

# **Critical Success Factor at Fertilizer's EPC Project in Indonesia: A Review**

**Sarwani**

School of Interdisciplinary Management and Technology,  
Sepuluh Nopember Institute of Technology  
Surabaya, 60111, Indonesia  
sarwani.207032@mhs.its.ac.id

**Imam Baihaqi**

Faculty of Creative Design and Digital Business,  
Sepuluh Nopember Institute of Technology  
Surabaya, 60111, Indonesia  
ibaihaqi@mb.its.ac.id

**Christiono Utomo**

Department of Civil Engineering,  
Sepuluh Nopember Institute of Technology  
Surabaya, 60111, Indonesia  
christiono@ce.its.ac.id

## **Abstract**

Engineering, Procurement, and Construction (EPC) projects are complex endeavors involving multiple stages, stakeholders, and activities, which require coordination and management of various technical and non-technical aspects. Literature has shown that EPC projects are also subject to various risks that could severely impact project performance. This paper reviews the literature in regard to the critical success factors (CSFs) of EPC projects, particularly in the fertilizer industry. CSFs are important for EPC projects as they determine the likelihood of the project being successful. CSFs provide a roadmap and guidelines for project managers and stakeholders to follow and ensure that the project is delivered on time, within budget, and to the expected quality. The objective of this paper is to identify the CSFs of the EPC projects and to identify the potential for future research that could overcome the project's failure.

## **Keywords**

Project Performance, Delay Factors, Critical Success Factors (CFSs), Stakeholders, EPC Project

## **1. Introduction**

Construction projects are forced to improve their performance, and research is needed to understand the characteristics of high-performing construction projects (Unterhitzberger 2019). Traditionally construction projects involve stakeholders such as owners, consultants, and contractors who all have different opinions and interests, but they all strive to ensure the success of the project. The project success is measured a cost, schedule, and quality performance output. Although previous research has mapped out the factors contributing to success and failure, project managers still have difficulties achieving project success (Lindhard and Larsen 2016). Several variations of success and failure factors can occur in different projects, so it is impossible to obtain universally applicable success or failure factors (Toor and Ogunlana 2009).

Construction projects are often influenced by success factors that help the project team to achieve their goals as planned or delay factors that can prevent or delay project completion (Salleh 2009). Construction project failures are increasingly being reported worldwide and achieving construction project success is becoming very difficult in today's turbulent environment (Susil 2015).

Applying only the critical success factors or taking the necessary precautions to avoid critical delay factors during construction may not be sufficient to assist the parties involved in the project to fulfil the contractual clauses. Studying the correlation between critical success factors and critical delay factors, and examining the influence of the identified critical success factors on each critical delay factor will directly explain which factors influence each other the most, and assist contracting parties and investors in deciding which factor is the most appropriate to get attention (Alkhatami 2004; Salleh 2009).

Project success is an abstract concept and determining whether a project is successful is subjective and very complex (Chan et.al. 2002), because there are many variables that can influence success, such as the internal organizational context and the external environment in which a project is carried out (Papke-Shields et al. 2010). Many studies have been conducted over the years to explore the factors that are critical to project success (Cooke 2002; Nicolini 2002; Andersen 2006). Therefore, it is important for the project team to understand the factors that contribute to success early in the project. After finding critical success factors, the next step is how these factors can help companies improve their project management practices (Toor and Ogunlana 2008). Critical success factor (CSF) refers to a limited number of areas where satisfactory results from that area will ensure successful performance for the organization. These are some of the key areas where things have to go right for a business to thrive (Luu et al. 2008).

The Delays in construction projects is a global phenomenon and occurs in all types of projects (Aziz 2013; Sambasivan, 2006), which can add complexity especially in developing countries (Al-Momani 2000; Aziz, 2016; Mahdi 2019; Mpofu, 2017). Despite much research on construction project delays, this timeless problem continues to disturb the construction industry globally (Hui Yap 2020). These project delays can be avoided if we can understand and identify the causes of these delays before project commencement and try to reduce gaps during the project life cycle (Akhtar, 2020). The aim of this kind of research is to contribute to the theory and practice of project management in the construction industry by identifying the main causes and exploring the underlying causes of construction delays and providing recommendations on mitigation measures to prevent delays from occurring (Arantes 2020).

