PROGRAMME RE-CONFIGURATION: HOSPITAL BUILDINGS, INTERNAL AND EXTERNAL WORKFLOW CONDITIONS, AND COMMUNICATORY BENEFITS

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ABSTRACT

Healthcare buildings are of great specific and general interest for architectural research as they are decidedly spatial at the same time as they are highly programmed, a type of architecture that has consistently challenged research to find clear relations between design solutions and performance or use. This paper argues that one of the main problems of finding consistent relations between workflow, organization, and spatial configurations valuable for the design of healthcare environments lies in that programmes and activities studied have been described from an organizational point of view rather than a spatial, and have been studied as efficiency machines. This paper attempts to begin a shift towards a more complex, if still ordered, approach. The line of argument is meant to be supportive in the programmatic and early planning stages, focused on how space and working conditions facilitate workflow for and communication between different personnel groups. It is proposed that of vital importance for such an understanding is the dual relations of primary ('functional') and secondary ('informational', 'communicative') benefits of programme configuration and distribution, as well as internal and external conditions of workflow – where the latter can be seen as a difference between conditions inherent in activities themselves and conditions produced by technical, organizational, practical, or other means that affect them. These benefits and conditions are rather studied as tensions where on one hand priorities need to be made between benefits, and on the other hand material conditions of architectural design force choices to be made on distribution and configuration of programme. This discussion is supported by empirical data gathered through interviews and observations from a research project of Karolinska University Hospital in Huddinge, south of Stockholm, where several hospital units have been studied to allow a continuously refined understanding of workflow and its spatial conditions in consecutive iterations.

Keywords: architecture; hospital architecture; workflow; spatial practice; spatial configuration; architectural programme

INTRODUCTION

The purpose of this paper is to critically discuss and develop on the relation between programme and architectural layout of workplace environments, specifically hospital units. The intent is to bring a broader complexity of the design and distribution of architectural programming into discussions that acknowledges and clarifies some of the tensions inherently emerging as organisational, medical and managerial ideals encounter material reality and are transformed into architectural solutions (e.g.: Anderson, 1984; Lundeqvist, 1998; compare Foucault, 1985; Nelson and Stolterman, 2012). This discussion will, after a brief outline of its background, go through a small series of empirical examples to illustrate the concepts of *primary* and *secondary benefits* of practices and solutions, set in relation to *internal* and *external* conditions of work tasks. In this way, the understanding of work tasks and communication in work place environments can be better nuanced to look at a wider set of properties than only directly functional measurements. The content has been derived from studies at the Karolinska University Hospital in Huddinge south of Stockholm, where the discussions and conclusions have also been validated in seminars with the personnel.

The paper will mainly consider the practices of and communication between personnel, which has long been recognised as important in mitigating perceptions of stressful situations and offloading stress (Cai and Zimring, 2012; House and Wells, 1978), as well as in building social relations and small groups or communities (Rashid et al 2005; Peponis, et al., 2007), which is important for both performance and knowledge development of knowledge-intense workplace organisations (Amin and Cohendet, 2004; compare: Baraldi, Fors and Houltz, 2006). It will be argued that this in part is dependent on design and distribution choices that are contrary to certain forms of functional optimisation (compare e.g. Ulrich, 2012). Unlike many studies of workplace interaction, however, the paper will focus on ‘indirect communication’ rather than the commonly focused on face-to-face interaction; in a simplified way, the communicative effects of seeing and being seen by one another rather than that of talking with one another. Following, the argument will by and large not engage with patients or directly with patient situations. However, as will be shown, many of the discussions can be applied also for patients’ situations or relations between patients and personnel.

Theoretical and Methodological Background

The basis and theoretical background behind this paper is largely to be found in what is commonly referred to as the space syntax field (e.g. Hillier and Hanson, 1984; Hillier, 1996; Hanson, 1998), even though it deviates from commonly used method in the field in several ways; a deviation we claim is a development and refinement. Thus while less obviously represented in its more common quantitative/correlation based form, some elaboration on this body in regards to the current paper is in order.

Within space syntax research, workplace environments have been thoroughly studied, providing a series of results but the field has also been consistently challenged in that few clear and consistent correlations have been found, that some results appear to be contradictory, and that to certain extents spatial configuration have appeared to be of little importance for the performance of organizations (Sailer and Penn, 2009; Sailer, 2007; Steen,

2009). Specifically regarding movement flows and interaction patterns, the main topics of many studies, results vary, and the interconnection between the two has been found to be weak even in situations where correlations between movement and spatial configurations have been high (e.g. Blombergson and Wiklander, 2006). Other found correlations, such as between positional exposure and degrees of face-to-face interaction by the desk (Markhede, 2010), tend to show little correspondence to movement flow patterns. While results thus *have* been found, there have been problems to establish them as consistently and thoroughly as has been done in urban environments (e.g. Hillier, 1996; Hillier and Iida, 2005), and public buildings (Rohloff, Psarra and Wineman, 2009; Tzortzi, 2007; Choi, 1999; Peponis, et. al., 2004; Koch 2005; 2009). It is in this context further important to note the work of Cai and Zimring (2011; 2012) beginning to establish some consistent result relating behaviours to configuration in hospital environments, as well as the findings regarding community building and co-awareness pointed out by Rashid, et al. (2005) and Peponis, et al. (2007), the distance effects on communication pointed out by Allen (1977) and the study by Grajewski (1993).

The reasons for the common weakness of correlations are many, ranging from the influence of organizational boundaries, to impact of programme and relevance of the spatial system versus experience and expertise of co-workers. Steps have been taken lately to move knowledge forward, e.g. the role-activity-space investigations of Heo, et al. (2009) Lu, Peponis, and Zimring (2009), Koch and Steen (2012a; 2012b), shifting focus from generic flows and behaviour to effects of configuration on role-specific tasks involving movement, a shift towards actor-network analysis suggesting relations to rather be on the levels of social networks than directly observable (generic) behaviours (Sailer and Penn, 2010; Sailer and McCulloh, 2011), and analysis of position and configurations of organizations as they are spatialized (Markhede, 2010; Steen and Markhede, 2010). Common between these papers, is that they reformulate the question of what relations between configuration and performance are to be found, and how these are to be analysed. This is also what this paper investigates.

CONTEXT AND EMPIRICAL BACKGROUND

The material herein has been developed through a research project investigating the role of visibility in cooperation and communication in hospital environments, specifically between medical staff (doctors, nurses, auxiliary nurses[i]). A refined understanding of the roles as decomposed into a number of activities became a central part of the study, as well as providing ways of describing work that allowed the staff themselves to better contextualize and describe the various needs they had. The study was made at the Karolinska University Hospital in Huddinge, south of Stockholm, which provides a number of beneficial conditions for such a study, and majorly through interviews and follow-up seminars.

Karolinska University Hospital in Huddinge

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 came to be as a result of an excessive need of health care buildings in the Stockholm Region in the late 1960s and construction began in the early 1970s, with a plan largely supported by a range of investigations into proper measures and systems for modular construction of healthcare

environments in the 1960s and 1970s (see e.g. Persson and Sjöqvist, 2010). Originally designed by Sven Lindholm and Karl-Åke Hellman at HLLS Arkitekter, it is constituted by an alteration between two-atrium and three-atrium modules, interconnected by corridors and staircases [Figures 1 & 2].

