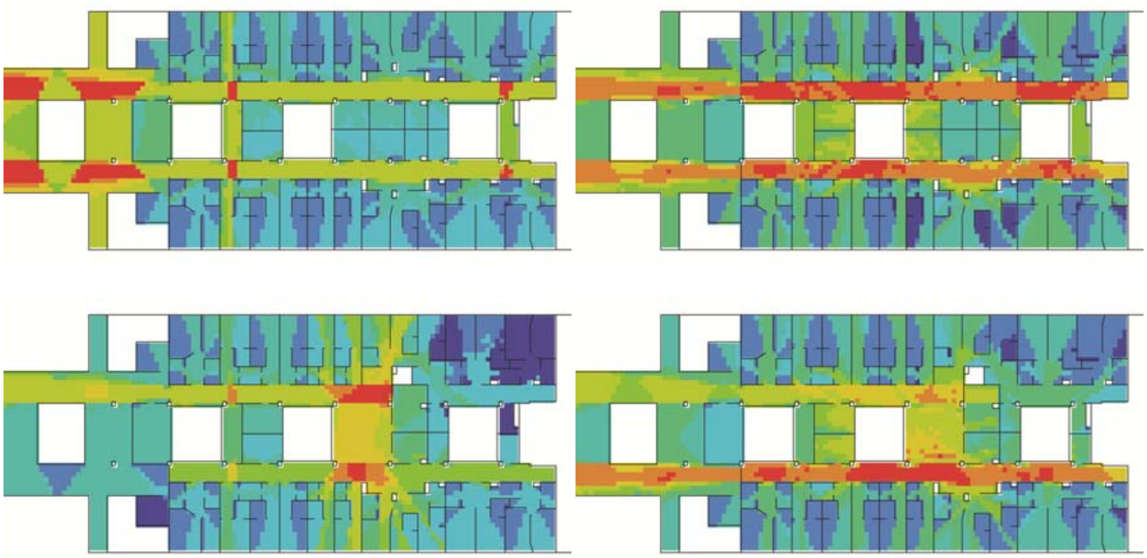

Figure 6. Comparison between the situation today (top) and the experiment results (below). The nurses' expedition with permeability integration on the left and visibility integration on the right. The experiment shown is the 'maximum difference' experiment, where closing one access door and intervention into the corridor was used to make greater configurative difference internally. Note how the nurses' expedition (at the end of the entrance corridor) is located centrally both visibility and permeability-wise, but by placing the door in the 'square' instead of in the end of the corridor is given a comparative slight seclusion. Figures made from drawings provided by Locum; analysis in Depthmap (see Turner 2001).

In both distributed and centralized solutions, however, there is an inherent conflict between how the stations respond to different demands of the unit's work: (1) closeness to the teams' patients and facilities facilitating the performance of patient care; (2) centrality within the unit supporting the workflow and interaction of the staff (compare Heo et al, 2009, and above); and (3) representation and reception of visitors (including doctors, compare Lu et al, 2009). This was brought up repeatedly, often suggesting a split into one 'expedition' and one or several 'stations', or a remake of one of the stations into a reception in a distributed solution. It can be argued that making use of the properties of visibility and visibility configuration as *different* from permeability (Dalton & Dalton, 2009; Koch, 2010) the conflict is less inherent than it may appear. Through a series of experiments it was tested how *visibility from the entrance* could be maximized, while *centrality within the unit* could be maintained, where the former also included *visual centrality seen from the point of view of the unit in its larger context.* As can be seen in [Figure 6], a series of steps were taken to achieve this goal, including closing one entrance from public access to allow an internally permeability centred expedition to also be contextually visually central by dislocating it into the main access corridor. The benefits of this in comparison to the conditions of work performed in the expedition proved to further be improved by removing obstacles in front of it, effectively creating a 'square'. The cost of such a solution is a larger variety of accessibility to other parts of the unit. Whether this constitutes a problem or not depend on the program inhabiting the unit and the conditions thereof. What it *could* offer is rooms either for documentation (i.e. work with longer questions that need to be conducted relatively undisturbed) or for doctor's offices or reading rooms (e.g. to conduct more complex analysis or perform or catch up with research) – or potentially for patients with larger needs of privacy.