Past academic research has also observed the importance of a structured approach to all stakeholders' identification, prioritization, and involvement. The ability of project managers and teams to properly identify and engage all stakeholders in an appropriate manner can determine project success and failure. To increase the chances of success, the process of identifying stakeholders and their involvement should be started as soon as possible after the project charter is approved, the project manager has been assigned and the team is formed (PMBOK 6th Edition 2017).

In the period 2010 to 2020, new fertilizer Engineering Procurement Construction (EPC) projects including its supporting facilities were built in Indonesia. However, the phenomenon stated in previous literature above also occurred in the fertilizer EPC project where in fact, 90% of EPC projects in the 2010-2020 period experienced delays and difficulties resolved disputes with the contractors. This has caused a decline in the performance of the EPC project, which disrupted the company's strategic plans and affected its ability to provide domestic fertilizer commodities that could threaten national food security. It is necessary to find critical success factors that can prevent the occurrence of critical delay factors and find the key stakeholders so that appropriate steps can be taken. This paper will review relevant literature to identify success factors that can prevent delays in fertilizer EPC projects. The objectives of this paper are two folds: (1) to identify relevant issues from literature combined with preliminary empirical facts and (2) to identify research opportunities dealing with the EPC project performance. The rest of the paper is structured as follows: the next section explains the methodology of this review followed by the results and discussion. The summary and research opportunities are then identified and the last section.

## **2. Review Methodology**

This paper applies a qualitative method initiated by collecting data from empirical facts in the Fertilizer EPC fertilizer project in Indonesia and previous research related to empirical facts. Then the data obtained is analyzed so that empirical gaps and theoretical mapping can be determined. The last is by synthesizing the gap between the empirical problems and the theoretical problems (research opportunities) so the research problem is obtained. The review methodology flow of this research is shown in Figure 1 below.

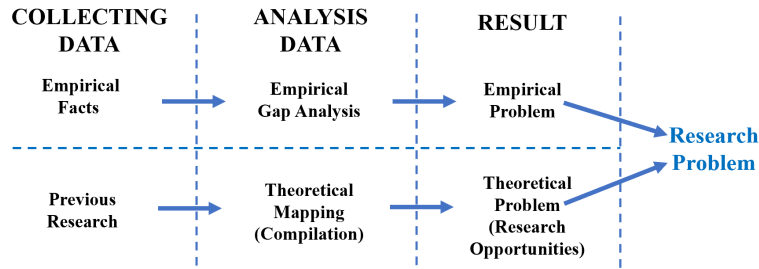


Figure 1. Review Methodology

### 3. Results and Discussion

One of the data collected in this research is through a study of the previous research (literature review). It defines and describes project delay factors, success factors, and stakeholders as identified in the previous research that correlated to empirical fact. A literature review provides a comprehensive overview of literature related to a theme/theory/method and synthesizes prior studies to strengthen the foundation of knowledge. One of the important goals of a literature review is to identify key research gaps based on what constructs, theories, and methods are widely applied in different settings and in what contexts (industry as well as country) studies have been carried out (Paul 2020).

#### 3.1 Project performance effect to delay factors, success factors, and stakeholders' engagement

Project performance is a multidimensional construct (Chipulu et al. 2014). Important dimensions are cost, time, and quality objectives which are also known as the iron triangle (Jha & Iyer 2007). The performance of cost and time is usually measured by the percentage deviation from the initial plan, whereas the performance of quality is usually measured regarding compliance with contractual agreements and technical standards (Tabish & Jha 2012).

Delay affects the performance of the cost and time of the project. Assessing the frequency of delay, the extent to which the delay may occur, and who is responsible for the delay can provide insights into early planning to control these factors and improve project performance. After the identification of delays, conclusions and recommendations to help mitigate such delays are detailed. We can't eliminate the total delay but we can minimize the delay activities affecting the project (Shaikh 2010).

Ogwueleka (2011) success factors that affect project performance are inputs to management that can lead directly or indirectly to project success. Based on the result, objective management, management of design, technical factors, top management support, and risk management were selected as the most critical success factors which influence project performance. The findings are focused to assist practitioners to gain a better understanding of the key areas based on prioritized success factors in order to improve performance in project delivery.

Stakeholder involvement plays an important and critical role in project performance (Magassouba 2019). Harold (2003) found that stakeholder involvement affects project goals during the planning phase, resource allocation, task specification, and, in turn, project performance.