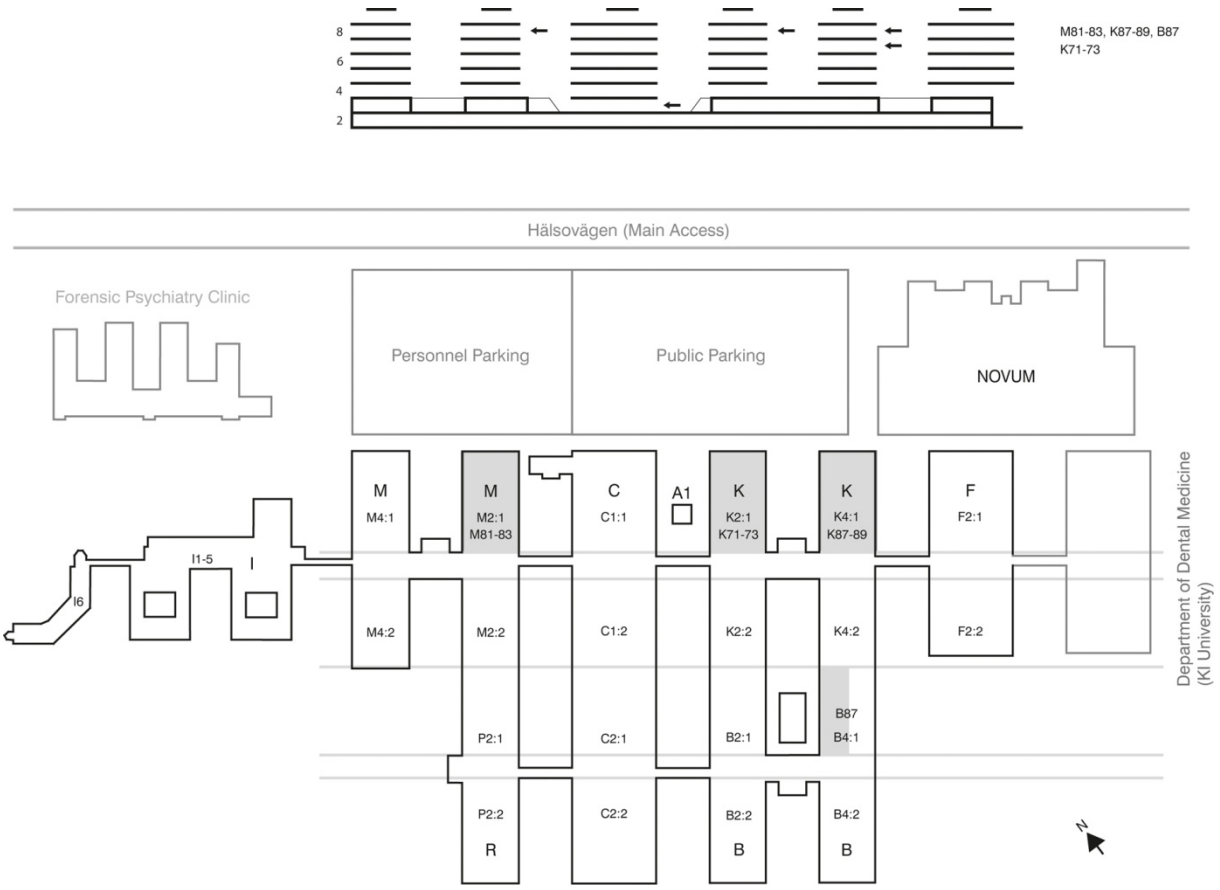

Figure 1. *Overview over the Karolinska University Hospital and the module Grid (indicated in grey lines), as well as units of study (marked with gray in plan and arrows in section). Figure based on drawings from LOCUM.*

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 grids (M, C, K, P, 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 half (one side of the row of atriums). The hospital is continuously being rebuilt, unit per unit, with at least two modules free for or under reconstruction so as to not interrupt operations, why the interior configuration is continuously developed and refined, and changing after concurrent healthcare ideals.

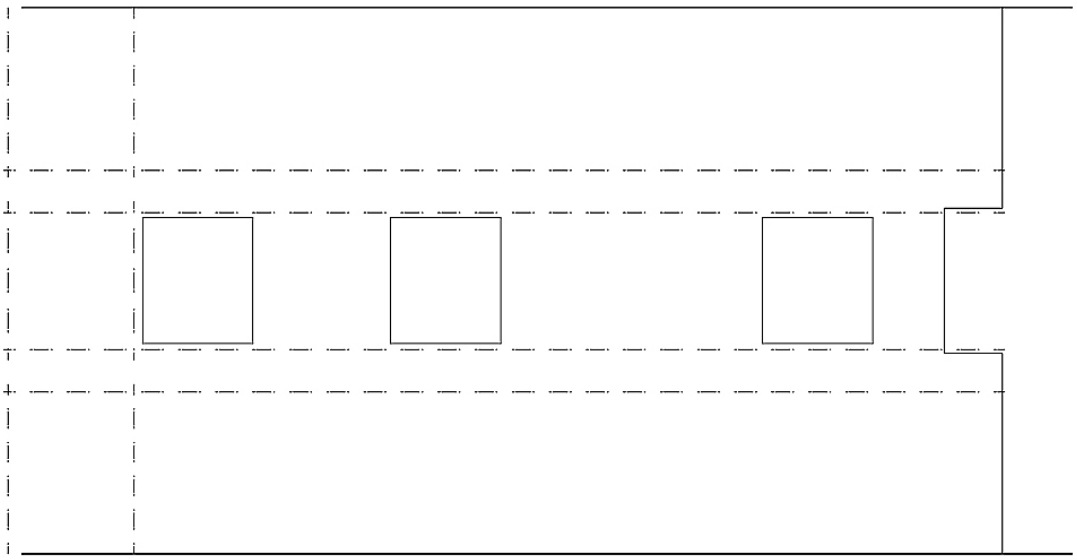

Figure 2. *The module unit of the Karolinska University Hospital, with indications of common partitioning principles (dash-dot) and atrium gardens. Worth noting is that modules in the center have two atriums whereas the ones in the ends have three per module.*

Methods

The research project has taken place over about two years, part-time, gathering empirical material and developing method in parallel, as the study has moved from hospital unit to hospital unit. Data was gathered primarily through interviews conducted with a minimum of two representatives of each of the three medical staff roles (doctor, nurse, auxiliary nurses) in each unit. The results of these interviews were then analysed before follow-up seminars with the interviewees were held in which a re-description of their workflow was presented in order to test accuracy and relevance. Furthermore, experiments based on syntactic analysis were made with the building plan to test different ways of accommodating reported problems or wishes regarding the work environment. These seminars further unearthed particularities of the workflow that did not come up during regular interviews, likely as they are deeply embedded in routine. Interviews asking the interviewees to make generalizations (i.e. patterns of workflow) were altered with interviews asking interviewees to describe specific workdays (e.g. 'yesterday'). Discrepancies in pattern results from these interviews have shown to be small, even if there appears to be a larger loss of side-activities in the former and more sensitivity for exceptions in the latter. Overall the follow-up seminars have worked well as quality assurance of the data. The units were selected to ensure reasonable similarity as well as difference in both working practice and spatial configuration, with the main focus on differences in spatial configuration. Observation studies were made of the emergency ward after these interview studies, providing further insights into the investigated questions.

