FLEXIBILITY: IMPLICATIONS ON PROJECT AND FACILITIES MANAGEMENT

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ABSTRACT

This paper analyzes flexibility in both a facilities and project management perspective. In a facilities management perspective, flexibility is desired to face changes in the business environment for the core activity in a building. On the other hand, flexible projects are generally not described as desirable from a project management perspective. These conflicting approaches to flexibility have justified an analysis of the dynamics related to project flexibility, both from a theoretical and an empirical perspective. In this context, flexibility is related to a capability to adapt to new, different or changing requirements. The paper discusses project flexibility categorisations, perspectives of analysis, flexibility drivers and enablers. The study addresses both flexibility relating to planning and construction processes, and flexibility as a characteristic of buildings. Finally, the paper identifies some characteristics of successful project flexibility management. Four approaches to project flexibility management are presented, and the implications on facilities management are presented. It is in the interest of facilities managers to ensure sufficient flexibility in projects that shall produce the facilities that they are to operate. For efficient operation and maintenance, it is desirable to be able to adjust the facility being built.

Keywords: Flexibility, project management, facilities management, adjustments

1 INTRODUCTION

Project flexibility is related to a capability to adapt to new, different or changing requirements. Project flexibility can be seen as a dilemma, a problem or an opportunity. Traditionally, projects tend to strive for increased predictability and robustness, by managing details and attempting to bring all variables under control (Kreiner, 1995; Mintzberg, 1994; Christensen & Kreiner, 1991; Packendorff, 1995; Engwall, (2003; Söderlund, 2004). 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. Project management and facilities management may have different incentives related to project flexibility.

From a facilities management point of view, buildings are means to an end. Work on usability highlight that the purpose of a building is to support people using the building, while they are performing their activities and living their lives (Hansen et al. 2010). Depending on how well building supports their users' activities, they can contribute to value creation in the user organizations (Alexander 2008, Fenker 2008). In such a perspective, flexibility is typically a positive attribute (Blakstad and Arge, 2010).

From a pragmatic project management point of view, experience shows that the chance of realizing a plan without major amendments decreases with increasing time horizon, which point to a need for flexibility, or adaptability (Hall, 1980; Bahrami & Evans, 2005; Koskela, 2000; Ballard & Howell, 2003, Mikkelsen & Riis 2003; Lee & Xia, 2005; Olsson, 2006). This notion is consistent with previous works on flexibility, that view managing flexibility as an orderly response to a changing world (Sager, 1994; Moseng & Bredrup, 1993; Sink & Tuttle, 1989; Volberda, 1997; Abbot & Banerji, 2003; Turner, 2004).

2 STATE OF THE ART

Flexibility can be studied from the perspective of different stakeholders, in different project phases and related to efficiency and effectiveness. Finally, drivers and enables of project flexibility are listed and discussed. Uncertainty, project duration, conflicts, and insufficient project preparations are highlighted as flexibility drivers. The enablers are degree of redundancy, incentives open to the stakeholders, and modularity.

2.1 Flexibility in the project and in building design

Flexibility can be divided into flexibility in the construction project decision process and flexibility in the building itself. Flexibility in the decision process is based on an approach where decisions and commitments in the projects are made sequentially over episodes. The use of decision gate models provides a successive commitment to a project. Flexibility in the product means that the design of the building has taken into consideration possible future changes in use or requirements, and that the building is prepared for alternative use (Brand 1994 and Blakstad 2001). According to Arge & Landstad (2002), a commonly used classification of building adaptability was made in Sweden during the 1960s and 1970s. Based on this classification, generality is the ability of the building to meet shifting demands without physical changes. In this terminology, flexibility is related to possibilities for technical changes with minimum cost and disturbance. Lastly, elasticity means the potential for adding to or reducing the size of the building. In this thesis, all three characteristics collectively are referred to as flexibility. Bjørberg and Verweij (2009) describe a similar terminology.

2.2. Perspectives of analysis

Project flexibility can be studied from both efficiency and effectiveness perspectives. A case in favour of flexibility emphasise the possibility to increase a project's effectiveness. Effectiveness is primarily addressed by external flexibility. Project scope is adjusted to utilise benefit opportunities. Regarding efficiency, such adjustment of project scope typically causes change costs. The net effect come from a balance between the values of benefit opportunities and incurred change cost.

