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Constructing healthcare spaces - The complex role of visualisations in negotiating hospital designs and practices

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Abstract

The aim of this paper is to inquire into the role of project visualisations in shaping healthcare spaces and practices. The study draws upon an ethnographic field study from a large on-going hospital construction project in Denmark, and focuses on the early phases of on-boarding the design team into the project organisation. The theoretical contribution concerns the ways in which project visualisations plays an active role in developing novel conceptions of space and how these are mobilized in the process of on-boarding, in terms of 1. Design space (especially the engagement of users in the design process), 2. Organisational space (work processes and their spatial-temporal dimension) and; 3. Economic space (cost estimations and budgets). In practice, our findings show that the visualisations of different yet connected project spaces and the development of future clinical practices is related to a number of emergent concerns in the processes of designing and constructing the new hospital, notably concerns and tensions between innovation and control.

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Keywords: Construction design; healthcare innovation; projects spaces; on-boarding; visualisation

1. Introduction

The paper is concerned with the development of designs for a new hospital in Denmark. The focus is on the 'on-boarding' of the design team, designs and users and the study inquiries into the material link between types of space

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and practices of design and of clinical work. Empirically, the study concerns how the project organisation, in interaction with members from the client organisation and various forms of visualisation, design and develop spaces for the New North Zealand Hospital, part of the Danish hospital building programme currently underway. Theoretically, the paper begins with a concern over the role of these visualisations in design processes, notably; how methods and technologies of visual representations are being used in the hospital project. We develop this to discuss how particular conceptions of space are developed and mobilized in the process of on-boarding, in terms of the physical architecture (area size and number of rooms, functions), but also the notions of design spaces (especially the engagement of users in the design), organisational spaces (work processes) and economic spaces (cost and budget). In practice, our findings shows, that the visualisations of different yet connected spaces and the development of future clinical practices is related to a number of emergent concerns in the processes of designing and constructing the new hospital.

The visualisation processes and the technologies of representations change the design as the members of the project organisation integrate their knowledge and understanding from the visual representations in the design. We identify at least three different yet interrelated concerns about:

- Economic space: Maintaining the economic budget frame, when the client organisation is communicating the project and the design to healthcare practitioners at the hospital.
- Design space: The degree and forms of user involvement, when the design team is developing and testing a methodology for the workshops with medical staff.
- Organisational spaces: The connection between new physical spaces and healthcare professionals, when members of the project organisation work with the aim of facilitating organisational changes in the way health care is delivered at the hospital.

These three all have implications for the hospital design. To understand how the visualisations are mobilized in the on-boarding phase, a relatively short phase (4 months) between the competition phase and the programming phase, we focus on how these representations are linked to different concerns and aspects of space and practices. We are concerned with mega-projects complex intra- and inter relationships (Flyvbjerg et al., 2003) and how they relate to spaces and practices through visualisations.

2. Concepts of spaces

Space is more than physical Cartesian space. We challenge a Cartesian view on space (Frandsen et al, 2012), and argue that spaces in the project have different meanings and functions, and that these different spaces can be linked to forms of visualisations in the project. Visual representation can constrain and enable different practices, and contribute to the broader construction of organisational spaces, and constitute and create economic spaces. The selected design proposal consists of complex visualisation of the hospital, and the team consists of many different companies with different competences. We focus on the role of visualisations as a part of design work (Ewenstein & Whyte, 2007, 2009; Yaneva, 2005) and as design space (Våland 2010; Kreiner & Tryggestad 2002) but we are also interested in what complex roles the visualisations have as a part of ongoing negotiations of the future spaces and practices of the hospital between the members of the project organisation and the client organisation that will own and use the new hospital. The project organisation has economic obligations in relation to stakeholders, which in turn influences the project economy (Flyvbjerg et al., 2003). The project economy appears in relation to certain forms of visualisation devices, such as budgets and Gant charts. Construction budgets are devices (Tryggestad et al., 2010) that visualize aspects of the project in terms of economic quantities such the cost of an individual item like building design as well as the budget sum and total cost of the hospital construction. The project budget delineates an economic space and affords certain logics and understandings of the physical spaces that are in the process of being designed and constructed, where aspects of the project can be measured and calculated, because physical aspects of space can be linked to the cost budget. How members of the project organisation handle multiple matters of concerns related to visualisation (Latour, 1986) of different spaces and functions is one important aspect of this

study. Various links between spatial settings and management of organisations have been explored in management studies (Kornberger & Clegg, 2004; Van Marrewijk, 2009) and in relation to organisational changes as a part of designing new buildings (Våland, 2010). We aim to describe and analyse the process when the design proposal, and the concepts and principles it builds on are being reworked and materialize in new forms in the on-boarding phase and how the visualisations have different meanings and functions in different project contexts, such as on-boarding of the design team and user involvement (Luck, 2003) of clinical staff.