Specific Research Problem

The specific problem investigated in this paper is how the influence of spatial configuration comes not in the form of correlations between movement flows and integration (as has been repeatedly stated elsewhere) but through what spatial configuration *does* as it is made use of *through programme*, where programme is considered both in its functional sense and as daily

routines and habits (following the argument of Sailer, 2007) – an approach that has further been proven useful in a parallel EU FP7 project (RIBS), which although focused on different issues has provided opportunity for a broader (integrated) development of methods. One way to understand the point made here is as a 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 do program and space interact to formulate spatial practices, and what do these spatial practices (re)produce, what do they support, and what problems do they cause?

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 generating activity itself. These practices include strategies and tactics that makes use of spatial configuration to negotiate between direct and indirect benefits, weighed differently for different roles and activities in the workplace environment. In this way, the line of argument complements and develops on e.g. Sailer (2007), Heo, et al. (2009), Lu, Peponis, and Zimring (2009), and Cai and Zimring (2012). As these papers also provide more rigorous statistics they contribute to further anchor the discussion herein in empirical evidence.

The coming discussion will first briefly introduce the concepts of primary and secondary benefits, to then focus on the empirical material by a number of specific cases: the effect on movement patterns by technological conditions, the effect on movement patterns by conditions set by medical treatment necessity, and the effect on communication opportunity, indirect communication, information gathering and sense of presence generated by ostensibly efficient and inefficient solutions.

ON PRIMARY AND SECONDARY BENEFITS

The point of departure for using a terminology as 'primary' and 'secondary' benefits is not that one is more important than the other, but that in the durée of daily workflow there are things that we go about to do, and things that come out as unintentional or additional results from doing so (compare: Giddens, 1984). Going to planning meetings can lead to networking or unexpected help with other tasks or problems, visiting the printer can give updates on recent professional or social developments, and so on. Commonly, programming of space focuses on 'primary' benefits; that is, the explicit purposes and activities taking place in a workplace environment and efficient connections between them. Thus in a hospital this typically becomes places such as offices, documentation rooms, patients' rooms, nurses' stations, medicine rooms, et cetera, and short distances them in-between, whereas it in the work flow becomes preparatory meetings, patient visits, documentation, materials and equipment restocking, medicine preparation, et cetera. In part, this is because these *can* be programmed, while such things as 'update each other on the run', 'keep track of where the others are', 'be visible for patients' or 'be allowed to be focused and undisturbed' are less easy to put into a 'traditional' architectural programme. However, they can be argued to be supported or restricted by the programming and configuration of the primary tasks. To some

extent, as will be shown in the coming, they emerge at the expense of direct, perceivable ease or efficiency of the programmed task – hence the terminology primary and secondary *benefits*, as the architectural layout can emphasise either the performance of the tasks themselves, or the additional possibilities that can come as a result of performing them or moving between them. This partial opposition is what Châtelet (2000) calls a 'true' opposition rather than a 'logical' opposition: it is not an either/or question but rather a case where there can be much and little of both, even if there are certain restricting architectural conditions that disallow a simple 'more of all' solutions and while not dichotomic, there are degrees at which they become contradictory. That is, it comes down to *priority* (compare: Lundeqvist, 1998; Nelson and Stolterman, 2012).

External Conditions: Technology and Workplace Routines

The first case in point investigates how technical workflow conditions also become socio-spatially generative. The units to be compared have similar *spatial conditions*, general workflow principles that are similar, but *workflow practices* that turn out very dissimilar due to a single, ostensibly minute difference. Both MAVA (Medical Emergency Care Unit; M81-83) and Stem Cell Transplantation (B87) work with teams of doctor, nurse, and auxiliary nurse, with a specialist doctor visiting select cases. As general practice, both begin the day by deciding the sequence in which patients are to be visited, after which patient visits take place.[ii] 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. For the purpose of this discussion this is inconsequential, as each team was assigned patients in one corridor only, and the medicine room had entrances from both corridors in the double-corridor unit.

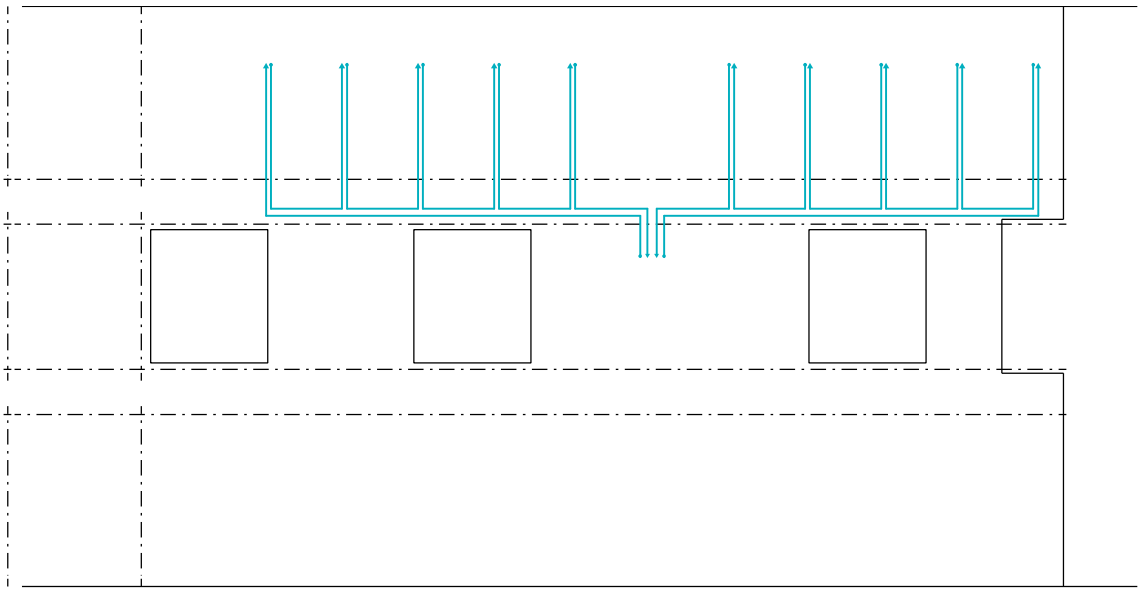

Figure 3. *The minimal movement generation for the nurse in M81-83, where the nurse has a wagon which he or she brings from the medicine room with the medicine for all of the team's patients. The figure is conceptual and illustrates a case with two teams of five patients each.*

The *difference to be focused on here* is that in the larger unit 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 prepare medication for each patient one at a time. In the first case, there is a machine through which medication is provided in prepared doses per patient, allowing a safe handling of many patients at a time. In the latter case, it is considered a safety precaution that medication is prepared and brought to the each room one at a time.[iii] 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, 1985). 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].