The flexibility for one project stakeholder can be another's risk. Project stakeholders are persons or groups of people who have a vested interest in the success of a project and the environment within which the project operates (McElroy & Mills, 2000). A study of large engineering projects found that it is important for a project management team to identify stakeholders that can affect a project, and then manage their differing demands throughout the project stages (Olander & Landin, 2005).

2.3 Flexibility drivers

This paper discusses "drivers" as factors that create needs or pressure on projects to be flexible. Uncertainty is the key driver for project flexibility, and arguable the only one. The other drivers mentioned below are in fact only highlights of selected types of uncertainty. Uncertainty can be defined as a gap between the amount of information needed to make a decision and the amount of information available (Galbraith 1973). In order to manage this information gap, flexibility is primarily a way of reducing the amount of information needed. Other project management approaches may focus on increasing the available amount of information.

The longer duration a project has, the more likely it is that some pre-requisites are not longer valid (Mintzberg 1994; Lee & Xia, 2005). Long duration is likely to result in more or less suppressed need for scope changes. Both cost and demand estimates are more uncertain the longer the time perspective is. What is "long" duration is highly depending of the type of project. Experiences from previous projects of the same type provide indications of for how long prerequisites are likely to stay stable enough.

Project flexibility can be an issue of conflict. Stakeholders who benefit from the initial decisions are less likely to favour a continued flexible decision process. Flexible decision processes are likely to be valued by those who do not prefer an initial decision. In this way, availability of flexibility options and redundant resources can serve as an invitation to adjustments. However, conflicts that arise during the preparation or execution of a project have also created a need for projects to be flexible, as a response to conflicts.

2.4 Flexibility enablers

This paper refers to 'enablers' as factors that contribute to making it possible for projects to be flexible. Redundancy can be an enabler for flexibility. In a project perspective, redundancy can be applied for flexibility in both the product and decision process. Flexibility in the product may be achieved by over-specification of future functionality. A flexible decision process calls for redundant resourses and time to perform analyses of alternative project concepts. The rationality behind the use of redundancy is that this use of resources is cost effective compared to later major changes.

Incentives faced by stakeholders affect their approaches to project flexibility. Incentives for different project stakeholders are strongly related to the contracting structure of a project and other financial obligations. Flexibility has a value for those that can benefit from adjustments, and it is a cost for those who have to adopt. Related to incentives, project management and facilities management do not have to have a common interest. In a facilities management perspective, adjustments that make maintenance and operation of a building easier are typically desirable, and a common topic in user involvement. An experience from user involvement is that users often struggle to point to practical details that increase efficiency in operations during the early phase of projects. Proposals for improvements may therefore come during detailed planning or executing, which typically is at a later stage than project management would prefer. Project management may therefore have incentives to downplay such late improvement proposals (Andersen et al. 2011).

Modularity can serve as an enabler for flexible project management. Modularity is related to the possibility to divide a project into more or less independent sub-units. Modularity can enable projects to cope with uncertainty because individual components do not have a critical role. Modularity can be applied on a micro and macro level. On a micro level, design modularity is a tool for efficiency, because it may reduce negative effect of changes. Design modularity is a common approach to achieve flexibility (Hellström & Wikström, 2005; Thomke, 1997). Modularization in product development projects has primarily been treated as a tool to improve project efficiency (Thomke, 1997). On a macro level, modularity can be an enabler for flexible decisions processes because decision makers can make the incremental commitments. An approach of minimal commitment at each decision stage is a part of the "anti-disaster methodology" proposed by Hall (1980). Macro modularisation of projects usually means that each module can be produced over a shorter time period than would have been the case for an integrated project. Shorter execution time reduces the probability for major adjustments during the project (Lee & Xia, 2005).

