The top ten universal delay factors in construction projects

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Abstract Projects often face delays and unnecessary use of time due to various factors and reasons, and hence suffer from unfavourable consequences. This paper will identify the universal delay factors from an intensive literature review, supplemented by delay factors in major Norwegian construction projects based on empirical data. The study on which this paper is based includes literature review, qualitative methods with interviews and survey questionnaires. This paper address frequency, and type of delay factors in construction projects in Norway and worldwide. The ten most important universal delay factors are: (1) Design changes during construction/ Change orders; (2) Delays in contractor's payment; (3) Poor planning and scheduling; (4) Poor site management and supervision; (5) Incomplete or improper design; (6) Inadequate contractor experience /Building methods and approaches; (7) Contractor's financial difficulties; (8) Sponsor/ Owner/ Client’s financial difficulties; (9) Resources shortage (Human resources, machinery, equipment); (10) Poor labour productivity and shortage of skills.

Keywords: Delay Factors, Construction Projects, Universal, Norway.

# Introduction

Construction industry is one of the major industries contributing significantly to the growth and economy of any country. Among the substantial problems in the construction industry is time overruns. Construction delays play a key role in project success. There are many factors contributing for delays in construction projects. Delays occur in most construction projects and the magnitude of these delays varies considerably from project to another. It is essential to define the actual causes of delay in order to minimise, mitigate and avoid delay in any construction project. The delay factors are very crucial within a construction project and it is vital that all organisations must have certain knowledge regarding this issue in order for the project to be completed effectively and satisfactorily (Wong and Vimonsatit, 2012).

Delay in construction industry is a “universal” phenomenon and it has become a typical part of the project’s construction lifetime (Sambasivan and Soon, 2007; Sweis et al., 2008). Assaf and Al-Hejji (2006) defined it as “the time overrun either beyond completion date specified in a contract, or beyond the date that the parties agreed upon for delivery of a project”. Trauner et al. (2009) define delay in construction projects 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”.

Most of the construction projects are frequently behind schedule due to various reasons. Unfortunately, nowadays with all the advanced technologies, and the good understanding of project management and engineering techniques, have not solved the problem of delays (Sweis et al., 2008; Yang et al., 2013). A study done by Sweis (2013) shows that 81.5% of the construction projects has experienced delay in Jordan during period 1990-1997. According to Assaf and Al-Hejjei (2006), 76% of the contractors indicated that average of time overrun is between 10% and 30% of original duration, while about 56% of the consultants specified the same percentage. In addition, a study from Faridi and El-Sayegh (2006) revealed that 50% of the construction projects in UAE encounter delays and they were not completed on time. Similar researches investigated the delay factors and their effects in the literature from a total of 46 countries worldwide.

Over the last forty years, significant attention has been paid to identify possible causes of delays (Yang et al., 2013). To identify delay causes, some authors (e.g. Doloi et al., 2012b; Kazaz et al., 2012; Sambasivan and Soon, 2007; Assaf and Al-Hejji, 2006; Faridi and El-Sayegh, 2006; Chan and Kumaraswamy, 1997; Chan and Kumaraswamy, 1995) have used semi-quantitative methods like surveys and questionnaires. Whilst others like Asnaashari et al. (2009) have employed purely qualitative methods like interviews to identify causes. A review of project literature shows that causes of delays differs among countries. Different situations such as environment, working cultures, management style, methods of construction, geographical condition, stakeholders, the government policy, economic situation, availability of resources, political situation as well as different perspectives of researchers (Yang et al., 2013; Khoshgoftar et al., 2010; Asnaashari et al., 2009). Differences between countries may also cause different frequency and significance of causes (Abbasnejad and Izadi Moud, 2013; Asnaashari et al., 2009).

This paper aims to highlight the theory on the delay factors in construction projects in general; where among of all, we included the delay factors in the Norwegian construction projects based on empirical study. A comparison between delay factors from our findings compared to the theory.

Therefore, the research questions covered in this paper are:

1. What are the ten major delay factors based on each research study listed in the literature for the construction industry?
2. What are the top ten universal delay factors based on the existing studies done in 46 countries worldwide?
3. What are the delay factors in major Norwegian projects based on our empirical study; and compare the findings with the previous studies?

This study represents compilation of the multiple studies done in different countries worldwide about the delay causes/ factors. Few have been done in Europe, thus we hope this tiny work will also contribute to a better understanding of time and flow problems in projects, since we contributed also by an empirical study regarding delay factors in Norway..

# Literature review

According to Al-Khalil and Al-Ghafly (1999) delays can undesirably effect on project stakeholders. To the client, delay perceives loss of revenue due to lack of rentable space or lack of production facilities. On the other hand, delay can be meant to the contractor as higher overhead costs, higher material and labour costs because the project takes longer than it was planned. The possibility to deliver projects on time can be marked as an indicator of efficiency, but the construction activities involves of many unpredictable factors and variables arisen from various sources (Assaf and Al-Hejji, 2006). These resources may include environmental circumstances, availability of resources, stakeholders’ performance and contractual relations. Nevertheless, Trauner et al. (2009) states that it is hardly ever occur that a construction project is finished within the planned time.

Projects running behind schedule may serve as an indicator of poor productivity and bad project performance (Ramanathan et al., 2012). Any delay in a project may lead to cost and time overruns and these two are often related (Sambasivan and Soon, 2007). Delays can also cause increased cost, loss of competitive advantage and market share. Additional costs may be incurred through disputes and claims between involved parties (Odeh and Battaineh, 2002). When projects are delayed, they are either extended or accelerated and therefore, incur additional cost. Its common practice to keep a percentage of the estimated project cost as a contingency allowance in the contract price (Ramanathan et al., 2012). For the project owner; delays may lead to loss of revenue through lack of production facilities, rentable space or shortcomings with present facilities. For the contractor; delays may result in cost overruns due to longer period of project work, penalties incurred, higher material and labour costs (Assaf and Al-Hejjei, 2006; Khoshgoftar et al., 2010).

