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## Sustainable Planning in Refurbishment Projects – An Early Phase Evaluation

Ola Bråten Lund<sup>a,\*</sup>, Amin Haddadi<sup>a</sup>, Jardar Lohne<sup>a</sup> and Svein Bjørberg<sup>a, b</sup>

<sup>a</sup>Norwegian University of Science and Technology (NTNU), Høgskoleringen 7A, 7491 Trondheim, Norway

<sup>b</sup>Multiconsult, Nedre Skøyen vei 2, 0276 Oslo, Norway

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### Abstract

Approximately 80 % of the current Norwegian building stock is expected to still be in use in 2050. Norwegian government demands that the refurbishment and modernization of these buildings should be sustainable. According to the authors the early phase planning should therefore be improved in order to be able to fulfill the sustainability requirements. A great deal of the potential for a successful project lies in the early phase, but there seem to be no clear definition of when it starts or when it finishes. This paper investigates different definitions of “early phase” and what this phase of the project should contain to facilitate a successful rehabilitation. Economy is important when defining if a project has been successful or not, but budget overrun is an everyday problem in refurbishment projects. This paper will see if it is possible to determine a more secure economic framework in the early phase. The research has been conducted as a case study approach, based on a literature study, ten interviews and a survey. The first case study was a refurbishment with both technical and financial challenges. The other case study consisted of an investigation of how two municipalities in Norway decide whether to refurbish or demolish their school buildings. The interviews and the survey have been carried out with major stakeholders such as building owners, architects, consulting engineers and contractors. There seems to be no unanimous agreement of what the content of the early phase in refurbishment projects should be. The interviewees have individual definitions, depending on their role. Another notable finding is that all the respondents mean that they have more to contribute with, if they were contracted at an earlier stage in the project. The results will hopefully enable stakeholders in refurbishment projects to improve the structure of their activities. This will support the shareholders to get better and more sustainable end results.

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\* Corresponding author. Tel.: +47 970 77 132

E-mail address: [olabl@stud.ntnu.no](mailto:olabl@stud.ntnu.no)

## 1. Introduction

On a worldwide basis, people use approximately 70% of their time indoor, and in the western world this number is closer to 90% [1]. Based on this information there is a demand for high quality buildings. According to Statistics Norway (SSB), Norway has 4.085.834 different buildings [2]. It is expected that 80% of these buildings will still be in use in the year 2050 [3]. In the upcoming years other challenges will also occur. Currently there are approximately 615.000 buildings in Norway which is located in areas with high risk of rot and mould growth. In the future the temperature is likely to increase, and it is anticipated that in year 2100 about 2.400.000 buildings in Norway might be in high risk areas [4].

Based on the amount of time we spend indoors, the upcoming challenges in context with the temperature and the ageing building stock there is interesting to see what has to be done to facilitate the work with existing buildings. This work must be done as satisfying as possible, and in the same time be sustainable for future generations.

A lot of the premises for a successful project lies in the early planning phase. It is in this phase of the project you can facilitate a great deal of the value creation [5-8]. At the same time there seem to be no clear definition of what the content in this phase should be.

Budget overrun is an everyday problem in refurbishment project, and the cost seems to be difficult to determine [9-12]. It will therefore be interesting to see if the professional actors believe it is possible to predict a budget which is more certain, and how.

In this paper the early phase of refurbishment projects will be evaluated to see how important this phase of the project is. The main research questions that this paper is trying to answer is:

- What should an ideal early phase in refurbishment projects contain to achieve successful projects?
- When does the early phase starts and when does it end?
- Is it possible to determine a certain financial secure framework for refurbishment projects?

## 2. Methodology

The research has been carried out with both a qualitative and a quantitative approach. The research process is shown in figure 1. A literature review of relevant themes such as refurbishment, sustainable refurbishment, early phase and project success was conducted in accordance with the procedures described by Blumberg et al. [13]. These themes were viewed relevant considering:

- Our 1<sup>st</sup> research question suggest that we need a better understanding of what success is, and what is special about refurbishment projects.
- The 2<sup>nd</sup> research question suggest that we try to identify whether there is a common understanding of when early phase starts and when it ends.
- Finally, our 3<sup>rd</sup> research question suggest that we should have a closer look on the financial aspect, and if it is possible to determine a secure financial framework for refurbishment projects.

