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PROJECT DELAYS

KEYWORDS
• Time issues • Causes of delay • Cures for delays • Norwegian construction projects.

Causes of DELAY AND THEIR CURES IN MAJOR NORWEGIAN PROJECTS

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• ABSTRACT •

Several projects encounter delays and unnecessary use of time as a result of to various factors and hence suffer unfavorable consequences. The Norwegian construction industry is no exception. There are factors causing delays in Norwegian construction projects which have many negative effects on all parties, including the projects' outputs and outcomes. This paper will identify the main time issues (delay factors) in major Norwegian construction projects and the recommended solutions. The methodology on which this paper is based includes an intensive literature review, open questionnaires and unstructured interviews with practitioners. The paper addresses frequency and type of delay factors in major Norwegian construction projects and their solutions. It is based on an open questionnaire, which gave the opportunity to discover new delay factors and possible remedies: thus we encourage similar studies in other countries to uncover other possible delay causes and solutions.

INTRODUCTION

In Norway, the construction industry is one of the major industries contributing significantly to growth of the economy. Among the considerable problems in the Norwegian construction industry is delivering projects after the scheduled date. Construction delays play a key role in project success/failure.

Construction delay is defined by Trauner et al. (2009) as: "to make something happen later than expected; to cause something to be performed later than planned; or to not act timely. It is what is being delayed that determines if a Project or some other deadline, such as a milestone, will be completed late".

There are many factors contributing to delays in construction projects. Delays occur in most construction projects and the degree of the delay varies considerably from project to another. It is essential to define the actual factors causing delays in order to minimize, mitigate, and avoid them in any construction project (Asnaashari et al. 2009). More precisely, the risk of delays can be minimized only when the causes are recognized and required actions to prevent delays are implemented (Pourrostam and Ismail 2011; Yang et al. 2013). The delay factors are crucial within a construction project and it is vital that all organizations have certain knowledge regarding this issue in order for the project to be completed effectively and satisfactorily (Wong and Vimonsatit 2012).

Many studies regarding causes and effects of delay have been conducted worldwide; while conducting our literature review we encountered more than 500 sources about the causes of delays. Nevertheless, in Europe, we found only the recent studies by Arantes et al. (2015), and Couto and Teixeria (2007), both studies in Portugal, and those by Elhag and Boussabaine (1999) and Nkado (1995) in the United Kingdom, both dating back to the 1990s. A possible reason is that in the European construction industry, delay factors are considered as risk factors; thus they are studies within the field of uncertainty and risk management. In this study, which is conducted in Norway, we collected data about time issues. In terms of existing literature, we refer both to studies that consider delay a late completion of the entire project and that deal with less-than-optimal project pace or delays of activities/milestones during a project, but that do not necessarily delay the completion of the project (the empirical data collected by us fall into the latter category). The paper aims to highlight the significant time issues and their remedies in major Norwegian construction projects based on a survey and in-depth interviews; moreover, it seeks to add to the knowledge about delays in large scale engineering projects in European-type countries. Time issues deriving from our findings will be compared to the theory. Therefore, the research questions covered in this paper are:

1) What are the significant delay factors in the major Norwegian construction industries?

2) What are the remedies for the identified delay factors?

LITERATURE REVIEW

These last four decades, there have been many studies about causes of delay in large-scale engineering projects, in construction projects particularly. **Table 1** lists most relevant studies done worldwide. We discuss some of them, being the most cited and/or the most recent.

