

MAIN FACTORS CAUSING DELAYS IN LARGE CONSTRUCTION PROJECTS: EVIDENCE FROM NEW ZEALAND

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ABSTRACT



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Construction delays occur frequently on large projects, resulting in not only the client getting their completed project later, but it can also have a major impact on the cost, duration and quality of the project. Delays can have a debilitating effect on all parties involved, as it's often the cause of adversarial relationships, a feeling of apprehension and distrust between parties. The purpose of this research was to establish the main factors causing delays on large construction projects in Auckland and compare results with the situation in other countries. Construction managers and site managers with a minimum of 10 years' experience working in large construction projects were surveyed, with both questionnaires and face-to-face interviews as methods, to collect quantitative as well as qualitative data. A significant factor that occurs often was "unforeseen ground conditions", and was due to the fact that geological tests do not always predict the condition of the whole site. The participants in general agreed that the design group contributes most to construction delays through "lack of producing design documents on time, late instructions, and unclear and inadequate details on drawings." These findings however are not generalizable, due to the small sample size, so further empirical research is suggested, on a larger scale, and surveying not just construction managers, but also other project team members, including the client.

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Keywords; Construction Industry; Delay; New Zealand; Contractor.

INTRODUCTION

The construction industry is a major player in the economy, generating both employment and wealth (Sweis et al., 2008). However, many projects experience extensive delays and thereby exceed initial time and cost estimates (Durdyev et al.,

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2017). Since the construction industry is a project based production, the construction supply chain is relatively fragmented. As a consequence, the industry's performance has been low compared to other industries (Vrijhoef and de Ridder, 2007). Factors that cause delays on construction projects are a universal problem and often occur. By identifying possible delays, there is a better chance to manage and control possible causes through the life cycle of a project (Afshari et al., 2011). The success of a project is determined by the cost, time and quality once the project is completed. Each project has its own quality standards, but time constraints and budget cannot be compromised. Previous studies on construction delays have been done by a number of authors from a variety of countries (refer to Table 1); however, no such research has been done in New Zealand.

There are a number of factors that play a role leading to these delays. Not only do site related challenges cause delays, the parties involved can contribute as well (Frodell and Josephson, 2009). Maintaining a relationship of high quality as a strategic policy, not only reduces recourse to the contract, but also improves the quality and predictability of project performance. It can act as an antidote to ill-aligned contractual elements (Anvuur, 2006). Thus, the aim of this study is to determine the main factors that cause delays and results in a project being not completed on time. The time period included for the research is taken from the possession of site, to the handover, i.e. the construction phase. The research is informed by a review of the literature, from which a survey was designed. The sample for the survey was construction and site managers and data was collected through a questionnaire and interviews with the aim to provide guidelines to clients, design teams and consultants with information addressing the concerns.

LITERATURE REVIEW

The construction industry is highly fragmented and is renowned for poor performance and productivity in comparison with other sectors (Durdyev and Ismail, 2012). Often delays result in projects finishing late and running over budget. Construction delays and their effects are mainly to blame for the low performance in construction, as they are a common problem worldwide (Durdyev et al., 2017).

Delays often cause disputes, as both the client and the contractor are affected in a negative way because of the delay. The client may not be happy with the performance of the main contractor, and the contractor not paid on time for work done, so there are many causes that can lead to lawsuits and disputes (Alaghbari, 2007). Some delays are caused by a single event or party, whereas others are caused by a number of factors and with no involvement or cause by any of the parties. A project needs to be kept within budget (cost) and prescribed schedule (time) to have a successful outcome. This takes good planning and requires sound judgment (Ahmed et al., 2002). Delays occur on almost every construction project and the severity of these delays varies between the individual projects. To minimise and avoid these delays, it is important to define the causes of delays first (Ahmed et al., 2002). By understanding the reasons why these

delays happen, the problems may be resolved and/or solutions offered. This can contribute to higher productivity and therefore enhances the importance of identifying the factors causing delays. By acquired knowledge, the severity and effects of delays may be minimized on future projects (Faridi and El-Sayegh, 2006).

The extant literature shows that a number of factors cause construction delays in the industry (Kumaraswamy and Chan, 1998; Assaf and Heijj, 2006; Toor and Ogunllana, 2007; Alaghbari et al., 2007; Doloi et al., 2011; Marzouk, 2013; Durdyev et al., 2017). Research carried out over the past thirty years was reviewed, and the most significant factors summarised into nine major groups, which are depicted in Table-1.