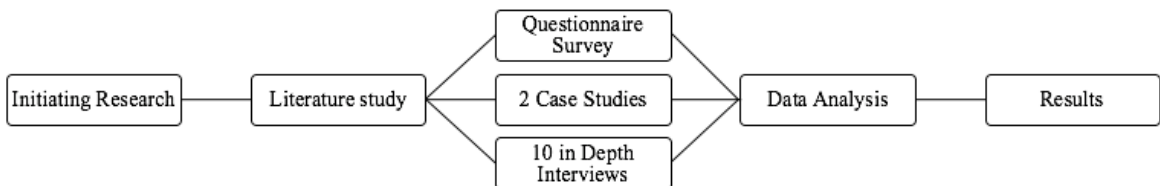


Figure 1: Research Process

A questionnaire was sent to actors within the Norwegian building industry who work, or have worked, with refurbishment projects. The questioner got 44 answers, with respondents from the whole specter of actors in the refurbishment industry represented. The purpose of the survey was to generate a broader data basis concerning refurbishment in general and to have a closer look upon the execution of refurbishment projects. The survey aimed further to reach out to more stakeholders in the building industry than the other research would do.

Two case studies were executed. The first case study was a refurbishment project (Case A) with both technical and financial challenges. The other case study (Case B) consisted of an investigation of how two municipalities in Norway decide whether to refurbish or demolish school buildings. Five semi-structured interviews with people with background in the cases was conducted. In Case A three persons involved in the project were interviewed. The building owner, the architect and the planning authorities. In Case B two interviews with the real estate department in the two municipalities were conducted. The purpose of the case study in Case A was to see how a complicated and unusual refurbishment project is done, and what they take into consideration. The goal of the case study in Case B was to map different decision processes in refurbishment projects, and what issues gets the highest priority. Some decisions lead to successful projects, while other choices seem poor after the project has been finished.

Ten semi-structured interviews on general basis were conducted with actors who have worked with refurbishment for a number of years. The interviewees consisted of two building owners, two architects, two contractors, two consulting engineers, planning authorities and a scientist from a leading Norwegian research institution. The goal of these interviews were to create an image of how refurbishment projects normally are executed today, and how it can be improved.

The interview procedures were completed according to the recommendations from Yin [14].

### 3. Theoretical Framework

In order to get better understanding of this study, key theory will be presented in this section. The theory is considered relevant to answer the research questions stated in the beginning of this paper.

#### 3.1. Early Phase in Refurbishment Projects

Refurbishment sector is one of the most important sectors in many developed countries [12]. Concerning work on existing buildings more than 20 expressions are used with almost the same meaning to describe attempts to redress the effects of depreciation [15]. Refurbishment, renovation, rebuild and upgrade are just some of them. The European Standard uses the following definition of refurbishment; *“Modification and improvements to an existing building in order to bring it up to an acceptable condition”* [16]. In this paper Quah [17] definition of refurbishment has been used to cover the whole range of terms; *“Refurbishment refers to upgrade, major repairs work, renovations, alterations, conversions, extensions and modernization of existing building, but exclude routine maintenance and cleaning work.”*

When refurbishing a building there are several reasons to do it in a sustainable manner. Some of the benefits with a sustainable refurbishment is that it can contribute to preservation of the existing built environment and its protection for future generations. Sustainable refurbishment also contribute to a reduced environmental footprint and better adaption to climate change [18].

A common widely accepted definition of “Sustainability” is; *“Improving the quality of human life while living within the carrying capacity of supporting ecosystems”* [19]. While “Sustainable Development” is by the United Nations (UN) defined as: *“Development that meet the needs of the present without compromising the ability of future generations to meet their own needs.”* [20].

In these two definitions, the quality of life (social) and the ecosystem (ecological) seem to be the main focus. The economical aspect is however not specified.

According to the Brundtland Commission [20] the three main sections within sustainable development is; economic, social and ecological. Sustainable refurbishment has the same main foundation as sustainable development. When refurbishing a building the ideal will be to focus on the interaction between the three main pillars of sustainable development.

