Journal of Engineering and Applied Sciences 13 (5): 1222-1227, 2018
ISSN: 1816-949X

The 4Ps: A Framework for Evaluating Construction Projects Delays

Richard Hannis Ansah, Shahryar Sorooshian and Shariman Bin Mustafa
Faculty of Industrial Management, Universiti Malaysia Pahang (UMP),
Lebuhraya Tun Razak, 26300 Kuantan, Pahang, Malaysia

Abstract: Delays are often challenging in probably every organization and the construction industry is not an exception. However, the alarming rate of delays in construction projects calls for debate and a critical assessment into the real sources of delays in the industry. Industry studies have demonstrated that meeting client's requirements are firmly impacted by effectiveness of the project team. This study investigates delay sources in the internal environment of construction projects through '4P' framework analysis namely, project management, project related, project participants and procurement. It is expected that the study's framework will be used for project performance assessment studies and benchmarking in the construction industry.

Key words: Construction project, delay sources, framework, performance, '4Ps' (project management, project related, project participants and procurement), calls

INTRODUCTION

Delays are often challenging in probably every organization and the construction industry is not an exception. The alarming rate of delays in construction projects calls for debate and a critical assessment into real sources of delays in the industry. Generally, a construction project is expected to be completed within the agreed duration before the physical task of the project commences and projects that have performed well have been completed within the contracted period and budget. Delays in construction projects are often defined as the additional time needed before a project gets completed as compared to its original time which was agreed by the client given the project and the contractor constructing the project.

According to Majid (2006), construction projects are normally considered successful when it meets schedule, expected cost, project and client's requirements. As a result of significant impact of schedule for primarily owners and contractors; in relation to performance and budget, respectively Sorooshian (2014) in his analysis of "delay-based reliability on construction projects," described delays as an additional time needed for a project to be completed as compared to the original completion date that was agreed upon before commencing the construction works. It is important to mention that the effects of these delays on the performance of the construction industry, project parties, human lives, infrastructural developments, governments and the overall economy, makes this study a very important research area for discussion as previous studies have not been able to effectively address the challenges associated with delays in the industry. Construction projects are capital intensive as it involves professionals from diverse fields, technology, machinery and considerable amount of funds and due to this any additional time for project completion will incur a lot of losses in capital and investment (Ansah *et al*., 2016).

Even though delays are global problem, the magnitude level varies considerably across projects and geographical borders (Assaf and Al-Hejji, 2006; Faridi and El-Sayegh, 2006; Iyer and Jha, 2006; Lowsley and Linnett, 2006; Alaghbari *et al*., 2007; Sambasivan and Soon, 2007; Tumi *et al*., 2009; Shehu *et al*., 2014a, b). Several delays have been reported in several projects with some exceeding schedule for about days, some about year (s) and some delayed forever (total abandonment). In this regards, having a thorough understanding of main sources of delays is crucial for empowering project teams to deploy practical strategies to mitigate and reduce the effects resulting from delays. This could only be achieved through identification of the real causal factors of delays in the industry. Also, several literatures have reported the causes of delay without a systematic analysis and groupings of the sources. However with this study, all the delay factors will be categorized into fundamental groups based on their common properties. The current research investigates the internal delay sources and their effects on project development cycle through 4Ps framework.

Corresponding Author: Shahryar Sorooshian, Faculty of Industrial Management, Universiti Malaysia Pahang (UMP), Lebuhraya Tun Razak, 26300 Kuantan, Pahang, Malaysia

Types of delays: In order to establish comprehensive understandings of delays, the types of delays has been addressed by this study in the proceeding section.

Compensable delays: These delays are basically generated from the owner and his representatives. Errors in designs, drawings and specifications are the most cited examples of this type of delay. When owner or his representative fails to respond on time to a request made for drawings or information, payments requests, interruptions and interference by client, material, design or specification changes by owner, among others, delays of this nature may arise. This type of delay entitles the contractor for both additional time and money (Arcuri *et al*., 2016; Alaghbari *et al*., 2007; Tumi *et al*., 2009).

Non-compensable/excusable delays: This type of delay is normally called "force majeure", meaning "chance or unavoidable occurrence". It is also known as "acts of God" because it is caused by nature and none of the project parties are responsible for it occurrence. In procurement, contractual and some legal agreements, there are clauses for "force majeure" that allow time extension for contractors should in case these unforeseen circumstances delay a project. Even though time extension is allowed but according to Alaghbari *et al*. (2007) and Tumi *et al*. (2009), there is no additional money given to contractors. Examples of these delays may include; hot and cold temperatures, rain, flooding, eruption from the volcano, earthquake, among others.