#### 3.2 Delay Factors

Assaf and Al-Hejji (2006) defines delay as the exceeded time either outside the completion date specified in the contract or outside the agreed date of the parties for project completion. Delays in the construction industry are a "universal" phenomenon and have become typical of project construction (Sambasivan 2007; Sweis 2008).

Research related to the delay in completion time has been carried out across the world from developed countries such as the USA (Baldwin 1971) and the UK (Sullivan 1986). Then it was also carried out in developing countries such as Turkey (Arditi, 1985), Nigeria (Mansfield 1994), Saudi Arabia (Assaf and Al-Hejji 2006), Thailand (Ogunlana, 1996), Indonesia (Kaming, 1997) and Hong Kong (Chan and Kumaraswamy 1997).

Then when observed from the type of project, research like it can be classified as construction projects, rise building projects, public projects. highway construction (infrastructure project). (Chan and Kumaraswamy 1997; Kaming, 1997; Noulmanee 1999; Al-Momani 2000), oil & gas/petrochemical (Kaming 2019; Akhtar 2020)

Although construction projects around the world have similar characteristics, some characteristics still remain very country-specific (Olawale 2010). Therefore, Mpofu (2017) argues that the delay factor is country-specific and

influenced by socioeconomic and cultural backgrounds. Zidane (2018) states that the factors causing delays differ between countries for various reasons (e.g. project type, project context, political situation, government policy, environment, work culture, management style, construction method, geographical conditions, stakeholders, economic situation, researcher perspective. , etc.)

In 2006, Assaf and Al-Hejji conducted a time performance survey of various types of construction projects to determine the causes of delays and their importance according to each project participant group consisting of 15 owners, 19 consultants, and 23 contractors. They identified seventy-three causes of delays and arranges the factors that cause delays which are grouped into eight.

Huiyap (2020) conducted a meta-analysis of 52 common causes of delays identified from a literature review, and the 20 most cited causes were categorized by linkage to owners, contractors, consultants, labor, equipment, and others. A field survey was conducted to obtain the views of 148 Malaysian construction practitioners from a respondent group consisting of owners, consultants, and contractors. These causes are prioritized according to an index of importance that integrates the frequency and severity indices, identifying five main causes such as lack of proper planning and scheduling, too many change requests by clients, lack of competence from field management and supervision, lack of competence from sub-contractors and financial problems.

Kaming (2019) conducted a study that aims to analyze the factors that influence the causes of delays in LNG construction projects in Indonesia. Data was collected using a survey method by distributing questionnaires to respondents representing experts in LNG construction contractors. The grouping of variables was applied by factor analysis, then the resulting factors and project delays are analyzed for their relationship with Structural Equation Modeling (SEM). The results of this study produce seven factors that affect the delay in the EPC contract on the LNG project. These factors are human resources; management; material; external; equipment factory; method; quality.

From the results of the SEM analysis, a model is generated to analyze the delay in EPC LNG projects in Indonesia Aziz (2016) studied the list of causes of delays in construction projects collected from the literature which has different types of construction, different countries, different periods, and the number of causes of delays and different groups of delays. Individual questionnaires and interviews collected the 293 causes of tardiness on which this paper is based. The questionnaire survey was distributed to 500 construction participants and returned as many as 389 people representing consultants, contractors, and site/design engineers excluding owners who represent the government in road projects as one party. The value of the Relative Importance Index (RII) is calculated and based on the highest value the top twenty are determined as the twenty causes of delays in construction projects in Egypt

### **3.3 Characteristics of Fertilizer EPC Projects in Indonesia's**

The fertilizer industry is incorporated in the Indonesian fertilizer holding company is a state-owned company that influences how subsidiaries conduct their EPC projects. In general, the project delivery type implemented in the fertilizer industry is Design and Built (DB) where the design and construction of the project are conducted by one party, so the contractor's responsibility is clear. The researcher observes that there are two characteristics that contribute to the delay in the EPC project, namely the slowness of management decisions regarding change orders and the procurement method being the single stage with the lowest bid.

Several previous studies related to slow management decisions consisting of slow decision-making or revising and approving design documents conducted by the Owner as the one of critical delay factors that cause delays in many projects were carried out by Aibinu (2006), Albogamy (2012) and Doloi et.al. (2012).