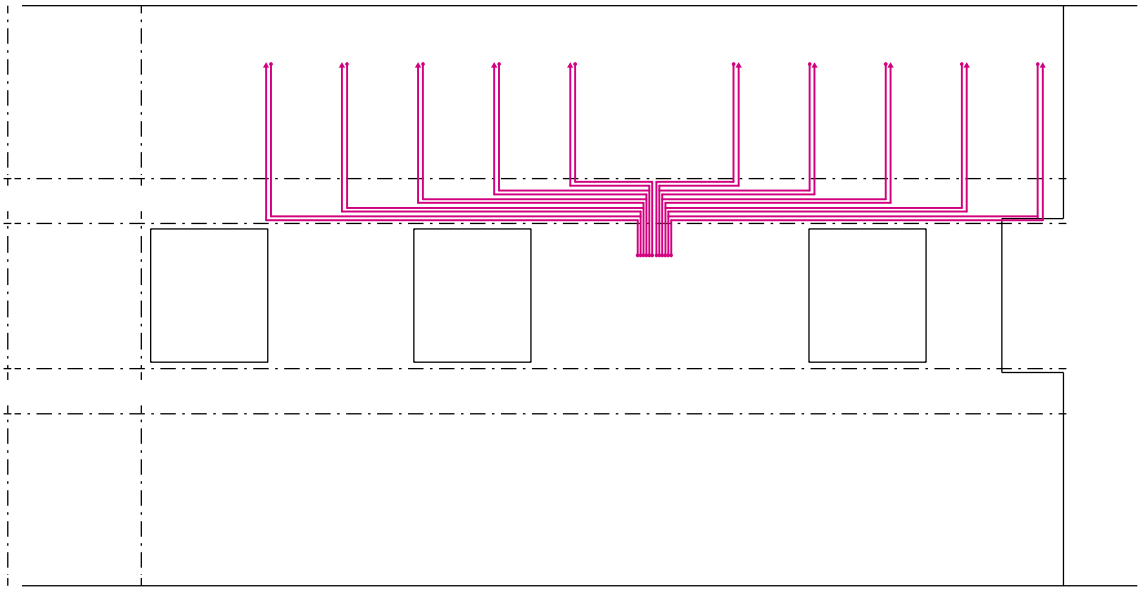

Figure 4. *The minimal movement generation for the nurse in B87, where the nurse has to return to the medicine room for each patient. The figure is conceptual and illustrates a case with two teams of five patients each.*

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 generates 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 a nurse passes by the medicine room only two-three times during the patient visits in one case, and in the other *at least* double the amount of patients they are to visit (i.e. between eight and twelve). 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. This difference grows the closer practice gets to the 'ideal implementation' of the specific workflow: 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.

This has consequences outside of the time at the patient's bed, however. If someone who is not a member of the team (another team, another doctor, the specialist doctor) needs to find or communicate with the team it would be more difficult to find the team following the series workflow as the team spends less time in the corridor and are less likely to be met by chance. This can be the specialist doctor just trying to check if the planned visit to a patient is up. 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 provide more regular opportunity to find a nurse. That is, it is more likely for 'space-time bundles' to occur where people who need to or benefit from meeting each other also do so (Mattsson, 2006). It is also more likely that nurses from different teams have an overview of each other's location, thus being able to provide information. Constant returns to the medicine room, together with more time spent in the corridor, can be argued to 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).

The extra amount of walking in the case of B87, naturally, is both cumbersome and provides less direct time with patients per working hour, and is therefore less efficient under certain definitions of the term. Perhaps counter-intuitively, however, a configuration spreading out the patients and to some extent maximizing movement distance would (to a breaking point) maximize potential indirect communication in the course of patient visits. 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, becomes a key design parameter that responds differently to different organisations and configurations.

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 in part 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). The location of the medicine room also becomes differently affecting the pattern, efficiency, and emergent effects of presence and communication in the two cases; in one case it seems highly important to have it centrally and/or closely accessible from most patient rooms, whereas in the other it is more flexible.

INTERNAL CONDITIONS: PERFORMATIVE NEEDS OF WORKING TASKS

With the second case we want to compare the two sub-units of the Emergency Ward, *infection* and *neurology*, and describe the observed process of a patient visit from a rather 'ignorant' point of view (compare: Latour and Woolgar, 1979). Through this example we intend to make an observation regarding the practices of the Emergency Ward unit that closely relates to the above but at the same time provide another understanding of *programme* seen as *spatial*

practice in general. Once more, we will forego any overview of the unit and go directly into a specific comparison. While the *overall* rhythm of the units were similar for 'regular' cases but varying greatly in specific, more emergent cases, the *internal* rhythms of the patient visits were radically different.

A. "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." (Koch and Steen, 2012a, pp. 8146:11-8146:12)

B. "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." (Koch and Steen, 2012a, p. 8146:12)

Movement and/or seclusion generated by a single patient visit thus radically differ for units that even within the hospital *at times* are discussed as similar. The reason for this difference is that the analysis of infections is heavily based on 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. Analysis and prognosis thus includes a fair deal of waiting, whereupon efficient use of working time means spending the intermediary phases while waiting for results either on other patients or on preparation or research. Neurological

issues, however, require 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. Symptoms may overlap, be vague in their expression, or take time to manifest enough to be diagnosed. In a visit to the neurology ward, patient and medical staff by default spend a fairly long continuous time together.

While this observation may seem obvious for medical staff, even simplistic, the point here is that such a hands-on description makes apparent radically different *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. Following, the number of opportunities for encounters also differs radically as a result of the number of generated movements. 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. One can be easily altered and manipulated by decisions around routines and processes, whereas in the other 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 programme 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 [Figure 5] (Steen, 2009), and the impact of the distinction can thus become clearer.[iv]

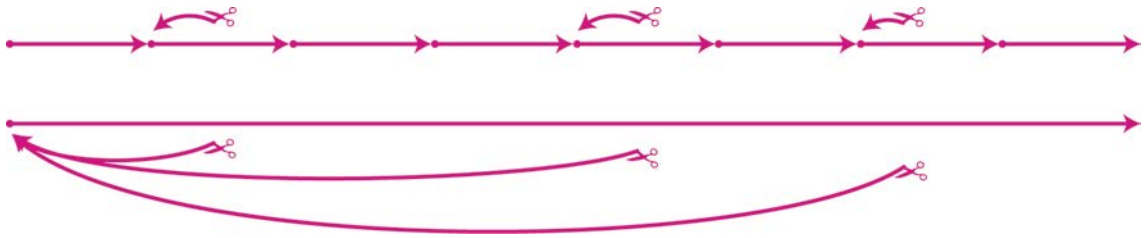

Figure 5. *The concept of long and short questions does not have to do with the length of the work in question but the way work can consist of small sub-tasks or longer passes of continuous reasoning, making it respond differently to interruption.*

The point of long and short questions, somewhat translatable to long and short processes, has little to do with the length during which they are worked with, or how focused or concentrated the work is. The point is how the work responds to interruptions. Short questions are open and flexible as the workflow either consists of a number of tasks following one another, or can be subdivided into steps that are 'finished' so that an interruption leads to minimal loss of time. Long questions, comparatively, require long consistent time working as interruption may lead

to losing a strain of thought or similar, requiring the process to begin again from a much earlier stage. Short questions are therefore also *easier* to blend with other tasks and to do 'whenever time allows'. To a certain extent, these two models correspond to the two different Emergency Ward sub-units, and seen as descriptions of the process it becomes rather accurate. They allow for very different treatment of programme, however.