Many studies have been carried out worldwide to determine the delay factors in construction projects. Sambasivan and Soon (2007) have identified the ten most important causes of delay in Malaysia through a questionnaire survey. The questionnaire survey was carried out with clients, consultants and contractors. Based on their survey results, the most important delay factors were: contractor’s improper planning, contractor’s poor site management, inadequate contractor experience, inadequate client’s finance and payments for completed work, problems with subcontractors, material shortage, labour supply, equipment availability and failure, lack of communication between parties, and mistakes during the construction stage. A similar study in Malaysia was carried out by Alaghbari et al. (2007) with a list of 31 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. However, Al-Momani (2000) in a research on construction delays in 130 public projects in Jordan found that weather, site conditions, late deliveries, economic conditions and increase in quantity are the critical factors which cause construction delays in Jordan construction industry. Chan and Kumaraswamy (2002) conducted a survey in Hong Kong to determine and evaluate the relative importance of the significant factors affecting the construction delays. They analysed and ranked the main factors affecting the construction time, and classified them into two groups: the role of the parties in the local construction industry and the type of projects. Based on their survey results, they indicated that the five major causes of delays were: poor site management and supervision, unforeseen ground conditions, low speed of decision making involving all project teams, client initiated variations and necessary variations of works. Fugar and Agyakwah-Baah (2010) also studied the causes of delays in building construction projects in Ghana. They identified 32 possible causes of delay and further categorised into nine major groups. The list of the causes of delay was conducted into a questionnaire survey, which included 130 respondents who participate in the survey. Based on their analysis, they concluded that the delay in honouring certificates, underestimation of the costs of projects, underestimation of the complexity of projects, difficulty in accessing bank credit, poor supervision, underestimation of time for completion of projects by contractors, material shortage, poor professional management, fluctuation of prices/rising cost of materials and poor site management were found to be the top ten most important factors affecting the construction time. The study of El-Razek et al. (2008) was carried out to determine the causes of delay in building construction projects in Egypt. A questionnaire survey was carried out to confirm the causes and identify the most important delay factors. Based on the survey results, the top five delay causes were: financing by contractor during construction, delays in contractor’s payment by owner, design changes by owner or his agent during construction, partial payments during construction and non-utilization of professional construction management. Sweis et al. (2008) in a similar study carried out in Egypt, also concluded that financial difficulties faced by the contractor and too many change orders by the owner are the leading causes of construction delay. Both research outcomes showed that financial difficulties were important factors causing delays in Egypt. Tumi et al. (2009) studied the delays in construction project in Libya. They concluded that the main causes of delay in construction projects were improper planning, followed by lack of effective communication, material shortage, design errors and financial problem. Alwi and Hampson (2003) had a similar study on the causes of delays in building construction projects in Indonesia. A questionnaire survey was carried out targeting only the contractors. The respondents were asked to assess the effects of the 31 potential delay factors on their projects. The delay factors were grouped into six major groups. The results showed that the top five most important delay causes were: slow decision making, which was ranked the highest, followed by design changes, poor distribution of labour, inappropriate construction methods, and poor coordination among project participants. Kaming et al. (1997) carried out a research to study the impact factors on 31 high-rise projects in Indonesia and it was found that time overrun is less severe than cost overruns. The significant factors that lead to cost overrun are material fluctuation, inaccurate material estimation and degree of complexity. Whereas, design changes, poor labor productivity, inadequate planning, and resource shortages are marked as time overruns. Mezher and Tawil (1998) carried out a research in to find out the Causes of delays in the construction industry in Lebanon. A total of 64 causes of delays were identified through research in which client, contractor and consultant were undertaken the study. All three parties generally agreed on the ranking of the major categories of delay factors. Owners had more concerns with regard to financial issues, while contractors ranked contractual relationships highest, and finally, consultants firms ranked project management highest. These causes were categorized in 10 main groups: materials, manpower, equipment, financing, changes, government relations, project management, site conditions, environment and contractual relationships. Le-Hoai et al. (2008) conducted a study to find out the cause of delays and cost overrun in Vietnam and 7 critical factors were identified such as, Slowness and Lack of constraint; Incompetence; Design; Market and Estimate; Financial capability; Government; and Worker. Assaf and Al-Hejji (2006) studied the causes of delay in large building construction projects in Saudi Arabia. They found 73 factors that cause construction delays. They categorized these factors into 9 groups. Some of the most important causes of delay included approval of shop drawings, delays in contractors' payment by owners, design changes by owners, cash problems during construction, the slowness of the owners' decision-making process, design errors, excessive bureaucracy in project-owner organization, labour shortages and inadequate labour skills. Assaf et al. (1995) identified 56 main causes of delay in Saudi large building construction projects and their relative importance. Based on the contractors surveyed the most important delay factors were: preparation and approval of shop drawings, delays in contractor’s progress, payment by owners and design changes. Koushki et al. (2005) carried out a research in Kuwait and identified estimates of time delays and cost increases and their causes. The three main causes of delays are changing orders, owners’ financial constraints, and owners’ lack of experience. And three first causes of cost overruns are contractor- related problems, material-related problems and owners’ financial constraints.

As such, delays is an inherent risk in most project work and should be addressed in a similar fashion to other risks. Generally, risks can be managed, shared, minimized, or accepted, but overall must not be ignored (Asnaashari et al., 2009). More specifically, the risk of delays can be minimized only when the causes are recognized and required actions to prevent delays are implemented (Yang et al., 2013, Pourrostam and Ismail, 2011).

# Methodology

For writing this paper an intensive literature review was conducted based on more than 500 different sources in the first iteration. A wide variety of books, journal articles and professional reports was considered. Most of the journal articles are found through resources given by the university database like SCOPUS [(Elsevier)](http://uniport.hosted.exlibrisgroup.com/V/EI77M39L8E2QTU1RXMFIET93BJKLECA9TAJPH94YP34CJJGPEC-07850?func=native-link&resource=UNI10157) and Web of Science (ISI). High quality journals such as International Journal of Project Management (IJPM), Journal of Construction Management Economics (JCME), Engineering Construction and Architectural Management Journal (ECAMJ), Harvard Business Review (HBR), and Lean Management Journal were used for writing this paper. We extended our search to the reference lists provided in the previous search results (reference lists of the relevant articles). We extended the search using google scholar. All countries worldwide were considered in this study, without any exception.

Once we selected the most relevant sources (Mostly journals articles, where their number exceeds the 150 articles); we proceed in extracting the top ten delay factors based on each study, the results were classified in table based on the country as first criterion and the authors as second criterion (Ramanathan et al., 2012 did similar review, but limited to 16 research articles). We excluded studies with weak research methods, low number of respondents and participants, small samples, or very small size projects. Also we excluded the studies where there were no ranking of the delay factors, or the studies where they identified less than ten delay factors (e.g. Chan and Kumaraswamy, 2002). While extracting the delay factor in each study, we avoided repetitions in listing the factors (e.g. “poor subcontractor performance”, “late presence of subcontractor on site”, etc. all these factors will be in the category “problem related to subcontractors”). Or we used similar factors when it may reflect the same meaning between a study to another (e.g. “Complex project seen from contactor perspective”, “unexperienced contractor”, “poor building methods” etc. these will be in category Inadequate contractor experience /Building methods and approaches). The result of this intensive literature study is top ten delay factors for 45 countries worldwide, where Norway is the 46th in the list. The number of sources and research studies used in the sum-up table 1 is 104 research articles, the 105th article is this study (there are 103 rows in the table because we grouped Doloi et al. (2012a) with Doloi et al. (2012b); and Ahmed et al. (2003a) with Ahmed et al. (2003b) since they presented the same results). The number of delay factors appeared by repetition is 33 delay factors. To identify the “Top ten universal delay factors”, we considered the frequency of the 33 repeated delay factors in the 105 studies , then based on the original ranking we calculated the new universal ranking. The results are presented in table 2.

The calculation of the overall ranking index for the 33 delay factors in table 1 is based on this equation:

Where *ORI* is the overall ranking index; the number *F* is the number of rows (the total number of studies, which is equal to 103 based on 104 articles and this study); the number *i* is the actual ranking (from 1 to 10 since all the rankings are about the top ten); *Ni* represents the frequency of each rank in one column (e.g. column one for the delay factor “Sponsor/ Owner/ Client’s financial difficulties” and for the value of the rank *i*=1, we will have *N1*=10. Column eight for the delay factor “Design changes during construction / Change orders” and for the value of the rank *i*=7, we will have *N7*=12. Etc.). The overall ranking is based on the value of *ORI*, the higher *ORI*, the better ranking of the delay factor. The final results are in table 2.

This study builds on the past studies when it comes to identify the universal delay factors by investigating the most important delay factors identified by other researchers worldwide. However, the identification of delay factors in Norwegian projects is based on semi-quantitative methods with a combination of semi-qualitative questionnaire survey. Besides that, this work also examines the delay factors influencing the construction period for Norwegian construction industry by conducting a qualitative questionnaire survey to seek professional opinions from the respondents in Norway.