In DB projects, the selection of appropriate procurement methods is critical to the success of the project. The four main procurement methods consist of low-bid, best-value, qualification-based, and single-bidder (Molenaar et al. 2010). Due to the DB contract combining design and construction under one umbrella contract, project owners typically expect that DB contractors will provide the best value and not just the lowest price (Palaneeswaran and Kumaraswamy 2000). Molenaar et al. (1998) compared the time and cost performance of DB projects using a one-stage procurement method with the lowest bid, two stages with the best value, and qualifications, finding that the two-step with the best value is the procurement method that has the least cost and time growth, followed by a one-step, low-bidding, qualification-based procurement method. The main reason for improving performance in two-stage procurement at the best value is that the scope of work using this procurement method is usually well-defined, with about 35% of the design provided in the request for proposals. In other words, the possibility of disputes in understanding the articles in the EPC contract and project specifications in the one-step procurement is large.

### **3.4 Success Factors**

Success, as a subjective term, depends on the perspective of those who measure it (Iyer and Jha, 2005). The definition of success often changes from project to project (Parfitt and Sanvido 1993), traditionally, success is defined as the extent to which project goals and expectations are met. It has to be viewed from multiple individual perspectives and objectives related to various elements, including technical, financial, educational, social, and professional issues (Parfitt and Sanvido 1993; Lim and Mohamed 1999).

Toor and Ogunlana (2008) observe that most studies of CSFs for construction projects are context specific. The specific implications of the study of success factors are therefore limited to the countries and cultures in which these studies have been conducted. Therefore, it is important for the project team to understand the factors that will lead to success at the start of the project. Having established the existence of critical success factors, the next step is to look at how these factors can help companies improve their project management practices

Yong (2013) although extensive research has been conducted on critical success factors/CSFs for construction projects, few of this research contains information specific to the local context. While several local studies have been carried out within the confines of the same research, an increasingly important factor in the literature, namely human-related factors, has not received much attention. Therefore, the main objective of this study is to gain a new understanding of the emerging trends of CSFs being considered by various stakeholders in the local construction industry. This was achieved through a comparative study of 48 construction stakeholders in Malaysia classified into three categories, namely developers, consultants, and contractors.

Banihashemi (2017) looks at critical success factors (CSFs) that influence the integration of sustainability into construction project management practices in developing countries. CSFs related to the triple bottom line/TBL sustainability consisting of environmental, social, and economic were identified through a comprehensive literature review. The 332 factors identified cover various areas related to sustainability in the construction industry and project management

Tabish (2011) through an extensive literature review, 36 success attributes were identified and a questionnaire-based survey was conducted to obtain the views of professionals on these success attributes. Responses from 105 professionals with an average of 22 years of experience in public construction projects in India were collected and analyzed. Factor analysis yielded four success factors: awareness of and compliance with rules and regulations; pre-project planning and scope clarity; effective partnerships among project participants; and external monitoring and control

### **3.5 Stakeholders**

Every project has stakeholders who are impacted by or can impact the project in a positive or negative way. Some stakeholders may have a limited ability to influence the project's work or outcomes; others may have a significant influence on the project and its expected outcomes (PMBOK 6th Edition 2017). Freeman's classical definition defines a stakeholder as any group or individual who can influence or be affected by the achievement of organizational goals (Freeman, 1984). The main issue in stakeholder theory is identifying salient stakeholders, i.e. knowing who and what is really important (Freeman, 1994). In the 1990s and 2000s, the CSF framework began to develop and the recognition of involvement from internal and external stakeholders began. In the 21st century, the definition of project success has evolved to focus more on stakeholders with project success depending on the project life cycle (short-term goals) and not on the broader organization (long-term goals) (Turner and Zolin 2012).

There are three main stakeholders involved in every construction project whose performance plays an important role in determining the success of the project. These stakeholders include project contractors whose task is to carry out construction in accordance with technical specifications, management and contracts; project owner, a company appointed as the owner of a government-funded construction project which procures construction contractor through bidding/tender and assumes financial and other responsibilities relevant to the project; project management consultant, who takes on technical, organizational and human responsibilities as well as the responsibility of controlling the project from time, cost and quality and safety point of view (Zanjirchi 2012).

### **3.6 Empirical Data**

The preliminary study of several fertilizer EPC projects in Indonesia in 2010-2020 which experienced delays reflects those identified in the literature. The preliminary observation show that common problems that cause delays related

to contractors were delays in engineering work, poor financial conditions, standard documents from Chinese contractors that do not match project specifications, lack of technician skills that cause rework, lack of competence and experience of engineers/designers, poor storage of equipment in the field, late arrival of materials, low productivity of local workers. Then those related to the owner were determining the project duration too short, clauses in the contract and project specifications that have multiple interpretations, decisions related to slow change orders, acquisition costs 80% below OE, lessons learned that do not reach the next project team and lack of subsurface data. The last one related to external parties/factors were extreme rainy weather, social disturbances, and long licensing processes from local authorities.

