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Management of flexibility in projects

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Abstract

Project managers are challenged to keep their projects focused and at the same time support their organisation's need to adapt to changes and uncertainty in the business environment. The purpose of this paper is to analyse the dynamics related to project flexibility, both from a theoretical and an empirical perspective. To ensure the efficiency of the project organisations, flexibility is usually not desired in the late phases of projects. The projects in this study often applied flexibility even during these phases, usually based on initiatives from project owners or users. It is paradoxical that while flexibility was frequently needed in the studied projects, it was rarely prepared for. As a consequence, structured approaches to project flexibility management are called for. The study indicates that the opinion on project flexibility held by the involved stakeholders can to a large extent be explained by their incentives related to the projects. The empirical results in this paper are based on a multi-case study covering 18 projects.

Keywords: Managing projects; Implementing strategy; Flexibility; Adjustments

1. Introduction

In a changing world, there is a desire of project owners and users to have "room to manoeuvre"; to be able to adjust projects as they gain knowledge about their needs and changes in the project context, as discussed by Midler [1]. A number of scholars, including Kreiner [2], argue that flexibility is necessary to face the changes and uncertainty in the business environment. On the other hand, a wide range of studies (including [3–5]) indicates that a clear project definition is a critical success factor for projects.

This paper analyses flexibility in large investments projects. To begin with, project flexibility is discussed from a theoretical standpoint. In order to illustrate different aspects of flexibility, 18 Norwegian projects have been analysed. The projects include a wide range of different industries, project sizes and types. Most of the projects are publicly financed.

2. Perspectives on project flexibility

Flexibility management is not a new concept. Sager [6] found several examples of flexibility as one approach to prepare for the effects of uncertainty in planning. However, Sager also notes that flexibility is an important term often used by planners but rarely scrutinised theoretically. Kreiner [2] points out that the traditional focus on stability in project management becomes challenged under uncertainty. This creates "drifting environments". Kreiner's drifting environments are not necessarily caused by actual changes in the project context. They may also occur when project stakeholders get a better understanding of their actual needs and improved ability to express the needs. Flexibility can also be seen as a response to environmental uncertainty, as

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discussed by Karlsen [7]. Real options are an established perspective on project flexibility with roots in financial options theory; see for example Brennan and Trigeorgis [8]. In this perspective, the value of flexibility can be quantified in monetary terms. Amram and Kulatilaka [9] compare flexibility to owning an option – the right, but not the obligation to take an action in the future. According to the real-options paradigm, uncertainty can increase the value of a project, as long as flexibility is preserved and resources are not irreversibly committed.

Mandelbaum and Buzacott [10] uses the number of the remaining alternatives after a decision has been taken as a measure of flexibility. In a similar manner as Midler [2], Eikeland [11] discusses project flexibility related to "room for manoeuvring". The "room for manoeuvring" is made up by future yet undetermined internal decisions, and may also be seen as a measurement of internal uncertainty of the project. According to Eikeland [11], a decision is within the room for manoeuvring if it does not violate the consequences of previous decisions. Terms like adaptability and robustness are often used when discussing issues related to what this paper calls flexibility. Flexibility may also be described as a way of making irreversible decision more reversible or postponing irreversible decisions until more information is available. Husby et al. [12] defines project flexibility as "the capability to adjust the project to prospective consequences of uncertain circumstances within the context of the project". The use of the term flexibility in this paper is based on this definition.

2.1. Flexibility in the process and the product

The capability of projects to adjust can be related to how the projects are executed and to how adaptable the final product will be, once it has been produced. Flexibility in the decision process is based on an approach where decisions and commitments in the projects are made sequentially over episodes.