Surveys will involve selecting a representative and unbiased sample of subjects drawn from the group we wish to study. The main methods of asking questions face-to-face or by telephone, or send a questioners by e-mail/web. The researcher will typically use some kind of multiple choice, semi structured questionnaires or more open-ended questions where the respondent can state their own opinion (Kvale et al., 2009; Marshall & Rossman, 1995). There are two main types of survey descriptive and analytical survey (Kvale et al., 2009; Marshall & Rossman, 1995). The descriptive surveys are concerned with identifying and counting the frequency of a particular response among the survey group and the analytical are concerned with analysing the relationship between different elements (variables) in a sample group.

Questionnaire survey was designed to draw on the work experiences of engineers in the construction industry in Norway. This survey was developed to assess the perceptions of clients, consultants and contractors on the relative delay factors in the industry. The data collected through questionnaire surveys were analysed and ranked based on their frequency, followed by discussions and suggestions to mitigate the delays, which were presented in this paper. This survey presents a total of 43 delay factors clustered into 11 major delay factors (Table 2).

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 singular most important delay factor and potential mitigation solutions.

We received completed questionnaires from 202 respondents out of 300 potential participants. This gives a return rate of approximately 67%. Most of the respondents (53%) have more than 10 years of working experience; and 25% have 5 to 9 years of working experience. Most of the respondents are project managers (54%) and team members (40%). 60% of the respondents are from public organisations; and 40% from private companies.

We need to mention that 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 important part in answering the survey; by touching all the layers in the project roles, we will have all the different perspectives of 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. The 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.

After an analysis of the data collected, the authors grouped common identified delay factors into eleven groups, each group had sub-groups with the same interpretation (e.g. Poor planning and scheduling which is the sum up of the five subgroups: Last minute tasks; Unclear demands from project manager; Poor project planning; Lack or no delegation; and Poor project management performance). Similar approach was used on remedies that was suggest from the 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.

Two approaches have been used in order to validate the findings; member checking and triangulating. To determine the accuracy, major findings has been presented to the participants and they have been given the opportunity to comment the findings and determine whether they feel that they were accurate or not. Case study was conducted concurrently with the literature study. The case studies consisted of seven construction projects with the same conditions, but different size. A review of project documentation and an interview session was conducted to examine the factors affecting schedule performance in the seven projects.

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 delay factors 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, the findings are consistent with similar studies assessing the delay causes of construction project.

Our respondents were obtained from participants in a research project focused on reducing time spent in projects – this might carry an obvious bias. However, the majority of the respondents have not personally directly been involved with the research project (which is primarily attached with PMO-like entities in each organization).

Similarly, there is an ever-present possibility of researcher bias in the analysis. As project professionals focused on time- and risk-management, our interpretation and induction steps will naturally be influenced by our academic and professional backgrounds.

Knowing the fact that analysing a large population of respondents that have been asked open questions can be challenging due to the vague findings it might lead to.

# Analysis and Discussion

Based on the conducted intensive literature review, the top ten rankings of construction delay factors in various countries and based on different studies are summarised in table 1. The reason why there are 33 delay factors in table 1 is because after extracting the top ten delay factors in each study, their overall overlapping gave those 33 delay factors. On the other hand, this does not mean that those 33 factors are major in each country. Ramanathan et al. (2012) proposes that there is no universal root cause. On the other hand, reviewing the body of literature factors causing delays in construction projects are mostly identical across developing countries, but with different rankings in terms of importance (Toor and Ogunlana, 2008). Analysis from Akogbe et al. (2013) shows that factors such as the country income and the growth of GDP have a great impact on project delay, comparisons between developing countries and developed countries show that financial difficulties is the common factor of delay. Other causes of delay are very similar for developing countries and related to lack of technology, management, skills and competencies of project participants (Akogbe et al., 2013).

Our review of the literature shows that causes of delays differ from country to another. The causes of delays may differ because of the different situations such as environment, working cultures, management style, methods of construction, geographical condition, stakeholders, government policy, economic situation, availability of resources, political situation as well as different perspectives of researchers can impact on projects and cause delays (Yang et al., 2013; Khoshgoftar et al., 2010; Asnaashari et al., 2009). Even within the same country the causes of delays may differs from a study to another. The extreme where it varies within studies done by the similar authors (e.g. from table 1: Haseeb et al. (2011a) and Haseeb et al. (2011a)).

There are many other studies, which are not mentioned in table 1, because of the reasons listed in the methodology chapter. Some authors have studied for example the magnitude of construction project delays and their relation with the organisational culture (Arditi et al., 2017). Aibinu and Jagboro (2002) had made empirical study about the effects of construction delays on project delivery in 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). 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. The study by Gould (2012) was more about the responsibility of contractor for delay, as well as the study done by Keane and Caletka (2015). Sepasgozar et al. (2015) investigated the major delay causes in Iranian construction projects and they come up with the top nine list which is: (1) contractor organization attributes, (2) labour shortness, (3) external factors, (4) material deficiency, (5) design issues, (6) owner attributes, (7) technology restriction, (8) consultant attributes and (9) project attributes. Comparing to the many other studies, some of their factors are more broader in description (e.g. contractor organization attributes, this may mean poor planning, site management etc. and in many other studies these factors were not grouped under the contractor attributes as a single set; the same for owner attributes).