Non-excusable delays: Usually, the contractors and his subcontractors or suppliers are the causal parties involved in the generation of this type of delay. There is to some extent some entitlement in the form of compensation to the contractor from the subcontractor or the supplier if the delays are coming from them. The contractor receives no extra money and time or entitlement from the owner, however, through compensation or work acceleration the contractor has to make it up to the client or the owner (Alaghbari *et al*., 2007; Tumi *et al*., 2009; Arcuri *et al*., 2016).

Concurrent delays: This type of delay usually occurs in situation where two or more delay factors or type overlap at the same time. For instance when excusable and non-excusable types of delays occur at the same time, the resulted delay is concurrent delay (Tumi *et al*., 2009). Conflict between the client and contractor may arise from this type of delay as excusable delay entitles the contractor for extra time but the client may turn down his request because of the non-excusable delay.

Overview of delay sources: There are indications through observations and evidence from literature review that today's construction industry faces more challenges than before and that construction project delays are global phenomenon (Ansah *et al*., 2016). A study conducted by Faridi and El-Sayegh (2006), revealed that 50% of projects in United Arab Emirates encounter delays. Also, in 2004, reports from Infrastructure and Project Monitoring Division of the Ministry of Statistics and Programme Implementation confirmed that out of 646 central sector projects amounting to $50 trillion in India, over 40% of the projects constructed are facing time overrun with delays ranging from 1-252 months (Iyer and Jha, 2006). Similarly, in their reports, Building Cost Information Service (BCIS) found that almost 40% of all the projects studied had time overruns in the United Kingdom (Lowsley and Linnett, 2006).

In Malaysia, there have been a lot of under listed cases of development projects that have failed to meet their intended objectives. Instances include; the 1998 Commonwealth Games Monorail (fully completed only in 2003); the Batu Kawa's General Forces Project; the International Airport at Kuching and also a few other projects which showed critical defects after their completion. These numerous records of problems in projects confirm that there is a pressing need for real causal factors identification. The factors may however, come from various sources; internal and external to the environment of the project. Again, 2005 report on government contract projects in Malaysia confirmed that about 17.3% of 417 projects were considered sick with some projects having more than 3 months delays or totally abandoned (Sambasivan and Soon, 2007). A more recent survey in Malaysia by Shehu *et al*. (2014a, b) concluded that, roughly all very large projects surveyed have below 10% cost overrun showing in their completion time. More also, the findings of Memon *et al*. (2014) reveal that in Mara, fluctuation in prices of materials; cash flow and financial difficulties faced by contractors; shortage of site workers; lack of communication among parties and ineffective planning and scheduling, respectively were the most significant factors affecting construction cost performance in projects.

All these studies confirm in one way or the other that there are serious delay problems in construction projects. In addition, these problems are generated from different sources and may occur at different stages in the project construction (right from inception to completion and even sometimes maintenance period).

Internal sources of delays: The internal sources emanate from the project parties and these may include; clients, engineers, designers, consultants, contractors,

subcontractors, suppliers, manufactures, among others. From literature review, the main sources of delays identified included, delays related to client, delays related to contractors, delays related to consultant, delays related to materials and their procurements, delays related to labor and delays related to contractual relationship and contract.

Delays related to client included factors such as work suspension, finance, orders changes in the government sector, material approvals from client, slow-paced process of decision making by client and technical submittals are low. Again, delays related to the contractor included, less qualified and inexperienced technical staff in the contractor's organization, problems associated in financing projects, inter-party conflicts, etc. Also, delays related to consultants stem from; inexperienced and lack of staff in the consultant office for design documents review. Unavailability of materials in the market for construction works and delays in the procurement systems were found to be the most causes of delays related to materials. More also, unavailability of manpower and their low level of skills were causes relating to labor. Furthermore, delays relating to contractual relationship and contract have its root source in unrealistic timeframe.

Reviews and observations from the available literatures indicate different groupings of the internal causes of delays. For the purpose of this study, the available internal factors affecting delays from literature have been clustered into 4 main broad sources of delays known as the "4 Ps". These sources are:

- Project management sources
- Project related sources
- Project participants sources
- Procurement sources

Project management sources: It is generally, acknowledged that managements of projects must endeavour to achieve the goals of projects that were agreed upon before the start of the project. They must utilize and deploy tools, skills, techniques and available resources to facilitate projects to be able to complete projects on time. Project management that is effective will help meet and even exceed the expectations of the customer, they will maximize the use of available resources; be it time, money, people, space, etc. and endeavour for a successful completion of project within budget and on time; they will instil confidence in their team and also file what has been done for references in the future (Glenn, 2007).

