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Identification of Critical Factors Affecting Flexibility in Hospital Construction Projects

Abstract

Objective: This paper analyzes the dynamics relating to flexibility in a hospital project context. Three research questions are addressed: (1) When is flexibility used in the life cycle of a project? (2) What are the stakeholders' perspectives on project flexibility? And (3) What is the nature of the interaction between flexibility in the process of a project and flexibility in terms of the characteristics of a building?

Background: Flexibility is discussed from both a project management point of view and from a hospital architecture perspective. Flexibility in project life cycle and from a stakeholder perspective is examined, and the interaction between flexibility in scope lock-in and building flexibility is investigated.

Methods: The results are based on case studies of four Norwegian hospital projects. Information relating to the projects has been obtained from evaluation reports, other relevant documents, and interviews. Observations were codified and analyzed based on selected parameters that represent different aspects of flexibility.

Results: One of the cases illustrates how late changes can have a significant negative impact on the project itself, contributing to delays and cost overruns. Another case illustrates that late scope lock-in on a limited part of the project, in this case related to medical equipment, can be done in a controlled manner. Project owners and users appear to have given flexibility high priority. Project management teams are less likely to embrace changes and late scope lock-in. Architects and consultants are important for translating program requirements into physical design. A highly flexible building did not stop some stakeholders from pushing for significant changes and extensions during construction.

Key Words: Hospitals, projects, flexibility, adjustments

This paper analyzes flexibility in hospital buildings and construction projects. The study addresses both flexibility relating to planning and construction processes, and flexibility as a characteristic of hospital buildings. The objective of the study is to analyze three research questions concerning flexibility:

- When is flexibility used in the life cycle of a project?
- What are the stakeholders' perspectives on project flexibility?
- What is the nature of the interaction between flexibility in the process of a project and flexibility in terms of the characteristics of a building?

To answer these questions it is necessary to distinguish between flexibility as a concept used

in connection with physical characteristics and flexibility in the process of the building project, including design, planning, and execution. First, different aspects of flexibility in hospital projects are discussed, from both a project management point of view and, more briefly, from a hospital architecture perspective. Following a presentation of the methodology used to perform and analyze the case studies, a brief presentation of four Norwegian hospital projects is provided and the results are summarized. Finally, in the concluding section, the research questions are addressed and suggestions for further research are made.

The study is exploratory in nature, based on case studies of four hospital projects. However, the authors believe that the study and findings may be of interest to both practitioners and researchers in the fields of healthcare facility and project management.

Background

According to de Neufville, Lee, and Scholtes (2008) and Miller and Swensson (2002), flexibility is an important concern in hospital buildings. Large hospital construction projects are planned from 10 to 20 years in advance, and hospitals are typically designed to have a lifespan of more than 40 years. During this time, demands on the infrastructure are likely to change significantly. Changing demands may result from new forms of medical technology, changes in regulations, the organization and funding of healthcare services, demographic changes, or changing epidemiological patterns. It is common for hospital buildings to have to accommodate several of these changes. High levels of uncertainty and changing technology and treatment methods create the need for flexibility. In addition, governing factors such as the prevailing general economic situation, conditions for financing, and the demand for medical treatment may change. These are typical factors that serve as a more or less explicit basis for all hospital projects.

The concept of project flexibility highlights a dual perspective on projects.

However, Pati, Harvey, and Cason (2008) claim that discussions of flexibility in healthcare literature are rare. This contrasts with a substantial amount of thought concerning flexibility in retail and workplace settings, as shown in Brand (1994) and Blakstad (2001). According to Cremieux, Ouellette, Rimbaud, and Vigeant (2005), flexibility may be characterized as the ability of a firm to maintain average costs despite changes in selected input prices by substituting cheaper inputs. Walker and Shen (2002) studied flexibility in a hospital construction project; they point out that the ability to utilize flexibility options is influenced both by the *ability* of an organization to be flexible, but also by its *commitment* to being flexible.