Country	Authors
Afghanistan	Gidado and Niazai (2012)
Australia	Wong and Vimonsatit (2012)
Bangladesh	Rahman et al. (2014)
Benin	Akogbe et al. (2013)
Botswana	Adeyemi and Masalila (2016)
Burkina Faso	Bagaya and Song (2016)
Cambodia	Durdyev et al. (2017); Santoso and Soeng (2016)
Egypt	Abd El-Razek et al. (2008); Aziz (2013); Aziz and Abdel-Hakam (2016); Ezeldin and Abdel-Ghany (2013); Marzouk and El-Rasas (2014)
Ethiopia	Zewdu (2016)
Ghana	Amoatey et al. (2015); Frimpong et al. (2003); Frimpong and Oluyowe (2003); Lugar and Agyakwah-Baah (2010)
Hong Kong	Lo et al. (2006)
India	Doloi, Sawhney, and Iyer (2012); Doloi, Sawhney, and Rentala (2012)
Indonesia	Alwi and Hampson (2003); Kaming et al. (1997)
Iran	Abbasnejad and Izadi Moud (2013); Fallahnejad (2013); Khoshgoftar et al. (2010); Pourrostam and Ismail (2011); Pourrostam and Ismail (2012); Saeb et al. (2016)
Iraq	Bekr (2015)
Jordan	Al-Momani (2000); Odeh and Battaineh (2002); Sweis (2013); Sweis et al. (2008)
Kenya	Seboru (2015)
Kuwait	Koushki et al. (2005)
Lebanon	Mezher and Tawil (1998)
Libya	Shebob et al. (2011); Tumi et al. (2009)
Malawi	Kamanga and Steyn (2013)
Malaysia	Abdul-Rahman et al. (2006); Alaghbari et al (2007); Mydin et al. (2014); Ramanathan et al. (2012); Sambasivan and Soon (2007); Tawil et al. (2013)
Nigeria	Aibinu and Odeyinka (2006); Akinsiku and Akinsulire (2012); Dlakwa and Culpin (1990); Mansfield et al. (1994); Odeyinka and Yusif (1997); Okpala and Aniekwu (1988); Omoregie and Radford (2006)
Oman	Ruqaishi and Bashir (2013)
Pakistan	Gardezi et al. (2014); Haseeb, Lu, Bibi et al. (2011); Haseeb, Lu, Hoosen et al. (2011); Rahsid et al. (2013)
Palestine	Enshassi et al. (2009); Mahamid (2013); Mahamid et al. (2012)
Portugal	Arantes et al. (2015); Couto and Teixeria (2007)
Qatar	Emam et al. (2015); Gündüz and AbuHassan (2016)
Rwanda	Amandin and Kule (2016)

TABLE 01. Countries and authors of the existing studies on delay factors 1/2

Saudi Arabia	Al-Khalil and Al-Ghafly (1999); Al-Kharashi and Skitmore (2009); Assaf and Al-Hejji (2006); Elawi et al. (2015)
Singapore	Ayudhya (2011); Hwang et al. (2013)
South Africa	Aiyetan et al. (2011); Baloyi and Bekker (2011); Oshungade and Kruger (2017)
South Korea	Acharya et al. (2006)
Syria	Ahmed et al. (2014)
Taiwan	Yang et al. (2010); Yang et al. (2013); Yang and Wei (2010)
Tanzania	Kikwasi (2013)
Thailand	Ogunlana et al. (1996); Toor and Ogunlana (2010)
Turkey	Arditi et al. (1985); Gündüz et al. (2013a); Gündüz et al. (2013b); Kazaz et al. (2012)
UAE	Faridi and El-Sayegh (2006); Motaleb and Kishk (2013); Ren et al. (2008); Zaneldin (2006)
Uganda	Alinaitwe et al. (2013); Muhwezi et al. (2014)
UK	Elhag and Boussabaine (1999); Nkado (1995)
United States	Tafazzoli (2017); Ahmed et al. (2003a); Ahmed et al. (2003b)
Vietnam	Kim et al. (2016); Le-Hoai et al. (2008); Luu et al. (2009); Luu et al. (2015)
Zambia	Kaliba et al (2009); Muya et al. (2013)
Zimbabwe	Nyoni and Bonga (2017)

TABLE 01. Countries and authors of the existing studies on delay factors 2/2

--- Delay factors ---

The recent study by Arditi et al. (2017) studied the magnitude of construction project delays and their relationship with the organizational culture. Aibinu and Jagboro (2002) conducted an empirical study about the effects of construction delays on project delivery in the Nigerian construction industry and the possibilities to minimize their negative effects. Some authors have studied construction projects delays and the various aspects of delay analysis methods (Arditi and Pattanakitchamroon 2006, 2008; Kim et al. 2005; Shi et al. 2001).

Gould (2012) carried out a study into contractor responsibility for delay; a similar study was done by Keane and Caletka (2015). Enshassi et al. (2010) studied the causes of variation orders in construction projects in the Gaza Strip, which they consider one of the major delay factors. Another study by Mahamid et al. (2012) in the Gaza Strip identified more than 52 causes of delay, where the top twelve were: (1) the political situation; (2) segmentation of the West Bank and limited movement between; (3) awarding projects to the lowest bid price; (4) progress payments delay by owner; (5) shortage of equipment; (6) delays in decision making by owner; (7) low productivity of laborers; (8) delay in approving sample materials; (9) poor communication by owner with other construction parties; (10) conflict between contractor and other parties; (11) lack of equipment efficiency; and (12) difficulties in financing project by contractor. Sepasgozar et al. (2015) investigated the major delay causes in Iranian construction projects and listed the top nine factors: (1) contractor organization attributes; (2) labor shortage; (3) external factors; (4) material deficiency; (5) design issues; (6) owner attributes; (7) technology restriction; (8) consultant attributes; and (9) project attributes. Compared to the many other studies, some of their factors are broader in description—for example, contractor organization attributes: this may mean poor planning, site management, etc. and in many other studies these factors are not grouped under contractor attributes as a single set; the same is the case for owner attributes.