There have been incidents of delays that have been attributed to the failures of the employed project management approaches. According to Sadi *et al*. (1995), there have been observations and evidence that have indicated that the models behind construction management and project management tools like; critical path method; work break down and earned value management; have failed to complete project within budget, on time and the quality desired for the project. There are various sources of project management related delays and these may arise from the following; capabilities in feedback, effectiveness in coordination and making of decision, the structure of project management, frequent communication, troubleshooting, prior experience of management, monitoring, scheduling and planning effectiveness and some among others (Walker, 1995; Chua *et al*., 1999). Others may also include; project management capabilities, health and safety programs, monitoring of subcontractor's works, managerial support and actions, etc.

Project related sources: These are concerned scope and the inherent risks including health and safety. Walker (1995) reported that the most useful tool for predicting time is the scope of a project. Many researchers have also confirmed the significance of the use of the scope of project (Chua *et al*., 1999; Ramabodu and Verster, 2010). Attributes considered for evaluating this source are project's size, project's nature, project's complexity, project's type, health and safety, among others (Alaghbari *et al*., 2007). All these attributes may lead to time and cost overruns if not regulated effectively. It must be emphasized here that because of the significant nature of scope, any change in scope could lead to delay. This is because scope is the prime focus of any project and other variables such as budget, estimation, plan of the project, schedule, project quality, just to mention a few, are all heavily dependent on the project scope. There is high tendency of project failure should any omission, adjustment and alteration occur in the scope of the project in the execution stages; that is, the laid out plan for the project would have to be assessed and modified and this might come with its own budget and schedule. It is therefore keen for project managers, clients and all the parties involved in a project to effectively regulate and stick to the project scope as its changes may result in change orders and eventually lead to cost and time overruns (Salunkhe and Patil, 2014).

Project participants related sources: The main project participants causing delays in projects are as follows; client/owner, designer/engineer, consultant, contractor and subcontractor or supplier. These sources have further been categorized into, client related sources, consultant related sources, design related sources and contractor related sources.

The client related sources: Mostly consist of; the knowledge and experience of the project by client, type of client (public, semi-public, private, etc.), client's financial capabilities, client's skills in managing project, risk aversion skills of the client, trust towards the project team by the client, well-laid out scope, etc. (Dissanayaka and Kumaraswamy, 1999). Commonly, joint ownership conflicts, change in orders, design documents approval delays, problems in funding resulting in delays in progressive payments, low level of technical staff in the client's office, work suspension by owner, method of tendering or bidding being bureaucratic, unqualified contractor selection, low level of experience by the owner in construction project, ineffective coordination and communication between client and the contractor, just to mention a few (Aziz, 2013; Owolabi *et al*., 2014; Salunkhe and Patil, 2014)

The consultant related sources: These sources are associated with the effectiveness of coordination and communication between the consultant and the contractor and again the consultant and the engineer, construction project experience by the consultant, testing and inspection, approvals of works, etc. The most common examples of delays are low level of experience in construction project by the consultant, scope changes approval delays, testing and inspection delays, inaccuracies in the investigations of sites, delays in design documents reviews and approvals, ineffective communication between consultant and contractor, frequent disputes with design engineers, etc. (Aziz, 2013; Salunkhe and Patil, 2014).

The design related sources: These sources involve; experience of the design team, complexity in project design and design documents production mistakes or delays. More also, examples of design related delays include; changes in design by owner or his representative, omissions and errors in design by designers, low level of experience by design team in construction projects, low level of modern design software usage, incomplete and defective designs, client's requirements misunderstanding by design team, etc. (Aziz, 2013; Salunkhe and Patil, 2014)

The contractor related sources: These sources include; experience and knowledge of contractor, management of site, subcontractor's supervision and involvement, financial capabilities by contractor, system of cost control effectiveness, etc. (Dissanayaka and Kumaraswamy, 1999). Contractor inadequate experience, use of old technology, project team's incompetency, ineffective coordination and communication between contractor and client or consultant, inefficient supervision and management of site, errors in works which usually result in reworks, poor scheduling and planning of project, etc. (Aziz, 2013; Owolabi *et al*., 2014).

It is intriguing to note that, project parties sometimes attribute causes of delays on each other, a situation that is possibly referred to by this study as "constrpolitics" (construction politics). In their quest to understand the actual factors causing delays in large building projects as well as the relative importance of these factors, Assaf and Al-Hejji (2006) outlined about 56 factors causing delays in Saudi Arabia. Factors considered as most important by the project parties included the following; from the view of contractors, there were delays in drawings preparation and approvals, delays by owner in progressive payments and changes in design by owner were also common; the engineers and architects also attributed causes of delays to financial problems during construction works, ineffective relationship from the camps of contractors and slow paced process in decision making by owners were also cited while as owners also related the delays to errors in design, unavailability of labours, inadequacies in the skills of labours, among others.