Three strategies to achieve flexibility in the decision process may be identified. Firstly, a "late locking" of project concepts, specifications and organisation can be used, as discussed by Miller and Lessard [5]. Miller and Lessard refer to late locking as an exploring, iterative front-end process. They claim that late locking is as key success criteria for large engineering projects. Once the projects are locked, they are executed in a traditional way. The second strategy is related to a continuous step-by-step locking of the project by a successive commitment to projects. This may be achieved by the use of decision gates models, as shown by Eskerod and Östergren [13] or by incremental decision making, as advocated by Genus [14]. The third strategy is found in contingency planning, where a set of base plans is defined, but also a set of alternative plans that can be activated if needed. According to Chapman and Ward [15], contingency plans reflect anticipated potential departures from the defined plans for a project. Contingency plans are alternative plans that can be used if the baseline plans cannot be executed. Chapman and Ward point out that it is important to restrict the development of detailed contingency plans in order to reduce planning cost.

Flexibility in the product is achieved when the final product of the project is prepared for alternative use. As described by Brand [16] and Blakkstad [17], this approach to flexibility is used in building construction. According to Arge and Landstad [18], 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 the possibility for construction and technical changes with minimum cost and disturbance. Finally, elasticity means the potential for increasing or reducing the size of the building. In this paper, all these three characteristics are summarised as flexibility in the product.

2.2. Interaction between flexibility in the decision process and the product

Flexibility in the decision process and the product may interact for any given project. The real options approach treats flexibility in the decision process and the product relatively similar. However, from a project management point of view, it makes a major difference if the flexibility lies in the product or the decision process. Different strategies for project flexibility management are identified in Fig. 1, each characterised by high or low flexibility in the process and product, respectively.

As indicated in Fig. 1, the situation with low flexibility in both the product and the decision process assumes stable environments. This does not necessarily mean that the environments are actually stable. It only means that the project concept and the management of the project

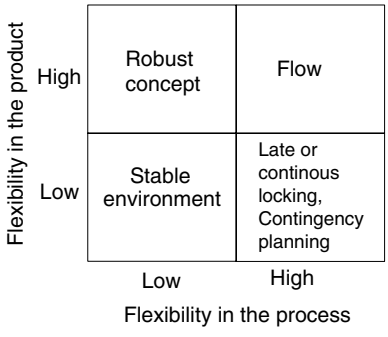

Fig. 1. Flexibility in the product and the decision process.

are not designed for adjustments within the project time frame. A strategy characterised by high flexibility in the product and low in the process is termed "robust concept" in Fig. 1. This project situation assumes that the decision process related to the project can be fairly straight forward because the result of the project is prepared for alternative use. An argument against such a strategy is that flexibility in the product can be costly. It is also challenging to target the flexibility to where it is needed. Flexibility in the product that turns out to not be used, can be seen as a waste of resources.

A basic principle in the situation with low flexibility in the product, and high flexibility in the process is that final decisions can be postponed (for example, the freezing of specifications) in order to gain as much knowledge as possible. A low flexibility in the product is desirable when flexibility in the product is costly. A potential drawback of this strategy is that it might cause frustration among project stakeholders, due to a lack of commitment and perceived uncertainty.

Fig. 1 also includes the situation with high flexibility is both the product and the process. "Flow" has been used as a description of this situation. It contains many of the aspects related to the other two strategies with high flexibility in either the process or the product.

2.3. Modularity

Flexibility can be related to the degree of modularity in the projects. Modularity refers to the possibility to divide the project into more or less independent sub-units. According to Miller and Lessard [5], modularity can enable projects to cope with uncertainty because individual components do not have a critical role. Major "one-piece" projects such as bridges and tunnels have a low level of modularity, based on the "we do not build half a bridge"-approach. Projects that are assumed to have higher levels of modularity include IT-system development and road improvement projects.

2.4. Flexibility in different project phases

This paper makes a distinction between three different project phases: front-end, planning and execution. The front-end phase covers the activities prior to the final decision to go ahead with the project. Even though planning is a part of the front-end phase, most projects also have a planning phase for more detailed preparation after the project has been decided upon. Projects are implemented in an execution phase, which ends when the project outputs are realised.