Most of the theory (e.g., González et al. 2014; Pourrostam and Ismail 2011; Sambasivan and Soon 2007) focuses primarily on causes of delay. Common to these articles is that they do not argue delay prevention methods in detail. Despite existing methods that focus on schedule reduction (e.g., Hastak et al. 2008), there are no specific procedures to overcome delays in the projects and research is mainly related to the causes and proper actions (Chan and Kumaraswamy 1997).

Akogbe et al. (2013) explain that avoidance of construction delay in developing countries may include the development and maintenance of planning, coordinating, controlling, organizing, motivating program resources, and supervising the component projects.

Al-Khalil and Al-Ghafly (1999) mention that delays can affect project stakeholders undesirably: delay leads to loss of revenue due to lack of rentable space or lack of production facilities. The possibility of delivering projects on time can be marked as an indicator of good performance and high efficiency, but construction activities involve many unpredictable factors and variables arise from various sources (Assaf and Al-Hejji 2006).

Assaf and Al-Hejji (2006) conducted research into different types of project delay in Saudi Arabia, concluding that more than 70 percent of projects experience time overrun. The survey was conducted with contractors, consultants, and owners. The outcome of the survey, agreed by all three parties, was that changing order and changing design during construction led to project delay.

A similar study was carried out by Alaghbari et al. (2007), but this time in Malaysia with a list of 31 delay factors, since it was more a deductive approach with predefined delay factors. The major delay factors from their survey results were financial difficulties and economic problems, contractor financial problems, late supervision and slowness in making decisions, material shortages, poor site management, construction mistakes and defective work, delay in delivery of materials to site, and lack of consultant's experience.

In their study of Libyan construction projects, Tumi et al. (2009) mentioned that the main causes of delay in construction projects were improper planning, then lack of effective communication, material shortage, design errors, and financial problems.

Sweis et al. (2008) identified the causes of delay in Jordan. The results of their study show that the financial difficulties faced by contractors and too many change orders by the owner are the major causes of construction delay.

Syed et al. (2003) identify the major causes of delay in the building construction industry based on their study in Florida. The results show that design-related issues (owner and consultant) were very important in causing delays.

Sambasivan and Soon (2007) conducted a study into the causes of delay in Malaysia. In a survey in which 150 respondents participated, the study identified the top ten most important causes of delay from a list of 28.

Based on research on construction delays in 130 public projects in Jordan, Al-Momani (2000) found that weather, site conditions, late deliveries, economic conditions, and increase in quantity are the critical factors which cause construction delays in the Jordanian construction industry. Fugar and Agyakwah-Baah (2010) also studied the causes of delay in building construction projects in Ghana. They identified 32 possible causes of delay and further categorized these into nine major groups.

Figure 1 represents the most cited major delay factors in the studies listed in **Table 1**. However, it is very important to mention that all the studies in **Table 1** have a list of delay factors, the number of which varies from ten delay factors—e.g., Amandin and Kule (2016) in Rwanda—to a list of more than 80 factors—e.g., Acharya et al. (2006) in South Korea and Gidado and Niazai (2012) in Afghanistan. The frequencies in **Figure 1** are based on delay factors which are among the first ten delay factors in the original studies. If we go beyond that, the frequency changes: for example, 'design changes during construction/ change orders' was mentioned in all the studies, meaning the frequency would be more than 77.

FIGURE 01. Most cited major delay factors

--- Solutions to delays ---

The literature on causes of delays is plentiful; however, few focus on the remedies for these causes of delays. Since delay is pricy, even a small advance in delay recovery may have a substantial impact on the financial returns of the parties involved in the project (Faridi and El-Sayegh 2006; Khoshgoftar et al. 2010); thus, it is very important to address cures for delays. The first step to minimize delays is to identify the factors that may lead to delay (Pourrostam and Ismail 2011; Yang et al. 2013).