Again, Salleh (2009) concluded that factors causing Brunei construction industry's delays consisted of ineffective communication among project parties (owners, contractors and engineers), slow paced process in decision making and regular changes in orders by owners, ineffective planning and lack of experience by the contractor, issues relating to payments of finished works, lack of subcontractors experience were reported as issue affecting critical success. Manager's experience and abilities, project's scope clarity, definition of work, control systems usage, commitment on goals by the project manager, motivation of project teams, adherence to safety requirements and procedures were some among the findings asserted to be crucial in avoidance of delays which are critical to the industry. Furthermore, their findings on the variables causing delays in Lebanon's construction industry regarding the view on owners, contractors and consultants on most influential delay factors confirmed that; owners were very concerned about financial issues; the most important issues to contractors are contractual relationships and project management issues were most important to consultants (Mezher and Tawil, 1998).

Chan and Kumaraswamy (1997) conducted a more extensive study on potential delay in Hong Kong using 400 questionnaires after which follow up interviews were held. From the point of view of project parties including the clients/owners, consultants and contractors, there

were 5 common and significant factors causing delays and these included; inefficiencies in both supervision and management of site; unforeseen conditions in the ground; variations works initiated and required by clients and slow paced process in decision making by clients.

A survey was conducted by Salunkhe and Patil (2014) on large construction projects in India to assess the effects of construction delays on project time overrun. The view of project implementing agencies, clients, contractors and consultants were sought. The survey outlined the following delays and that which were associated with the project implementing agencies included; delays in acquiring land for project works, contractor's mobilization delays, delays in revising specification, problems with funding, etc. Delays associated with client were scope of work changes by owner, payment issues for completed works, low technical capabilities of the owner and others. The delays caused by contractors were ineffectiveness in scheduling and planning and its resultant effects on duration, low level of experience and ineffectiveness in making decisions, etc. Also, delays caused by consultants included the following; delays in revising specification, low level of coordination between consultants and contractors, etc.

RESULTS AND DISCUSSION

Procurement related sources: The procurement systems in the construction industry have been an area with so, interest and intense debate. This is because procurement is at the center of the industry as it brings the resources both team for managing the resources or building the project and the material resources needed through the life cycle of the project and to bring to bear the intended project plans into successful completion. Procurement is the system through which the construction industry secures and carries about projects (Dissanayaka and Kumaraswamy, 1999). However, there have concerns about problems associated with the selection of procurement methods for design and the adopted procedure method for project and tendering (Alaghbari *et al*., 2007). Examples of the sources of these delays from studies were unavailability of material for construction and its price escalation, inefficient supervision and management of materials, ineffective material procurement and delays associated with delivery of materials contracting and tendering disputes, funding problems, inaccuracies in the estimation of materials, unclear and ambiguous contract, etc. Unclear clauses in contract agreement can bring disputes that may lead to cost and time overruns. In addition, selecting unqualified contractors, estimations and bidding differences could be potential for delays (Singh, 2010).

CONCLUSION

The identified internal variables which had been clustered into 4 main sources (4Ps-Project management sources, project related sources, project participants sources and procurement sources) and their impacts on construction projects have been evaluated and analyzed. The review analyses showed that the major internal sources of delays are associated with the '4Ps'. Likewise, these sources have significant effects on construction projects with regards to time, cost and the overall client's requirements. More essentially, the results from the findings indicated that the effects of the identified delays on construction projects are a global phenomenon, however, its level of magnitude may vary across projects and geographical boundaries. It is therefore imperative for project teams and industrial practitioners to undertake a routine industrial introspective scan to understand these sources and devise appropriate strategies to deal with them. It is expected that the framework for this study will be used for delay assessment studies and serves as a benchmark for the industry.

ACKNOWLEDGEMENT

Reseachers wish to thank Universiti Malaysia Pahang for providing financial support under the FRGS Research Grant RDU150304.

REFERENCES

Alaghbari, W., M.R.A. Kadir, A. Salim and Ernawati, 2007. The significant factors causing delay of building construction projects in Malaysia. Eng. Constr. Archit. Manage., 14: 192-206.

Ansah, H.R., S. Sorooshian and S.B. Mustafa, 2016. An environmental impact framework for evaluating construction projects delays. Proceedings of the 2016 International Conference on Industrial Engineering and Operations Management Detroit, September 23-25, 2016, IEOM Society, Detroit, Michigan, pp: 764-772.