Table-1: Factors Causing Construction Delays

Researchers	Country	Major factors causing construction delays
Ahmed et al., (2003)	USA	Building permits approval Change orders Changes in drawings Incomplete documents Inspections Changes in specifications Decisions during development stage Shop drawing approval Design development Change in laws and regulations
Aibinu and Odeyinka (2006)	Nigeria	Contractor's financial difficulties Client's cash flow problems Designer's incomplete drawings Slow mobilization Equipment breakdown and maintenance problems Late delivery of ordered material Incomplete structural drawings
Doloi et al., (2011)	India	Unrealistic time schedule imposed Slow decisions from owner Unforeseen ground conditions Delay in approval of shop drawings Poor labour productivity Delay in material procurement by contractor Poor coordination among parties
Faridi and El-Sayegh, (2006)	UAE	Approval of drawings Slowness of the owners Shortage of manpower Productivity of manpower Skill shortages Material shortages Building permits approval Financing by contractor during construction
Frimpong and Olywoye (2003)	Ghana	Monthly payment delays Poor contract management Financial difficulties by contractor Planning and scheduling difficulties Cash flow during construction Inflation

Mohammed and Isah (2012)	Nigeria	Improper planning Lack of effective communication Shortage of supply like steel, concrete Design factors Slow decision making Financial issues Lack of information on design drawings Cash flow problems during construction Shortage of material
Sambasivan and Soon (2007)	Malaysia	Poor planning by contractor Inadequate client's finance and payments Problems with subcontractors Shortage in material Labour supply Equipment availability and failure Lack of communication between parties Mistakes during construction stage

RESEARCH METHOD

The survey methodology was appropriate for this research and it is fairly simple in design (Durdyev and Ismail, 2016). A questionnaire survey was designed to draw on the work experience of construction managers (CM) and site managers (SM) working on large construction projects in Auckland. This survey of 40 delay factors was conducted to determine the relative importance and frequency of occurrence of the delay factors in the industry. It was of paramount importance that questions were written down clearly and prepared with great care for the survey to be valid and reliable. Survey questions like “How many? Who? Where? When?” are more favourable to answer (Naoum, 1998). Open-ended questions were minimized as they could generate large amounts of data and participants could feel it is too time consuming to respond. The questionnaire consisted of two sections. The first section gathered basic information about the participant’s profile. The second section related to questions on the factors that cause delays in projects. The 5 point Likert-type semantic rating scale was used to rate their perceptions as follows (Durdyev and Mbachu, 2011):

- 1 - Not significant
- 2 - Slightly significant
- 3 - Significant
- 4 - Very significant
- 5 - Extremely significant

In survey research, participants tell us what they believe is true. Their memories for events could be distortions of events – what they think happened is not always what did happen. Often they construct their opinions on the spot and do not really think about the situation. An additional problem could be that they misinterpret facts in order to present a more favourable answer to the researcher.

The main source of data was collected through the personal distribution of 28 questionnaires to professionals working in four different construction companies in Auckland. A further benefit is that the same questions were repeated to add to the validity of the results, as each participant answered exactly the same questions. To include interviews as part of the data collection allowed for open and semi-structured questions. It prompted participants for additional information from the data collected through the questionnaires and was to the benefit of the data needed for the research. The data gained during the interviews added value to the existing questionnaire. A questionnaire survey was designed on the basis of the literature review of various international causes of project delays, to draw upon the work experiences of local construction and site managers.

Data Analysis

The best way to analyse data is to break it down into manageable themes, patterns and trends (Mouton, 2001). The factors that cause delays were grouped into 8 main categories and individual responses to the questionnaire which were then assigned with a numerical code. Data was analysed by calculating the Relative Importance Index (RII) of individual factors for their significance, as well as their frequency of occurrence. See the individual formulas below: The ranking of factors in each category were based on the RII to determine the degree of correlation on ranking the factors among the groups. The Relative Importance Index (RII) was calculated in the following way:

$$RII = \sum W_i (A \times n) \quad (1)$$

Where:

$\sum W_i$ = total score assigned to the factor by respondents

A = highest weight (which = 5 in this study)

n = total number of participants' responses to the question

The Frequency Index (FI) is computed using the following equation:

$$FI = a \times n \times 100/3N \quad (2)$$

Where:

a = weighting given to each response (ranges from 1 for 'never' to 3 "very often")

n = the frequency of the responses;