Efficient and Inefficient Solutions

If we return to the main question of this paper, that of primary and secondary benefits of hospital layouts, we now have three components to work with, the *programmatic generation of movement* of different task, be it for reasons of internal or external conditions, the *distribution effect of programme and locations in space,* and, thirdly, the *spatial configuration through which movement is structured.* These work together in the generation of primary and secondary benefits of work activity in various ways. A simple case can be seen in a comparison between two connections past a corridor [Figure 6]. Movement efficiency is maximized in one case, and in the other communication opportunity and indirect information gathering is maximized. The emerging results are apparently and radically different, and the preferred choice is one of priority: is proximity and thereby efficiency of the primary task of most importance, or is the communicative, informative production (secondary benefit) important enough to warrant deviation from the most functionally efficient? If we introduce a third party (illustrated with a circle), the difference may appear even more radical. The third party can also be key in breaking out of simpleminded responses to the question: while it may be most beneficial for the task itself, and perhaps even the one performing it, to maximize efficiency, the secondary benefits of a less apparently efficient layout may outweigh this.

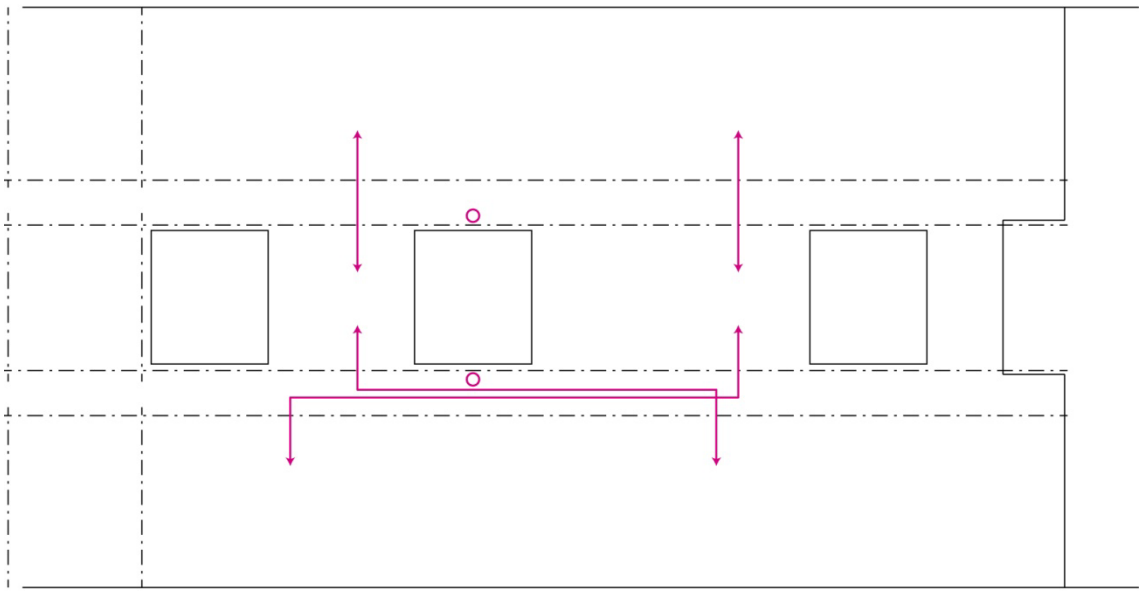

Figure 6. *Two different connections between e.g. work stations across corridors, illustrating the difference between movement efficiency and communicative potential. Arrows correspond to the programmed movement, and the ring a potential third party.*

The ring, in this case, could also represent a patient or a patient's relative(s).

It is in this discussion important to remind of that the argument is not to create obstacles for or decrease personnel-patient contact, but to open up for other definitions of it, such as the perception of personnel presence when they are 'not in my room.' This can be further developed by a more thorough discussion on roles and the time-space practices of the working day. For the sake of clarity, this will be done similarly to the discussion of the nurses' movement pattern in relation to medication practices. To start, the nurses' movement pattern in the unit in question can be expanded to include a larger part of a workday [Figure 7]. In this way it includes visits to the preparatory meeting room, the doctors' office, the auxiliary nurses' room, and their own offices.

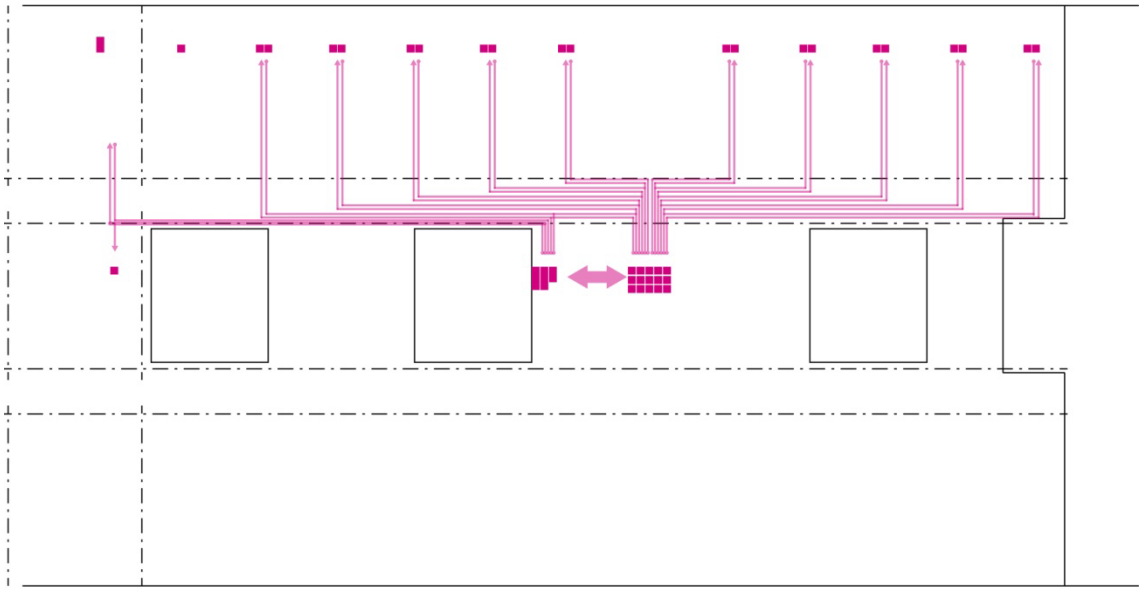

Figure 7. *The programmed movement pattern of nurses in a working unit in the 'ideal case', i.e. if only the movements necessitated by the program take place.*

In a similar vein, the pattern of the auxiliary nurses and doctors can be drawn [Figure 8]. Both show a more *serial* character of movement, even though the auxiliary nurses shift between the seriality of patient visits and a more dispersed pattern, and the doctors shift between the seriality of patient visits and more focused work in their offices. Auxiliary Nurses are also in contact with patients more often and longer, as well as visit the kitchen and various close-proximity storages.