Most authors agree on the value of flexibility in the front-end phase of projects while flexibility is commonly seen as undesirable in the execution phases of projects. Lundin and Söderholm [19] describe how a project moves from relative openness in the beginning of the project, to relative closeness in the execution phase. In the execution phase, the predetermined action is supposed to be carried out according to the plans, in a "planned isolation". The concept of project flexibility in the execution phase disturbs this planned isolation. In a similar way, Mahmoud-Jouini et al. [20] characterises project management by the speed of three project phases: preparation, freezing and implementation.

Many authors on project management, including Morris and Hough [4], warn against changes in projects once specifications have been established. Miller and Lessard [5] point out the irreversibility of large engineering projects and the importance of bold commitment from key stakeholders. They argue against flexibility once the front-end phase is over.

2.5. Efficiency and effectiveness

Efficiency 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 scope, quality, cost and time. It is an internal measure. Effectiveness, on the other hand, is linked to the longer-term effects of the project, or to do the right things. Effectiveness is an external measure. Eikeland [11] relates effectiveness to how the results of a project contribute to value added for owners and users. According to Samset [21], effectiveness concerns the extent to which the project's tactical objective, or the goal, can be achieved.

The literature review [22] found that flexibility is primarily an approach to improve effectiveness of projects rather than efficiency. Major drawbacks of flexibility are related to reductions in efficiency. Flexibility was seen as a threat to delivering the project on time and within budget. In order to maximise efficiency, projects needs to be clearly defined in the front-end phase and executed according to the plans. Adjustments or remaining decisions shall be minimised. Flexibility promoters emphasise the possibility for increased effectiveness. A project with sufficient flexibility to utilise opportunities to increase the value for owners and users might in the end prove to be more effective, as discussed in [2] and quantified by the real options approach [8].

2.6. Project stakeholders

Key stakeholders who are directly linked to most projects are; project owners, users, project management and contractors. Olsson [22] analysed the expected opinion on project flexibility. That project owners and users are likely to be more positive towards changes aimed at increased effectiveness. Stakeholders those main responsibility lie on the cost side of the project, such as project management and contractors, are less likely to embrace changes. According to Kreiner [2], the project owner is made the guardian of relevance and there-

by the project's effectiveness. The project manager is made the guardian of efficiency.

2.7. Changes and extensions

Changes and extensions are a source of major disagreements between different actors in projects. PMI [23] defines the management of both changes and extensions as scope change control.

Many authors, including [1,4,24], have pointed to scope changes as a key driver to cost overruns of projects. From a project management and contractor perspective, scope changes are generally seen as undesirables, even though contractors can see changes as a possibility to improve the profit from the projects [25]. Scope changes are key issues when discussing flexibility, but project flexibility as discussed in this paper is a wider concept than scope change management.

A typical scope change is proposed because the users or project owner wants to increase the effectiveness of the project. As shown by Ibbs et al. [26] using benefit-to-cost ratio, the reduction in efficiency might be compensated by a higher increase in effectiveness, depending on the timing and type of change. Two sources of conflicts related to scope changes can be identified. Conflicts may arise regarding: (a) the quantification of the increase in effectiveness and reduction in efficiency; (b) the responsibility for the reduction in efficiency.

Based on a study of 448 projects, Dvir and Lechler [27] showed that changes in both plans and goals of projects typically reduce both the efficiency and customer satisfaction of engineering projects.