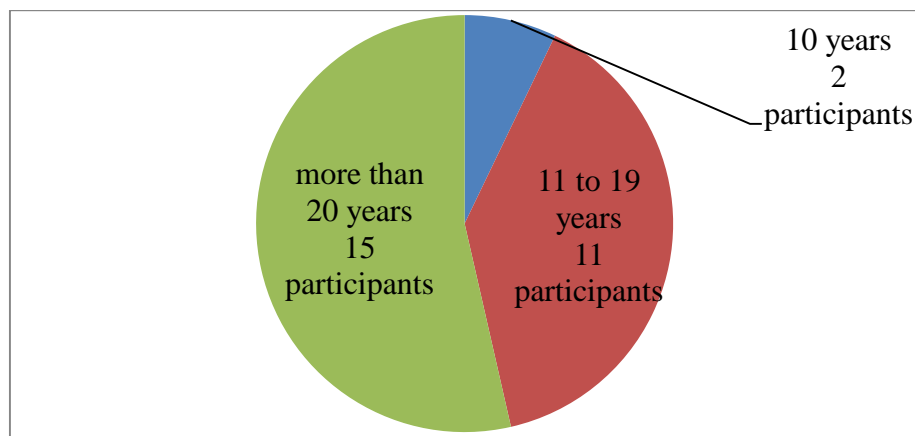
N = total number of responses responding to that factor.

RESEARCH FINDINGS AND DISCUSSION

Participant Demographics

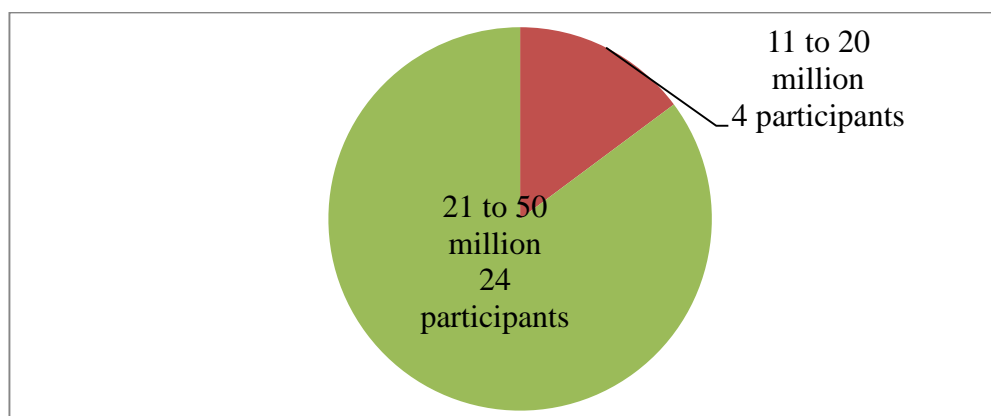
It was important to choose participants with experience and a long history in the construction industry. It was decided that the best data for this research would be collected from construction and site managers with a minimum of 10 years' experience, working on and/or managing large construction projects. Figure 1 shows the balance of the participating members in this research.

Figure-1: Participants' Years of Experience in Construction Industry (n=28)



The research focuses only on delays that occur on large construction projects. The participants' experience had to be relevant, therefore 4 participants had experience working on projects to a value of \$11- 20 million, whereas the other 24 had experience working on projects ranging from \$21 - 50 million (including 5 working on projects between \$150 – 200 million). Figure 2 shows the graph representing the project value and number of participants.

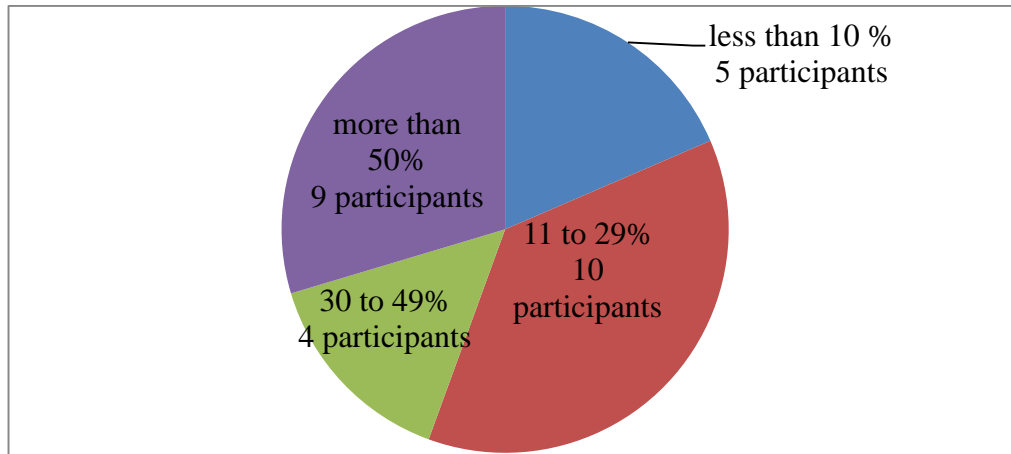
Figure-2: Projects' Value in This Research



From the 28 participants, only 5 experienced delays on less than 10% of projects, and 10 experienced delays on 11-29% of projects. Four participants experienced delays on

30-49%, and 9 experienced delays on more than 50% of projects. The “11-29%” and “more than 50%” categories represented the largest number of participants who experienced construction delays. Figure 3 shows the representation of the individual numbers.