3. Methodology and data collection

The research builds on an ethnographic study in a construction setting (Pink et al., 2010; Kreiner et al., 2011; Jacobsen, 2014) during the on-boarding phase at NHN that lasted from April 2014 to July 2014. The empirical study of the on-boarding phase began the week after the winner of the project competition was announced. We studied the on-boarding phase and how the design team and the design project were integrated into the project organisation at NHN as a part of forming a new project organisation. Our study focuses on the project organisations everyday work, collaborations and negotiations in the on-boarding phase, and how a new project organisation is formed and structured in a way that enables the project organisation to handle the new tasks that it will meet in the next phases of the construction project.

Data collection is based on direct observation, meetings and document studies with the main research method being participant observations of meetings. These participant observations were supplemented by informal interviews after meetings, or in other informal environments (lunch meetings and talking when transporting back from the meetings). We observed 1) *client-meetings* at the strategic level of the project organisation where the management of the project organisation participated. At the client-meetings the overall decisions was made. This level is where the contracts between the design team and the client organisation are signed. The project owner, the management of the hospital is also participating at this level. At the tactical level we observed 2) *process meetings* that represented the link between the strategic levels of the project organisation, where head of construction and the managers of the design team and project managers participated. We also followed work at 3) *user involvement meetings* are the operational level, where project managers from the client organisation and project managers from the design team planned the user involvement in the next phase of the project. Some members participated at all levels of the project organisation, such as the Head of construction. The collected documents consist of Gant diagrams, budgets, project manuals, project plans, contracts, drawings of the project office etc.

As a part of the participant observations, a large number of documents were collected. Before each meeting, members of the client organisation sent the agenda and the documents that were to be discussed at the meeting. During the observed meetings the members of the client organisation, as well as members of the design team, presented documents as a part of the collaboration and negotiations between members of the client organisation and the design team. After the meetings the client organisation sent minutes and other documents that they worked on after the meetings to the researchers.

After each observation research notes was transcribed. The documents was numbered and structured in a way that gave the researchers an overview over when the different documents were discussed at the meetings, and what issues the documents represented at the meetings. These documents, plans and visualisations are not analysed as isolated, our research interests is to understand how the documents is used during the meetings, and how they are a part of the collaboration and negotiations between the client organisation and the design team during on-boarding phase when they form a new project organisation. In between observations the researchers meet on weekly basis and discussed relevant themes from the observations, these discussions created a number of themes that focused the later observations. The research entails interventions with practice. After the on-boarding phase ended the researchers invited the members of project organisation to participate in a seminar were observations and preliminary results were presented and concerns at NHN were discussed. This seminar gave a more nuanced understanding about the client organisations strategic considerations before on-boarding that the researchers did not catch during the observations. The observed meetings represented tasks and responsibilities related to different levels in the project organisation.

4. Background: Danish healthcare reform

In 2007 "Kvalitetsfonden", the current building and renovation program for the Danish hospitals was established. "Kvalitetsfonden", is the largest investment in public physical infrastructure in Denmark with a total budget of 42 billion Danish crowns, includes renovations of existing hospitals, five green field hospitals, and five new "super hospitals". These 42 billion Danish crowns are co-financed by the Danish state and the five regions in Denmark. The ambition behind the reform is to create a more effective, cheaper and better healthcare delivery in Denmark. The construction and renovation of the hospital buildings changes how healthcare is delivered to patients in Denmark, and the hospital projects bring with them complex challenges of how to manage several institutional concerns, such as; the location of the new hospitals, the design of the hospitals, new technology and treatment capacity, flexibility for future use, the division of labour between medical professions within and between hospitals, regions and municipalities, patient and end-user involvement, public participation and democracy. These national challenges touch in more than one way on the complex and evolving relationships between the hospital's healthcare practices and the organisation of the physical spaces for these future healthcare practices. The design of the new hospitals is regulated by national standards e.g. a committee formed by the Danish Government decided, that all the new hospitals had to be design with single bedrooms. Redesigning the Danish health care affects patients and health care practitioners in a number of ways. When it was decided to build the new super hospitals, it was not easy to decide where to locate the new hospitals, many people, especially outside the big cities have been worried because their local hospitals are being closed, as a part of centralizing healthcare delivery in larger and more specialized hospitals.