If the building owner decides to go thru with a sustainable refurbishment, the decision must be made in the trigger point of the project since a considerable part of the premises for a successful project lies in the early phase. [5-8]. There are numerous definitions for the term “early phase”. The expression is used equivalent with other phrases like front-end planning, preproject planning, front-end loading and conceptual planning [6]. One of the most common definitions is created by The Construction Industry Institute (CII) which has defined front-end planning as; “*The process of developing sufficient strategic information with which owners can address risk and decide to commit resources to maximize the chances for successful project*” [21]

Another definition of the expression is compiled by Arge and Hjelmbrække [22]; “*The pre-design phase as all project related activities executed before detailed design and construction.*” Although these definitions describe the nature of early phase, they do not include defined activities that should be conducted in this period of the project, and can therefore be hard to utilize.

In order to be capable of executing sustainable refurbishment of building successfully, we need to look into how success in these kinds of projects is defined. Project success can be characterized as ambiguous depending on the interest of the stakeholders [23], and the term project success have been studied by a numerous authors [23-25]. The following is a various collection of some definitions to the phrase success;

Ashley et al. [26] defines success as, “*results much better than expected or normally observed in terms of cost, schedule, quality, safety, and participant satisfaction*”. While Tuman [27] focuses on requirements and resources in his definition, “*having everything turn out as hoped...anticipation all project requirements and have sufficient resources to meet needs in a timely manner*”. De Wit [28] has a more comprehensive definition of success with focus on both performance and satisfaction and define success as, “*the project is considered an overall success if the project meets the technical performance specifications and/or mission to be performed, and if there is a high level of satisfaction concerning the project outcome among: key people in the parent organization, key people in the project team, and key users or clientele of the project effort*”. De Wit point out that a project can be a success for one party and a disaster for another, simultaneously success is time dependent [28]. Certain factors have been worked out as more critical to project success than others. These factors are often called Critical Success Factors (CSF), and they will vary from project to project [24].

There are divergent opinions on the definition of the term “project success”. Regardless of the definitions, they can be related directly to sustainable development. The focus on among others cost, safety, meet needs, technical performance can be linked to the three main elements in sustainable development: Economy, Social and Ecological.

### 3.2. Financial Framework

Refurbishment work is risky and uncertain, and the work is normally less well planned and more difficult to control than new build projects [29]. Shah et al. [10] remarked that refurbishment projects are often completed with high cost and time variances. One of the main factors contributing to this is late discovery of design information. To prevent this uncertainty one of Shah et al. suggestions is that the building owner should strengthen the information foundation ahead of the building start. Normally “Norwegian Standard 3424 – Condition survey of construction works” is being used when a condition survey is conducted. This report is often the groundwork for the further resolutions.

Table 1: Economical Challenges

<i>Challenges</i>	<i>Explanation</i>	<i>Consequence</i>
Detect building damages	Building damages are located too late	The estimated expense of refurbishing will increase
Satisfy antiquarian regulations	Local authorities set certain restrictions	Hard to satisfy without applying for exemptions, and they are therefore time consuming
Calculate risk	The contractor often calculates the risk inaccurate	The tender documents become miscalculated

When working on buildings in Norway there are different legislations and guidelines that have to be followed depending on how old the building is, and if the building has any antiquarian value. The Cultural Heritage Act and the Planning and Building Act are the key legislations when it comes to refurbishment. When a building is protected by Norwegian law the process of refurbishment can be extra resource intensive for the building owner and the contracted participants. The legislations put limitations on what is legal to do, both indoors and outdoors. All buildings and constructions which the Directorate for Cultural Heritage has reported as protected, cannot be changed without getting approval from the government. The permission to do these changes must be given ahead of construction start, and must therefore be done in an early phase of the project.

In 2012 the Norwegian government signaled a wish to prepare an own refurbishment regulation called Rehab. TEK. In many occasions, refurbishing according to the current regulation can be demanding, and sometimes even impossible. This new regulation was intended to reduce the scope of the application process for aberrations from the current regulation, TEK.10, and prevent in some cases needless bureaucracy. A Norwegian consulting engineer company delivered a report in 2012 that concluded that creating an own refurbishment regulation would be beneficial, and have a good social economic return [30]. In 2016 no refurbishment regulation is compiled by the Norwegian Directorate of Building Quality (DiBK).