Table 1

Major delay factors classified by countries/ then by authors

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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| Country | Authors | Delay Factors | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1 - Sponsor/ Owner/ Client’s financial difficulties | 2 - Interference from Sponsor/ Owner / Client | 3 - Site handover/ Site change/Site location | 4 - Optimism (Unrealistic) estimation of project duration and cost | 5 – Slow/ poor decision-making process | 6 - Delays in contractor's payment | 7 - Late/slow delivery of materials | 8 - Design changes during construction / Change orders | 9 – Late/ Slow/ or Incomplete or improper design | 10 - Slow Quality Inspection process of the completed work | 11 - Poor contract management/ or bidding process | 12 - Slow progress/ underestimating of deadlines/ many projects | 13 - Inadequate contractor experience /Building methods and approaches | 14- Contractor's financial difficulties | 15 - Poor communication and coordination between parties | 16 - Poor planning and scheduling | 17 - Poor site management and supervision | 18 - Poor labour productivity and shortage of skills | 19 - Equipment failure/ Equipment less productive based on estimations | 20 - Problems related to subcontractors | 21 - Shortage of materials | 22 - Resources shortage (Human resources, machinery, and equipment) | 23 - Unforeseen geological conditions | 24 - Weather condition | 25 - Difficulties in obtaining permits and excessive bureaucracy | 26 - Economic problems (e.g., inflation, fluctuation) | 27 - External stakeholders | 28 - Corruption/ Fraudulent practices | 29 - Security and/ or instable political situation | 30 - Major Forces/ Acts of God | 31 - Internal administrative procedures and bureaucracy within project organisations | 32 - Office issues (e.g. IT troubles, noise and disruption, many useless trips, etc.) | 33 - Sponsor/ Owner/ Client lack of commitment, clear demands (Goals and objectives) |
| Afghanistan | Gidado and Niazai (2012) |  |  |  |  |  | ➍ |  |  |  |  | ➐ |  | ➒ | ➑ |  | ➏ | ➎ | ➌ |  | ➓ |  |  |  |  |  |  |  | ➋ | ➊ |  |  |  |  |
| Australia | Wong and Vimonsatit (2012) |  |  |  | ➍ | ➒ |  |  |  | ➓ |  |  | ➑ |  | ➋ | ➐ |  | ➏ | ➊ |  |  |  | ➌ | ➎ |  |  |  |  |  |  |  |  |  |  |
| Bangladesh | Rahman et al. (2014) |  |  |  |  |  | ➏ | ➒ |  |  |  |  |  | ➑ | ➐ |  |  | ➍ | ➌ |  | ➎ |  | ➓ |  |  |  | ➊ |  |  | ➋ |  |  |  |  |
| Benin | Akogbe et al. (2013) | ➊ |  |  |  |  |  |  | ➎ | ➒ | ➐ |  |  |  | ➋ |  | ➏ |  | ➓ |  | ➌ | ➍ | ➑ |  |  |  |  |  |  |  |  |  |  |  |
| Botswana | Adeyemi and Masalila (2016) |  |  |  |  |  | ➍ |  | ➓ |  |  |  |  | ➌ |  | ➒ | ➊ | ➋ | ➐ |  | ➎ | ➏ | ➑ |  |  |  |  |  |  |  |  |  |  |  |
| Burkina Faso | Bagaya and Song (2016) | ➋ |  |  |  |  | ➍ |  |  |  |  |  |  | ➑ | ➊ |  | ➏ | ➓ |  |  | ➎ |  | ➌ | ➒ | ➐ |  |  |  |  |  |  |  |  |  |
| Cambodia | Durdyev et al. (2017) |  |  |  |  |  |  | ➌ | ➑ |  |  |  |  | ➎ |  |  | ➋ | ➓ | ➍ |  | ➒ | ➊ | ➏ |  | ➐ |  |  |  |  |  |  |  |  |  |
| Santoso and Soeng (2016) |  |  |  |  |  | ➒ |  |  |  |  | ➍ |  | ➑ |  |  |  | ➏ | ➓ |  |  |  | ➎ | ➐ | ➊ |  |  | ➌ |  |  | ➋ |  |  |  |
| Egypt | Aziz and Abdel-Hakam (2016) | ➊ |  |  |  |  |  |  | ➒ | ➏ |  |  |  | ➌ |  |  |  | ➓ |  | ➎ | ➑ | ➍ | ➋ | ➐ |  |  |  |  |  |  |  |  |  |  |
| Marzouk and El-Rasas (2014) | ➑ |  |  |  | ➓ | ➎ |  | ➌ |  | ➍ | ➊ |  |  |  |  | ➋ | ➏ | ➐ |  |  |  |  | ➒ |  |  |  |  |  |  |  |  |  |  |
| Ezeldin and Abdel-Ghany (2013) |  |  |  |  | ➊ | ➓ | ➏ |  |  |  |  |  |  |  | ➋ | ➒ |  | ➌ |  |  |  | ➎ | ➐ |  | ➑ | ➍ |  |  |  |  |  |  |  |
| Aziz (2013) |  |  |  |  |  | ➊ |  | ➐ |  |  |  |  | ➑ |  |  | ➎ | ➏ | ➒ | ➍ |  |  | ➌ |  |  |  | ➓ |  | ➋ |  |  |  |  |  |
| Abd El-Razek et al. (2008) | ➍ |  |  |  | ➑ | ➋ | ➏ | ➌ | ➓ |  | ➎ |  |  | ➊ | ➐ | ➒ |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Ethiopia | Zewdu (2016) |  |  |  | ➑ |  | ➒ | ➎ |  | ➊ |  |  |  |  |  | ➓ | ➌ | ➋ |  |  |  | ➐ | ➏ |  | ➍ |  |  |  |  |  |  |  |  |  |
| Ghana | Amoatey et al. (2015) | ➌ |  |  |  |  | ➊ |  | ➍ | ➐ |  |  |  | ➒ | ➎ | ➑ |  |  |  |  |  |  |  |  |  | ➏ | ➋ |  |  | ➓ |  |  |  |  |
| Fugar and Agyakwah-Baah (2010) |  |  |  | ➋ |  | ➊ |  |  |  |  |  | ➌ | ➑ |  | ➎ | ➏ | ➓ |  |  |  | ➐ |  |  |  |  | ➒ | ➍ |  |  |  |  |  |  |
| Frimpong et al. (2003) | ➏ |  |  | ➒ |  | ➊ | ➓ |  |  |  | ➋ |  |  | ➎ |  | ➐ |  |  |  |  | ➌ |  |  | ➑ |  | ➍ |  |  |  |  |  |  |  |
| Frimpong and Oluyowe (2003) | ➊ |  |  |  |  |  |  |  |  |  | ➎ |  |  | ➋ |  | ➏ |  |  |  |  |  | ➐ |  | ➍ |  | ➌ | ➒ | ➓ |  |  |  |  |  |
| Hong Kong | Lo et al. (2006) |  |  |  | ➐ |  |  |  | ➓ |  |  | ➌ |  | ➍ | ➊ | ➎ |  | ➏ |  |  |  |  |  | ➋ | ➑ | ➒ |  |  |  |  |  |  |  |  |
| India | Doloi et al. (2012a); Doloi et al. (2012b) |  |  |  | ➑ | ➏ |  | ➊ | ➍ | ➋ |  |  |  | ➓ | ➌ |  |  | ➐ | ➒ |  |  |  |  |  |  | ➎ |  |  |  |  |  |  |  |  |
| Indonesia | Alwi and Hampson (2003) |  |  |  |  | ➊ |  | ➐ | ➋ | ➓ | ➑ |  |  | ➍ |  | ➎ | ➏ |  | ➌ |  |  | ➒ |  |  |  |  |  |  |  |  |  |  |  |  |
| Kaming et al. (1997) |  |  |  | ➋ |  |  |  | ➒ |  |  |  | ➏ |  |  |  | ➐ |  | ➑ | ➌ |  | ➍ | ➎ |  | ➊ |  |  | ➓ |  |  |  |  |  |  |
| Iran | Saeb et al. (2016) |  |  |  |  |  | ➋ |  | ➐ |  |  | ➎ | ➓ | ➌ |  |  | ➍ |  | ➑ | ➏ | ➒ |  |  |  |  |  | ➊ |  |  |  |  |  |  |  |
| Abbasnejad and Izadi Moud (2013) | ➊ |  |  | ➓ |  | ➋ |  |  | ➍ | ➎ |  |  | ➐ |  | ➌ | ➏ |  | ➑ |  |  |  | ➒ |  |  |  |  |  |  |  |  |  |  |  |