Many textbooks on project management, including [3,28], include explanations and illustrations that illustrate that the scope change cost is typically low in the front-end phase of projects, and getting higher and higher as time goes by. This increase in scope change cost over time is widely accepted as a rule of thumb, and is a major challenge to project flexibility. Once a project has been decided upon and the planning or execution has begun, changes are likely to reduce the efficiency of the project, as shown by Hanna et al. [30]. However, Poppendieck and Poppendieck [29] argue that the almost exponential increase in scope change cost over time in a project is not always applicable to IT-projects. Some types of changes are less damaging to efficiency than others. An alternative approach to project flexibility is to identify areas or types of changes that are less challenging to accommodate in projects than other changes. Thus, at least two different strategies can be chosen to manage scope changes: (a) to avoid them or (b) to reduce the negative impact from changes that do come. A *change* requires that something already has been decided. One key purpose of the flexibility strategies identified in Fig. 1 is to achieve flexibility without creating scope changes in the project. In this way, scope changes might be avoided or reduced by the use of late locking of projects and by not taking decisions until one really have to. Scope changes may also be avoided by the use of flexibility in the product.

2.8. Contracting and incentives

Incentives for different project stakeholders are strongly related to the contracting structure of a project and other financial obligations. A common tool for achieving flexibility in projects is the use of option based contracts, which enables a continuous locking of the projects. Mahmoud-Jouini et al. [20] discusses time management in projects. Their discussion also includes flexibility aspects. They point out that a key factor in creating win–win situations between the stakeholders in Engineering, Procurement and Construction (EPS) contracts lies in flexibility of contracts and the implicit relations that are created by the contracts. Garel and Midler [31] studied contractual structures that enable front-loading and coherent incentives for manufacturers and suppliers in the automotive industry. Their analysis is based on a game theory approach, where dealing with flexibility can be a win–win or zero-sum game between the stakeholders. In co-development of automotive parts, the supplier gets no additional payments for late identification of need for modifications in the design phase. The supplier therefore has strong incentives to provide engineering expertise to work closely with the manufacturer in order to understand the needs and the production process [31].

The users are a group of stakeholders that often do not have direct contracts related to the projects. Their incentives are therefore less connected to the direct cost of the project, and more often connected to the quality and usability of the final result.

3. Empirical indications

A study was carried out to investigate to what extent the results from the theoretical review of project flexibility corresponds with observations from a number of projects. This section of the paper describes the data material, discusses the applied methodology and presents the results from the study.

3.1. Data collection and analysis

A qualitative case study research approach has been used in this study. In the terminology of Yin [32], the analysis is a multi-case study. The study is based on an analysis of 18 Norwegian projects. Information related to the projects has been obtained from two main sources: third party evaluation reports and personal experience from consulting and applied research engagements. The

third party reports usually have a high professional standard and analyse the projects in depth as well as in a broad perspective. Of the projects, 15 are described primarily based on third part reports. For three of the projects, information is based on both third part reports and personal experience. Case study reports have been established for the projects that have personal experience as a data source. The analysed projects have been carried out between 1986 and 2003, the majority between 1995 and 2000. A wide variety of projects have purposely been analysed in order to capture different aspects of project flexibility. The type of projects in the study is shown in Table 1.

On the basis of the descriptive information, an assessment was made of the project flexibility characteristics. Due to the size of the projects, the analysis is based on the strategies of the projects and major events.

To analyse the information related to the projects, codified data were entered into a database. Table 2 shows the project attributes that were used in the study. The table also shows the alternatives and scales that were used. Some of the information relates to the project itself, such as industry and project budget. The analysis includes information related to approaches to flexibility that were planned for or observed, including scope changes, delays and postponed decisions. In addition, the observed opinion on flexibility for different stakeholders is included in the analysis. In order to validate the data, informants with experience from analysed projects have reviewed the relative scores of the projects.