Figure-3: Percentage of Construction Projects Experiencing Delays (n=28)



Project

From the quantitative data collected “original contract duration is too short”, “type of project bidding and award” and “complexity of project design” were rated the most significant and frequently occurring factors, with an aggregated mean of 24/28 participants rating these factors as having a “significant” to “extremely significant” impact on delays (i.e. a rating of 3,4 or 5), and their frequency of occurrence was rated as “often” to “very often” (i.e. a rating of 2 or 3) on the frequency scale. Most participants said the overall project duration for project completion was too short (refer to Table 2), especially with some highly complex contracts. Responses to the open ended questions made it clear that this was a problem. As one participant stated “many projects have an unrealistic finish date from day one, but these must be agreed on to be awarded the contract.” Another participant stated that the construction time for projects had become shorter and shorter. “In the past you had 12 months to complete a project, where now, that same size project’s completion time is shortened to 8 months.” Factors that can contribute to the complexity of a project are knowledge of material and components used (and their performance), proper review of the design and its’ constructability, as well as the scope of off-site fabrication of materials. Participants said that “it is the large amount of imported material used and the delivery that can cause delays.” The material they have the biggest problem with is structural steel and one person mentioned that he can see “precast panels going down the same path.”

Flyvbjerg (2005) raised awareness of the risks and problems involved in large infrastructure projects, purporting that these projects involve technology that is not standard, and are risky due to their complexity and long planning horizons. This means the project scope can change significantly over time, which leads to cost overruns or

shortfalls. Flyvberg (2005) believed that the industry needs to aim to have measures in place for better planning and decision making; this is an attribute that can benefit all large projects in Auckland as well.

Table-2: Project Related Delay Factors (n=28)

Project								
Delay Factor	Significance					RII	FI	
	1	2	3	4	5			
Original contract duration is too short	1	3	10	11	3	0.69	0.75	
Type of project bidding and award (negotiation, lowest bidder)	2	4	9	11	2	0.65	0.71	
Type of construction contract	4	7	12	5	0	0.53	0.57	
Complexity of project design	0	2	4	17	5	0.78	0.70	

Client

When the client continually initiates design and/or specification changes, it affects the quality and productivity of the project, and can also have an impact on the project's schedule. When this happens during the construction phase, it can have a ripple effect and influence a variety of trades/subcontractors. According to Motaleb and Kishk (2010) these changes can cause disruption and potential loss in revenue, as the changes were not caused by, nor allowed for, by the contractor. To have changes to the design occurring during the construction phase was seen as significant to extremely significant by 24/28 participants (refer to Table 3). These changes can include materials that require long lead times for ordering and delivery, as well as specialist installation. Either way, the changes becomes an additional responsibility of the contractor, as it can influence the original construction program.

When these changes occur during the design phase, it influences the designer's time schedule for completion and obtaining council approvals. If it is relatively small changes, regarding a colour scheme for instance, it is easier to allow for than if it involves changes in design, sizes or changes to the structure. A participant said "the client does not always understand the plans and makes incorrect assumptions." Once construction starts "they visualise what the finished project will look like and decide to make changes to the design." This leads to design changes during construction, causing delays, but it is not the fault of the designer or contractor. These changes do not only involve additional work, but can also involve further council approvals, and new dimensions can have an influence on tolerances of existing materials used. A participant noted that "variations have increased significantly in the past 10 years due to poor documentation and incorrect assumptions."

When construction is in progress with drawings that are not appraised sufficiently by the client beforehand, it can result in many changes during construction. Instead of saving time, the client contributes to additional work, and thereby can extend the

duration of the project. Only 2 participants didn't see this as a significant problem in Auckland – the rest of them rating it 4 or 5, i.e. they had a significant to extremely significant impact on delays, and happening very often with a 2 to 3 rating on the 3 point frequency scale. They saw it as “the client not realising the implication and time frame required to implement changes to the original design. More time should be spent by the client to fully understand the design, to limit revision of drawings and to approve drawings sooner.”