Besides the problems of delays as above, the researcher also observed several things that contributed to the success of the project, especially those related to the owner, namely having a tender document template and its completeness, support from top management, implementation of best practice in safety and environmental, the tender process complies with the principles of openness and transparency. fairness, support from the government, implementation of quality control and quality assurance, competent project managers and project team members, collection of lessons learned from previous projects, implementation of risk management, and implementation of good project control and monitoring.

Then efforts to increase the involvement of key stakeholders have also been carried out by providing regular reports, being responsive to the direction of management, keeping relations with external parties, CSR, complying with local government regulations, etc.

The status of the fertilizer industry in Indonesia is under the fertilizer holding company which is a state-owned company that has characteristics such as slow management in making decisions, the form of the contract is Design & Build / Lumpsum Turn Key (LSTK), and uses a one-stage auction method with two covers and determines the winner of the auction for the bidder with the lowest bid was suspected to contribute to the delay in the EPC project. Meanwhile, the role of the key stakeholders has not been maximally involved as a determining factor for the success of the EPC project. This empirical fact has been suspected led to a decline in the performance of Fertilizer EPC projects in the last ten years, where which has adversely affected the performance of the fertilizer industry and disrupted the company's strategic plans.

### **3.7 Empirical Gap Analysis**

In preparing for EPC projects, the fertilizer industry has made plans by using references to the success of previous projects. Good things or best practices that contributed to the success of previous projects have been implemented and bad things or lessons learned that contributed to project delays have also been mitigated. Then the management of stakeholders by optimizing their involvement from the beginning to the end of the project has been carried out. However, the fact remains that there were delays in the EPC project, and the unsatisfied of some stakeholders was observed.

### **3.8 Theoretical Mapping**

Many previous studies have examined the factors that cause delays and contribute to the success of various types of construction projects in various countries around the world that are carried out separately/individually. However, few existing studies have synthesized success factors and delay factors to obtain critical success factors that can prevent critical delay factors from occurring. In this paper, The same thing will be done but the key stakeholders who will contribute to the success of the project will be obtained and the influence of the characteristics of fertilizer EPC projects on project delays will also be examined. Figure 2 below shows the research gap or the position of this research against existing ones.

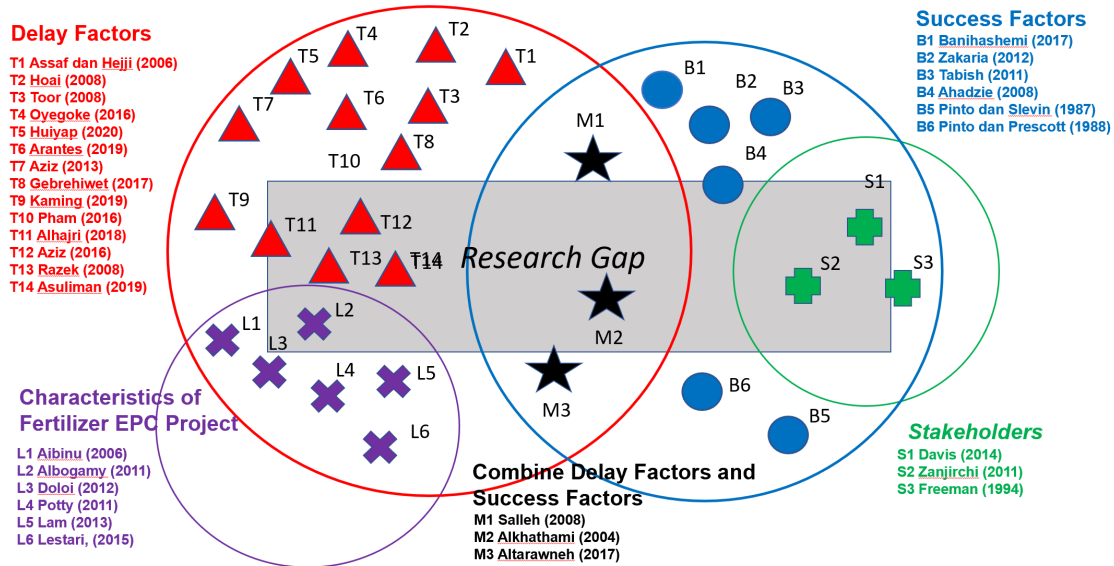


Figure 2. The position of this research against existing ones on success factors and delay factors