While studies on the causes and effects of construction delays are numerous, there is a shortage of findings on mitigation measures to address these delay causes and effects (Amoatey et al. 2015). Sambasivan and Soon (2007) made recommendations on delay mitigation for contractors, consultants, and clients. Mahamid (2011) investigated factors affecting time delay in road construction projects and recommended training programs to improve the managerial skills of project parties.

Gidado and Niazai (2012) did study on causes of project delay in construction industry in Afghanistan; they gave six general recommendation to deal with the major delay factors and beside that they included tailored recommendations to the parties (i.e. clients, contractors and consultants). Amoatey et al. (2015) based on their study Ghanaian state housing construction projects; they identified in their study thirteen causes of delays, ten effects of delays, and they recommended solution for the top six delay causes.

Odeyinka and Yusif (1997), in their study of Nigerian housing construction projects, suggested that the best solution to deal with the causes of delay involved the joint efforts of all involved parties (i.e., clients, contractors, government, etc.). Within the same country, and a similar study done by Aibinu and Jagboro (2002), two possibilities were suggested to minimize the negative effects: the acceleration of subsequent activities, which was successful in Germany as a solution based on the study of Mobbs (1982); and a contingency allowance. Pourrostam and Ismail (2011, 2012) made recommendations to each of the involved parties based on their ownership of the major causes of delay. Haseeb, Lu, Bibi, et al. (2011) and Haseeb, Lu, Hoosen et al. (2011) did the same for causes of delay in Pakistan. Kikwasi (2012) made general recommendations for the top six causes of delay in Tanzanian construction projects, which are "adequate construction budget, timely issuing of information, finalization of design and project management skills should be the focus of the parties in project procurement process".

Some authors gave tailored solutions to tailored causes

of delay in a specific area (e.g., procurement, leadership, contacting, etc.). The case of Manavazhi and Adhikari (2002) focused on the causes of delay in procurement in Nepal, Odeh and Battaineh (2002) on contracting, and Arditi et al. (2017) on the effect of organizational culture on delay. Unfortunately, few of the studies based their recommendations on empirical data, but rather on their own perceptions and knowledge.

METHODOLOGY

An inductive approach was used in this study. Inductive methodology emerged from the development of social sciences during the twentieth century as a direct critique of the dominant deductive approach associated with natural sciences. Researchers using an inductive approach are likely to be concerned with the context in which events take place (Tong and Thomson 2015). Thus, the study of a sample of subjects might be more appropriate than study of a large number as with a deductive approach (Saunders et al. 2012). Induction means drawing universally valid conclusions about a whole population from a number of observations (Tong and Thomson 2015). An inductive approach involves collecting data at the outset to establish what is happening and to better understand the nature of the problem by asking questions about the phenomenon of interest. The collected data must be categorized into meaningful categories from which a theory may be developed (Saunders et al. 2012). This approach creates a more flexible structure that allows for alternative explanations of the phenomenon to be considered.

The identification of time issues (which we later compare to delay factors from other studies) in Norwegian projects is based on survey as the research strategy, the data collection technique being an open questionnaire. It is known that analyzing the responses of a large population of respondents that have been asked open questions can be challenging due to the vague findings it might lead to.

In addition, some recommendations to alleviate the identified time issues will be provided, but just for the case of the Norwegian construction industry, and these will be compared with recommendations collected from the interviews and the literature. This study is intended to identify the most common and critical delay factors based on all the respondents that participated in the survey in order to prepare an action plan to reduce and mitigate any delays associated with a construction project.

Surveys will involve selecting a representative and unbiased sample of subjects drawn from the group we wish to study. There are two main types of survey—descriptive and analytical survey (Kvale et al. 2009; Marshall and Rossman 1995). Descriptive surveys are concerned with identifying and counting the frequency of a particular response among the survey group, which was the case with this study, while analytical surveys are concerned with analyzing the relationships between different elements (variables) in a sample group. The survey data was collected in three rounds; a first round among employees in a selection of organizations involved in a research project called SpeedUp, where some of the results are used in some of the papers – e.g., Eik-Andresen et al (2015),

The questionnaire survey was designed to draw on the work experiences of engineers in the construction industry in Norway. It was developed to assess the perceptions of clients, consultants, and contractors on the relative delay factors in the industry. The data collected through questionnaires were analyzed and ranked based on their frequency.

The questionnaire survey was designed to consist of three main parts:

1) Background data about the respondents and their company (name of company, public or private sector, years of project experience, and role in projects).

2) Delay factors, asking the respondents to name the three most important delay factors in projects.