Arcuri, F.J., J.C. Hildreth and V. Tech, 2016. The principles of schedule impact analysis. Master Thesis, Virginia Tech, Blacksburg, Virginia.

Assaf, S.A. and S. Al-Hejji, 2006. Causes of delay in large construction projects. Int. J. Project Manage., 24: 349-357.

Aziz, R.F., 2013. Ranking of delay factors in construction projects after Egyptian revolution. Alexandria Eng. J., 52: 387-406.

Chan, D.W.M. and M.M. Kumaraswamy, 1997. A comparative study of causes of time overruns in Hong Kong construction projects. Int. J. Project Manage., 15: 55-63.

Chua, D.K.H., Y.C. Kog and P.K. Loh, 1999. Critical success factors for different project objectives. J. Constr. Eng. Manage., 125: 142-150.

Dissanayaka, S.M. and M.M. Kumaraswamy, 1999. Evaluation of factors affecting time and cost performance in Hong Kong building projects. Eng. Constr. Archit. Manage., 6: 287-298.

Faridi, A.S. and S.M. El-Sayegh, 2006. Significant factors causing delay in the UAE construction industry. Constr. Manage. Econ., 24: 1167-1176.

Glenn, E., 2007. The importance and awesome power of project management in today's business environment. Renaissance Group LLC, Cincinnati, Ohio, USA.

Iyer, K.C. and K.N. Jha, 2006. Critical factors affecting schedule performance: Evidence from Indian construction projects. J. Constr. Eng. Manage., 132: 871-881.

Lowsley, S. and C. Linnett, 2006. About time -?: delay analysis in construction. Royal Institution of Chartered Surveyors, Parliament Square, London, Englnad, UK.

Majid, I.A., 2006. Causes and effects of delays in ACEH construction industry. Ph.D Thesis, Universiti Teknologi Malaysia, Johor Bahru, Malaysia.

Memon, A.H., I.A. Rahman, M.R. Abdullah and A.A.A. Azis, 2014. Factors affecting construction cost performance in project management projects: Case of MARA large projects. Intl. J. Civ. Eng. Built Environ., 1: 30-35.

Mezher, T.M. and W. Tawil, 1998. Causes of delays in the construction industry in Lebanon. Eng. Constr. Arch. Manage. J., 5: 252-260.

Owolabi, J.D., L.M. Amusan, C.O. Oloke, O. Olusanya and P.F. Tunji-Olayeni *et al*., 2014. Causes and effect of delay on project construction delivery time. Intl. J. Educ. Res., 2: 197-208.

Ramabodu, M.S. and J.J.P. Verster, 2010. Factors contributing to cost overruns of construction projects. Proceeding of the 5th ASOCSA Conference on Built Environment, July 18-20, 2010, ASOCSA, Durban South Africa, ISBN: 978-0-620-46703 -2, pp: 131-143.

Sadi, A.A., M. Al-Khalil and M. Al-Hazmi, 1995. Causes of delay in large building construction projects. J. Manage. Eng., 11: 45-50.

Salleh, R., 2009. Critical success factors of project management for Brunei construction projects: Improving project performance. Ph.D Thesis, Brisbane, Australia.

Salunkhe, A.A. and R.S. Patil, 2014. Effect of construction delays on project time overrun: Indian scenario. Intl. J. Res. Eng. Technol., 3: 543-547.

Sambasivan, M. and Y.W. Soon, 2007. Causes and effects of delays in Malaysian construction industry. Intl. J. Project Manage., 25: 517-526.

Shehu, Z., I.R. Endut and A. Akintoye, 2014a. Factors contributing to project time and hence cost overrun in the Malaysian construction industry. J. Financial Manage. Property Constr., 19: 55-75.

Shehu, Z., I.R. Endut, A. Akintoye and G.D. Holt, 2014b. Cost overrun in the Malaysian construction industry projects: A deeper insight. Int. J. Project Manage., 32: 1471-1480.

Singh, R., 2010. Delays and cost overruns in infrastructure projects: Extent, causes and remedies. Econ. Political Weekly, 45: 43-54.

Sorooshian, S., 2014. Delay-based reliability analysis on construction projects. Life Sci. J., 11: 104-113.

Tumi, S.A.H., A. Omran and A.H.K. Pakir, 2009. Causes of delay in construction industry in Libya. Proceedings of the International Conference on Economics and Administration, November 14-15, 2009, University of Bucharest, Romania, pp: 265-272.

Walker, D.H.T., 1995. An investigation into construction time performance. Construct. Manage. Econ., 13: 63-274.