Table-3: Client Related Delay Factors (n=28)

Client Delay Factor	Significance					RII	FI
	1	2	3	4	5		
Defective materials provided by client	8	9	2	8	1	0.49	0.38
Change orders by owner during construction	2	2	5	12	7	0.74	0.83
Client's cash flow problem/ delay in payment	5	11	5	4	3	0.52	0.46
Late in revising and approving design documents by owner	0	2	7	10	9	0.79	0.75
Slowness in decision making process by owner	1	2	5	12	8	0.77	0.75
Waiting time for approval of shop drawings and sample materials	0	3	9	13	3	0.71	0.69
Material type and specification change	1	4	12	10	1	0.64	0.54

It is difficult for the parties involved to do their planning if they do not receive sufficient information from the client. The participants saw this as quite a significant factor: “the client is not only slow in making decisions; they often change the scope of the project too, but do not document it properly. There is a lack of leadership from the client’s project manager/representative and not all communication is straightforward and clear.” This factor is rated as highly significant in most countries. Countries such as Iran (Afshari et al., 2011), Hong Kong (Assaf and Al-Hejji, 2006) and Jordan (Odeh and Battaineh, 2002) rated it as a significant factor contributing to delays. The client needs to have good administration skills, settle claims on time and provide feedback and answers when required (Al Khalil and Al-Ghafly, 1998). With the face-to-face interviews the following factors were identified: “the client has a fixed completion date, but loses too much time in the design/consent process, meaning the tender/construction period is inadequate – this allows less time for adequate planning and scheduling.” Also “some special requirements regarding health and safety by the client can lead to significant delays”.

The supply of materials by the client, changes to the specification and late payments by the client were rated very low in level of significance as well as the frequency of occurrence. This is positive in the sense that there is often speculation about the contractor /client relationship. When the client is financially stable and makes payments

on time it is to the benefit of the project. In comparison “delay in progress payment by client” is one of the main delay factors in Malaysia (Sambasivan and Soon, 2007) and “monthly payment difficulties by client” in Ghana (Frimpong and Oluwoye, 2003). All payments need to be up to date to ensure the project progresses according to the schedule (Ren et al., 2008). When a client does not make regular monthly payments to the main contractor, the contractor is often not in a financial position to make payments to suppliers and subcontractors. It can have an effect on all the parties and the project. From the data collected, no one referred to any delays because of financial problems.

Plant/Equipment

The delay factors caused by short supply of plant and breakdown were rated relatively low and it happens very infrequently. Around half the participants’ mode of significance was 1-2 and very low levels of mode 5. Even though the frequency of occurrence is low, when it does happen, the significance can be very high. The cost of hiring plant is high, so low productivity is not seen as a very significant factor regarding construction delays (see Table 4).

Table-4: Plant/Equipment Related Delay Factors (n=28)

Plant/Equipment							
Delay Factor	Significance					RII	FI
	1	2	3	4	5		
Frequent breakdown of construction plant and equipment	3	15	4	5	1	0.50	0.45
Plant shortages	4	13	6	5	0	0.49	0.43
Low productivity and efficiency of equipment	3	9	10	4	2	0.55	0.42

Compared to other countries, “shortages of plant, frequent breakdowns, transportation problems or low efficiency of equipment” is not significant in the construction industry in Auckland. More than half the participants (18/28), thought these factors had no significant impact on delays (i.e. a significance rating of 2) and that the frequency of occurrence is also low (1 on the 3 point frequency scale, i.e. not often occurring). In Malaysia many contractors do not own their own construction plant, so during busy construction times, equipment is in short supply, and it is not very reliable, due to lack of maintenance (Sambasivan and Soon, 2006). The CM’s did agree that if something does go wrong, it can be very significant. Even so, it does not often occur, as most participants gave it a mode rating of “1”, which means it never occurs.

Design Team/Consultants

Delays in producing design documents ranked as significant in the delay of a project. Ogunlana, et al. (1996) mentioned that a delay in design documents and poor designs contributed to causes of delays in construction projects. Design is always important to any project; without good design the whole project can be delayed.

When the design documents are not produced on time, the building and/or building consent is not approved in time, and that can add additional time to the schedule, causing delays. A participant stated that “the design team can be the cause of a number of “small” delays in the form of waiting for answers, waiting for details and coordination issues – these small delays end up in lost time waiting, however no extension of time (EOT) is ever issued.” Design documents can have inconsistencies, errors and often lack clarity in their presentation. Participants mentioned “the poor quality of designs – drawings can often lack the necessary specifications and standards needed”. Inadequate details affect the design/construction interface, because the construction team has to carry out work that they do not necessarily have the correct information for. Unclear drawings result in variations that have a cost, as well as a time implication. This unplanned work can be the cause of a number of delays (Ren et al., 2008). In many cases it is only during the execution phase of the project that design errors are detected, so becoming problems that have to be solved by the contractor on site. Often the problems are detected just before starting construction of the specific task. Participants said “the number of variations increased over the past 10 years, due to poor documentation.”

