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Understanding effects of design – mapping healthcare processes in spatial configurations

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Abstract: The paper reports and reflects on an evaluation project at Malmö Nya Sjukhus, NSM, Sweden, where the relationship between healthcare performance objectives and indicators in the built environment have been studied. The starting point of the study was the outcomes in performance set by the hospital and a retrospective analysis of how these could be related to evaluation of the design of the new hospital. The paper discusses evaluation against a backdrop of existing studies on evaluations and with an argument that that there is a need for tools and methods to strengthen design work in general. The main argument is that it is valuable to evaluate the work processes in healthcare against spatial configurations in addition to studying effects of specific design features. Connecting healthcare process indicators to spatial design also envision several challenges and possibilities that are addressed in the paper. The study presented is mainly qualitative with and explorative approach.

Keywords: healthcare built environment; evidence based design; mapping; healthcare processes; design effect

1. Introduction

Understanding built environment, and healthcare facilities in particular, is a challenging endeavor. To understand the effects of a particular design or layout on the activities planned to be executed requires robust and reliable methods and approaches (Brambilla & Capolongo, 2019; Li et al., 2018). It is interesting to note that in the field of medicine and healthcare management, measure-oriented approaches and quality assessment tools are regularly used as the foundation of clinical activities to foster the quality improvement of the services delivered (Brambilla et al., 2021). This is however neither done for design and planning of healthcare facilities nor for evaluation of outcomes. In the history of research on building evaluation we find aspects related to the efficiency of the buildings per se (Preiser & Vischer, 2005), but also initiatives to understand the users and their context to understand what is valuable and meaningful to them (Vischer, 2008). This is an area that spans from quantitative aspects to qualitative and that includes organizational as well as individual objectives. This paper takes its starting point in a study conducted at Malmö new hospital, NSM, in Sweden. This is an ongoing project where there is an identified need to find possibilities to evaluate the new hospital's healthcare processes against the facilities it uses. The starting point of the study explore the assumption of hospital organization being that "if we invest this much we should be able to evaluate it" (P. Lanbeck, personal communication, September 14, 2021). The study is based on a discussion on the objectives for the healthcare activities and how these can be related to the design of the new hospital. To this is added a discussion on the challenge of measuring and evaluating healthcare facilities.

2. Background, to measure or not to measure

Research on the efficiency of facilities is nothing new but has been ongoing since the 1960s in various forms. This has focused on the performance of the buildings themselves and the effects of building components. Methods and processes for documenting the effects of buildings and premises have also been developed. Especially methods to evaluate buildings once they have been taken into use. However, what remains to work on is to develop methods for linking business goals to the design of premises that can be included in systematic follow-ups. This is a challenge in healthcare where operations usually change in connection with organizational changes and the impact of facilities is therefore difficult to describe without systematic support.

There are methods available for evaluations in a pre-stage, where simulation models are developed. These are generally surrounded by a higher degree of uncertainty and their level of usefulness is not yet internationally recognized (Schaumann et al., 2020). Once a building is in use a common method is Post Occupancy Evaluation (POE). POE can be seen as a way to ensure how a building delivers what is actually expected and its consequences in the form of "ends" instead of how this is provided ("means")

(Adrian, 2003, p.). Two main issues are proposed to guide the work; "How does the building work?" and "Is this what it intends to do?". The second question here is what most often challenge systematic evaluations as there seldom are baselines or a pre-study to compare against. This often results in the effect that new is better, which usually is true for new buildings in their first phase of use.