The concept of project flexibility highlights a dual perspective on projects. According to Blyth and Worthington (2001), it is normal to find some very strong contradictory conditions in projects. One such contradiction involves alternative perspectives on projects when two parties are involved. For instance, the client and users (as one party) will focus on organizational needs and requirements, while the contractor will focus on the technical aspects of the building in question. In addition, the two parties may have different cultural backgrounds and use different frames of reference or languages. The demand side representing the client/users will use a business language, and the supply side representing the project will use a building language. However, the most important dilemma in a building

project is the conflicting interests between the demand and supply side regarding the decision-making process. Experience shows that there is a desire on the part of project owners and users to have "room to maneuver," as discussed by Midler (1995). Room to maneuver can be seen as allowing room for future definitions of scope or for incorporating the most recent developments in technology within the larger scope of the design. According to Blyth and Worthington (2001) and Eikeland (2001), clients/users will leave decisions to the latest possible moment to ensure that the best and most up-to-date solutions are employed, whereas the building project will lock in the decision-making process at the earliest possible moment to reduce risks.

The demand side of a project focuses on the effectiveness of the project. Effectiveness is linked to the longer-term effects of the project, or in other words, doing the right things. It is an external measure. Eikeland (2001) relates effectiveness to how the results of a project contribute to the value added for owners and users. The supply part of a project is concerned with the efficiency of the project, which, in turn, is linked to the immediate outcome of a project. It is a question of doing things right and producing project outputs in terms of the agreed-upon scope, quality, cost, and time.

Key stakeholders directly linked to most projects include project owners, users, project management, architects, consultants, and contractors (McElroy & Mills, 2003; Samset, 2003). In hospital projects, users include both hospital staff and patients. As pointed out by Garel and Midler (2001), the approach to flexibility held by different stakeholders is closely related to the incentives open to them. Flexibility is a relevant concept and has value for those who can align a project to suit their priorities, but flexibility often represents a cost for those who have to adapt (Mahmoud-Jouini, Midler, & Garel, 2004; Olsson, 2006).

Traditionally, flexibility is described as undesirable in a project management context. Several studies, including those by Hall (1980), Morris and Hough (1991), and Miller and Lessard (2000), indicate that a clear project definition is a critical success factor for projects. Projects are established to be targeted, focused instruments for the execution of defined tasks. Many authors on project management, including Morris and Hough (1991); Ibbs, Wong, and Kwak (2001); Hanna, Calimic, Peterson, and Nordheim (2001); and Dvir and Lechler (2004), warn against changes in projects once design development and specifications have been established.

In contrast, there is a growing interest regarding project agility in the project management community (Leybourne, 2008). Koskela (2000) and others have adapted production principles, such as just-in-time, in a theoretical framework called *Lean construction*, which has already been applied in construction projects. In this framework, the term *last responsive moment* is used to achieve flexibility in projects (Ballard & Howell, 2003). According to Ballard and Howell (2003), the last responsive moment means that decisions must be made within the lead time for realizing alternatives and that a decision should not be made until it has to be made. Another approach to flexibility is represented by *real options* (see, for example, Amram & Kulatlaka, 1999; Brennan & Trigeorgis, 2000), which are based on financial options theory.

Winch (2004) and Jaafari, Doloi, and Gunaratnam (2004) point out that a major limitation in project management theory during recent decades is that it assumes that the scope of a project can be completely known in advance. In a planning perspective, Sager (1994) pointed to

flexible planning as a tool for conflict resolution, because it may favor democracy in collective choice processes. An emerging view on project management focuses on social interaction and sense-making (Hodgson & Cicmil, 2006), in contrast to the traditional focus on timescale and costs.

Gill, Tommelein, Stout, and Garrett (2005) and Olsson (2006) describe how flexibility in a project process and the product may interact in any given project. In general, one can say that all projects have the same tasks to be resolved. However, the differences among them concern time, place, cost, and how the projects are organized. In this study, the product is represented by hospital buildings. One objective of this article is to study the interaction between flexibility in the project process and flexibility in hospital building design.

Flexibility in hospital buildings has often been associated with the existence or absence of interstitial spaces as intermediate service floors between primary floors. According to Miller and Swensson (2002), the interstitial concept highlights a life-cycle cost perspective in hospital design. The high cost of interstitial spaces requires a long time perspective to be justified. Even so, Miller and Swensson (2002) claim that the concept is generally judged as too costly to put into practice. In reality, flexibility is a more general concept. According to Pati and colleagues (2008), three aspects of flexibility are adaptability, convertibility, and expandability. A similar classification is used by Agre and Landstad (2002) and Bjørberg and Verweij (2009). *Adaptability* can be defined as the ability of a building to meet shifting demands without physical changes. *Convertibility* can be defined as the possibility for construction and technical changes with minimum cost and disturbance. Finally, *expandability* can be defined as the ability to increase (or reduce) the size of a building. In this article, all three characteristics are summarized as *flexibility in the product*.