| Fallahnejad (2013) |  |  |  | ➋ |  | ➐ | ➌ | ➎ |  |  | ➏ |  |  | ➊ |  | ➓ |  |  |  | ➒ |  |  |  |  | ➑ |  | ➍ |  |  |  |  |  |  |
| Pourrostam and Ismail (2012) |  |  |  |  | ➍ | ➊ |  | ➋ | ➒ | ➏ |  |  |  | ➎ |  | ➑ | ➌ |  |  | ➐ |  |  |  | ➓ |  |  |  |  |  |  |  |  |  |
| Pourrostam and Ismail (2011) |  |  |  |  | ➏ | ➋ |  | ➌ | ➐ | ➑ | ➒ |  |  | ➎ |  | ➍ | ➊ |  |  | ➓ |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Khoshgoftar et al. (2010) |  |  |  |  |  | ➊ |  | ➓ |  |  | ➍ |  | ➒ |  | ➎ | ➋ | ➌ |  | ➐ | ➏ | ➑ |  |  |  |  |  |  |  |  |  |  |  |  |
| Iraq | Bekr (2015) |  |  |  | ➒ |  | ➑ |  | ➎ | ➏ |  | ➍ |  | ➌ |  |  |  |  |  |  |  |  |  |  |  | ➋ | ➓ | ➐ |  | ➊ |  |  |  |  |
| Jordan | Sweis (2013) |  |  |  |  | ➏ | ➐ |  | ➎ | ➑ |  | ➌ |  | ➒ |  |  | ➍ |  | ➊ |  |  |  | ➋ |  | ➓ |  |  |  |  |  |  |  |  |  |
| Sweis et al. (2008) |  |  |  |  | ➐ |  |  | ➌ |  |  | ➒ |  | ➎ | ➋ | ➏ | ➊ | ➓ | ➑ |  |  |  | ➍ |  |  |  |  |  |  |  |  |  |  |  |
| Odeh and  Battaineh (2002) |  | ➌ |  | ➎ |  | ➋ |  |  |  |  |  |  | ➊ |  |  | ➒ | ➏ | ➍ | ➑ | ➐ | ➓ |  |  |  |  |  |  |  |  |  |  |  |  |
| Al-Momani (2000) |  |  | ➐ | ➋ |  |  | ➎ | ➒ | ➓ |  |  |  | ➊ |  |  |  |  |  | ➌ |  |  |  | ➏ | ➑ |  | ➍ |  |  |  |  |  |  |  |
| Kenya | Seboru (2015) |  |  |  |  | ➋ | ➊ | ➓ | ➐ |  |  | ➌ |  | ➍ |  |  |  |  |  | ➒ |  |  | ➑ | ➎ | ➏ |  |  |  |  |  |  |  |  |  |
| Kuwait | Koushki et al. (2005) | ➋ |  |  | ➍ |  |  |  | ➊ | ➎ |  |  |  | ➒ | ➌ |  |  | ➓ | ➑ |  |  | ➏ |  |  | ➐ |  |  |  |  |  |  |  |  |  |
| Lebanon | Mezher and Tawil (1998) | ➌ |  |  |  |  |  |  | ➍ |  |  | ➋ |  |  |  |  | ➊ |  |  | ➏ |  | ➐ | ➎ | ➒ | ➓ | ➑ |  |  |  |  |  |  |  |  |
| Libya | Shebob et al. (2011) |  |  |  |  | ➎ |  | ➋ | ➌ | ➒ | ➑ |  |  |  |  |  | ➐ | ➏ | ➊ |  |  | ➓ | ➍ |  |  |  |  |  |  |  |  |  |  |  |
| Tumi et al. (2009) | ➏ |  |  |  | ➎ | ➐ |  | ➑ | ➌ |  |  |  |  |  | ➋ | ➊ | ➒ |  |  |  | ➍ |  |  |  | ➓ |  |  |  |  |  |  |  |  |
| Malawi | Kamanga and Steyn (2013) | ➋ |  |  |  |  | ➑ | ➎ |  |  |  |  |  |  | ➍ |  |  | ➓ | ➒ | ➐ |  | ➊ | ➏ |  |  |  | ➌ |  |  |  |  |  |  |  |
| Malaysia | Mydin et al. (2014) |  |  |  |  |  |  |  |  | ➍ | ➑ | ➐ |  | ➓ | ➏ | ➒ |  | ➌ | ➎ |  |  |  |  | ➋ | ➊ |  |  |  |  |  |  |  |  |  |
| Tawil et al. (2013) | ➊ |  |  |  |  | ➋ |  | ➏ |  | ➌ | ➍ |  |  |  |  |  | ➒ |  |  |  | ➎ | ➓ |  | ➐ |  | ➑ |  |  |  |  |  |  |  |
| Alaghbari et al (2007) | ➋ |  |  |  | ➍ |  | ➑ |  | ➓ | ➌ |  | ➎ | ➒ |  |  |  | ➐ |  |  |  | ➏ |  |  |  |  | ➊ |  |  |  |  |  |  |  |
| Sambasivan and Soon (2007) |  |  |  |  |  | ➍ |  | ➓ |  |  |  |  | ➌ |  | ➒ | ➊ | ➋ |  | ➑ | ➎ | ➏ | ➐ |  |  |  |  |  |  |  |  |  |  |  |
| Abdul-Rahman et al. (2006) |  |  |  |  |  |  |  | ➊ | ➌ | ➐ |  |  |  |  |  | ➑ | ➒ |  | ➏ |  | ➎ | ➍ |  |  |  |  |  |  |  |  | ➓ |  | ➋ |
| Nigeria | Akinsiku and Akinsulire (2012) | ➊ | ➓ |  |  |  | ➍ | ➑ | ➌ | ➐ |  | ➒ |  |  | ➋ |  |  |  |  |  |  |  | ➎ |  |  |  | ➏ |  |  |  |  |  |  |  |
| Aibinu and Odeyinka (2006) | ➋ |  |  |  |  |  | ➎ | ➏ | ➌ | ➑ |  | ➍ |  | ➊ |  |  |  |  | ➒ |  |  |  |  | ➓ |  | ➐ |  |  |  |  |  |  |  |
| Omoregie and Radford (2006) |  |  | ➍ | ➏ |  | ➋ |  | ➐ |  |  | ➌ |  |  |  |  |  |  |  |  | ➑ | ➎ |  |  | ➒ |  | ➊ |  | ➓ |  |  |  |  |  |
| Odeyinka and Yusif (1997) |  |  |  |  |  |  |  | ➑ | ➏ | ➒ |  |  | ➐ |  | ➌ |  | ➍ | ➊ |  |  |  |  |  | ➋ |  |  |  |  | ➎ | ➓ |  |  |  |
| Mansfield et al. (1994) |  |  | ➌ | ➑ |  | ➋ | ➎ | ➍ | ➓ | ➒ | ➊ |  |  |  |  |  |  |  |  | ➏ |  |  |  |  |  | ➐ |  |  |  |  |  |  |  |
| Dlakwa, and Culpin (1990) | ➌ |  |  | ➑ |  |  |  | ➎ | ➐ |  |  |  |  | ➋ |  | ➍ |  |  | ➒ |  | ➏ |  |  |  |  | ➊ | ➓ |  |  |  |  |  |  |
| Okpala and Aniekwu (1988) |  |  |  |  |  | ➋ | ➑ | ➍ |  |  | ➌ |  | ➏ |  |  |  | ➎ |  |  | ➐ | ➊ |  | ➒ | ➓ |  |  |  |  |  |  |  |  |  |
| Oman | Ruqaishi and Bashir (2013) |  |  |  | ➓ | ➑ |  |  | ➐ |  |  | ➒ |  | ➌ |  | ➎ | ➍ | ➊ |  |  | ➋ | ➏ |  |  |  |  |  |  |  |  |  |  |  |  |
| Pakistan | Gardezi et al. (2014) | ➍ |  |  | ➒ |  | ➐ |  | ➌ | ➏ |  |  |  |  |  |  |  | ➎ |  |  |  |  |  |  |  | ➓ | ➑ |  | ➋ | ➊ |  |  |  |  |
| Rahsid et al. (2013) |  | ➋ |  |  | ➑ |  | ➊ | ➒ | ➎ |  |  |  | ➐ |  |  |  |  | ➓ |  |  | ➍ | ➌ |  | ➏ |  |  |  |  |  |  |  |  |  |
| Haseeb et al. (2011a) | ➊ |  |  | ➋ |  | ➍ |  |  |  | ➐ |  |  |  |  |  |  |  |  | ➑ |  | ➌ | ➏ | ➎ | ➒ |  |  |  |  |  | ➓ |  |  |  |
| Haseeb et al. (2011b) | ➊ |  |  |  | ➋ | ➒ |  |  | ➍ |  |  | ➑ |  |  |  | ➌ |  |  |  |  | ➐ | ➎ |  | ➓ |  |  | ➏ |  |  |  |  |  |  |
| Palestine | Mahamid (2013) | ➓ |  |  |  |  | ➌ |  |  |  |  | ➒ |  |  | ➎ | ➏ | ➐ | ➑ |  | ➍ |  |  |  |  |  |  |  | ➋ |  | ➊ |  |  |  |  |
| Mahamid et al. (2012) |  |  |  |  | ➎ | ➌ |  |  |  | ➐ | ➋ |  |  |  | ➑ |  | ➒ | ➏ | ➍ |  |  | ➓ |  |  |  |  |  |  | ➊ |  |  |  |  |
| Enshassi et al. (2009) |  |  |  |  |  | ➏ | ➎ |  | ➐ | ➑ | ➓ |  |  |  |  |  |  | ➒ |  |  | ➌ | ➍ |  |  |  |  | ➋ |  | ➊ |  |  |  |  |
| Portugal | Arantes et al. (2015) |  |  |  | ➌ |  | ➏ | ➓ | ➋ | ➊ |  | ➎ |  |  | ➍ | ➑ | ➐ |  |  |  |  |  |  |  |  | ➒ |  |  |  |  |  |  |  |  |
| Couto and Teixeria (2007) |  |  |  |  |  |  |  | ➐ | ➊ |  |  | ➑ | ➓ |  | ➒ | ➏ |  | ➍ |  |  |  | ➎ |  |  | ➋ |  |  |  |  |  |  |  |  |
| Qatar | Gündüz and AbuHassan (2016) |  |  |  |  | ➊ |  | ➏ | ➍ | ➒ |  |  |  | ➑ |  |  | ➓ | ➋ | ➐ |  |  | ➌ | ➎ |  |  |  |  |  |  |  |  |  |  |  |
| Emam et al. (2015) |  |  |  | ➑ | ➎ | ➓ |  | ➋ | ➏ | ➐ |  | ➍ |  |  |  | ➌ |  |  |  |  |  | ➒ |  |  | ➊ |  |  |  |  |  |  |  |  |
| Rwanda | Amandin and Kule (2016) | ➋ |  |  |  |  | ➊ |  | ➒ | ➓ |  |  |  |  | ➌ |  | ➑ | ➐ |  |  |  | ➎ | ➏ |  |  |  | ➍ |  |  |  |  |  |  |  |