Interaction between program and spatial configuration here again sets conditions for activities and tasks, although in these cases not necessarily movement but tasks such as documentation and/or locating others (the latter as also argued by Heo et al, 2009). That is, the discussion highlights the interrelations between occupational patterns, spatial configuration, and people finding.

CASE 3: THE EMERGENCY WARD: INTERNAL, EXTERNAL, AND TECHNICAL CONDITIONS

In the third case, we want to make an observation regarding the practices of the Emergency Ward unit that has significant implications for their design, but also for how to understand *program* as spatial practice in general. Once more, we will forego any overview of the unit and go directly into a specific comparison to illustrate the importance of understanding program and program needs. While with some exceptions, the *overall* rhythm of the units were somewhat similar for 'regular' cases but varying greatly in specific, more emergent cases, the *internal* rhythms of the patient visits were radically different. While observed in a specific unit, this difference in internal rhythm is reasonably valid for hospital work in general although degree of impact may vary. We will compare the sub-unit for *infection* and *neurology,* and describe the observed process of a patient visit from a rather 'ignorant' point of view (compare: Latour & Woolgar, 1979).

As the apparent patient arrives to the infection unit (which tended to be hard to find, easily explained through its configurative location) he or she was briefly talked to. The purpose appeared to be making sure that the data handed over by the reception assigning the patient to infection was correct and that they knew what case it was. Depending on judged degree of emergency, the patient is then either asked to wait in one of the few chairs available, or asked to enter a room. Once the patient is in one of the patient rooms, the nurse enters and talks to the patient, taking a pair of preparatory tests such as blood pressure (we think). The nurse then comes out and goes to the doctors room, before returning to her station. After a varying amount of time, the doctor comes out and enters the room with the patient for a rather brief visit, before he comes out and talks to the nurse, who then goes to the medical equipment cabinet and heads into the patient's room. After a still fairly short amount of time she comes back and either heads for another room, or a machine in the back of the station comparatively briefly, before returning to the station. Yet some time later she goes back to this place and gets something, heading into the doctor's room for a brief conversation. At this point, one of two things happen: the nurse comes out and repeats the process of getting equipment and entering the patient's room, coming out to head for the other room or the machine, and waiting, to then fetch what appear to be results and returning to the doctor. Potentially this could repeat, but more than one repeat was uncommon. A while later, the doctor may call the nurse into his room, before once more visiting the patient for a bit of a longer talk, after which he once more comes out for a brief talk with the nurse. Yet some time later, the nurse finishes documentation of the patient who is sent elsewhere, either in the hospital or home. If the patient is to remain within the hospital he or she is usually fetched by staff.

Comparatively, a visit to neurology begins the same way, but once it comes to being brought into a room, normally nurse and doctor enter the room together with the patient – and then stays there. This can take quite a long time, almost as long as the entire process of repeated visits in the infection unit. Upon exit, the process is often similar to that of the other unit with documentation and the patient being let out or moved onward to another unit in the hospital.

Movement and/or seclusion (with following potential problems of locating) generated by a single patient visit thus radically differs for units that even within the hospital *at times* are discussed as similar. The reason for this, it shows upon further questions, is that the analysis of infections is heavily based on chemical and biological tests performed in apparatuses, often located outside of the patient room, followed by thorough analysis of the results – often comparing to other cases or looking in databases. Treatment is decided in a similar way, which means it is best done in concentration and includes a fair deal of waiting time, whereupon efficient use of working time is spent either on other patients or on preparation or research. Neurological issues, however, requires a thorough understanding of the experiences and reactions of the patient in-situ; that is, how the patient functions, experiences, and performs when talking, walking, listening, feeling, sensing. Often, the problems can appear similar or be difficult to define for the patient, and symptoms may overlap, be vague in their expression, or take time to manifest enough to be diagnosed. Followingly, in a visit to neurology patient and medical staff by default spend a fairly long time together continuously.