Table 1
The studied projects by industry and size of project

	Number
Type of project (n = 18)	
Offshore	1
Hospitals	3
Transportation infrastructure	7
Defence	3
Public buildings	4
Project size (n = 17)	
<15 mill euros (100 mill NOK)	3
15–60 mill euros (100–500 mill NOK)	8
60–250 mill euros (500–2000 mill NOK)	3
>250 mill euros (2.000 mill NOK)	3

Table 2
The parameters used in the analysis

Dimension	Scale/alternatives
Type of project/industry	Transportation infrastructure; public buildings; hospitals; defence; offshore (oil and gas)
Size of project	Actual cost for finished projects, latest known budget for on-going projects
Specific type of flexibility	Change; extension; contingency planning; late locking; continuous locking, none
Project phase	Front-end; planning; execution; none
Flexibility in the product	Low; medium; high
Flexibility in the decision process (planned and actual)	Low; medium; high
Degree of modularity	Low; medium; high
Stakeholder who initiated the use of flexibility	Users; owner; project management; contractor; none; N/A
Stakeholder attitude to flexibility (project owner, user, project management and contractor)	Negative; neutral; positive; N/A

4. Results

In the following, the results from the study are presented. The results are divided into different sections, in order to address key research questions.

4.1. What type of flexibility has been used and when?

Changes and extensions are commonly used, and are observed in 11 projects, covering most types of projects. A late locking was applied in 4 projects. One defence project used a contract with predefined options as way of achieving a continuous locking of the project. Contingency planning was the main flexibility approach in one project. In only one project, a college building construction, flexibility was not applied.

Flexibility was used in all phases of the projects, but particularly during the planning phase. Three projects had need for flexibility in the execution phase, two of them being hospitals. One of these projects had extensive changes and extensions, followed by large cost overruns. The other project applied a late locking of the specification related to key medical equipment. Late locking was related only to a limited part of the project. This project was delivered on time and budget. The third project with flexibility need in the execution was a renovation of an old public building. Requirements related to preservation of cultural and historical features of the building proved to be challenging to specify before the work was started. These results are summarised in Table 3.

4.2. Stakeholder perspective on project flexibility

As shown in Table 4, the project owners and the users appear to look favourably upon flexibility. In only one project, the users were negative to flexibility. This was a school building project, where the users (primarily teachers and parents) wanted predictability in the

Table 3
Flexibility use by type and project phase

	Number
Type of flexibility applied in the projects (n = 18)	
Late locking	5
Continuous locking	1
Extensions	4
Changes	6
Contingency planning	1
None	1
Project phase for main use of flexibility (n = 18)	
Front-end	4
Planning	10
Execution	3
None	1

front-end phase regarding the time and scope of the school building refurbishing. The study indicates a mixed opinion on flexibility among project management. Contractors were overall negative (even though the contractor's opinion is based on fewer observations than the other categories).

Regarding project management, there are indications that they look favourably upon flexibility use in the front-end or planning phase, but not in the execution phase. Furthermore, project management appear to be positive to flexibility in projects where they and the project owner are found in the same or closely related organisations. This was usually the case in transportation infrastructure projects. When the project management and the project owner are in different organisations, project management had a negative view on flexibility. This was typically the case for public building construction.

Table 4 also illustrates that the stakeholders that most often initiate the use of flexibility, are also most positive to flexibility. Among the studied projects, it was mostly project owners and users who initiated the use of flexibility in the projects.

4.3. Modularity, flexibility in the decision process and in the product

As seen in Table 5, the majority of the projects planned for low flexibility in the decision process. Table 5 also shows that many projects had a high actual flexibility in the decision process. A high degree of planned flexibility in the decision process indicates that the projects were prepared for an iterative decision, planning or execution process. Projects that clearly illustrated that flexibility, or related terms, in the product was intended are rated as having a high flexibility in the product. Projects that are registered as having a low flexibility had no stated or observed intentions of flexibility. Medium flexibility indicates that the projects planned for flexibility in some phases or some areas, but not as a key issue.

Table 5
The analysed attributes related to flexibility in the projects

	Low	Medium	High	*N* total
Flexibility in the product	8	8	2	18
Flexibility in the process, planned	13	2	3	18
Flexibility in the process, actual	2	6	10	18
Modularity	8	5	5	18

A technical analysis of how different changes have affected the flexibility in the product was beyond the scope of the present analysis. In Table 5, flexibility in the product is therefore not divided into planned and actual, but treated as a characteristic of each project as a whole.