The concept of flexibility in hospital buildings has recently been developed further, and now includes a variety of principles and solutions. According to Rechel, Wright, Edwards, Dowdeswell, and McKee (2009), flexibility should encompass a wide range of hospital dimensions, including building characteristics, supporting infrastructure such as transport links, and relationships to other parts of the healthcare system, and it should also occur in relation to financing. The authors have focused on some of these aspects, mainly hospital buildings and the project processes that produce such buildings.

De Neufville and colleagues (2008) point out that flexible design in hospital buildings can be a matter of structural foundations that allow additional floors to be added on top of existing buildings, or areas that are built but not fitted out with medical equipment, or functional rooms that may be refitted for medical purposes other than their original use. Other principles that have been used in flexible design are standard room categories, single-bed clusters, standardization of equipment, and flexibility in terms of organization, management, and the use of facilities.

Methods

A study was conducted to investigate to what extent the results from the presented review of project flexibility correspond with observations from four Norwegian hospital projects. The analyzed projects were carried out between 1986 and 2005; they represent four of the largest hospital investment projects in Norway during that period.

A qualitative case study research approach was used. In the terminology of Yin (2003), the analysis is a multi-case study. Information relating to the projects has been obtained from three main sources: evaluation reports, other relevant documents, and interviews. The authors collected all important information related to the investigation in a case-study protocol. The protocol included collected documentation, transcribed notes from interviews, and codification of results for the parameters shown in Table 1. The codification of results has been reviewed by academics and practitioners with good knowledge of the projects in order to guard against personal bias in the case descriptions. In addition to the authors' collected material relating to the projects, the projects have been thoroughly described in evaluation reports or other types of third-party reports. These reports were subject to extensive quality assurance during their preparation. In addition, the authors have participated in professional discussions on the evaluation results and obtained documentation that highlights some diverse opinions on those results.

Parameters Used in the Analysis

Parameter	Scale/Alternatives
Final (last known) project budget	Actual cost of finished projects, latest known budget for ongoing projects
Year finished	
Phase when flexibility in scope lock-in was applied	Before funding; Planning; Execution; None
Flexibility in hospital buildings	Low; Medium; High
Planned flexibility in scope lock-in	Low; Medium; High
Actual flexibility in scope lock-in	Low; Medium; High
Stakeholder who initiated flexibility in project planning or execution phase	Users; Owner; Project management; Contractor; None; N/A
Project owner's attitude to flexibility in planning and execution phase	Negative; Neutral; Positive; N/A
Project management's attitude to flexibility in planning and execution phase	Negative; Neutral; Positive; N/A
Users' (staff) attitude toward flexibility in planning and execution phase	Negative; Neutral; Positive; N/A

On the basis of the case studies, an assessment was made regarding the characteristics of the flexibility of the respective projects. In particular, the researchers studied when and how flexibility in scope lock-in was applied as well as the flexibility characteristics in the buildings of the hospitals studied. They also studied how different stakeholders responded regarding flexibility in scope lock-in and during project execution. In the codification of results, the focus was on users, owners, and project management teams. However, qualitative information about architects, consultants, and contractors was also included whenever possible. Table 1 shows the project attributes specifically addressed in the study. It also shows the alternatives and scales that were used when summarizing case results. Some of the information relates to the projects themselves, such as that concerning project budget. To validate the data, informants who had personal experience with the analyzed projects reviewed the relative scores of the projects.

Results

The following is a brief overview of the four hospital cases with some narratives from the cases, and a special focus on how flexibility was addressed and managed.

In analyzing the documentation and discussions, the authors found that, when addressing flexibility issues, the four projects studied either used different terminology or the same terminology with different meanings. This applied to flexibility in the project process as well as in relation to physical buildings and work processes. Each of the projects tended to develop its own terminology. This was particularly the case for the largest projects. This highlights the need for attention to terminology clarification regarding flexibility in hospital projects.

The four hospital projects and the main facts and objectives regarding the intended and actual use of flexibility in the associated processes and buildings are presented in the following sections.