3 APPROACH

Several different information sources have been used. The main sources are:

1. Evaluations of Norwegian public investments
2. Ex-ante uncertainty analyses of major governmental investments
3. Case studies of Norwegian hospital projects

In the following, the main information sources are described. In the study of evaluations of Norwegian public investments, a set of independent project evaluation reports was collected. Personal experience from projects was also utilised. To analyse the information related to the projects, codified data were entered into a database. This included information on the general characteristics of the project. On the basis of the descriptive information, an assessment was made of approaches to project flexibility.

Hospital projects were chosen because flexibility is an important concern in hospital buildings (de Neufville, Lee, and Scholtes, 2008 and Miller and Swensson,2002). The benefits of projects materialise after the projects have been commissioned, calling for a rather long time perspective of the analysis. This called for analysis of hospitals built some time ago.

Being a multi-case study, the study is based on multiple information sources (Yin, 2003). The most important sources to the case studies of Norwegian hospital projects were:

- Documents from the involved organisations, as well as publicly available information. This includes reports, evaluations and quantitative information, such as timetables and statistics.
- Interviews
- Participant observation in meetings and other arenas where the projects have been discussed.

A summary of the most important information used in this paper is shown in Table 1.

Table 1: The primary information sources upon which the paper is based

Information	Content	N=	Type of information	Sources
Evaluations of Norwegian public investments	Public and private sector projects from different sectors. Projects initiated 1986-2000	18	Primarily qualitative	Evaluation reports; personal experience
Case studies of Norwegian hospital projects	Investment projects 1986-2000	4	Qualitative and quantitative	Interviews; statistics; evaluation reports; personal experience

4 RESULTS

The longer the time-frame of a project, the less likely it is that prerequisites will remain unchanged. This means that the longer the time-frame of a project, the more important it is to prepare the project to either avoid or manage changes. Even though the results are based on studies of a few projects, the results indicate that the potential drawbacks of flexible projects are substantial, both in terms of efficiency and effectiveness. There are also indications that the drawbacks are largest when projects do not prepare for subsequent adjustments.

In the beginning of this research, it was expected that the decision process related to the project can be fairly straight forward if flexibility in the product, such as a building, was high, because the result of the project was prepared for alternative use. Furthermore, it was assumed that a low flexibility in the product could be combined with high flexibility in the decision process because scope definitions could be postponed in order to gain as much knowledge as possible. These assumptions are only partially confirmed by the study.

Two explanations are proposed to this result:

- If there are possibilities for flexible decision processes, they are highly likely to be utilised
- Flexible decision processes can always be applied in response to unforeseen events

Regarding the first alternative explanation, possibilities for flexible decision processes may come from planned flexible decision processes. Availability of flexibility options and redundant resources can serve as an invitation to adjustments. If there are possibilities for adjustments and iterations, it is likely that flexibility options will be utilised. This means that the presence (or knowledge) of flexibility enablers can work as a flexibility driver. Flexible product designs may therefore serve as enablers for flexible decision processes.

The second alternative explanation means that even though it comes at a cost, and frequently at a high cost, plans can be changed. While the degree of flexibility in the product generally must be established at an early stage in a project, a flexible decision process may either be indented or ad hoc. Flexibility in the product is to a large extent an attribute that is designed into a delivery in the front-end of a project. On the other hand, a highly flexible decision process can be achieved

even if it not prepared for. It may therefore work as a kind of "security valve" for unforeseen development. This is similar to Galbraith's notions that if a firm fails to actively create other strategies to address uncertainty, a slack resources strategy will occur by default (Galbraith 1973).

As a response to uncertainty, projects can either isolate themselves in order to execute the defined task efficiently, or prepare the project to manage flexibility. A third, often unintended strategy occurs when projects plan for isolation, but cannot maintain the isolation. Projects are then forced to be more flexible than they have prepared for. Both of the first mentioned strategies have advantages and disadvantages. The research that this paper is based on indicates that the strategy to plan for isolation mainly has disadvantages, especially in a facilities management perspective. If some of the original assumptions that a project is based on prove to not be valid anymore, it is the facilities managers who have to live with a building that is not optimized for its purpose. Project management can just deliver according to the specifications that were set up, and then move on to another project.