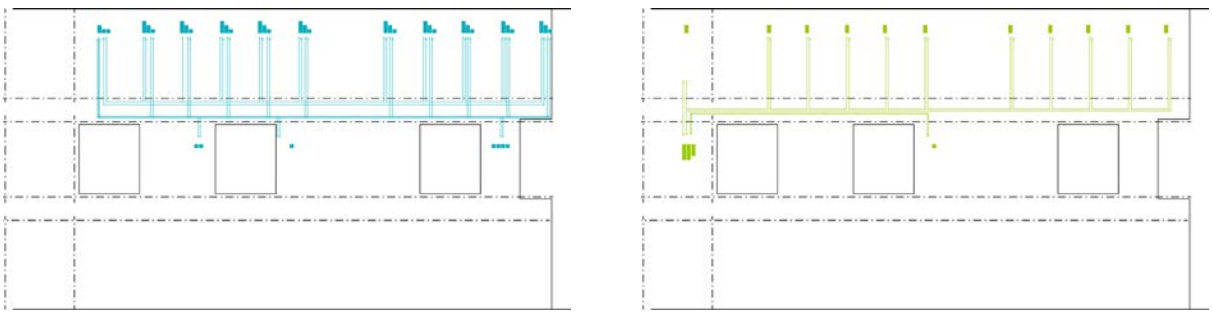

Figure 8. *As in Figure 7 but for the auxiliary nurses (left) and doctors (right).*

In total this results in a composite pattern as in [Figure 9], clearly showing where the emphasis of programmed movement flow lies as well as beginning to give a picture of where time is spent. Clearly, most total time is spent by the patients.

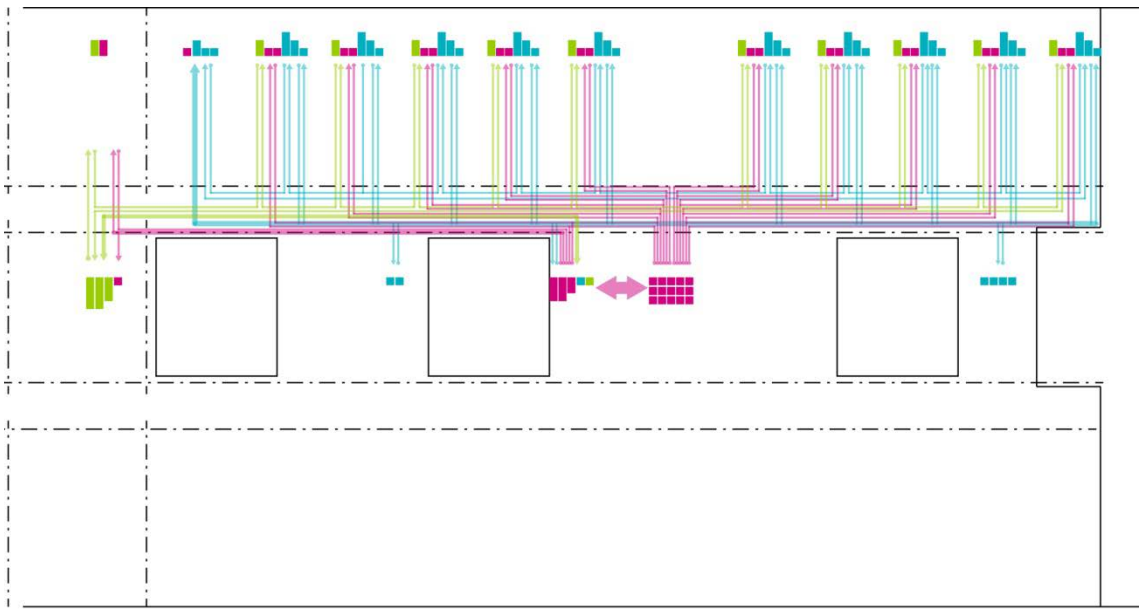

Figure 9. *Composite figure of the three different roles diagrammatized as in figures 7 and 8.*

Refocusing this analysis on the time-distribution of work for the different roles, the result ends up as in the table [Figure 10], where also the effect from the point of view of the patient is introduced. This clearly shows a central problem in the programming of hospitals; for each patient the time spent by their side will be little compared to the amount of time all personnel spend by patients during their day. But it also highlights another issue that is of interest for the ongoing discussion – the primary and secondary benefit of workplace practices *for patients.*

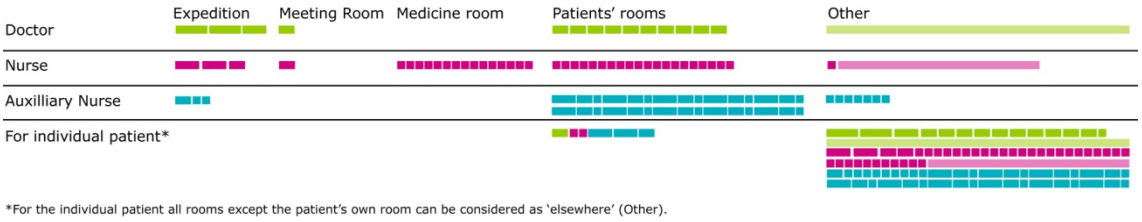

Figure 10. *The time spent by the different roles seen from the perspective of an individual employee (first three rows) and from an individual patient as compared to all employees in the unit (last line).*

In a simple way of understanding 'secondary benefits' from the patients' point of view is to see it as that the more the personnel move in the unit, the more potential exposure of the personnel for the patients will be generated while performing other tasks. This can be important for patients, even if they wish to 'just see where the personnel are at', or 'feel there is someone around'. The corridor is more likely to be 'lively', and if the patient looks out from her or his 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. 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 primary and secondary benefits.

To investigate this further, one experiment was made to test the potential benefits under three conditions [Figure 11]: (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. 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. The point of the experiment can be simplified to: 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.

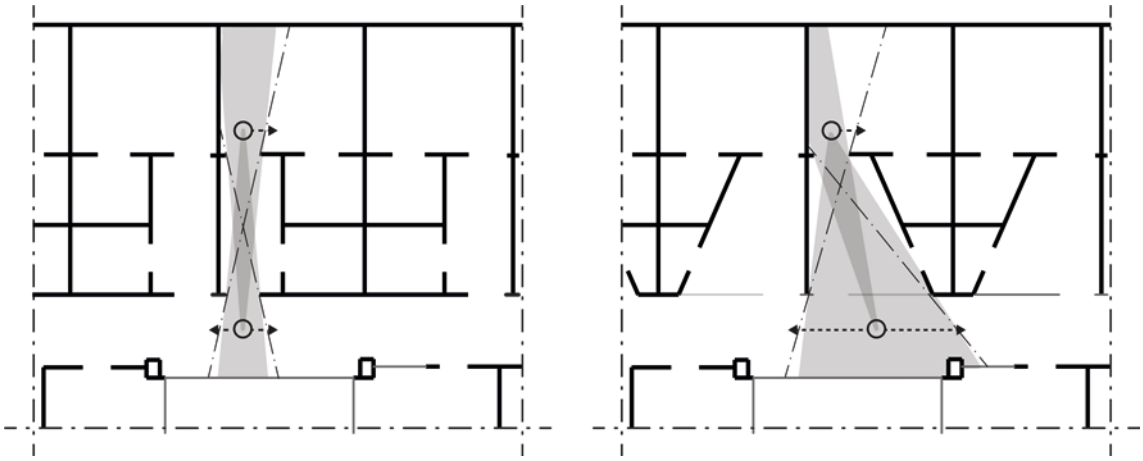

Figure 11. *By widening the corridor end of the airlock while leaving the windows into the patients' rooms small, most of the corridor is exposed to patients' rooms, whereas most of the patients' rooms are hidden from the corridor. The control over the (visibility/exposure) interface between patient and employee is shifted towards the patient by means of spatial geometry. Dash-dotted line in the figure showing the boundaries of possible visibility/exposure.*

Comparing to Lu, et al. (2009) an analysis can be made between secondary benefits of visual communication and primary 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 and 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).