| Saudi Arabia | Elawi et al. (2015) | ➋ |  |  |  | ➐ |  |  | ➏ |  | ➍ | ➑ |  | ➊ |  |  | ➌ | ➎ |  |  |  | ➒ |  |  |  | ➓ |  |  |  |  |  |  |  |  |
| Al-Kharashi and Skitmore (2009) | ➋ | ➒ |  |  | ➓ | ➊ |  | ➌ | ➏ | ➎ |  |  |  | ➍ | ➑ |  | ➐ |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Assaf and Al-Hejji (2006) |  | ➓ |  |  |  |  |  | ➒ |  |  | ➏ |  | ➍ |  |  | ➌ | ➐ | ➋ |  |  |  | ➊ | ➑ | ➎ |  |  |  |  |  |  |  |  |  |
| Al-Khalil and Al-Ghafly (1999) |  |  |  |  |  | ➓ |  |  |  |  | ➏ | ➌ | ➎ | ➒ | ➋ | ➐ | ➑ | ➍ |  |  |  | ➊ |  |  |  |  |  |  |  |  |  |  |  |
| Singapore | Hwang et al. (2013) | ➏ |  |  | ➒ | ➌ |  |  | ➎ |  |  |  |  | ➓ | ➑ |  | ➍ | ➊ | ➐ |  |  |  |  |  |  |  | ➋ |  |  |  |  |  |  |  |
| Ayudhya (2011) |  |  |  | ➓ |  | ➊ |  |  | ➐ | ➍ |  |  |  | ➌ | ➒ |  |  | ➑ |  |  |  |  |  | ➋ |  | ➏ |  |  |  | ➎ |  |  |  |
| South Africa | Oshungade and Kruger (2017) |  |  |  |  | ➌ |  |  | ➓ | ➐ | ➑ | ➊ |  |  |  | ➋ | ➏ |  | ➒ |  |  |  | ➎ |  |  |  |  |  |  | ➍ |  |  |  |  |
| Aiyetan et al. (2011) |  |  |  |  |  |  |  | ➒ | ➏ | ➑ |  |  |  |  |  | ➊ | ➋ | ➎ |  |  |  |  | ➍ | ➓ |  | ➌ |  |  | ➐ |  |  |  |  |
| Baloyi and Bekker (2011) |  |  |  |  | ➒ |  |  | ➎ | ➑ | ➐ |  |  |  |  | ➏ | ➋ |  | ➍ |  |  |  | ➊ |  |  |  | ➌ |  |  | ➓ |  |  |  |  |
| South Korea | Acharya et al. (2006) |  |  |  | ➍ |  |  |  | ➓ | ➎ |  |  |  |  | ➒ |  | ➐ |  |  |  | ➑ |  | ➏ | ➋ |  | ➌ |  | ➊ |  |  |  |  |  |  |
| Syria | Ahmed et al. (2014) |  |  |  | ➎ | ➓ | ➐ |  | ➊ |  |  | ➌ |  | ➑ |  |  | ➒ | ➏ |  |  |  | ➍ |  |  |  |  | ➋ |  |  |  |  |  |  |  |
| Taiwan | Yang et al. (2013) |  |  | ➋ | ➒ |  |  |  | ➊ |  | ➍ |  |  |  | ➓ |  |  | ➑ |  |  |  |  |  | ➎ | ➌ | ➐ |  | ➏ |  |  |  |  |  |  |
| Yang and Wei (2010) | ➑ |  |  | ➍ | ➎ |  |  | ➊ | ➌ | ➓ |  |  | ➐ | ➒ | ➋ | ➏ |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Yang et al. (2010) | ➌ |  | ➎ |  |  |  |  | ➐ | ➏ |  |  | ➓ |  | ➍ |  | ➒ |  |  |  |  |  |  |  |  | ➊ | ➑ | ➋ |  |  |  |  |  |  |
| Tanzania | Kikwasi (2013) | ➍ |  |  |  |  | ➋ | ➑ | ➊ |  |  | ➏ |  | ➓ |  | ➌ | ➐ | ➎ |  |  |  |  |  |  |  | ➒ |  |  |  |  |  |  |  |  |
| Thailand | Toor and Ogunlana (2010) |  |  |  | ➎ |  | ➒ |  | ➓ | ➊ |  | ➐ |  | ➋ | ➏ |  |  | ➑ | ➌ |  | ➍ |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Ogunlana et al. (1996) |  |  |  |  |  |  |  | ➑ | ➎ |  | ➍ | ➋ |  | ➒ |  | ➐ |  |  | ➏ |  | ➊ | ➌ | ➓ |  |  |  |  |  |  |  |  |  |  |
| Turkey | Gündüz et al. (2013a) |  |  |  |  |  | ➓ | ➎ | ➒ | ➍ | ➐ |  |  | ➊ |  |  | ➋ | ➌ | ➑ |  | ➏ |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Gündüz et al. (2013b) |  |  |  |  |  | ➓ | ➎ | ➒ | ➍ | ➐ |  |  | ➊ |  |  | ➋ | ➌ | ➑ |  | ➏ |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Kazaz et al. (2012) | ➋ | ➓ |  | ➏ |  | ➊ |  | ➎ |  |  | ➍ |  | ➑ | ➌ |  |  |  | ➐ |  |  |  | ➒ |  |  |  |  |  |  |  |  |  |  |  |
| Arditi et al. (1985) |  |  |  |  |  | ➋ |  | ➐ |  |  |  |  | ➍ | ➌ |  | ➒ | ➓ | ➏ |  |  | ➊ | ➑ |  |  | ➎ |  |  |  |  |  |  |  |  |
| UAE | Motaleb and Kishk (2013) | ➒ |  |  | ➑ | ➍ |  |  | ➊ |  | ➎ |  |  | ➓ |  | ➋ |  | ➏ |  |  |  |  | ➌ |  |  |  | ➐ |  |  |  |  |  |  |  |
| Ren et al. (2008) |  |  |  | ➊ |  | ➌ |  | ➐ | ➍ | ➎ | ➏ |  |  | ➑ | ➓ | ➋ | ➒ |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Faridi and El-Sayegh (2006) |  |  |  |  | ➌ | ➓ | ➐ |  | ➊ |  |  |  |  | ➒ |  | ➋ | ➎ | ➏ |  |  |  | ➍ |  |  | ➑ |  |  |  |  |  |  |  |  |
| Zaneldin (2006) |  |  |  | ➎ | ➌ | ➍ |  | ➊ |  | ➋ |  |  | ➐ | ➒ |  | ➑ |  | ➓ |  | ➏ |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Uganda | Muhwezi et al. (2014) |  |  |  |  |  | ➑ |  | ➐ | ➌ | ➊ |  |  | ➍ | ➋ |  |  | ➓ |  |  |  |  | ➒ | ➏ | ➎ |  |  |  |  |  |  |  |  |  |
| Alinaitwe et al. (2013) |  |  |  |  |  | ➎ |  | ➏ |  |  | ➓ |  |  |  | ➐ | ➑ | ➒ | ➍ | ➊ |  | ➋ | ➌ |  |  |  |  |  |  |  |  |  |  |  |
| UK | Elhag and Boussabaine (1999) |  |  |  | ➌ |  |  | ➒ | ➍ | ➊ | ➐ |  | ➏ | ➑ |  | ➎ | ➓ | ➋ |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Nkado (1995) |  |  | ➎ | ➊ |  |  |  |  | ➏ |  |  | ➍ | ➌ |  |  | ➋ | ➓ | ➑ |  | ➒ |  | ➐ |  |  |  |  |  |  |  |  |  |  |  |
| United States | Tafazzoli (2017) |  |  |  | ➏ | ➋ | ➒ |  | ➊ | ➌ | ➍ | ➎ |  |  |  | ➑ |  |  |  |  |  |  |  | ➓ |  | ➐ |  |  |  |  |  |  |  |  |
| Ahmed et al. (2003a); Ahmed et al. (2003b) |  |  |  | ➏ | ➐ |  |  | ➋ | ➌ | ➎ | ➍ | ➑ |  |  | ➒ |  |  |  |  |  |  |  |  |  | ➊ | ➓ |  |  |  |  |  |  |  |
| Vietnam | Kim et al. (2016) | ➊ |  |  |  |  |  | ➓ | ➌ |  | ➐ |  |  | ➍ |  | ➒ |  | ➋ | ➏ | ➑ | ➎ |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Luu et al. (2015) | ➎ |  |  |  |  |  |  |  | ➐ | ➋ | ➓ |  | ➍ | ➑ | ➊ | ➏ | ➌ |  |  |  |  | ➒ |  |  |  |  |  |  |  |  |  |  |  |
| Luu et al. (2009) | ➊ |  |  |  |  | ➏ |  | ➑ |  | ➎ | ➐ |  | ➋ | ➍ |  |  | ➒ |  |  |  | ➌ |  |  | ➓ |  |  |  |  |  |  |  |  |  |
| Le-Hoai et al. (2008) | ➌ |  |  | ➑ |  | ➐ |  | ➎ | ➓ |  |  |  |  | ➍ |  | ➋ | ➊ |  |  |  | ➒ |  | ➏ |  |  |  |  |  |  |  |  |  |  |
| Zambia | Muya et al. (2013) |  |  |  |  |  | ➍ |  | ➊ | ➌ | ➒ |  |  |  | ➋ |  | ➏ |  | ➎ |  | ➑ | ➓ |  |  | ➐ |  |  |  |  |  |  |  |  |  |
| Kaliba et al (2009) | ➋ |  |  |  |  | ➊ |  | ➐ |  |  | ➍ |  |  | ➌ |  |  | ➓ |  | ➒ |  | ➏ | ➑ |  |  |  | ➎ |  |  |  |  |  |  |  |
| Zimbabwe | Nyoni and Bonga (2017) | ➍ |  |  | ➒ |  | ➊ |  |  | ➌ | ➋ | ➑ |  |  | ➏ |  |  |  | ➐ | ➓ |  |  | ➎ |  |  |  |  |  |  |  |  |  |  |  |
| Norway | This study |  |  |  |  | ➋ |  |  | ➐ | ➒ | ➏ |  |  |  |  | ➎ | ➊ |  |  |  |  |  | ➍ |  |  |  |  |  |  |  |  | ➌ | ➓ | ➑ |