The client’s requirements and project standards are usually defined at the design stage. Because some procurement methods do not allow for any collaboration or interaction between the design team and the contractor at design stage, this can cause many problems during the construction phase: inadequate details on drawings; approval of drawings; incomplete designs, and change orders, to name a few. In the open ended questions, another factor was mentioned: “there is a reduced standard of documentation, due to the client paring down design team fees and attendances.”

The client selects an Architect and once their initial concept design is done, the other specialists get involved and prepare structural drawings and services designs. The design team themselves often have to deal with many changes, specifications and often a demanding client (Faridi and El-Sayegh, 2006). Participants said “there is a lack of design coordination, especially services (ceiling space and service clashes).”

Table-5: Design Team/Consultant Related Delay Factors (n=28)

Design team/consultants							
Delay Factor	Significance					RII	FI
	1	2	3	4	5		
Delays in producing design documents	0	3	5	9	11	0.80	0.76
Unclear and inadequate details in drawings	0	0	9	12	7	0.79	0.80
Change in specifications	0	7	8	9	4	0.67	0.58
Design errors due to unfamiliarity of local conditions	1	5	8	9	5	0.69	0.54
Late issue of instructions	0	1	7	12	8	0.79	0.74
Delay in approval of drawings	0	2	9	13	4	0.74	0.68

External Factors

Unforeseen ground conditions rated the most significant in causing construction delays. Moreover, this occurs very often as well. Participants stated that geotechnical reports are not always representative of the whole site's ground conditions. As excavations progress, new ground conditions may be discovered after work commences on site. Sambasivan and Soon (2007) also found that unforeseen ground conditions was one of the most significant causes of construction delays in Malaysia. The initial soil that is removed may differ considerably from other areas when hard rock or obstacles like contaminated soil are found. Even though the contract may allow for the contractor to submit a claim, it still causes a delay in ground works and preparation of the substructure, so it can cause a delay to the schedule. Unforeseen ground conditions' is rated very highly as a significant cause of delay in many countries. In Ghana, Frimpong and Olywoye (2003) found that ground problems and unexpected geological conditions contributed to delays and affected the speed of project delivery. Participants stated "there is often no time allowed for the contractor to do geotechnical tests" and that "the client wants the contractor to take the risk in the possible case of unforeseen ground conditions." Limited site access or inconvenient access can slow down the delivery rate of materials, access for plant or even staff working at the site. This can be due to the distance to cover or narrow roads leading to the site (Toor and Ogunlana, 2008). Most participants said "poor site access is a significant and very significant factor as it can slow down activities on site."

Table-6: External Delay Factors (n=28)

External factors							
Delay Factor	Significance					RII	FI
	1	2	3	4	5		
Unforeseen ground conditions	0	2	6	7	13	0.82	0.64
Poor site access	1	6	11	8	2	0.63	0.51
Rain/weather effect on construction activities	2	3	14	6	3	0.64	0.66
Design errors due to unfamiliarity of local conditions	2	4	7	12	3	0.67	0.52

Relatively high rainfall in Auckland over the winter months can have an impact on site preparation and ground works. If the project starts in this period, additional time may be needed and can influence the schedule. Half the participants said it can be significant to very significant in causing delays, but 10/28 participants said you can "generally plan for it and they didn't see it as a problem". For other construction activities, they do agree that high rainfall can have an impact on activities and frequency of occurrence is high.

Labour

The construction industry is a labour-intensive industry and there is a constant demand for skilled labour. Participants have said "available labour quality has declined on average, especially because of lack of experience and the low requirements as to entry

level.” When there is a shortage of skilled labour, contractors are forced to hire less skilled workers. That can lead to low quality workmanship and they do not have sufficient skilled tradespeople on board to supervise or train the available labour force. Only 5/28 of the participants said this factor had a low significance to delays, contrasting the 23/28 that rated it significant to extremely significant. At the other end of the scale, the skilled tradespeople over-commit themselves in their work and then risk compromising quality of workmanship, in order to finish all their projects on time. Even though the participants appreciated the Government’s initiative to train more tradespeople, “the lack of a program the past 15 years is felt through the industry now”. It comes down to “too little, too late.” Because productivity is a principal determinant of project durations, a lack in productivity can contribute to project delays (Durdyev and Mbachu, 2017). Participants said “over the decades the quality of tradesmen on all levels has dropped off dramatically”. Even though the participants said it does not happen that often, 23/28 said that when it happens, it has a significant to extremely significant impact on delays. When the standard and quality of work done drops, the result is lower productivity and remedial work becomes more common. This is a common problem worldwide, as the findings of Faridi and El-Sayegh, (2006) from the UAE show; they said productivity, skill and the shortage of manpower have emerged as the major causes of delays now.