While this may be a simple observation that for medical staff is apparent, the point here is that such a hands-on description makes apparent radically different resulting spatial practices of the two processes. In one, staff is likely to be found either at their station/in their room or moving between different places, whereas in the other staff is likely to be found with patients in examination rooms. Time spent in ‘public’ and ‘private’ parts, or ‘common’ and ‘secluded’, differs by order of magnitude under the same patient pressure. The number of opportunities for encounters also differs radically, as a result of the number of movements that could generate such. With little time spent moving, the likelihood of an actual matching timeframe spent moving increases or decreases rapidly as we shift spatial practice towards one or the other, as does the dependence on an efficiently arranged movement space and arrangement of functional program.

This is an effect similar to the discussion on the medicine room, but we argue that in this case it is generated by *internal time requirements for the main activity*, rather than spatial distribution and routines *between* activities as in the former. We can speak of a ‘functional requirement’ in the current case, and a ‘workflow routine effect’ in the former. This makes them radically different in spite of apparent similarity. In the case of the medicine room it can be easily altered and manipulated by decisions around routines and processes, whereas for the neurology emergency ward it is a conditional requirement for the activity to take place at all. Understanding which of these is the case for activities become vital for understanding interrelations between program requirements, routine emergence, and spatial configuration. What we have is an extreme case of what in office work has been termed short and long questions (Steen, 2009), and the impact of the distinction can thus become clearer.

TIME AND SPACE AS PROGRAMMED SPATIAL PRACTICE

With the above in mind, it is then time to return to the overall question of the paper, which concerns spatial configuration and spatial practice. To further define the terminology, which arguably is vague in Lefebre's (1991) version, spatial practice can at this point be seen as routine-space-activity patterns on both individual and collective level, which affords a range of benefits and produces a range of problems that are both direct and indirect. The time spent in corridors can be maximized or minimized by routine, workflow, configuration, and functional distribution, whereby possibilities of encounters is increased or decreased, but also opportunities for co-ordination, through visual communication or brief talks, and the strategies for locating one another differs radically. However, time spent and urgency of movement, if encounters do happen, further affect these, as do the degree to which movement takes place simultaneously or not, to similar locations for similar purposes, and under different functional conditions or not (e.g. degree of emergency or time constraints). Processes of producing recognition and communality are further affected, not only by movement but by distribution of occupational pattern in general. Such time-space properties (compare: Hägerstrand, Carlestam & Sollbe, 1991; Massey, 2005) can be worked with, but in this we claim that through the discussion and analysis above, as well as through other studies, simply producing encounters only reaches so far. What is needed, if benefits of encounters is to be capitalized on, is further focus on what could be called 'time-space bundles' (Mattsson, 2006); that is, when people in a similar enough situation, with similar enough purpose, under similar enough conditions, end up in the same space at the same time in order to exchange information. In this, 'similar enough' is likely to be variously elastic depending on purpose and situation. Whether this is in a corridor or at stations, or elsewhere, is a matter of what fits the workflow best, conditioned not only by working routines and communicative goals, but (as seen in the neurology ward) also by internal functional conditions of the work tasks at hand.

We can thus, in order to refine of the line of reasoning, further define spatial practice as routine-space-activity patterns on both individual and collective level, which produce patterns and potentials for time-space bundles to appear, which further than conditions of co-presence suggest co-presence of people relevant to each other performing activities in situations where they are so.

As a result of the discussion above, a central question for workplace analysis and design further becomes not only to optimize in general, but on one hand *what to optimize for*, which may ostensibly be an easier question – how much focus does the organization want to put on direct versus indirect benefits of establishing spatial practices? – and on the other hand, *who* to optimize for, on a much finer and nuanced level than 'boss' versus 'employees'. The resulting configuration and distribution of the workplace will be different. Into this mix also comes the question of the complexity of the spatial system, the degree of familiarity with it that can be expected within the organization, and the degree to which the organization and space is to interact with visitors. Spatial practice seen as workflow and configuration *in interaction*, thus seem to change the question of how configuration affects workplaces.