Hospital A

Plans for a new university hospital were prepared in 1991, and approved by the Norwegian Parliament in 1993. The new hospital ultimately will consist of 10 different medical centers. The project was divided into two construction phases. The first phase of the construction, consisting of four centers and totaling 88,000 square meters (m^2), was completed in 2006. The total cost of Phase 1 was $730 million. Phase 2 is scheduled for completion in 2014, by which time the completed hospital will total almost 220,000 m^2 and is expected to reach a total cost of $1.57 billion.

In the beginning, the project was organized under the local county, but a major part of the financing was to be supplied by the national government. However, the project concept was seriously questioned prior to the decision on the funding of Phase 1, and both the location and center model were subject to external analysis before the final solution was agreed upon. In 2002, Parliament passed a decision to build the university hospital at its current location based on the plans for Phase 1 of the building program. Today, a temporary organization is responsible for the construction of the hospital on behalf of the Central Regional Health Authority.

The development plan for the university hospital contains the vision, objectives, and framework conditions for the project. These were expressed as seven main objectives that elaborated and finalized the vision and that pointed out important focus issues for the project. Two of these objectives are especially important for the development of the physical design and are relevant to the discussion in this article:

1. Adaptability: The project must be adaptable and flexible to incorporate future changes.
2. Efficiency: The project is to contribute to an effective organization and represent value for money.

An important strategy in the planning and design of the hospital was the concept of a generic center, a virtual center or concept describing general and fundamental solutions common to all clinical centers in the hospital project. The project sought to achieve better and more efficient planning and operation through standardization. The concept comprises guidelines and instructions regarding basic principles for building structure, communication and logistics, standard room categories, infrastructure, and architecture to ensure a common overall structure, character, and recognition. In addition, this hospital project applied a principle of providing extra capacity in the foundation and main construction to allow for a 20% increase in technical installations and maintain a space reserve of 25%. Some of these space reserves have been used already because of changes and increases in the space programmed during planning and design. The design concept for the hospital has been robust, and the changes have not had any major negative consequences.

Flexibility in the decision and planning process was an important issue in the project. From the start, it was determined that there would be a flexible decision process. This allowed for adjustments throughout the project and also related to the ongoing operation of the existing hospital.

Project planning was a step-by-step process, with planning and decision making moving from an over-arching level to a more detailed and specific one. It was an iterative process that alternated between process analyses, programming, and designing with different levels of detail. The planning process was layered and iterative, and the briefing process was divided into three main levels: the main function brief (Level 1); a building project brief for each of the clinical centers (Level 2); and a space management brief for each center (Level 3).

The project has had extensive user participation. One of the problems or challenges in Phase 1 was the high degree of user participation and the fact that the users were involved on a detailed level. This resulted in the use of a lot of resources, a tendency toward suboptimization, and choice of specific solutions based on the situation in the old hospital; less attention was paid to principles and functional requirements.

Many of the discussions regarding the use of space, functionality, and adaptability in the development of the architectural design were related to the generic center. There was some disagreement about the principles described, and whether they should be absolute or guiding. Regarding the planning of the different centers, users wanted their own individual solutions and not “standard” solutions developed from the generic center concept (Paulsen, Berg, Jordanger, & Hansen, 2003). During the planning and development of the different centers, some of the objectives, such as the importance of future adaptability, were given a lower priority (Paulsen et al., 2003).

Hospital B

Hospital B was decided on by the Norwegian Parliament in June 1992 with a budget of $408 million. The final cost was $845 million (Whist, Bergsland, Jordanger, Ore, & Øvrebø, 2001). During the project, new funding was allocated for changes and extensions. The 150,000 m^2 hospital was finished in 2000.

The governmental facilities management agency held an architectural competition; in 1991 a

concept that emphasized flexibility in the building itself as well as in technology and organization won the competition. Parliament's original approval of the project was based on a change of responsibility for the patients in the county. The old hospital was to merge with a number of smaller institutions. The combined volume of the merged units in the new hospital was to be smaller and have fewer employees than the institutions had before the merger.

The organization of the project changed over time, but the general picture is as follows. The Ministry of Health Care and the Ministry of Administration served as project owners, even though Parliament became very engaged and to a certain extent acted as the project owner. The most involved users were the members of the administration board and hospital employees.