Traditionally the industry is seen as fragmented because conditions and projects vary, but participants’ overall view was that the level of productivity in New Zealand appears to be low in comparison to the construction sector in other countries (Durdyev and Mbachu, 2011). The lack of serious competition can be the reason for the low productivity and slow growth; it is regarded as an important determinant of productivity. However, the level of competition is difficult to observe directly. The barriers to entry into the local construction sector are on the increase with the introduction of occupational licensing, but may not have a direct influence on the level of productivity (Davies, 2007).

Table-7: Labour Related Delay Factors (n=28)

Labour							
Delay Factor	Significance					RII	FI
	1	2	3	4	5		
Shortage of skilled labour	2	3	9	7	7	0.70	0.62
Low productivity level of labours	1	4	12	8	3	0.66	0.62
Shortages of technical personnel	1	4	11	9	3	0.66	0.60

Communication

Misunderstandings between the parties slow down progress and can add more unnecessary work. Not all parties always have the interest of the others at stake, so act in their own interest, rather than in the interests of the project. Communication errors occur between parties: “it does happen that the parties involved do not fully understand the client and/or project needs, during the tender or construction phase.” Another observation was that “risk management has its place, but parties should stop hiding

behind disclaimers.” In the open ended questions the participants said “parties should learn to collaborate; the client, design team, contractor and sub-contractors should work together as a team”. Another remark was that “often there is poor communication between the site and management.” Another participant said “all parties need to take responsibility for their actions and stop playing the blame game.”

Table-8: Communication Related Delay Factors (n=28)

Communication							
Delay Factor	Significance					RII	FI
	1	2	3	4	5		
Lack of communicating the requirements	0	3	12	6	7	0.72	0.61
Unclear lines of communicating the requirements	1	6	8	8	5	0.67	0.52
Lack of coordination between team members	2	1	12	8	5	0.69	0.60
Delay in response between parties	0	5	8	9	6	0.71	0.66

Effective communication between the parties can contribute to the success of the project and enhance productivity. Communication takes on many forms: emails; drawings; phone calls; meetings, and interaction between parties. It is the way information is conveyed between two or more parties. A lack of responding to emails and phone calls can cause a delay in another party’s action, because they may lack the required information. Communication is the human tool to send and receive information, and everybody has the responsibility to act in a professional manner and with a code of conduct regarding the project. Sambasivan and Soon (2007) stated that inadequate communication between the parties involved in the project was an important reason for delays because it can result in problems with project coordination and schedules.

Contractor

The highest mode rating for individual factors was for poor subcontractors’ performance and poor supervision/site management. In the range of 1-5, poor subcontractors’ performance and poor supervision/site management had the most 4’s and 5’s. 18/28 participants said poor subcontractors’ performance rated very significant and extremely significant in construction delays. Only 2 participants rated it as slightly significant and none said it is not at all significant (i.e. no “1” mode was selected).

Inexperienced subcontractors can add to the problem with improper construction methods and errors during construction (Sambasivan and Soon, 2007). Preferred/nominated subcontractors are not always available when needed for a project; therefore, the available subcontractors’ work may not be of the same standard. This issue goes hand in hand with the lack of skilled labour and low productivity of labour.

It is the responsibility of the main contractor to manage and control all the activities on site. This includes the sub-contractors, storage facilities, materials and a well scheduled

program. To be able to do this, the managers on site need to have adequate procedures in place, and the support of their head office, including top management. Failure to do this can lead to a program delays and can include health and safety issues. Based on Table 9, the contractor's poor site management has a high degree of correlation with ineffective planning and scheduling by contractors and vice-versa. Some participants had the following to say: "increased health and safety compliance obligations have had a sour effect on the project program" and "some special requirements by the client can lead to significant delay." In the open ended questions a participants said "the number of variations increased over the past 10 years, due to poor documentation". Another participant stated that "tender designs are poor, with significant changes during construction." This is echoed by Marzouk and El-Rasas (2012), who said that variations by the client during construction were the most frequent cause of delay. It is also one of the top ten causes of delay considered in their questionnaire. Financial difficulties of contractors has reportedly been one of the important reasons for delays in construction projects (Assaf and Al-Hejji, 2006; Odeh and Battaine, 2002; Sambasivan and Soon, 2007). This was one of the factors that was rated highly in the literature review, but was rated relatively low in Auckland. The only recent case of a construction company's financial difficulty in New Zealand was the collapse of Mainzeal, which was one of the largest construction companies. None of the participants mentioned financial difficulty as a factor, which could possibly be because the employees do not often have the true information of a company's financial status. It is well known that after the GFC most companies worked on extremely low margins to stay in business. A participant stated that "if a project suffers budget constraints from the outset, it can be difficult to get changes approved."