This understanding requires a more careful mapping of behaviour than this study has performed partially due to time constraints, but also a different focus and content of the studies than what commonly can be found elsewhere within space syntax research, and much more spatially specific than many other studies. At least if it is to be developed further in a statistical or concretely measurable way. The studies performed in this project, together with earlier projects as well as the work of others (Sailer, 2007; Sailer & Penn, 2010; Sailer & McCulloh, 2011; Markhede & Koch 2007; Steen, 2009; Heo et al, 2009; Lu et al, 2009), provide good support for the line of reasoning being important for workplace design, and thus a modest contribution is made to an increasingly clear map of relations between strongly programmed environments and spatial configuration. It would seem to be an important next step to study this in relation to found relations of interaction (Markhede & Koch, 2007), conditions of work tasks (Steen, 2009), direct and indirect benefits (Heo et al, 2009; Lu et al 2009), and organizational interaction and networking (Sailer & Penn, 2010; Sailer & McCulloh, 2011).

ACKNOWLEDGEMENTS

This paper is part of a research project funded by FORMAS, Karolinska universitetssjukhuset in Huddinge, LOCUM, Västfastigheter, and Forum för Vårdbyggnadsforskning. The authors would like to especially thank Gunnar Öhlén, Head of the Department of Emergency Medicine at KS, for invaluable support, including aid with selecting units to study and arranging for the individual investigations, as well as in deciding in what order to study the units, so as to make comparison opportunities best possible.

REFERENCES

Choi, Y. K. (1999). The morphology of exploration and encounter in museum layouts. *Environment and Planning B: Planning and Design, 26 (2)*, 251-264.

Dalton, N.S. & Conroy Dalton, R. (2010). Solutions for visibility-accessibility and signage problems via layered-graphs. *Journal of Space Syntax, 1(1),* 164-167.

Foucault, M. (1997 [1985]). Of Other Spaces: Utopias and Heterotopias. In N. Leach (ed.), *Rethinking Architecture: a reader in cultural theory,* edited by Neil Leach (pp. 350-356). London: Routledge.

Hägerstrand, T., Carlestam, G., & Sollbe, B. (1991). *Om tidens vidd och tingens ordning: texter*. Stockholm: Statens råd för byggnadsforskning.

Heo, Y., Choudhary, R., Bafna, S., Hendrich, A., & Chow, M.P. (2009). A Modeling Approach for Estimating the Impact of Spatial Configuration on Nurses' Movement. In D. Koch, L. Marcus, & J. Steen (eds.), *Proceedings of the 7th International Space Syntax Symposium* (pp. 041:1-041:11). Stockholm: KTH.

Hillier, B. (1996). *Space is the Machine: A Configurational Theory of Architecture.* Cambridge, MA: Cambridge University Press.

Hillier, B., & Iida, S. (2005). Network Psychological Effects in Urban Movement. In A. G. Cohn, & D. M. Mark (eds.), *Spatial Information Theory: International Conference, COSIT 2005, Ellicotville, NY, USA, September 14-18, 2005. Proceedings* (pp. 475-490). Berlin: Springer-Verlag Berlin Heidelberg.

Koch, D. (2005). Parallel Spatial Scales: discerning cognitive levels of space. In A. van Nes (ed.), *Proceedings to the 5th International Space Syntax Symposium, Volume II* (pp. 373-386). Delft: Techne Press.

Koch, D. (2009). Architectural Fashion Magazines. In D. Koch, L. Marcus, & J. Steen (eds.), *Proceedings of the 7th International Space Syntax Symposium* (pp. 57:1-57:14). Stockholm: KTH.

Koch, D. (2010). Architecture Re-Configured. *Journal of Space Syntax, 1(1), 1-16.*

Latour, B. & Woolgar, S. (1979). *Laboratory life: the social construction of scientific facts*. Beverly Hills: Sage.

Lefebvre, H. (1991 [1974]). *The Production of Space,* trans. D. Nicholson-Smith. Oxford: Blackwell Publishing.

Lu, Y., Peponis, J., & Zimring, C. (2009). Targeted Visibility Analysis in Buildings: Correlating Targeted Visibility Analysis with Distribution of People and Their Interactions within an Intensive Care Unit. In D. Koch, L. Marcus, & J. Steen (eds.), *Proceedings of the 7th International Space Syntax Symposium* (pp. 68:1-68:10). Stockholm: KTH.