Flexibility was an explicit key issue from the beginning, when the concept for the new hospital was selected. Flexibility was a defined design criterion, and the flexibility of the proposed designs was subject to internal auditing on several occasions.

The hospital has interstitial spaces above the most critical clinical areas, such as the operating rooms, radiology rooms, and outpatient clinics. Emphasis was also placed on having a minimum number of supporting columns and walls. Ventilation was decentralized to support defined building sections. The selected design consists of a core building incorporating the main clinical activities, with other areas peripheral to this building, and with possibilities for expansion.

One consequence of using interstitial space is that it must be managed. A strategy is to locate installations and components related to their expected life spans. Installations with the longest time between services or replacements should be located in the least accessible parts of interstitial spaces, and installations that must be serviced more frequently should be easier to access.

Throughout the project, users had close contact with Parliament, which led to a number of extensions and changes. These changes meant that the original prerequisites of the project were gradually eroded; consequently, the project developed into a different hospital than was originally planned. Changes were introduced at a very late stage of the project and included both an extension and the reconstruction of already-built areas.

From the evaluation report relating to this project (Whist et al., 2001), it is clear that the users lobbied the Parliament to approve the changes. Furthermore, these users were strongly supported in their demands to change the project by project owners, arguing that the prerequisites for the project had changed, and that the project scope had to be adjusted accordingly.

Project managers confronted the new demands and were asked to make a cost estimate. Given that the construction work was already underway, spending time on preparing the best possible estimate meant that some of building under construction would have to be torn down and rebuilt. In this situation, it was decided to rush the estimate to minimize rework. In isolation, the changes were probably manageable; but seen in perspective, the consequences of the reconstruction part of the change order were highly underestimated. The changes hit the already strained project very hard and started a chain reaction that was the main cause of the cost overruns of the project. Efficiency was eroded because a number of contracts had to be

renegotiated.

A significant part of the flexibility in the design of Hospital B was utilized to accommodate the changes and extensions that were decided upon late in the project. According to one estimate, only 40% of the planned building flexibility remained after the hospital was put into use.

Hospital C

The Hospital C project was a new cancer ward connected to an existing hospital. The ward consisted of four main parts: a treatment area, an outpatient clinic area, patient rooms, and a hospital patient hotel, which is located on the hospital grounds. Patients with noncritical conditions can stay at the patient hotel to reduce demand for more expensive hospital ward beds. The local county was the project owner and deciding body. The new ward was a part of a national plan of action to improve cancer treatment that had been decided upon in 1997. It included funding possibilities for cancer treatment facilities and it lasted until 2003. In 1998 the local county decided to investigate the possibilities for a facility for cancer treatment. To obtain funding for this action plan, the hospital had to be finished by the end of 2003. Construction began in the summer of 2002, and the new facility of 5000 m^2, which cost $38 million, opened in the beginning of 2004.

The pressure to finish construction during 2003 meant less time for planning and execution than is common for this type of project. To finish on time, a higher degree of concurrent activities than usual had to be undertaken. As in concurrent engineering, planning and execution were done partly in parallel.

The project planning and execution were mainly carried out as planned. However, some design issues were purposely finalized as late as possible in the project. One major issue concerned the choice of medical equipment for radiation treatment. The goal was to use the latest versions of available equipment. Therefore, the final design of rooms and choice of equipment for radiation therapy were postponed for as long as possible, to achieve a late scope lock-in on these issues. Extra resources were allocated to the areas that were most affected by the late design freeze. Adjustments similar to those made for the Hospital B project were made by tearing down parts of the construction and rebuilding it.

Hospital D

Preparations for a new hospital were initially made during the 1970s. A project organization was established in 1980. The project manager remained the same throughout the whole planning and construction period. The hospital concept was developed over a number of years in cooperation with experienced architects and with a high degree of user involvement. In 1982, all hospital projects in Norway with the exception of two were halted by the government; Hospital D was one of the two survivors, but there was a price to pay. The government demanded a 20% space reduction in the existing plans. Planning based on new prerequisites began in 1982. The intended hospital, which included interstitial spaces, was redesigned to a large extent. The allocated budget of $257 million did not allow much freedom for flexible designs, and interstitial spaces could not be included. The 66,800 m^2

hospital was finished in 1991.