Strict legislation, superficial condition surveys and the occasionally mistaken calculation of risk seem to be contributing factors to the high cost level concerning refurbishment projects. Table 1 shows some of the normal economic challenges associated with refurbishment works in Norway.

#### 4. Result

The following paragraphs will present the results of the questionnaire survey, the case studies and the in depth interviews. The survey was answered by 44 respondents, and contained 15 questions. The survey was designed in two parts, where the first segment consisted of questions that deal with refurbishment in general. The second part consisted of questions dealing with execution of projects, from start to end.

Two case studies were completed by looking at two concrete situations. Case A was of a Swiss styled refurbishment project soon to be done, which have been technical difficult and have had big economical exceeding's. In Case B two municipalities were investigated to see how they manage their school buildings. In Case B it was attempted to find out why some schools are being refurbished while others are demolished and built up again, and what these decisions are based upon. The added value from the case studies were given as a better basis for the discussion and the final conclusion.

Ten in depth interviews have been conducted in a semi-structural manner. The respondents consisted of two building owners, two architects, two contractors, two consulting engineers, building authorities and a researcher.

All the results were collected from the Norwegian construction industry.

##### 4.1. Early Phase in Refurbishment Projects

When asked to define the beginning and the end of an early phase, no-one of the respondents answered identically. Several of the respondents claimed it was determined by when they were contracted into the project. The consulting engineers meant that the phase started when a task was described in a certain project, while the researcher meant that it started when an idea for a change occurs. The contractors on the other hand associated the term early phase with the calculation part of the project. The interviewees had likewise different opinions when asked when the early phase ended. The researcher was the most concrete and answered that the phase ended when the developer determines if he want to refurbish, demolish or keep using the building in the same manner.

100% of the respondents from the questionnaire survey meant that they should be involved in the early phase of the project. Several of the respondents said that they could contribute with skillful competence that the other participants do not possess. A recurring answer from the respondents were that professionals with a wider competence in different subjects combined with experience should be involved earlier. In table 2 an overview of some of the answers from the survey is presented, and what the respondents meant that these elements could contribute to the project.

Table 2: Early Phase Competence, Input and Decision Base

<i>What competence is most important in the beginning of a project?</i>	<i>Input</i>	<i>Decision base</i>
Practical experience from the consulting engineers.	Identify needs, Condition survey, Requirement analysis, Opportunity analysis, Past experience, Alternatives, Cost estimate	Management and operation, Analysis, Evaluation
Involvement of more special subjects like fire, acoustic, ventilation and sanitation etc.	Condition surveys, Requirement analysis, Opportunity analysis, Past experience,	Analysis, Evaluation
The contractors experience concerning price, progress and creation of a progress plan.	Cost estimate, Condition survey, Requirement analysis,	
Antiquarian competence.	Requirement analysis, Opportunity analysis, Past experience, Alternatives, Stakeholder analysis	Analysis, Evaluation
Actors who are able to cooperate good with clients	Stakeholder analysis, Intentions	Analysis, Evaluation

Table 3: Elements for a successful refurbishment project

<i>Stakeholder</i>	<i>Element</i>	<i>Contribution to project success</i>
Building Owner	User involvement, Fulfill user demands, Keep your budget	Stakeholder analysis, Intentions, Cost estimate
Architect	Achieve functionality, Preserve antiquarian values, Reasonable cost	Requirement analysis, Cost estimate
Consulting Engineer	Present alternatives for the client	Alternative
Contractor	Satisfied customer needs	Intentions
Researcher	Economy, Social and Ecology	A sustainable project

In the interviews, the respondents were asked if they could name certain criteria or elements to achieve successful refurbishment projects, as seen in table 3. The interviewed researcher specified in his answer that a successful project would depend on which role the stakeholder had in the project. According to him a building owner would have a completely different answer than what a house buyer would have, and therefore project success must be a project that is sustainable.