Markhede, H. (2010) *Spatial Positioning: Method development for spatial analysis of interaction in buildings.* Stockholm: KTH.

Markhede, H., & Koch, D. (2007). Positioning Analysis: Social structures in configurative modelling. In A.S. Kubat, Ö. Ertekin, Y. I. Güney, & E. Eyüboğlou (eds.), *Proceedings to the 6th International Space Syntax Symposium Volume I,* (069.1-069.14). Istanbul: ITU Faculty of Architecture.

Markhede, H., & Steen, J. (2006). Analysing Open Space Offices. In T. Haugen, A. Moum, & J. Bröchner, *Proceedings for Trondheim International Symposium CIB W70,12-14 June 2006: Changing User Demands on Buildings* (pp. 533-541). Trondheim.

Massey, D. (2005). *For Space*. London: SAGE Publications.

Mattsson, H. (2006). How Does Knowledge Production Take Place?: On Locating and Mapping Science and Similar Unruly Activities. In E. Baraldi, H. Fors, & A. Houltz (eds.), *Taking Place: The Spatial Contexts of Science, Technology and Business* (pp. 351-372). Sagamore Beach: Watson Publishing International.

Penn, A., Desyllas, J., & Vaughan, L. (1999). The space of innovation: interaction and com-munication in the work environment. *Environment and Planning B: Planning and Design, 26 (2)*, 193–218.

Peponis, J., Conroy Dalton, R., Wineman, J., & Dalton, N. S. (2004). Measuring the effects of layout upon visitors' spatial behaviors in open-plan exhibition settings. *Environment and Planning B: Planning and Design, 31 (3),* 453-473.

Persson, A., & Sjöqvist, F. (2010). *Huddinge Sjukhus: 1972-2002.* Stockholm: Karolinska Universitetssjukhuset.

Rohloff, I. K., Psarra, S., & Wineman, J. (2009). Experiencing Museum Gallery Layouts through Local and Global Visibility Properties in Morphology: An inquiry into the YCBA, the MoMA and the HMA. In D. Koch, L. Marcus, & J. Steen (eds.), *Proceedings of the 7th International Space Syntax Symposium* (pp. 94:1-94:14). Stockholm: KTH.

Sailer, K. (2007). Movement in Workplace Environments. In A.S. Kubat, Ö. Ertekin, Y. I. Güney, & E. Eyüboğlou (eds.), *Proceedings to the 6th International Space Syntax Symposium Volume I,* (068.1-068.14). Istanbul: ITU Faculty of Architecture.

Sailer, K., & McCulloh, I. (2011). Social networks and spatial configuration – How office layouts drive social interaction. *Social Networks, 673.* doi:10.1016/j.socnet.2011.05.005.

Sailer, K., & Penn, A. (2010). Towards an Architectural Theory of Space and Organisations: Cognitive, Affective and Conative Relations in Workplaces. In *2nd Workshop on Architecture and Social Architecture, EIASM, Brussels, May 2010* (12 Pages).

Steen, J. (2009). Spatial and Social Configurations in Offices. In D. Koch, L. Marcus, & J. Steen (eds.), *Proceedings of the 7th International Space Syntax Symposium* (pp. 107:1-107:9). Stockholm: KTH.

Turner, A. (2001). Depthmap: A program to perform visibility graph analysis. In J. Peponis, J. Wineman, & S. Bafna (eds.), *Space Syntax 3rd International Symposium: Proceedings* (pp. 31.1-31.9)

Turner, A., & Penn, A. (1999). Making Isovists Sytnactic: isovist integration analysis. *Paper presented at the 2nd International Space Syntax Symposium, Universidad de Brasilia, Brazil, April 1999* (9 pages).

Tzortzi, K. (2007). Museum Building Design and Exhibition Layout: patterns of interaction. In A.S. Kubat, Ö. Ertekin, Y. I. Güney, & E. Eyüboğlou (eds.), *Proceedings to the 6th International Space Syntax Symposium Volume I,* (072.1-072.16). Istanbul: ITU Faculty of Architecture.