The hospital was designed and built in a relatively traditional way. There were no interstitial spaces to serve as intermediate service floors between primary floors, even though there were rooms for ventilation above the operating rooms. The project was located in a region with few large construction companies. Therefore, it was decided to use relatively many but small contracts to enable local construction companies to compete for work on the hospital.

The project organization team reported directly to the county (Bjørnåvold & Johnsen, 1993). Throughout the project, there were no changes in the reporting structure. After a decision on funding was made, the project was planned and executed within the defined framework. Flexibility was low, both in the hospital design and in the project planning and execution. The county had limited financial resources, and the project did not receive any additional funding. There were no significant changes or expansions.

However, since the new hospital opened in 1991, there has been a series of reconstructions and some expansions. Some stakeholders claim that this is a consequence of the initial area reductions and the lack of flexibility in the construction process.

Synthesis of Case Results

The results of the case studies are synthesized in the following, and a summary of the parameters studied is presented in Table 2. Following this, the results are divided into different sections in order to address the key research questions.

Summary of Parameters Studied in the Four Cases

Parameter	Hospital A	Hospital B	Hospital C	Hospital D
Final (last known) project budget (in $millions)	1570	845	38	257
Year finished	2006	2000	2003	1991
Phase when flexibility in scope lock-in was applied	Before funding	Execution	Execution	Before funding
Flexibility in hospital buildings	Medium	High	Medium	Low
Planned flexibility in scope lock-in	High	Low	Low	Low
Actual flexibility in scope lock-in	High	High	Medium	Low
Stakeholder who initiated flexibility in scope lock-in	Owner	Users	Users	None
Project owners' attitude to flexibility in planning and execution phase	Positive	Positive	N/A	Neutral
Project management's attitude to flexibility in planning and execution phase	Neutral	Negative	Neutral	Negative

Users' (staff) attitude toward flexibility in planning and execution phase	Neutral	Positive	Neutral	Neutral

When Was Flexibility Used in the Project Life Cycle?

Both Hospital A and B projects had a late lock-in on their final scope, and adjustment of scope and budget prior to the funding decisions. In the case of Hospital A, this process was repeated twice, because the project was divided into two phases with two separate funding decisions. For Hospital A, some of the space reserves were used during planning and design because of changes and an increase in the space program with no major negative consequences for the physical concept and design. Late changes and extensions in the Hospital B project had a significant negative impact on the project itself, contributing to delays and cost overruns.

The Hospital C project had a late scope lock-in related to key medical equipment, but it was related only to a limited part of the project and was done in a controlled manner. This project was delivered on time and on budget.

In all of the hospital projects studied, the authors discovered a tendency toward less focus on flexibility in the late part of the process, or for the tendency toward flexibility to be lost when priorities associated with other important aspects arose and long-term perspectives were overruled by short-term thinking.

Stakeholders' Perspective on Project Flexibility

As shown in Table 2, project owners and users appear to have given a high priority to flexibility. Among the projects studied, it was primarily project owners and users who initiated the use of flexibility in the projects. Stakeholders whose main responsibility lay on the cost side of the project, such as project management, were less likely to embrace changes because of risk and uncertainty in the planning phase. There also was a tendency to shift from being more positive in the early phases of the project to being very negative when a project moved into the construction phase.

Regarding stakeholder roles, project owners and users were more likely to be positive toward changes aimed at increasing the benefit side of projects, or that were related to effectiveness. Project management teams were less likely to embrace changes. In projects with high user participation, two of the challenges are the risk of suboptimization and the development of specific solutions based on present-day situations and experience.

Consultants-especially architects-play a particular role in planning and design processes as “translators” of program requirements into physical design, and they have to consider conflicting issues such as user requirements, technology, quality, cost, and time. In Hospital A there was a very strong will to ensure quality in the project by using design guidelines and

general principles for the hospital design.

What Was the Nature of the Interaction Between Flexibility in the Project Process (Planning and Execution) and Building Flexibility?

In the early phases of the projects, flexibility typically was highlighted as an important aspect of the new hospital buildings. However, less attention was paid to flexibility in later phases when detailed designs were made, and the authors found few systematic approaches to ensure that principles to obtain flexibility were followed up to ascertain that detailed designs comported with flexibility principles. This means that ambitions regarding flexibility were implemented to a lesser extent.