#### 4.2 Financial Framework

According to the interviewees, there will always be uncertainty associated with refurbishment work. The more comprehensive the project is, the more uncertain the respondents claim estimating a price will be. Several of the interviewees mentioned that an exact price could not be set before the project was finished because of the unpredictability in refurbishment work. The professionals that price the projects (the contractors) are seldom involved that early in the project. According to the respondents, the contractors are best qualified to estimate the financial framework and cost.

The budgets in refurbishing project are according to the respondents based on shifting matters like condition surveys of the building followed by pricing of either single elements, or pure square meter considerations. This is the foundation for the financial plan. It is normal to determine a certain risk into the calculations to avoid any unforeseen circumstances.

The research shows that most of the professionals working with refurbishment projects regularly participates in condition surveys themselves. The interviewees utter that a destructive and more comprehensive inspection would expose a greater amount of building damages. The way it is done today is insufficient for identifying damages and weak spots. The result is that damages are uncovered too late, often far out in the design phase.

From Case B it was found that a survey formed in such a manner would be tough to accomplish. The funds given to public projects are usual granted later in the project by the municipality council. This require the project to be developed further than just the outline. Some of the other interviewees explained that in most of their refurbishment projects the users were using the building until the refurbishment starts. It would therefore be hard to go into the building and start flattening walls.

During the interviews, the interviewees were asked if investing more resources into the early phase would have a positive effect on the outcome of the refurbishment. The response was that it in many occasions more resources could give a favorable development on the projects. A challenge stated by the interviewees, is that many building owners want to get started with the detailed engineering right away. They do not want to use too much of their allocated budget on planning. One negative consequence mentioned was that increased spending in the early phase could make the project too detailed, too early. This would, according to the respondent, not benefit the refurbishment.

## 5. Discussion

This paper strives to discuss the following research questions:

- What should an ideal early phase in refurbishment projects contain to achieve successful projects?
- When does the early phase start end when does it end?
- Is it possible to determine a certain financial secure framework for refurbishment projects?

### 5.1. Early Phase in Refurbishment Projects

Based on the conducted literature study and on the research presented in this paper, the term early phase, or varieties of the term, is widely used by both academics and by professionals in the building industry. Accordingly, there seem to be no clear definition of what this phase should contain to facilitate the way to more successful refurbish projects. The participants did not agree on a clear definition either. Generally, the later the stakeholders were contracted in the project, the later they meant that the early phase started.

The interviewees pointed out various aspects they consider important to help the shareholders achieve overall project success. Azlan et al. [12] identify that greater involvement of key design participants is one of the ways to achieve integration and obtain more information in the design process. This is also shown in the research in this paper, where several of the stakeholders say user involvement is important for project successes.

In the study, it was specified that it would be impossible to make good decisions without a satisfying foundation to make those decisions. Any decisions made at the early stage of design have major influence on the overall design performance [12].

When this research was initiated, it was assumed that challenges concerning the Norwegian legislation, and the process of applying to the authorities could be time consuming. Almost 60% of the participants in the questionnaire survey meant that an own rehabilitation regulation would make this procedure easier. The interviewees on the other hand meant that they generally had a satisfying relation with the planning authorities, and that such a regulation would be hard to accomplish. They said that the projects they had been involved in often were so special that a Rehab. TEK. would not be capable of picking up the challenges. This indicates that a Rehab. TEK. seem to be unneeded in many of the more complicated refurbishing jobs.

## 5.2. Economic framework

Several authors have written about uncertainty associated with refurbishment works [9-11]. Of all the participants in the research no one had been in a project, with a certain complexity, where they had established an economic framework in the early phase that was precise. One indicator was that the more complex the project were, the higher were the uncertainty concerning the budget. It was suggested that an earlier involvement of the contractor could reduce this challenge. They have experience considering constructability, products and risk management among others. An earlier involvement of the contractors would also make the risk assessments more reliable, and the final price could potential be more accurate. This is confirmed by Sødal et al. [31] where the authors point out advantages of early contractor involvement. According to Sødal et al. the negative points could be challenges concerning designer interest and reduction of innovation. In some cases, the contractor focus to much on schedule and cost, and therefore other elements could be downgraded.