The last row of table 1 represents the results of our study based on the Norwegian construction industry. After an analysis of the data collected from the survey, we end up by gathering the delay factors into 11 groups, each group has subgroups which can be considered to be from the same similarities. The ranking was done based on the frequency of each delay factor group (table 3).

Table 2

Ranking of the universal delay factors.

|  |  |  |  |
| --- | --- | --- | --- |
| Delay Factors | Frequency | Overall Ranking Index | Overall ranking |
| 1 - Sponsor/ Owner/ Client’s financial difficulties | 37 | 6,76337648 | 8 |
| 2 - Interference by Sponsor/ Owner / Client | 7 | 0,093069 | 28 |
| 3 - Site handover/ Site change | 6 | 0,09473 | 27 |
| 4 - Optimism (Unrealistic) estimation of project duration and cost | 38 | 3,548336 | 13 |
| 5 - Slow decision-making process | 32 | 3,044044 | 16 |
| 6 - Delays in contractor's payment | 61 | 14,7788 | 2 |
| 7 - Late/slow delivery of materials | 28 | 1,814455 | 19 |
| 8 - Design changes during construction / Change orders | 77 | 17,7593 | 1 |
| 9 - Incomplete or improper design | 58 | 9,03697 | 5 |
| 10 - Slow Quality Inspection process of the completed work | 41 | 3,507651 | 14 |
| 11 - Poor contract management/ or bidding process | 44 | 5,130621 | 11 |
| 12 - Slow progress/ underestimating of deadlines/ many projects | 15 | 0,458738 | 26 |
| 13 - Inadequate contractor experience /Building methods and approaches | 52 | 7,171937 | 6 |
| 14- Contractor's financial difficulties | 46 | 7,030791 | 7 |
| 15 - Poor communication and coordination between parties | 37 | 3,208349 | 15 |
| 16 - Poor planning and scheduling | 64 | 12,57883 | 3 |
| 17 - Poor site management and supervision | 61 | 9,352581 | 4 |
| 18 - Poor labour productivity and shortage of skills | 47 | 5,416879 | 10 |
| 19 - Equipment failure/ Equipment less productive based on estimations | 22 | 0,985406 | 22 |
| 20 - Problems related to subcontractors | 26 | 1,133318 | 21 |
| 21 - Shortage of materials | 39 | 4,453988 | 12 |
| 22 - Resources shortage (Human resources, machinery, and equipment) | 50 | 6,18566 | 9 |
| 23 - Unforeseen geological conditions | 21 | 0,8661 | 23 |
| 24 - Weather condition | 30 | 2,236362 | 18 |
| 25 - Difficulties in obtaining permits and excessive bureaucracy | 21 | 1,28835 | 20 |
| 26 - Economic problems (e.g., inflation, fluctuation) | 29 | 2,979215 | 17 |
| 27 - External stakeholders | 13 | 0,52008 | 25 |
| 28 - Corruption/ Fraudulent practices | 5 | 0,082524 | 29 |
| 29 - Security and/ or instable political situation | 12 | 0,849653 | 24 |
| 30 - Major forces/ Acts of God | 4 | 0,034951 | 30 |
| 31 - Internal bureaucracy within project organisations | 2 | 0,008414 | 32 |
| 32 - Office issues (IT troubles, noise and disruption, many useless trips, etc.) | 1 | 0,000971 | 33 |
| 33 - Sponsor/ Owner/ Client lack of commitment, clear demands (Goals and objectives) | 2 | 0,012136 | 31 |