Only Hospital A had a structured approach to flexibility in the decision process. However, the Hospital A, B, and C projects had iterations in the decision process, and they applied flexible approaches regardless. In Hospital A the planning was based on a step-by-step process, with planning and decision making occurring from an over-arching level to a more detailed and specific level. It was an iterative process with alternation between process analyses, programming, and designing at different levels of detail from urban design, overall physical design, and space design down to technical and medical equipment at the latest possible time. None of the projects had lower actual flexibility than planned in the project planning and execution.

Interestingly, high ambitions regarding flexibility in the Hospital B building only slightly limited the use of flexibility in the decision process. A highly flexible building could have meant that it could be adjusted after opening. However, this did not stop some stakeholders from pushing for significant changes and extensions to the project during construction. This actually had more to do with the possibility of receiving funding for such changes while the hospital was still under construction than with the physical characteristics of the hospital. Obtaining significant funding for adjustments to a newly built hospital would most likely have been difficult; therefore, for stakeholders who desired a larger and different hospital, it was rational to try to include this in the construction project.

In Figure 1, each project is represented by two shaded circles: grey represents planned flexibility and black represents actual flexibility. The two circles for three of the projects (A, B, and C) are connected by an arrow to illustrate the shift in approach to flexibility. The arrows pointing to the right illustrate a shift from low planned flexibility in the decision process to medium or high actual flexibility in the decision process.

Planned and actual flexibility in building and scope lock-in for the four hospital

projects studied

Conclusions

The objective of this paper was to address three research questions. Our conclusions regarding these questions are summarized as follows.

When Was Flexibility Used in the Project Life Cycle?

All projects applied flexibility in the project process. Two projects had iterations before final decisions on funding. Two projects applied flexibility in the planning and execution phases. This was done in a controlled manner in the case of one of the projects, but in the other project the scale of the adjustments made project management untenable, causing major delays and cost overruns.

Plan revisions prior to the funding of investment projects are common and probably desirable (Miller & Lessard, 2000). From a project management perspective, flexible project planning and execution typically are undesirable. However, the differences between the Hospital B and C projects illustrate that flexible approaches can be combined with project management control if the area subject to flexibility is a limited and well-defined part of the project. The changes and extensions in Hospital B were of significant size compared to the project as a whole, and they affected a large part of the whole project, both physically and contractually. In the case of the Hospital C project, the late scope lock-in was of manageable size and the contractual structure supported flexibility.

As long as the funding model for a project means that the users have nothing to lose from demanding changes and extensions, they will have an incentive to push for scope changes.

Two of the projects had low flexibility in the project execution phase, after funding had been allocated. This was done in a controlled fashion in the Hospital C project; however, late changes and extensions in the case of Hospital B had a significant, negative impact on the project itself, contributing to delays and cost overruns. The Hospital C project applied a late scope lock-in for key medical equipment. Late scope lock-in was related only to a limited part of the project, and the project was delivered on time and budget. The other two projects had a late lock-in as well as adjustments of scope and budget before the funding decisions. In the Hospital A project, this process was repeated twice, because the project was divided into two phases and had two funding decisions.

Stakeholders' Perspective on Project

Flexibility

Most authors writing about project management agree on the value of flexibility in the front-end phase of projects, and on the undesirable effects of flexibility during the execution phase. The hospitals' project management teams appeared to be the only type of stakeholder that showed the expected shift from being positive toward flexibility in the front-end, to being less positive in the planning phase and finally negative in the execution phase.

Stakeholders' opinions regarding flexibility in the decision and project execution phases related to the stakeholders' incentives. In general, flexibility in the decision process of project execution has a value for the stakeholders who benefit from changes and late scope lock-in in projects, while it implies a cost for those who have to adapt.

As long as the funding model for a project means that the users have nothing to lose from demanding changes and extensions, they will have an incentive to push for scope changes. This was found to be the case in all of the hospital projects studied.

Norwegian hospital projects have high user involvement. Hospital staff on all levels and patient representatives are involved in hospital design. The observed tendency for users to advocate flexibility in late phases of projects indicates that projects with a high user influence have a greater need for an active approach to project flexibility compared to projects with less user involvement. Even though it is not a recommended situation, projects that for political or other reasons are pushed to a premature go-ahead decision also need an active approach to project flexibility.