Successful strategies for project flexibility either aim at avoiding flexibility in projects or enabling projects to manage flexibility. Projects avoid adjustments or live with them. The main drawback of project flexibility that has been observed in this research is not necessarily flexibility itself, but flexibility applications in projects that lacked structure and preparation for flexibility. It is therefore in the interest of future facilities managers to ensure that projects have a certain amount of flexibility.

One indication from the analyses is that project flexibility requires a structure. In the referred studies, the potential drawbacks of flexible projects are substantial both on efficiency and effectiveness. It has also been shown that the drawbacks are the largest when projects did not prepare for flexibility. To avoid cost overruns, but also to obtain desirable benefit from a project, it is advised that flexible decisions are supported by a structural framework of strategies and guidelines. There are indications that if a structural framework for a project is established, flexibility options could be utilised without destabilising the project organisation.

5 PRACTICAL IMPLICATIONS

The paper has identified some characteristics of successful project flexibility management. These findings can be of value in front-end preparations of future projects. The following summary is based on results presented in the literature, along with results from the studied projects. Four approaches to project flexibility management are presented in Table 2, together with a summary of implications on both project and facilities management.

The indicated strategies are described in the following.

1. Late locking of scope and fast execution
After an extensive front-end phase, the project scope is defined and the project is executed. This is similar to a traditional project management approach, but emphasises a fast transition from front-end to execution. The approach means minimising external flexibility after the scope is established.

Table 2: The primary information sources upon which the paper is based

Objective	**Approach**	**Project management implications**	**Facilities management implications**
Avoid adjustments (after locking of scope)	1. Late locking of design and fast execution	Depends on fast locking of scope and execution. Lack of decisions in front-end phase can cause frustration.	Requires involvement of users and future facilities management representatives.
Manage (limited) adjustments	2. Shield off areas of uncertainty, for example technical installations in buildings finally specified later than the rest of project	Allows the major part of a project to be executed without adjustments. Still-open items must be of limited size.	Users and future facilities management representatives are expected to point to areas that are likely to have need for adjustments.
Avoid adjustments (in modules); Manage adjustments (between modules)	3. Incremental commitments. Buildings divided into sections, built independently	Allows each module to be executed without changes. Longer total implementation time	Fast collection of facilities management experiences from the first modules delivered is important, to be able to adjust specifications for future modules.
Manage adjustments	4. Over-specification of functionality. Redundant engineering capacity	More cost effective than dealing with adjustments with no available resources. Amount of adjustments can escalate beyond control	Opens for continuous input, but may increase project cost.

2. Shield off areas of uncertainty

In the process of defining project scope, certain parts may be defined later than others. This can be manageable, provided that the still-open items are well defined and of a limited relative size. Areas where there is substantial uncertainty can be identified. The bulk of the scope can be defined in the front-end phase, while some issues remain unsettled until later stages.

3. Incremental commitments

In an incremental approach, projects are committed to piece by piece. Large projects are decided upon and executed as a series of smaller projects. Each module can be executed relatively isolated due to a relatively short implementation period. Modularising (on the macro level) of major projects offer flexibility options for decision makers. For modular projects, effectiveness may be low unless each module is designed to provide benefits as individual deliveries, and not only providing a foundation for future improvements.

4. Absorption

Absorption can be obtained by redundancy or decoupling of dependencies. Regarding the physical design, redundancy includes over-specification and other types of flexibility in the product. Decoupling of dependencies can be achieved by a modular design, which reduces domino effects from changes. As for the project organisation, 'slack' is a keyword, including budget reserves, time slack in plans and organisation capacity to manage changes. In the studied

projects, the lack of available resources has been observed more frequently than availability of such resources.

The study indicates that successful strategies for project flexibility either aim at avoiding flexibility or at enabling projects to be flexible. Projects can avoid adjustments or live with them. One key to successful flexibility management in projects lies in the transition from an initial open-minded environment to the subsequent focused phases. Even though the results are based on studies of only a few projects, there are indications that the drawbacks of flexible projects are largest when projects do not prepare for future adjustments. This notion is consistent with previous works on flexibility, which highlight that flexible decisions require a structural framework of strategies and guidelines. The suggested approaches and categorisations related to project flexibility are intended as an input to such a structural framework. It is in the interest of future facilities managers that projects have an approach for flexibility management.

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