5. On-boarding at NHN

The case hospital NHN is a green field hospital and a "super hospital", with a budget on 3.8 billion Danish crowns located south of Hillerød. Initially, the 42 billion Danish crowns were shared accordingly to the amount of square meter in each hospital, as well as the hospitals functions. Therefore, the university hospitals were given more money pr. square meter than non-university hospitals, and new buildings were given less that renovations pr. square meter. NHN that is not a university hospital was given 27.000 Danish crowns pr. square meter. The economic premises have been negotiated between the five Regions in Denmark and the Danish state after the 42 billion was distributed to the projects, and the hospital projects are debated on weekly basis in the news. Due to economic concerns some hospitals have decided to reduce their amount of space. The hospitals was allowed to reduce their number of square meter after the budgets where settled. NHN as well as some other Danish hospital projects have decided to cut out kitchen facilities of the hospital project to keep their budget on track. When the hospital is finished in 2020 the hospital will treat more than 300.000 persons in North Zealand. As a part of the construction of the hospital the infrastructure in the area changes radically: new train stations and roads will be constructed, and the new suburb Favrholm is being planned around the hospital.

The resulting ambition of the competition brief was high "Setting new standards" in the design and delivery of public health care. Furthermore, the last phase of the project competition for New North Zealand Hospital the client organisation, and a panel of judges, advisors and a group of healthcare practitioners negotiated with three remaining teams, before the teams handed in their final design proposals. The teams with competences within areas such as: architecture, engineering and hospital planning changed their designs during the competition to meet the critique and feedback they received in the dialogues. The client and project owner was not just interested in receiving analogue drawings and models in the project competition. The teams' designs of the future building also included 3D visualisations and film animations. The teams also had to produce BIM visualisations due to economic (cost) concerns, but also because BIM visualisations were seen as a method to secure sufficient amount of total space in the future hospital.

Visualisations of the hospital, spaces and healthcare functions are used as tools to involve future patients and healthcare practitioners in the development of the organisation of the future hospital, its working spaces and functions. In the on-boarding phase we identify a number of different yet interrelated concerns related to

visualisation processes and spaces. We therefore develop the idea of the production of spaces when these different concerns to the future functions and practices at the hospital are taken into account.

6. The construction of interrelated spaces

We introduce aspects that show different concerns related to space and practices in the on-boarding. These concerns are different from each other, but they are also connected, because they all relates to the visualisation of spaces and practices in the construction of the new hospital. First, we illustrate how visualisation of (1) *economic spaces* are connected, and how economic concerns are related to work in the on-boarding phase, when the progression of the project have to be measured on monthly basis. Second, we show how the visualisation of spaces is also connected to concerns about the (2) *design spaces* in the form of the involvement of the users in the next phase of the project. This aspect is about design practices and how spaces can be developed in the next phases. These concerns are connected to the economic frame, because the design of the hospital cannot be changed. The third aspect is the concern is related to the economic concerns and the user involvement, because it relates to how the project organisation can develop (3) *organisational spaces* through the introduction of designs principles and concepts to the health care practitioners, when space is being visualized it the user involvement.

6.1 Economic spaces

As a part of the work on-boarding phase the design project is being translated into categories and spaces that can be measured in the economic terms, the hospital has to be structured in subprojects to make this economic measurement possible. During on-boarding we observed a tension when the spaces are being measured in outputs that can be translated to economic terms. The hospital project has to be monitored by the project organisation, that has strict obligations to rapport the progression in the project on monthly basis to both the Region and to state auditing (Rigsrevisionen). During the on-boarding phase the members of the client organisation and members of the design team discuss how the design project can be structured in tracks and a number of subprojects.

"We would like traffic lights. It is important with the output from the user workshops. Are we on track?"
(Member of client organisation)

"We cannot measure every project every month"
(Member of consortia)

How many subprojects that will be established are not settled at the beginning of on-boarding and the number of subprojects creates tensions between the client organisation and the design team. Splitting up the project is important to visualize the projects spaces in quantitative categories. We observed an important tension between the design team and the client organisation when they discussed and negotiated how to structure and measure the progression with members of the client organisation, because the design team was afraid that the measurement of the project would be to "bureaucratic", but the members in charge of the budget in the client organisation is interested in how it will be possible to measure the progression of the project. The client organisation uses the metaphor of traffic lights in relation to each of the subproject. Members of the team argue that the structure that exists in the tracks does not exist in their world. Furthermore, the team is concerned that too many subprojects will collide with design work.

6.2 Design space

Engaging with the users of the hospital during on-boarding and design is a requirement for the project organisation. In user workshops the design team have to visualize the spaces of the hospital to demonstrate the design to clinical personnel and to get inputs and feedback from them, related to their own experience and expectations. However, this is not a fully open and negotiable process for the design team and there is, from their

perspective, a need to limit the possible requests for adaptations and changes the users and user workshops might produce.

"How do we explain space in a way that they know what inputs to come with?"
(Member, Design team)

Some important arguments for limiting potential changes in the design are to be found in the economic concerns, with the inflexibility of the budget translating into relative inflexibility of design options. The user involvement is even undertaken by the economic subprojects rather than the design as a whole, showing the connection to the economic spaces. But it is also reflected in the planning of the workshops.