3) Phased prioritization, where the respondents were asked to indicate the single most important delay factor and potential mitigation solutions or remedies.

We received completed questionnaires from 202 respondents. For the last round, the exact number of people invited to take part is unknown, but in total we estimate that about 300 practitioners were invited, based on their having had active involvement in the planning and follow-up of construction projects.. Most of the respondents (53 percent) have more than ten years' working experience and 25 percent have between five and nine years' working experience. Most of the respondents are project managers (54 percent) and team members (40 percent). Sixty percent of the respondents are from public organizations and 40 percent from private companies.

The participants are both from public and private sectors (i.e., clients, owners, sponsors, contractors, subcontractors, suppliers, etc.). The years of working experience of the participants and their role in the projects play an important part in answering the survey; by touching all the layers in the project roles, we will have all the different perspectives on delay factors. With the exception of the background data, the questions were formulated as open-ended questions, allowing the respondents to write their answers in free text. Analysis of the data was performed through these steps:

1) Coding the collected data.

2) First-pass analysis: grouping identical or near-identical responses and assigning frequencies of response to each delay factor.

3) Second-pass analysis: grouping related responses and identifying the dominant delay factors.

4) Third-pass analysis: looking for differences in response across project role, length of experience, and sector.

Following an analysis of the data collected, the authors grouped common identified time issues into eleven groups. Each group had sub-groups with similar interpretations (e.g., poor planning and scheduling which is the sum up of the five sub-groups: last minute tasks; unclear demands from project manager; poor project planning; little or no delegation; and poor project management performance). A similar approach was used for the remedies suggested by respondents. Finally, the results emerging from our data were compared with literature to verify whether the identified delay factors are in accordance with previous findings or deviate from them.

The survey was followed by in-depth interviews involving discussions and suggestions to mitigate the time issues, which are presented in this paper. Interviewees are six senior project managers; they belong to a client of the biggest construction organization in Norway. Employees from this organization also took part in the survey. Since our approach was inductive, at the end of our study we conducted a literature review based on a wide variety of books and journal articles. Most of the journal articles are found through resources given by the university database. We extended our search to the reference lists provided in the previous search results (reference lists of the relevant articles). The aim of this literature review is to compare our findings about delay causes and remedies with those in similar studies. Two approaches have been used to validate the findings: member checking and triangulating. To determine the accuracy, major findings are presented to the participants and they are given the opportunity to comment on the findings and determine whether they feel that they are accurate. It is important to state that the findings of this study cannot be generalized. Though the study covered projects across the country, the findings are based on using a clustering analysis of qualitative survey data. Again, the study is based on self-reported perception of time issues by project parties (namely, contractors, consultants, and clients), which tends to vary and may not always be reliable. Furthermore, the study did not distinguish between ranking by individual project parties. However, most of our findings are consistent with similar studies assessing the delay causes of construction project.

--- Time issues in Major Norwegian Projects ---

The findings from our study derive from a survey as the research strategy and a qualitative questionnaire as the data collecting technique. After analyzing the data collected, we were able to group them into 44 sub-groups at first, then into eleven groups. The results are in **Table 2**. The major time issues in major Norwegian projects based on the survey is poor planning and scheduling, with a frequency of 189, followed by slow/poor decision-making process, with a frequency of 123. These two factors are the highest in their frequencies compared to the nine others; this indicates that the priority is to improve the planning and scheduling and the decision-making process during the project lifecycle. The second group with high frequencies consists of internal administrative procedures and bureaucracy within project organizations, resources shortage (human resources, machinery, equipment), poor communication and coordination between parties, and slow quality inspection process of the completed work; their frequencies are 109, 107, 103, and 87 respectively. After this come design changes during construction/change orders, sponsor/owner/client lack of commitment and/or clear demands (goals and objectives), and office issues. The last two time issues are late/slow/incomplete/improper design and user issues.