#### 4. Summary and Research Opportunities

The unidentified success factors, delay factors, and key stakeholders before starting the project are a problem and they contribute to the declining EPC project performance in the fertilizer industry in Indonesia, and it has had a negative impact on all parties involved in the project and potentially generated significant losses for all. Related to these problems, this research investigates them in order to highlight the importance of the success factors that could prevent or eliminate the delay factors. The research proposes that simply applying critical success factors or taking the necessary precautions might not be enough to enable project partners to avoid critical delay factors during construction. Further investigation to examine the correlation between the critical success and the critical delay factors will allow contract parties and investors to determine which factors deserve the most attention. Then identify the key stakeholders and engage them to support project success.

From this review, three research questions are identified, including:

- What are the real causes of delays in fertilizer EPC projects in Indonesia and are the characteristics of the fertilizer EPC projects in Indonesia one of them?
- How does this critical delay factor correlate with the critical success factor in fertilizer EPC projects in Indonesia?
- Who are the key stakeholders who have a significant influence on the critical success factor of the fertilizer EPC project in Indonesia?

It is important to address these research questions in order to improve the performance of future fertilizer EPC projects in Indonesia. Further research is needed to answer those research questions employing various research methodologies such as quantitative, qualitative, and case studies methods.

#### References

- Akhtar, M., Dealing with EPC Project Management Problems and Challenges A Case Study on Petrochemical, Oil and Gas EPC Projects in Middle-East, Abu Dhabi International Petroleum Exhibition & Conference to be held in Abu Dhabi, UAE, 9 – 12 November 2020.
- Aibinu, A.A, and Odeyinka, H.A., Construction Delays and Their Causative Factors in Nigeria, Journal of construction engineering and management, July 2006
- Alkathami, M., Examination of the correlation of critical success and delay factors in construction projects in the kingdom of Saudi Arabia, The School of Engineering in partial fulfillment of the requirements for the degree of Doctor of Philosophy University of Pittsburgh, 2004.