During on-boarding the design team and the project organisation discuss how to limit where users engage with the design, to reduce the design space in which users can participate. Two aspects are important in relation to this delineation of the design space. The first aspect is how to keep the design intent clear and understandable for the users. There is a challenge to ensure that all aspects of the hospital are being handled and discussed in the workshops and that nothing is neglected. The design team have described their design methods in the proposal for the competition, but in this subsequent on-boarding phase they have to be more concrete. But the second aspect is how to limit the impact on the design, as they want to avoid changes and alternatives. The question is what kind of methods that the design team is going to use in the workshops in the next phase of the project to balance these concerns related to both demonstrating the design to the users, but also limiting the design space in which users can affect changes. This is connected not only to the selection of visualisations presented to the users, but also to the decision to make the workshops themed around the hospitals specialities and parallel workshops about particular issues, such as patient security and 'the secure hospital' or hygiene rather than presenting the purely spatial layout of the design.

6.3 Organisational spaces

The new design of the hospital has wide implications for the organisation of the daily work practices of the future hospital, and the design team are highly aware of the possible ramifications of this. The design of the hospital is based on a number of principles and concepts. One important aspect of these design principles is that of optimizing the use of space.

"What does 'right of use' instead of ownership mean for the staff?" We need many perspectives on this.
(Member, client organisation)

The quote from the member of the client organisation illustrates a concerns about the principle, because the project organisation during on-boarding need the perspectives of the clinical personal on what "right of use" instead of ownership means for the clinical personal and their daily practices. It is not only functions such as offices, research activities and administration that are being transformed into "shared spaces" at the new hospital. Also, the patient bedrooms are organized in a flexible "snake" structure and the different specialities have to share these patient bedrooms according to the number of patients they have at any one time. The new design implies, or has embedded within it, new organisational spaces. The project organisation are aware that the healthcare practitioners may not understand these principles and concepts, or that they may react negatively, because their territories and usual ways of working are being challenged.

The members of the project organisation decide that the schemes that visualize how different rooms are organized are too abstract in relation to communicating this and that the design team need something concrete when they are explaining these principles to them. In the end the design team and the project organisation agreeing about leaving architectural drawings out of the visualisation of the principles and concepts in the beginning, because they want to start with discussing aspects such as movements and "closeness" associated with this new way of working within the physical space. They effectively move to discussions around the new organisation spaces.

When the users understand the principles and concepts is it is possible to go into more details of the design. As a part of the involvement of the healthcare practitioners the project organisation have agreed with the project owner (the hospital) that they will involve a pilot group consisting of people involved with working environment and collaboration issues at the hospital. This pilot test of the method before the workshops user workshops is related to organisational changes, because this group of staff is a strong voice at the hospital representing both the management of the hospital and the clinical personal.

7. Conclusion

First, we identified three aspects of spaces and showed the production of spaces and their dynamic links. Second, we analyse and discuss how these spaces are connected, and how they both enable and constrain innovation in design and with what practical implications for hospital construction projects and healthcare.

Spaces are more than the product of visualizing Cartesian space, and rooms, corridors and offices. In the on-boarding process, debates with economic spaces configure the contours of the design. The project organisation uses these contours to define (and, indeed, limit) the impact of the user on the design process. Changes that are being made in the design spaces will have a negative impact on the economic spaces, because changes in the design spaces are costly if it will delay the project, but also because economic considerations already are an integrated part of the principles and concepts in the design of the hospital. Therefore, the project organisation is forced to push the guiding design principles and concepts and stick to that they cannot be changed. Organisational changes are being facilitated through the principles and concepts that will be a part of the new hospitals future functions and spaces.

Economic spaces: The project budget as an economic space that visualizes the project in economic (cost) terms. It affords project management with a control device in relation to the design team. The budget frame must be maintained. Additional visualisations such as the break down structures, that helps to detail the control of the design team. We identified tensions between control (client organisation) and innovation in design and healthcare practices (design team).

Design spaces: Control of what users can contribute with, a tension between an economic concern with the project budget and design innovation based on user involvement. The design team becomes a spokesperson of the design, but is also expected to maintain control of the design space so that the project can stay within the budget. Thus the design team is spokesperson of several concerns, including an economic concern and is in turn monitored on its progress within the break down structure of subprojects.

Organisational spaces: Materialization of organisational principles and concepts about healthcare in architectural design. The project organisation has to integrate concerns about physical spaces for health care and facilitate organisational changes in healthcare practices through novel architectural designs as a part of their work. The clinical staff cannot understand physical spaces of the new architectural design without relating it to their existing practices. Yet, it is these existing practices that are about to change as integral parts in hospital construction projects.

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