Ranking	Major delay factors (Grouping)	Freq.	Delay factors in Norwegian construction industry
1	Poor planning and scheduling	189	Last minute tasks
			Unclear demands from project manager
			Poor project planning
			Little or no delegation
			Poor project management performance
2	Slow/poor decision-making process	123	Late decisions
			Wrong decisions
			Re-play of decisions
3	Internal administrative procedures and bureaucracy within project organizations	109	Administrative demands (e.g. filling hour list – file list –accountability)
			Unnecessary or unclear reporting
			Search after documents for archives
			Annual budgeting – political management agendas
			Administrative systems – access – filing system
4	Resources shortage (human resources, machinery, equipment)	107	Lack of tools or equipment
			Lack of personnel
			Lack of structured subcontractors
			Too many projects
			Work load – project management level
			Work load – engineering level
			Shortage of human resources
			Lack of senior/key players
			Absence and sickness
5	Poor communication and coordination between parties	103	Poor interdisciplinary communication
			Bad or wrong communication (by email, phone, etc.)
			Unstructured colleagues
			Unstructured meetings – many and useless meetings – irrelevant meetings
6	Slow quality inspection process of the completed work	85	Slow control of production
			Slow quality check
			Slow internal QA
			Slow external QA

TABLE 02. The major delay factors in Norwegian construction projects 1/2

7	Design changes during construction /change orders	60	Unnecessary changes and many change orders
8	Sponsor/owner/client lack of commitment and/or clear demands (goals and objectives)	51	Unclear demands from client
			Lack of delegation from owner
			Unclear demands from sponsor/ owner
9	Office issues	41	Software trouble
			Working conditions
			Office noise and disruption
			Too much traveling
10	Late/slow/incomplete/improper design	29	Poor/incomplete documentation (designs, engineering documents)
			Missing or error in documentations during construction
			Error in engineering causing changes
			Poor quality in designs and materials causing changes
11	User issues	13	Short questions from users
			Late/new demands from the users

TABLE 02. The major delay factors in Norwegian construction projects 1/2

Comparing these major time issues in Norwegian construction projects to the delay factors in similar studies conducted in several countries worldwide, we found many similarities and overlaps. **Figure 2** shows the number of appearances of our time issues in other studies: the appearance is counted only when the delay is listed as a major delay in another studies—i.e., the factor is considered and counted only if it is among the top ten in the original study. Comparing other literature with our findings: poor planning and scheduling, which is number one in our list, was listed as a major delay factor in at least 64 other studies, and among other delay factors in more than 105 studies; slow/poor decision-making process, which is second in this study, was mentioned in more than 32 studies as a major delay factor and in more than 100 studies as one of the delay factors in their delay factors list; resources shortage (human resources, machinery, equipment), which is the fourth factor in major Norwegian projects, was identified in another 50 studies as one of the major delay factors, and was a delay factor mentioned in more than 100 studies; poor communication and coordination between parties is the fifth in **Table 1** and is found in more than 40 studies as a major delay factor and in more than 105 studies as one of the delay factors; slow quality inspection process of the completed work from our study was seen to be a major delay factor in more than 40 studies; design changes during construction/change orders are mentioned in all the studies that we had chance to review: this is seventh in our list and was mentioned in all studies we encountered; late/slow/incomplete/improper design, which is tenth in our study, was mentioned in more than 60 studies as a major delay factor and in more than 105 as one of the delay factors.