The top ten universal delay factors from table 2; based on 105 studies from 46 countries worldwide are: (1) Design changes during construction/ Change orders; (2) Delays in contractor's payment; (3) Poor planning and scheduling; (4) Poor site management and supervision; (5) Incomplete or improper design; (6) Inadequate contractor experience /Building methods and approaches; (7) Contractor's financial difficulties; (8) Sponsor/ Owner/ Client’s financial difficulties; (9) Resources shortage (Human resources, machinery, equipment); (10) Poor labour productivity and shortage of skills.

On the other hand, the top ten delay factors in the Norwegian construction industry from table 3 and based on our study are: (1) Poor planning and scheduling; (2) Slow/poor decision-making process; (3) Internal administrative procedures and bureaucracy within project organisations; (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.

Table 3

Top ten universal delay factors and the major delay factors in Norwegian construction projects.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Ranking | The top ten universal delay factors | Norway | | |
| Norwegian major delay factors (Grouping) | Frequency | Delay factors in Norwegian Construction industry |
| 1 | Design changes during construction / Change orders | Poor planning and scheduling | 189 | Last minute tasks |
| Unclear demands from project manager |
| Poor project planning |
| Lack or no delegation |
| Poor project management performance |
| 2 | Delays in contractor's payment | Slow/poor decision-making process | 123 | Late decisions |
| Wrong decisions |
| Re-play on decisions |
| 3 | Poor planning and scheduling | Internal administrative procedures and bureaucracy within project organisations | 109 | Administrative demands -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 | Poor site management and supervision | 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 | Incomplete or improper design | Poor communication and coordination between parties | 103 | Poor in the interdisciplinary communication |
| Bad or wrong Communication (by email, phone, etc.) |
| Unstructured colleagues |
| Unstructured meetings So many and useless meetings Irrelevant meetings |
| 6 | Inadequate contractor experience /Building methods and approaches | Slow Quality Inspection process of the completed work | 85 | Slow control of production |
| Slow quality check |
| Slow internal QA |
| Slow external QA |
| 7 | Contractor's financial difficulties | Design changes during construction / Change orders | 60 | Unnecessary changes and many change orders |
| 8 | Sponsor/ Owner/ Client’s financial difficulties | 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 | Resources shortage (Human resources, machinery, equipment) | office issues | 41 | Software troubles |
| Working conditions |
| Office noise and disruption |
| Too much traveling |
| 10 | Poor labour productivity and shortage of skills | Late/ Slow/ Incomplete/ improper design | 29 | Poor/ incomplete documentation (designs, engineering documents) |
| Missing or error in documentations during construction |
| Error and mistakes in engineering part causing changes |
| Poor quality in designs and materials causing changes |
| \_ | \_ | User issues | 13 | Short questions from users |
| Late/ new demands from the users |

Comparing the major delay factors in Norwegian construction projects to the top ten universal delay factors (table 3). We find an overlapping, which are the “Design changes during construction/ Change orders”; “Poor planning and scheduling”; and “Resources shortage (Human resources, machinery, and equipment)”. However, two delay factors resulted from our survey which are “Internal administrative procedures and bureaucracy within project organisations” and “Sponsor/ Owner/ Client lack of commitment, clear demands (Goals and objectives)” had appeared in only one previous study done by Abdul-Rahman et al. (2006) for the Malaysian construction industry. Here we should distinguish between the lack of commitment resulted from the conclusion of the study by El-Razek et al. (2008) and confirmed by Doloi et al. (2012); where both considered lack of commitment as the most critical delay factor. However, it would be very broad to group multiple factors from multiple stakeholders and consider all that in a single group called lack of commitment. The lack of commitment we mentioned here is more related to the stakeholder driving the project; the client is the one driving the project.

One of the major delay factors appeared only in our study which is “User issues”; but only with small frequency (13 over 202, and ranked as last one, the 11th). This last factor appeared because of some type of construction projects (e.g. hospitals, office facilities, etc.) where the end users are concerned about the final delivered product more than its sponsor/ owner/ client. The vice versa can be said about delay factors appeared in other countries and not in Norway; which are 23 delay factors; there would have reasons to justify the differences.

If we go back to number one universal delay factor, which is “Design changes during construction/ Change orders”; it makes sense. We do not know if we call it coincidence, since the literature related to it is not included sufficiently to say the opposite. However, comparing this topic which is delay factors with the topic change causes in construction projects, we may come to huge surprise. Almost we will have a feeling that “delays” and “changes” are synonyms. Example of studies where we can see these strong overlapping between the two topics are Wu et al. (2005) and Sun and Meng (2009).

# Conclusions

We investigated the causes and effects of delays facing in the Norwegian construction industry. An open qualitative questionnaire was designed and distributed among the three major groups of participants (clients, consultants and contractors). We identified major causes of delay and the ten most important factors are: (1) Poor planning and scheduling; (2) Slow/poor decision-making process; (3) Internal administrative procedures and bureaucracy within project organisations; (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.

As an important contribution, we also did an intensive literature review on the top ten delay factors based on 104 studies that cover 45 countries. And based on the findings we ranked the most cited the delay factors which are 33 delay factors and come up with the top ten universal delay factors in construction industry which are: (1) Design changes during construction/ Change orders; (2) Delays in contractor's payment; (3) Poor planning and scheduling; (4) Poor site management and supervision; (5) Incomplete or improper design; (6) Inadequate contractor experience /Building methods and approaches; (7) Contractor's financial difficulties; (8) Sponsor/ Owner/ Client’s financial difficulties; (9) Resources shortage (Human resources, machinery, equipment); (10) Poor labour productivity and shortage of skills.

The number one universal delay factor which is “Design changes during construction/ Change orders” can tell that the clients are always responsible for delay because of changes during construction. This delay factor appeared in many studies even those not listed in this paper. On the other side, many studies regarding design changes and change orders shows the strong correlation between delay factors and causes of changes.

We believe that the results of this study can be of immense help to the practitioners (sponsors/ owners/ clients, contractors, subcontractors and consultants) and especially academicians. The practitioners can better understand the dynamics of managing projects and make efforts to reduce the incidences of delays. The academicians can conduct similar studies in other countries and identify causes and effects of delays. As mentioned earlier, some causes and effects may be unique to certain countries.

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