Most projects had a low modularity, particularly public buildings. To achieve a high modularity, two transportation infrastructure projects (one road construction and one railway line) were divided into sections, which could be built fairly independently. The two defence projects with a high modularity were related to system development and acquisition, were the systems were possible to divide into modules, both from a technical and a contractual point of view. Finally, one school building project had a high modularity because the project actually consisted of upgrading of a fairly large number of school buildings. Even if the plans for each school had consequences for the other schools and the decision process addressed the whole upgrading plan, each school building could be managed as a subproject (and some would argue that this "project" was a "programme", and each school was a project).

An attempt was made to investigate the relation between modularity and flexibility in the decision process. If a project was highly modular, flexibility in the decision

Table 4
Different perspectives on project flexibility hold by project stakeholders

		Project owner	Users	Project management	Contractor	None
Stakeholder opinion on flexibility	Positive	12	9	6	0	0
	Neutral	4	3	5	3	0
	Negative	0	1	7	4	0
	n =	16	13	18	7	0
Stakeholder who initiated the use of flexibility (*n* = 16)		8	5	2	0	1

process was likely to be utilised. A high modularity appears also to be the major way of achieving a high planned flexibility in the process, which frequently resulted in a high actual flexibility in the process. The combination of high modularity and low actual flexibility in the decision process was not observed.

5. Discussion

In the following, the results are discussed in relation to the theoretical overview of project flexibility. At the end of the section, some implications for project management practice are listed.

5.1. Different stakeholders have different perspectives to project flexibility

It was expected that project owners and users were more likely to be interested in flexibility than the project management and contractors. On average across the 18 projects, this study supports this assumption.

In the studied projects, users were generally positive to flexibility. However, one case showed that the users did not uniformly favour flexibility in the front-end phase, because they wanted to know what they could expect from the project. Fig. 2 gives a summary of the observed opinion on flexibility seen in a time perspective. Owners of the studied projects appear to be clear in their support of flexibility, and contractors in their dislike.

Most authors agree on the value of flexibility in the front-end phase of projects, and on the undesired effects of flexibility in the execution phase. In this study, project management appeared to be the only type of stakeholder that showed the expected shift from being positive to flexibility in the front-end, less positive in the planning phase and finally negative in the execution phase. As a possible explanation, project management might be the stakeholder that is most likely to see the effects of flexibility, both on the benefit and cost side.

Fig. 2 indicates that users and project management have different needs for flexibility in different project phases. As long as the funding model for a project means that the users have nothing to lose from demanding changes and extensions, they have incentive to push for scope changes. This is typically, though not always, the case in the Norwegian public sector from which the majority of the projects in the study come.

	Front-end	Planning	Execution
Owner	+	+	+
Users	+/-	+	+
Project management	+	+/-	-
Contractor	N/A	-	-

\+ = Positive opinion on project flexibility
\- = Negative opinion
+/- = Mixed opinion

Fig. 2. Stakeholders' opinion on flexibility in different project phases.

Kreiner [2] termed project management "the guardian of efficiency". Results from the studied cases show that this guardian role is depending on the organisational connection to the project owner. In cases where the project management was found in the same organisation as the owner, project management was more likely to be positive to flexibility, compared to cases where project management had a weaker organisational connection to the project owner and the guardian role could be exercised more freely.

The opinion on flexibility held by the different stakeholders can also be explained based on the incentives faced by the stakeholders. Flexibility has a value for the stakeholders that benefit from changes and late locking of projects. In this study, the stakeholders that have their incentives related to achieving the project's purpose were the advocates of flexibility. Stakeholders that have their incentives related to delivering the project on time and within budget saw flexibility as a threat. Flexibility usually means that the contractors have to spend resources to adopt. This disturbs the efficiency of their organisations and typically causes waiting or rework. Note that this study has been carried out on rather strategic level. Garel and Midler [31] show that the contractors, depending on the contract structure, may have incentives to embrace changes because this gives them room to ask for additional payments.