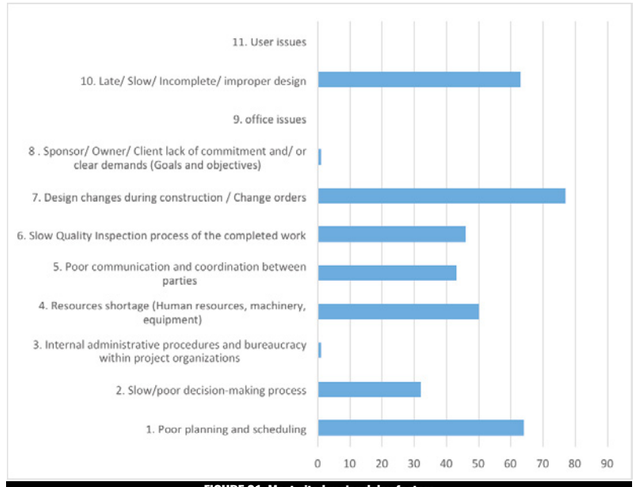

FIGURE 01. Most cited major delay factors

Two issues—internal administrative procedures and bureaucracy within project organizations and sponsor/owner/client lack of commitment and/or clear demands (goals and objectives) were mentioned only in one study as major delay factors, being that of Abdul-Rahman et al. (2006) in Malaysia. The authors used a deductive approach in their study, where they extracted the existing delay factors from theory then ranked them and identified new ones. Two important points require clarification. Internal administrative procedures and bureaucracy within project organizations should not be confused with difficulties in obtaining permits/bureaucracy from theory (**Figure 1**): the delay factor in our findings is related to bureaucracy within the same organization, while that from the theory is related to bureaucracy between multiple organizations (e.g., client with authorities or regulators, contractor with the client). In addition, sponsor/owner/client lack of commitment and/or clear demands (goals and objectives), may be confused with other delay factors (e.g., design changes during construction/ change orders, slow/poor decision-making process, etc.). The lack of commitment we mention here is more related to the stakeholder as the driver and impetus for the project: the client is the one driving and leading the project. Internal administrative procedures and bureaucracy within project organizations constitute one of the major time issues in our survey: however, this was only seen as major in the study by Abdul-Rahman et al. (2006). It was listed as a delay factor in some studies, but with less impact (e.g., Ahmed, Azhar, Castillo et al. 2003; Ahmed, Azhar, Kappagntula et al. 2003; Aziz 2013; Ezeldin and Abdel-Ghany 2013; Marzouk and El-Rasas 2014; Shebob et al. 2011; Tafazzoli 2017; Tumi et al. 2009).

The ninth factor, office issues, comprises software trouble, working conditions, office noise and disruption, and too much traveling: it was mentioned nowhere in our literature review. However, this issue is typical for the Norwegian construction industry. Another major issue appearing only in this study is user issues, but this has lower frequency (13 out of 202). This last factor appeared because of some construction projects (e.g., hospitals, office facilities, etc.) where the end users are more concerned about the final delivered product than about its sponsor/owner/client.

The factor of user issues is incorporated within design change in the post-project phase in other studies. However, in this study, most respondents mentioned that design changes during construction /change orders as a factor which appears during the construction. Once the project is delivered, changes in the post-project phase generally come from the end users (e.g., doctors and nurses for hospitals). This also explains why user issues only appeared within this study, since we gave respondents the freedom to mention all delay factors within the whole project life cycle.

SOLUTIONS AND REMEDIES FOR TIME ISSUES IN MAJOR NORWEGIAN PROJECTS

As mentioned in the methodology section, the second part of the survey is about the possible remedies to deal with time issues and their causes. The data collected from the survey were analyzed in the same manner as was presented in the previous section. The findings from the interviews (the third column in **Table 3**) came from the interviews conducted after the survey. Interviewees were six senior project managers belonging to a client of the biggest construction organization in Norway. Employees from this organization also took part in the survey, including the interviewees.

In addition to the survey, the six in-depth interviews conducted in respect of remedies gave some interesting recommendations.

When it comes to the major time issues in Norway, it can be seen that the recommendations from the survey and the interviews complement one another when they do not overlap. If we take the first major issue, it is very clear that the survey, the interviews, and the literature all suggest training and knowledge sharing as a solution. As we can see, there is no universal root cause and no universal solution for a specific cause. However, as recommended by most of the au-

Delay factors (from Survey)	Cure/ Remedy/ Reduction/ Mitigation		
	From the survey	From the interviews	In the literature
1 Poor planning and scheduling	- Combination of project management training and more efficient procedures - Improve the front end planning - Improve the start-up process - Competent project managers - Better prioritization - Improve front end planning - Improve planning engineering - Improve the plan	- Structuring the planning phase - Facilitate better compliance schedule - Proactively transition between planning and the construction phase - Improve experience and knowledge sharing within the organization	- Virtual modelling (Toor and Ogunlana 2008) - Unrealistic contract duration and requirements (Sambasivan and Soon 2007) - Accurate estimation (Mansfield *et al.* 1994) - Provide training and self-study on proper planning (Lim and Mohamed 1999)
2 Slow/poor decision-making process	- Improve owner/client decision-making process - Business strategy training	- Anchor major decisions in advance of engineering	- Decision-makers should be clearly identified (Chan and Kumaraswamy 1997)
3 Internal administrative procedures and bureaucracy within project organizations	- Improve administrative system (access system, filling system)	- Simplification of procedures	- Make quick decisions (Sambasivan and Soo, 2007)
4 Resources shortage (human resources, machinery, equipment)	- Improve resource allocation - Executive support and involvement - More personal needed - More power to the project managers - Better prioritization	- Performing prequalification - Establish an upper rent limit - Retaining parts of the project organization between projects - Provide knowledge transfer to new project members	- Use of industrialized building system (IBS) (Alaghbari *et al.* 2007) - Training for laborers (Hwang *et al.* 2013 2013; Khoshgoftar *et al.* 2010) -Long-term procurement contracts (Hwang *et al.* 2013; Kaming *et al.* 1997)
5 Poor communication and coordination between parties	- Improve interdisciplinary coordination - Improve communication - Structured meetings - Improve collaboration - Committed and organized subcontractors	-Involve contractor earlier in planning process - Prepare project phase transition to construction phase - Facilitate internal informal learning through seminars and start-up meetings - Utilizing software coordinator between different parities	- Virtual modelling (Toor and Ogunlana 2008) - Efficient methods of information processing (Chan and Kumaraswamy 1997)
6 Slow quality inspection process of the completed work	- Improve quality engineering - Simplified monitoring and control system - Simplify external QA	- Setting incentives on major milestones - Use systematic methods for monitoring progress	
7 Design changes during construction/ change orders	- Fewer changes - More control of the engineering process - Better configuration management	- Clarify the user's real needs - Utilizing software coordinator between different parities	- Virtual modelling (Toor and Ogunlana 2008)