INTERNAL TENSIONS IN ARCHITECTURAL PROGRAMMING

The discussion above lead us to develop a set of figures, or rather thought models, through which these factors could be made nuanced and discursive rather than remain dichotomies. For these reasons, the models introduced work with specific pairings of perceived or real potentials or problems of socio-spatial character, also possible to realize spatially through manipulation of configuration and programme, but which were not translatable directly to organizational role. The aim here was to primarily define social or organizational working conditions as questions from which to produce responses that had spatial implications. They also should be considered as 'true' oppositions as introduced above (see Châtelet, 2000), in that they are not 'sliders' to move between or along, but tensions affecting the situations in which work tasks are best performed. These were tested in several iterations through the project to refine and develop their precision and relevance.

An initial diagram illustrates the oppositions of spatial and functional properties, deliberately staged to challenge simplistic proposals of direct benefits of spatial solutions by introducing the question of secondary benefits, to a large extent possible to further understand through e.g. Lu, et al. (2009) and Heo, et al. (2009) with a certain expansion of the argument. It starts with the simple opposition of near and far architecture always faces due to its materiality. On the other axis, the direct benefit of saving time can be posed against the indirect benefit of movement generating overview. Here, the indirect benefit could have been set to e.g. generation of potential for encounters, or exposure to co-workers or patients, but it was decided that the clearest opposition was between functional efficiency and the gathering of information for the one moving – which to some extent can be measured through adaption of targeted visibility analysis (Lu, et al., 2009) – producing the diagram in [Figure 12].

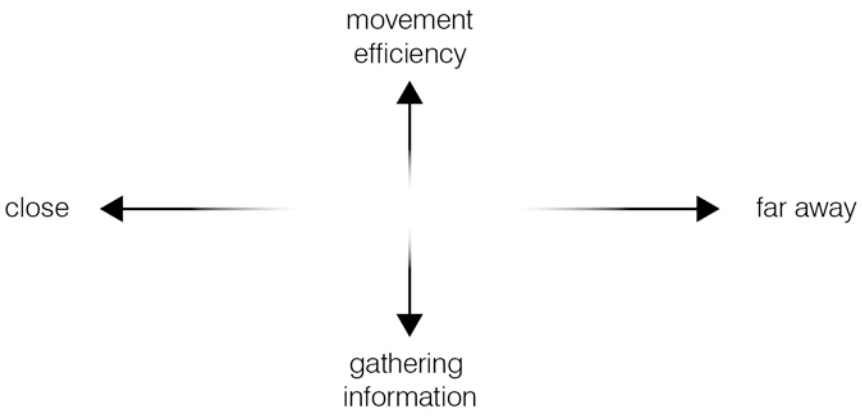

Figure 12. *The relation between direct and indirect benefit of location strategies offering a refined discussion of the logistical choices to be made in relation to non-direct or non-function centered benefits offered by visibility.*

Another way of looking at it is rather for the one not moving; the one 'to be found' rather than the one 'finding'. While conceptually the inverse, this diagram gets a rather different

character. Instead of efficiency or information gathering, an important question became the need to be left undisturbed versus the need to be available for others, paired with the tension between being able to control this availability on one's own or if it was up to others to interrupt or leave be [Figure 13].

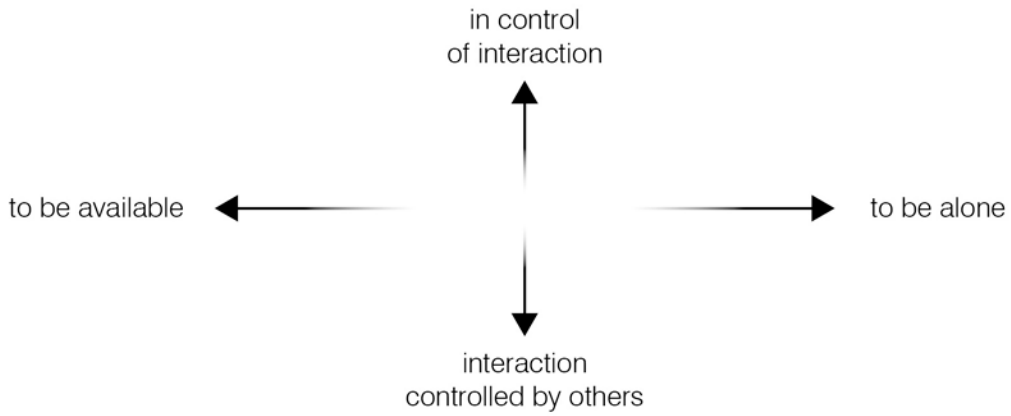

Figure 13. *Principles of work conditions, describing the current situation and its relation to others, as well as who is in control of this relation.*

These 'tension figures' were well received and productive for the discussions, beginning to with more precision explain what was sought after within the different working roles and tasks, and also possible to relate to configurative properties either directly on existing plans or as discussions of principles. It also highlighted differences in the configuration of the organizational roles and the degree of tension between different demands inherent to them, such as that doctors had an internal functional demand to be undisturbed (in order to perform thorough analysis, catch up with latest research development or, as it is a university hospital, develop their own research) and a systemic functional demand to be available (nurses are not formally allowed to make decisions regarding e.g. changes of medication and thus need to be able to contact doctors at any time).

This internal versus systemic functional demand, in conflict within the same role, potentially highlights where spatial solutions may be of aid, if it can be further defined what the different demands are. For instance, it can be discussed whether the nurses disturb a doctor more if she or he is unseen (e.g. 'elsewhere' so that contact must be made to find out if it is appropriate), or if a visibility solution may alleviate this through providing simple and direct information regarding whether the doctor is busy in deep concentration or look more open for disturbance (Steen, 2009). This can then be weighed against the risk of exposure implicating availability, but experiences from units with glass rooms indicate that it can work well, as long as there is an agreed upon symbolic means of communicating openness (in the case in particular quite direct: a door that can be open or closed). Such symbolic communication, it should be noted, is highly dependent on workplace practice and collective agreements on what they mean in order to function.