5.2. If flexibility is prepared for, it will be used. It will often be used even if it is not prepared for

In the analysed projects, changes and extensions were found in more than half of the projects, in spite of the well-known risk for cost overruns in such occasions. This may be characterised as a traditional type of flexibility. The structured approaches to project flexibility that are discussed in the literature are also found, but in a minority of the projects.

It appears to be a strong desire to use flexibility in the studied projects. This was particularly the case when it was prepared for, but also when it was not. Most projects did not plan for flexibility in the decision process, but used flexible approaches anyway. All projects with a high planned flexibility in the decision process also had a high actual flexibility in the decision process. Flexibility in the product could only to a limited extent result in less use of flexibility in the decision process. This indicates that if there is a possibility for flexibility in a project, it will probably be utilised.

5.3. Implications for project management practice

In the studied projects, flexibility was often managed in a traditional way. It appears to be a potential for more frequent use of structured approaches to management of project flexibility.

Flexibility in the front-end phase is the least controversial part of project flexibility. The study indicates that after the front-end phase, flexibility in well-defined parts of the projects can be managed without major reductions in efficiency. To manage flexibility, it is beneficial to identify critical part of projects where flexibility is needed. It is likely that these parts of the projects are similar to the critical parts that are identified in project uncertainty analyses. In the next step, appropriate strategies for project flexibility of the identified areas are chosen. In this way, project flexibility can enable utilisation of the often neglected opportunity side of uncertainty management.

Note that flexibility as discussed here is not seen as an alternative to strategic management, but as a means to help realising a strategy. This is in accordance with Samset [28] who argues that successful projects are characterised by a distinct strategy in combination with sufficient tactical flexibility.

The observed tendency for users to advocate flexibility in late phases of projects indicates that projects with a high user influence should have a higher need for an active approach to project flexibility than other projects. 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.

6. Conclusions

This study indicates a paradoxical approach to project flexibility: flexibility is frequently used but rarely prepared for. As Engwall [33] and Jugdev [34] point out, current project management knowledge is a practitioner-driven theory focusing on supporting advices to the project manager. In this perspective, efficiency is the prime focus and flexibility should de minimised once the front-end phase is over.

Projects in this study often had need to be flexible even after this point, usually based on initiatives form the project owners or users. Current project management theory then proposes a stronger emphasis on the front-end phase in order to prepare the projects as well as possible. Given the volume of flexibility use in the studied projects and generally changing environments of projects, it seems unrealistic to strive for an elimination of project flexibility. Flexibility appears to be so commonly used that it must be addressed seriously.

The opinion on flexibility held by the different stakeholders appears to be related to the incentives faced by the stakeholders. In general, flexibility has a value for the stakeholders that benefit from changes and late locking of projects, and it is a cost for those who have to adopt. In this study, the project owners and users had their incentives related to achieving the project's purpose and they were often the advocates of flexibility. The stakeholders that have to adapt to different forms of flexibility were primarily the project management and contractors. Changes, late locking and other forms of flexibility usually disturb the efficiency of their organisations and typically cause waiting or rework. Project management had their incentives either primarily related to the project purpose, or the delivering the project according to specification, on time and within budget. The opinion on flexibility among project management appears to vary accordingly. Incentives related to project purpose increases the likeliness that flexibility is look favourably upon. Stakeholder incentives related to direct project outcome increases the likeliness that flexibility is looked negatively upon.

Interesting areas for further research include studies of actual use of different approaches for flexibility in different types of projects. In addition, analysis of which types of scope changes that can be managed without severe reductions in project efficiency is proposed.

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