User involvement in projects is often presented as a way of reducing conflicts during projects. Experiences from Hospital A demonstrate that user involvement actually can generate conflicts. This became the case when the users felt that their opinions were not given due consideration. User involvement generated expectations, some of which could not be met within the given budget. On a conceptual level, most stakeholders were able to agree on desirable solutions. As the level of detail increased, so too did awareness of different group interests.

All projects were to a certain extent based on the political possibility of obtaining a decision to proceed. From a project management perspective, such situations generally are regarded as extremely challenging, because they mean that many necessary clarifications likely have not been made and changes are inevitable. The Hospital B project especially was subject to major changes; this circumstance highlights the risk involved for the project management team of a project subject to substantial change, namely, blame for overruns.

Only Norwegian investment projects were analyzed. Rodhe (2001) studied nine European hospital projects outside Norway and found varying degrees of user involvement, but the Norwegian tradition was at the high end of user involvement in his sample. It is a Scandinavian management tradition to emphasize user involvement as a key success factor in projects involving organizational change (see, for example, Emery & Thorsrud, 1976; Trist & Bamforth, 1951). In addition to user involvement, funding and also regulatory and organizational structure are likely to influence stakeholder dynamics in hospital projects.

The relevance and generalizability of the results presented can be discussed from at least three perspectives: (1) framework conditions for the healthcare sector; (2) cultural perspectives; and (3) architectural perspectives. Regarding framework conditions, Rechel and colleagues (2009) point out that most governments in Europe have taken responsibility for ensuring that health services are available, accessible, affordable, and of acceptable quality. To achieve these goals, European governments typically have at least some control over major capital investment in hospitals through regional and national planning mechanisms. To estimate future demand for healthcare services, government bodies at different organizational levels conduct health capacity planning. The results presented here occurred in this type of environment and may therefore be more relevant to cases in environments with a high level of governmental involvement in healthcare planning and provision, compared to those with a lower level of governmental involvement.

The influence of user involvement is to a certain extent a cultural issue. Hofstede (1991) studied different parameters to illustrate the cultural differences among 27 countries, including power distance and individualism. In Hofstede's (1991) terminology, power distance relates to the extent to which the less powerful members of organizations accept that power is distributed unequally. Norway was characterized by relatively high individualism and low power distance. In cultures with low power distance, people expect power relations to be consultative or democratic. Regarding individualism and power distance, Hofstede (1991) places Norwegian behavior in the same group as countries such as the United States, Germany, Italy, Sweden, Denmark, and the Netherlands, even though the United States has a higher degree of individualism than Norway. This indicates that, from a cultural point of view, the behavior observed in Norwegian projects may be relevant to projects in other countries as well.

When it comes to the architectural tradition in Norwegian hospitals, especially the two largest of the hospitals studied, Hospitals A and B, have gained international attention because of the creative use of lighting, inspiring views, single rooms, curved corridors, relaxing gardens, and many works of art on display (Alvarez, 2004; Architecture+Design Scotland, 2008).

What Is the Nature of the Interaction Between Flexibility in the Project Process (Planning and Execution) and Building Flexibility?

It might be expected that hospital projects with high flexibility in the design of the building itself could be executed with low flexibility in the project planning and execution, because the physical structure is prepared for alternative uses and expansions or is flexible in other ways. The authors note that, in spite of a high level of flexibility in the Hospital B buildings, the project was still subject to significant adjustments. They have argued that this had more to do with the funding structure and project history than with the physical structure of the hospital under construction. The authors also found that Hospital D, which had low flexibility in both the building and the project process, had no choice because there was no possibility of additional funding.

Thus, based on the four hospital projects studied, there are indications that the management situation-especially the potential for additional funding-has a greater influence on the need for flexible project processes than does design flexibility in hospital buildings.

The primary aim of this study was to illustrate selected aspects of flexibility in a hospital project context. Over time, this and similar studies will increase the understanding of how to obtain necessary flexibility in healthcare facilities without over-specifying the functionality of buildings or eroding the efficiency of planning and construction projects with changes. Because the study is based on only four cases, it represents a small step in this direction. To achieve generalizability, additional studies are needed, based on larger samples. There is also potential for investigating flexibility at a more detailed level, in both the hospital projects studied and the hospital buildings themselves.

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