The next step, rather complementing than replacing the figures above, was to elaborate on the 'external' or 'systemic' situation, i.e. the individual in his or her context. Here the interviews as well as research in general (compare Amin and Cohendet, 2004) point to the organizational

problem of not individual and collective, but the smaller social or professional unit (e.g. group or team) and larger unit (e.g. hospital unit or division), including but not limited to inter-group communication. It thus centred on the purpose and social context of *communication* as to exchange information, for instance, within the team or within the unit. As with the above diagrams, it was also set into nuance by introducing another axis of the difference between 'social' and 'professional' communication, where the former is working to produce social relations and community whereas the latter is more about knowledge exchange. *It is crucial for the model that we consider both to be necessary in a workplace environment* (see e.g. Amin and Cohendet, 2004; Peponis, et al., 2007), and that they to some extent facilitate each other. However, it may be that certain groups are in greater need of one or the other, and they may be differently important in different scales (or between different vertical or horizontal layers of the workplace organization). Thus, the diagram is formulated as in [Figure 14].

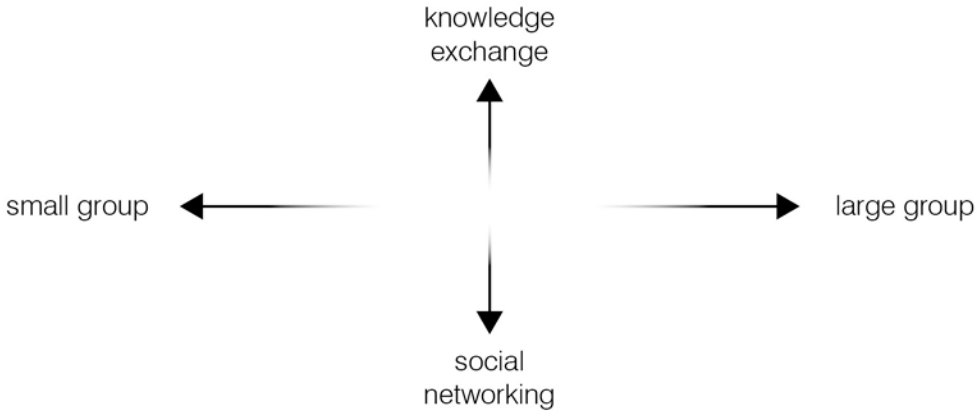

Figure 14. *Principles of communication in the unit (or hospital), allowing a mapping of forms of interaction and the roles it has both socially and professionally.*

Through this diagram, it is also possible to further understand the spatial conditions of different kinds of interaction that together make up the interaction of the hospital unit, and arguably any workplace – which has also been developed in parallel projects. The length and spatial situation in which they can take place, as well as the degree of spontaneity with which they can happen, clearly has implications for what spatial configurations are needed to support them. I.e. the diagram helps develop a refined understanding of 'meeting places' and the relation between encounter-based interaction (produced through space-time bundles; see Mattsson, 2006), planned meetings, and semi-spontaneous meetings which are not to be considered as 'planned' but not happening on-spot as a result of an encounter. It further points towards the need to work much more deliberately with a range of meeting places responding to the contextual spatial conditions as well as the social preconditions of what meetings are aimed to be supported. One result is a simple need of differentiated meeting places considered as a contextual activity (compare Bergström, Marcus and Koch, 2010). The nature of this differentiation is, however, in need of development. It is thus not only levels of meetings but meetings as situated activity with the complexity that follows that provides a better potential to capture the kind of interaction which is aimed to be understood.

Finally, it becomes clear that the there are inherent problems in hospital programming in the different amount of personnel present over different parts of the days and weeks – regardless of if the focus is on primary or secondary benefits. This can be illustrated through [Figure 15]. However, it may be possible that what is *problematic* differs over the day – primary and secondary benefits. If this is clarified, then it might lead to other, and more deliberate strategies for dealing with the two situations.

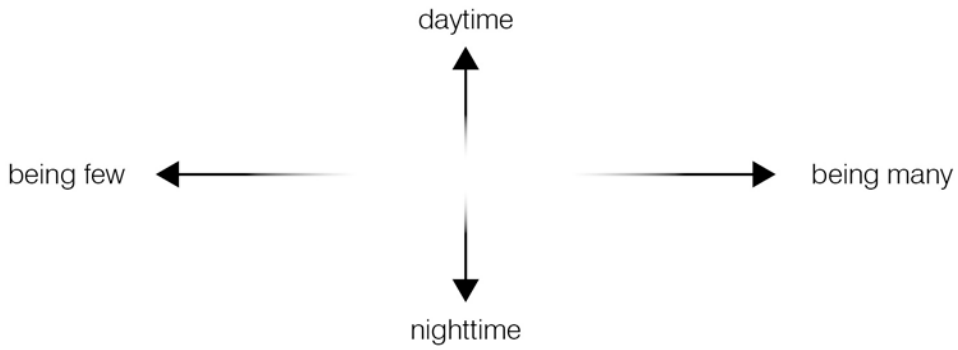

Figure 15. *Personnel mass tends to shift over the day, for instance between night time and day time, at the same time as work may have different character. The spatial, social and professional conditions or needs for these different situations can be radically different and may need to be addressed to find either flexibility or an acceptable mean solution.*

What these figures allow, is highlighting tensions within roles and relation between roles of both functional and social character, which help us break them down into not only direct work tasks but into work tasks contextualized into their organizational, spatial, and social context. It further leads to a better understanding of why certain arrangements for a specific task is experienced as problematic by some and well-working by others, depending on the composition of functional, social, and organization-systemic demands and practices within their role. Adding the relation and tasks in regards to patients naturally complexes the picture further, but this is outside the scope of the current project.

CONCLUSION

The main point of this paper has been to introduce ordered complexity into the understanding of program, by introducing two terminologies: *primary and secondary benefits,* and *internal and external conditions.* In the former case, it has to do with programmable and generated on one hand, and functional and communicational on the other. In the latter, it has to do with parts of programme that can be manipulated and parts that are inherent to the activity taking place at all. It has been shown how primary and secondary benefits *may* be oppositional in many cases and that focusing solely on one can lead to problems, and that which of them to focus on is a question of *choice* and thereby *priority.* A priority that should be made more deliberately and consciously than what is common, taking into account the benefits and losses of decisions made. This prioritisation is to a large extent the central problem in the design process, deliberate or not. To allow the hospital personnel to participate in this prioritisation in a meaningful way, it may also be more beneficial to point to the choices and priorities at

stake rather than at specific solutions or plans which they seldom have training and experience in reading. It has further been shown how apparently similar spatial practices may be only superficially similar due to technical conditions or routines, but in reality radically differently adaptable to other ways of working. Following, they set different conditions for how to work with primary and secondary conditions, as routines can be manipulated to support or counter them, whereas internal conditions need to be managed 'as is'. It has been clearly shown through seminars and presentations how such a shift of perspective that includes secondary benefits and that provides understanding of internal and external conditions emphasises and makes discursive issues that are relevant for hospital personnel.

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[i] 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.

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

[iii] 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.

[iv] It is worth noting that there are other sides to 'long' and 'short' questions that are not included here that has to do with how they are dealt with and with whom.

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LIST OF FIGURES

All figures by the authors.