- Albogamy, A., Scott, D. and Dawood, N., Addressing Construction Delays in the Kingdom of Saudi Arabia, International Proceedings, 2012.
- Al-Momani A.H., Construction delay: a quantitative analysis, International Journal of Project Management, 18, pp. 51-59, 2000.
- Andersen, E.S., Jessen, S.A., Birchall, D. and Money, A.H., Exploring project success, Baltic Journal of Management, Vol. 1 No. 2, pp. 127-147, 2006.
- Arantes, A. and Ferreira, M.D.F, Underlying causes and mitigation measures of delays in construction projects, Journal of Financial Management of Property and Construction Vol. 25 No. 2, 2020 pp. 165-181, 2020.
- Arditi, D., Akanz, G.T. and Gurdamar, S., Reasons for delays in public projects in Turkey, Construction Management and Economics, 3, 171-181, 1985.
- Assaf, S.A. and Al-Hejji, S., Causes of delay in large construction projects, International Journal of Project Management 24, 349–357, 2006.
- Atkinson. R., Project management: cost, time and quality, two best guesses and a phenomenon, its time to accept other success criteria, International Journal of Project Management Vol. 17, No. 6, pp. 337-342, 1999.
- Aziz, R.F., Ranking of delay factors in construction projects after the Egyptian revolution, Alexandria Engineering Journal, Vol. 52 No. 3, pp. 387-406, 2013.
- Aziz, R.F. and Abdel-Hakam, A.A., Exploring delay causes of road construction projects in Egypt, Alexandria Engineering Journal, Vol. 55 No. 2, pp. 1515-1539, 2016.
- Baldwin, J.R. and Manthel, J.M., Causes of delay in the construction industry. Journal of Construction Division, ASCE, 97, pp. 177-187, 1971.
- Banihashemi, S., Hosseini, M.R., Golizadeh and H., Sankaran, S., Critical success factors (CSFs) for integration of sustainability into construction project management practices in developing countries. International Journal of Project Management, 2017.
- Chan, D.W.M. and Kumaraswamy, M.M., A comparative study of causes of time overruns in Hong Kong construction projects, International Journal of Project Management Vol. 15, No. 1, pp. 55-63, 1997
- Chan, A.P.C., Scott, D. and Lam, E.W.M., Framework of Success Criteria for Design/Build Projects, Journal of Management in Engineering, July 2002, pp. 120-128, 2002.
- Chipulu, M. et.al., Exploring the Impact of Cultural Values on Project Performance, University of Southampton, United Kingdom, 2014.
- Cooke, T. and Davies, The ‘real’ success factors on projects. International Journal of Project Management, 20(3), 185–90. 2002.
- De Wit, A., Management of project success, International Journal of Project Management, Vol 6 No 3, pp.164 – 170, August 1988.
- Freeman, R. E., Strategic management: A stakeholder approach. Marshfield, MA7 Pittman Publishing, 1984
- Freeman, R. E., The politics of stakeholder theory: Some future directions. Business Ethics Quarterly, 4(4): 409-421, 1994.
- Doloi, H., Sawhney, A., Iyer, K.C. dan Rentala, S., Analysing factors affecting delays in Indian construction projects, International Journal of Project Management 30 (2012) 479-489, 2012.
- Harold, K., Advance Project Management Best Practice on Implementation, 2<sup>nd</sup> Edition, John Willey & Soon, Inc Hoboken New Jersey, Canada, 2003
- Hui Yap, J.B., Goay, P.L., Woon, Y.B. and Skitmore, M., Revisiting critical delay factors for construction: Analyzing projects in Malaysia, Alexandria Engineering Journal (2021) 60, 1717-1729, 2020.
- Iyer, K.C. and Jha, K.N., Factors affecting cost performance: evidence from Indian construction projects, International Journal of Project Management, 23(4), 283-295, 2005.
- Jha, K.N. and Iyer, K.C., Commitment, coordination, competence and the iron triangle, International Journal of Project Management 25, 527–540, 2007.
- Kaming, P.F., Olomaiyr, P.O., Holt, G.D. and Harris, F.C., Factors influencing construction time and cost overruns on high-rise projects in Indonesia. Construction Management Economics, Vol .15(1), pp. 83 -94, 1997.
- Kaming, P.F., Koesmargono, A., and Aji, B.W., Delay model for Engineering Procurement Construction (EPC): a case of Liquefied Natural Gas (LNG) projects in Indonesia. MATEC Web of Conferences 270, 05010, 2019.
- Lim, C.S. and M Zain Mohamed, M.Z., Criteria of project success: an exploratory re-examination, International Journal of Project Management Vol. 17, No. 4, pp. 243-248, 1999.
- Lindhard, S. and Larsen, J.K., Identifying the Key Process Factors Affecting Project Performance, Engineering, Construction and Architectural Management vol 23 no. 5, pp 657 – 673, 2016.