Research conducted in this paper signals that a more far-reaching condition survey should be organized in an early stage of the refurbishment project. In some cases the design need to be revised totally when new information is discovered [12]. It could therefore be rational to manage a destructive condition survey where the analysis is executed in a fashion where more of the construction is taken down to detect more of the building damages. "The availability of design information would influence the quality of decisions made" [12]. A survey level at at least Level 2 or higher, according to Norwegian Standard 3424:2012, should therefore be the minimum. Norwegian Standard 16096:2012 on the other hand recommend not to make destructive measures on buildings with an antiquarian value [32]. Seen relative to the financial prospects and progress in the building phase this seem unreasonable according to the results of this study.

In table 4 challenges regarding refurbishment projects are presented. As well as the challenge the table contain a description of the challenge, the consequence of the challenge, and a proposal to how it could be solved.

Table 4: Refurbishment challenges

<i>Challenges</i>	<i>Description</i>	<i>Consequence</i>	<i>Proposal</i>
Unknown technical condition	In many cases hard to define a detailed technical condition of the construction	The insecurity increases, the contractors estimate more risk when calculating tender documents and surprises occurs when the construction is "opened"	Conduct a more comprehensive and destructive condition survey
Laws and regulations	If a building is listed or protected certain changes are not allowed	Limited room for technical equipment and bad solutions have to be used.	A better understanding for antiquarian values by the executers, and innovative solutions.
Processes	Not a clear approach when starting a refurbishment project	Failed financial estimates, and not sustainable buildings	More structure thru the whole process using analyses and different evaluation methods
Financial unsecure	Many of the projects costs more than first estimated	Not possible to trust the calculated budget, and decisions are made on the wrong premises	Comprehensive condition survey and earlier involvement of the contractor



## 6. Conclusion

The goal with this research was to examine what an ideal early phase should contain to organize successful refurbishment projects. The research also tried to define when an early phase start, and when it should end. Finally, the study wanted to investigate if a secure financial framework was possible to accomplish in an early stage of the project.

An early phase could start when a need for upgrading is identified with the construction. It is recommended that this early phase continue up to when a decision can be made. When the early phase is completed, a settlement based on the conducted measures should be possible.

The results in this study show that numerous assessments should be done in the early phase to give the building owner a better decision support. Today's approach is not good enough, and many decisions are done on insufficient information. Based on the research conducted in this paper an early phase framework has been compiled, seen in figure 2.

The results of the study reveal that the building owner should consider doing a more comprehensive study before settling on an outcome for the building. This paper concludes that a more extensive and destructive condition survey should be done. This will expose more of the building failures, and at the same time give the performing stakeholders a more secure fundament for the further work. According to the research this will furthermore lower the uncertainty concerning the economic framework. Additionally, the research show that the building owner should implement more analyses in the early phase to better the decision backing. These analyses should consist of evaluations of the buildings requirements, opportunities concerning the building and stakeholder interests. The building owner should further evaluate the intentions with a possible refurbishment, before he continues with an alternative evaluation of the building. The contracted parties in the project should try to collect earlier experiences from similar projects if possible. If these analyses and evaluations are generated in the early phase, the authors of this paper mean that the building owner has a good decision foundation to come up with a valid conclusion. This will lead to a better chance of constructing a successful refurbishment project.

Results from this study determine that an exact economic framework for refurbishment projects would be difficult and it might even be impossible to assemble in the early phase. The study suggest it would be possible to compose a more certain budget with involvement of contractors in the early phase. The study further show that the more complex the refurbishment project is, the better it would be to involve experienced contractors in the initiate phase to remove insecurity.

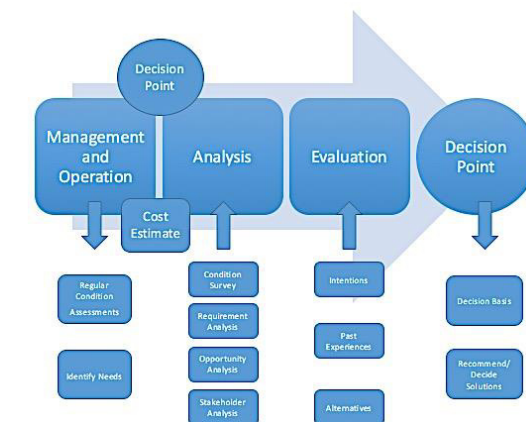


Figure 2: Early Phase Framework

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