TABLE 03. Solutions to delay causes in Norwegian construction projects 1/2

7 Design changes during construction/ change orders	- Fewer changes - More control of the engineering process - Better configuration management	- Clarify the user's real needs - Utilizing software coordinator between different parities	- Virtual modelling (Toor and Ogunlana 2008)
8 Sponsor/owner/ client lack of commitment and/ or clear demands (goals and objectives)	- Clear goals and demands - Better owner/client representatives (marketing, accounts, and sale managers)	- Introducing fast and frequent meeting frequency during the planning phase	- Interfere less frequently during the execution (Sambasivan and Soon 2007)
9 Office issues	- Improve the office design - More IT engineers in office - Easy software tools for use		
10 Late/slow/ incomplete or improper design	- Better structured process	- Create a schedule for the submission of documents - Clarify expectations of content - Prepare internal quality assurance documents and prepare the receiver - Execute projects as turnkey contracts with proposition or interaction	- Virtual modelling (Toor and Ogunlana 2008) - Prepare and approve drawings on time (Sambasivan and Soon 2007)
11 User issues	- Intensive involvement of users in the type of project where users are key stakeholders (e.g., doctors and nurses as users for hospital)		

TABLE 03. Solutions to delay causes in Norwegian construction projects 2/2

thors, each of the parties involved in the project can handle their own causes, and all the parties can come together to face the factors coming from shared responsibilities or from the project context.

CONCLUSIONS AND RECOMMENDATIONS

From the survey and interviews conducted, the main reasons for time issues in major Norwegian projects were identified: (1) poor planning and scheduling; (2) slow/ poor decision-making process; (3) internal administrative procedures and bureaucracy within project organizations; (4) resources shortage (human resources, machinery, equipment); (5) poor communication and coordination between parties; (6) slow quality inspection process of the completed work; (7) design changes during construction/change orders; (8) sponsor/owner/client lack of commitment and/or clear demands (goals and objectives); (9) office issues; (10) late/slow/incomplete/improper design; (11) user issues. Comparing them to 105 other studies worldwide, there were seven issues that appeared in many studies as major delay factors (i.e., among the ten first within the same study), which are the issues numbered 1, 2, 4, 5, 6, 7, and 10. Factors 3 and 8, other than in this study, appeared only in the study carried out in Malaysia, while factors 9 and 11 are only in our study.

All the time issues/delay factors are followed by recommendations for how to deal with them, from the survey, the interviews, and what was found in the literature. We should mention that most of the studies focus only on the causes of delays and then the effects of delays; there are very rare studies looking at how to deal with the delays. Thus we encourage researchers to consider contributing to the remedies and solutions for the delays when they are identified. An advantage of the solutions identified in our study is that they are more proactive than reactive: for example, for slow/poor decision-making process, the inputs from the survey and the interviews proposed proactive solutions like improving the decision-making process, business strategy training, and anchoring major decisions in advance of engineering, instead of just recommending speeding up decisions, which is a more reactive solution.

As an important contribution, we also studied the empirical qualitative relationships between the time issues and their solutions. We believe that the results of this study can be of immense help to practitioners (clients, contractors, and consultants) and academicians in particular. Practitioners can better understand the dynamics of project management and make efforts to reduce the incidences of delays; academicians can conduct similar studies in other parts of the world and identify causes and remedies for delays. The practitioners can better understand the dynamics of managing projects and make efforts to reduce the incidences of delays, and consider the remedies suggested in this study, since they are more proactive and protect projects from delay factors. It is important to mention that some causes may be unique to certain countries, including, in this study, the delay factors of internal administrative procedures and bureaucracy within project organizations, office issues, and user issues.

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