- Mahdi, I. and Ehab Soliman, E., Significant and top-ranked delay factors in Arabic Gulf countries, *International Journal of Construction Management* (2019) 1–14, 2019.
- Mansfield, N.R., Ugwu, O.O. and Doran, T., Causes of delay and causes of overruns in Nigerian construction projects, *International Journal of Management*, 12(4), pp.254-260, 1994.
- Molenaar, K.R. and Songer, A.D, Model for public sector design-build project selection, *Journal of Construction Engineering and Management*, Vo. 124, No.6, November/December, 1998.
- Molenaar, K.R., Sobin, N., and Antillón, E.I., A Synthesis of Best-Value Procurement Practices for Sustainable Design-Build Projects in the Public Sector, *Journal of Green Building*, November 2010
- Mpofu, B., Godfrey, E., Moobela, O.C., Pretorius, A., Profiling causative factors leading to construction project delays in the United Arab Emirates, *Engineering, Construction and Architectural Management* 24 (2) (2017) 346–376, 2017.
- Nicolini, D. (2002) In search of ‘project chemistry’. *Construction Management and Economics*, 20(2), 167–7
- Noulmanee A., Wachirathmrojn J., Tantiichattanont P., Sittivijan P., Internal causes of delays in highway construction projects in Thailand. [www.ait.ciet.com](http://www.ait.ciet.com), July, 1999.
- Ogunlana S.O. and Prumkuntong, K., Construction delays in a fast-growing economy: Compare Thailand with other countries, *International Journal of Project Management* 14 (1), pp.37-45. 1996.
- Olawale, Y.A, and Ming Sun, Cost and time control of construction projects: inhibiting factors and mitigating measures in practice, factors and mitigating measures in practice, *Construction Management and Economics* 28, 509–526, May 2010
- Ogwueleka, A., The critical success factors influencing project performance in Nigeria, *International Journal of Management Science, and Engineering Management*, 6(5): 343-349, 2011
- Palaneeswaran, E., and Kumaraswamy, M.M, Contractor selection for design/build projects, *Journal of Construction Engineering and Management*, Vol. 126, No. 5, September/October, 2000 .
- PMBOK Sixth Edition, A guide to the project management body of knowledge, 2017.
- Paul, J., Alex Rialp Criadoc, A.R., The art of writing literature review: What do we know and what do we need to know?, *International Business Review* 29 101717, 2020.
- Parfitt M.K. and Sanvido, V.E., Checklist of critical success factors for building projects, *Journal of management in engineering*, 9(3), pp.243-249, 1993.
- Salleh, D., Critical success factors of project management for Brunei construction projects: Improving project performance. Unpublished PhD thesis. Faculty of Built Environment and Engineering, Queensland University of Technology, 2009.
- Sambasivan, M. and Soon, Y.W., Causes and effects of delays in the Malaysian construction industry, *International Journal of Project Management*, 25 (5) 517–526, 2006.
- Shaikh, A.W., Muree, M.R. and Soomro, A.S, Identification of critical delay factors in construction, *Sindh Univ. Res. Jour. (Sci. Ser.)* Vol.42 (2) 11-14, 2010
- Susil, S.G.A.K., Warnakulasuriya, B.N.F. and Arachchige, B.J.H., Critical Success Factors for Construction Projects: A Literature Review. *Proceedings of 12th International Conference on Business Management*, 2005.
- Sweis, G., Sweis, R., Hammad, A. and Shboul, A., Delays in construction projects: the case of Jordan, *International Journal of Project Management*, Vol. 26 No. 6, pp. 665-674, 2008.
- Sullivan, A. and Harris, F.C., Delays on Large Construction Projects, *International Journal of Operations & Production Management*, Vol. 6 Iss 1 pp. 25 – 33, 1986.
- Tabish, S.Z.S. and Jha, K.N., Success Traits for a Construction Project, *Journal of Construction Engineering and Management ASCE* / 138:1131-1138, October 2012.
- Tabish, S.Z.S. and Neeraj, J.H.A., Identification and evaluation of success factors for public construction projects. *Construction Management and Economics* 29, 809–823, August 2011.
- Toor, S.R. and Ogunlana, S.O., Construction professionals’ perception of critical success factors for large-scale construction projects. *Construction Innovation: Information, Process, Management*, 9(2), 149–67, 2008.
- Turner, J.R., Zolin, R., Forecasting success on large projects: developing reliable scales to predict multiple perspectives by multiple stakeholders over multiple time frames. *Project Management Journal* 43 (5), 87–99, 2012.
- Unterhitzberger, C., and Bryde, D. J, Organizational Justice, Project Performance, and the Mediating Effects of Key Success Factors, *Project Management Journal*, Vol. 50(1) 57–70, 2019.
- Yong, Y.C. and Mustaffa, N.E., Critical success factors for Malaysian construction projects: an empirical assessment. *Construction Management and Economics*, 2013 Vol. 31, No. 9, 959–978, 2013.
- Zanjirchi, S.M. and Moradi, M., Construction project success analysis from stakeholders' theory perspective. *African Journal of Business Management* Vol. 6(15), pp. 5218-5225, 18 April, 2012.

Zidane, Y.J.T., Andersen, B., The top 10 universal delay factors in construction projects, *International Journal of Managing Projects in Business* 11 (3) (2018) 650–672, 2017.

## **Biography**

**Sarwani** is a student in the doctoral program of the Department of Interdisciplinary Management School of Technology, Sepuluh Nopember Institute of Technology. He is an ASEAN Engineer and holder of a Project Management Professional (PMP) certificate. He has 25 years of experience in executing various EPC projects in the fertilizer industry in Indonesia.

**Dr Baihaqi** is an associate professor of operations and supply chain management in the Department of Business Management, Sepuluh Nopember Institute of Technology. His main research interests include sustainability, digital supply chain, and green supply chain management.

**Dr Christiono** is an associate professor of construction project management in the Department of Civil Engineering, Sepuluh Nopember Institute of Technology. His main research interests include value management in design and construction, project investment and financing, and sustainable science in the built environment.