To succeed with evaluations, tools are needed to be able to maintain feedback during and after the construction process (Macmillan, 2004). Four approaches that are proposed, which can be used both in combination or separately, are observations, questionnaires and interviews, informative discussions and physical review, statistical tests and analyses of performance. In the chapter “Learning more from what we build” of Macmillans book “Designing Better Building”, Lil Bordass stated that many consider the best results to be produced through a combination of "hard" and "soft" values (Macmillan, 2004). Francis Duffy in 1990 recommends in-depth measurements by considering that they must be operational through validity and reliability in the measurement process - they must be rigorous and practical to carry out(Duffy, 1990). The measurements should be clear and popular science in such a way that it is clear what is being measured and for what purpose it is being measured, in other words, why it is advantageous to make the specific measurement / evaluation. An evaluation must also be performance-based, which is directly related to individual or organizational success. They should also be comparative to enable information to be stored in databases and encourage benchmarking and comparisons both within and between organizations. Furthermore, Duffy suggested that an evaluation should be broad and equally capable of evaluating the intricate details of a specific workstation as a large factory premises (Duffy, 1990).

It is therefore important to also ensure that the evaluations can be made in a robust way, even if the information cannot be checked in the same way as in laboratory-controlled experimental studies (Leaman et al., 2010). The results of an evaluation also depend on the circumstances in which the evaluation is made, how the building or facilities are operationalized and in what context they are evaluated - but the method can be the same. Additionally, the way in which the evaluation is carried out should whenever possible be repeatable, credible and give convincing results.

3. The case, NSM, Malmö

The starting point for this paper is, as mentioned above, the operational goals developed for the NSM project. The NSM project is being done mainly because the existing buildings are becoming old and difficult to maintain and adapt to today's healthcare needs (Region Skåne, 2021). The new facilities therefore need to be able to be flexible and adaptable to future working

methods and care needs. The goal is to create the best possible care environment.

The new care building will consist of two buildings on 10 and 11 floors, respectively, interconnected (Region Skåne, 2021a). The case building is part of a development of the hospital area in Malmö and intends to create better conditions for high-quality and safe care. In addition to the new care building, a new service building, a new mortuary and an expansion and improvement of culvert systems and technical infrastructure are also being built.

NSM is Region Skåne's largest construction project ever. The scope of the healthcare building is 108,000 sqm. The project also includes service buildings, replacement buildings and technical infrastructure. The budget for the project is SEK 12.3 billion for the construction project and SEK 1.9 billion for equipment. The decision to carry out the redevelopment was made by the Regional Council in 2013, with the initial allocation of SEK 6 billion with a project period between 2014–2020 (Region Skåne, 2021b).

The operative goals are divided into political goals and goals according to the planning principles established by the Regional Board in Skåne. The effect goals are broken down and are followed in the NSM project for an annual report to the steering group. This follow-up refers to how the project enables the goals to be met.

Based on thes effect goals and how they have been structred for evaluation, a research study has tested and translated these into evaluation aspects / points for the physical environment.

The evaluation and discussion how effect goals could be related to and evaluated in conjunction with spatial design or spatial aspects was done via semi-structured interviews with staff related to the project. The choice of respondents was based on relevance and accesibility of key persons in the project. The gathering of data was based on semi structured interviews and discussions where reflection, clarification and definition was in focus of the discussion part. The approach is valid for small scael research projects aiming at mapping an area for development of further research questions (Denscombe, 2020).

It is also important to note that the evaluation of the project was done on the basis of set goals and in relation to other similar projects. Region Skåne, nor other regions in Sweden, have a uniform evaluation model for construction projects of this magnitude, especially with regard to outcomes for employees and patients.

4. Findings - what did we learn from the Malmö case

The operational goals that guided the analysis of NSM were divided into five main aspects: political directives, patient safety, flows, sustainability and knowledge and development. As the policy directives were not set from an evaluation point of view, this has been omitted in this study. In total, the

study has touched upon 100 different operational goals, which has provided a broad and comprehensive basis for future evaluation work (Widmark et al., 2022).

Each aspect/operational goal in the study has been found to have several evaluation alternatives, with a range from employee and patient surveys through both surveys and interviews, to pure register analyses based primarily on various reports found within the healthcare system, care production statistics and quality registers. In the case of surveys, they can advantageously be combined and spread over most of the five aspects.