Table-9: Contractor Related Delay Factors (n=28)

Contractor							
Delay Factor	Significance					RII	FI
	1	2	3	4	5		
Ineffective planning & scheduling of project by contractor	1	6	8	6	7	0.69	0.55
Contractor's financial difficulties	6	6	2	8	6	0.61	0.41
Poor subcontractors' performance	0	2	8	11	7	0.76	0.68
Poor supervision and site management	0	5	6	11	6	0.73	0.61
Necessary variations	0	5	9	10	4	0.69	0.68
Delay in special manufactured imported materials	1	6	8	7	6	0.68	0.54

When the contractor is not able to execute work according to the schedule and plan, it may lead to a delay in the progress of the works and eventually lead to project delay (Abdullah et al, 2010). Planning and scheduling of a large project is demanding and needs experienced project managers to manage the process. A building services

contractor complained that “too many contracts do not have adequate design/consultation time allowed for in the program, let alone time for commissioning the building correctly.” There are many elements to consider in the program: the client’s requirements; site conditions; availability/pre-ordering of materials, and the construction methodology employed. In an interview that was done with one participant of a large construction company in Auckland, it became clear that effective planning and scheduling is possible. In saying that, it takes a lot of experience and a special skill and interest; in this case this person thrived on the challenge and applied his knowledge and experience acquired over his many years of working on large projects. Regarding coordination a participant stated “services coordination could be significantly improved to avoid costly changes and delays.” Sometimes clients have unquantifiable items in the schedule of quantities that the contractor does not allow for during the programming of the project. When the full scope of those activities transpires at a later stage, the work schedule may be affected, as there was no proper estimate for the duration of these operations. This makes it hard to meet the original target date for project completion (Ren et al., 2008).

CONCLUSIONS AND RECOMMENDATIONS FOR FUTURE STUDIES

The study investigated factors causing construction delays on large construction projects in Auckland through a literature review that highlighted a variety of factors encountered overseas. It was not possible to draw conclusions from these studies in other countries and apply them to the Auckland market, as no similar research has been undertaken examining the causes of construction delays in New Zealand. Data was collected through a questionnaire and some personal interviews with experienced construction managers from four large construction companies. Most of the participants’ perceptions were based on their years of experience on large construction projects, and some on their personal opinions. Both were valid, as a perceived barrier forms a barrier regardless of whether (or not) it is real or a perception.

Construction delays are a normal occurrence and will continue to occur in the future. It is their severity, and how they are managed that will make the difference. These factors need to be managed at a higher level and if companies do not work towards mitigating these factors, delays may become more common and costly due to the ever-increasing complexity of large construction projects. The most significant factors identified in the Auckland market were: unforeseen ground conditions; delays in producing design documents; late issue of instructions; client’s late revising and approving of design documents, and unclear and inadequate details on drawings. Taking all categories into consideration, there was only one category that participants didn’t have much of a concern about, and that was the plant and equipment category. Shortage of skills and low productivity of manpower are factors that are destined to become worse. Conflict between contractors and consultants is a cause of concern from the contractors’ point of view. It may sound biased, but the literature revealed that a client can be the cause of many delays that the design team are blamed for. Even though it was rated lower,

the lack of communication and coordination between all parties is seen as significant, and relationships are declining.

A sample size of twenty eight participants employed by four large commercial main contractors was selected for the collection of data related to the research topic. The aim of the data collection was to facilitate an in-depth analysis of the perceptions of Auckland contractors towards factors that cause construction delays. The sample size was adequate for the purpose of this research, but in order to get a better overall view of the factors, it would be more informative to include other parties, such as the client, design consultants and quantity surveyors. No other studies on construction delays in New Zealand were found, which limited the external validity of the study. However, this limitation did not compromise the research as the data collected was adequate to enable a comprehensive analysis of the factors that cause delays in the Auckland construction industry.

A similar study can be undertaken where other parties (aside from contractors) are surveyed as well. Collecting data from design teams, clients and quantity surveyors may identify further factors that have not been mentioned here. How do companies' management adapt to change and solve some of these factors which cause delays? Do they put processes in place and take an open minded approach looking at ways to make construction projects of the future easier for all the parties involved? Is it all possible?

This study identified a number of concerns regarding the design team. It would be beneficial for designers to act on these concerns by making a positive contribution to lessen these causes that contribute to delays. Without apportioning blame it should be a team effort from all parties to take the strain off the design team in general. The introduction of building information modelling (BIM) in the construction industry – with its more collaborative ethos - could make a positive contribution to minimising delay in industry, but will still take many years to raise productivity levels sufficiently to really improve the situation. If all parties can work towards a common goal and take pride in how they do it, it can be highly beneficial to the construction industry in Auckland.

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