The implementation of the evaluation of the premises and buildings at NSM is largely based on comparative data, before and after the move. This means that there is a need to start part of the evaluation as early as possible after project completion, in order for data to be available, i.e., not being forgotten or skewed or out of the organization due to staff changes. Depending on which approach is used for each evaluation area, an overview also needs to be made of how information is entered into the chosen system of documentation. Several persons, in the interviews, raised the issue of the need to be able to draw direct conclusions from the documentation systems as the input and definition of information does not always correspond to the actual situation. Such an analysis can at the same time identify systematic “errors” that can be expected to be consistent, i.e., the measurements before and after moving to the new premises are expected to have an equal margin of error. In that case, they can be used for comparisons.

Based on the interviews conducted, and reflections made by the project group for the NSM study, it can be stated that the there are many evaluation possibilities for the new premises within NSM depending on what is sought after. In this paper the focus concerns translating operational goals, aimed to be enacted in the new premises, into aspects possible to relate to evaluation in turn related to aspects connected to facilities design/aspects. Although premises and the physical location can be measured and evaluated through measurement of specific functions and criteria, also experiences, and opinions from those who use the premises need to be weighed in. Even if the premises meet the technical requirements required, this must additionally be evaluated considering what those operating on/in the premises consider meaningful. For a hospital environment, this involves both care staff and patients, but also administrative and service staff. In order to as complete as possible evaluate a complex system such as a hospital, many parts need to be identified and interrelated..

5. Key points and comments

An important point to consider in the continuation of work with evaluations of premises is the crucial point of introducing evaluations systematically after moving to the new facilities. For example, conclusions were drawn from a study based on a hospital in Kolding, Denmark, that a

significant number of problems were only discovered five years after operations moved into the new buildings (Godtsygehusbyggeri, 2020). It is not inconceivable that an initial evaluation reflects a bias in the form of a positive effect based solely on the fact that buildings are new - the newness effect hinted at above. Only after more longitudinal examinations and replicable assessments definitive conclusions might be drawn.

The proposal on how Region Skåne should work with the evaluation of NSM, as a result of this study, is thus primarily to establish measurement methods for the current situation in existing premises, before moving to the new ones. A review of available systems and an overview of the possible new systems to structure evaluations is needed. A key requirement is that it must be able to compare data over time (before and after moving) in the most accurate way possible. A proposal for the inclusion of academia for more detailed evaluations of specific impact goals has also been discussed including for example doctoral projects, bachelor's and master's level thesis etc. If databases are established, privacy issues must be taken into account and, in cases involving research affecting personal data, ethical permits will be needed.

During the execution of the study, which this paper is based on, it has been proposed to establish a platform for evaluations of hospital premises within the region Skåne. Knowledge gathered from both NSM and other new construction/conversion of healthcare buildings within the region can be compiled in this platform to serve as a basis for both future projects and development of evaluation models/approaches. This can also be related to the activities in *the Health System of the Future* action (Region Skåne, 2014), Region Skåne's process for adapting healthcare to the requirements of the future.

6. Research Outlook

The study conducted on the NSM project, as a preliminary pilot of assessment and evaluation, is important to note as an approach of design research that is pushing the idea of the necessity of incorporating measurement and evaluation tools of the effects of buildings into the built environment development process. This is particularly relevant for healthcare sector where features of the physical built environment can have impacts on organizational outcomes, occupant wellbeing, clinical results, stress and satisfaction etc. Such tools are also relevant, and needed, when addressing usability aspects of a building, pushing for a real user-centered approach of the architecture and construction industry. Future research will need to deepen this approach, replicate studies in different contexts and provide longitudinal protocols for measurement and monitoring of improvements in healthcare facilities. Development of structured pre- and post occupancy measurements, mapping of processes to facilities will also be needed. Such research outlooks will be addressing the question “Does it get

better knowing the effects?" To the best of our knowledge, the answer to that question is most likely "yes", because it is possible to improve only what you can articulate, describe and measure.

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