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Success Factors of Design-Build Public Sector Projects in Malaysia

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Abstract. Various procurement methods are employed in the construction industry, with each having varying success rates. The popularity of design and build (D-B) method has been increasing worldwide because its distinctive features of integrating design and construction have successfully addressed the problems inherent in the traditional design-bid-build (D-B-B) method. Previous research efforts in Malaysia have been focused on establishing a D-B strategy, including its challenges and risks and defining a broader scope for implementing D-B in public projects. However, not many empirical studies have identified the D-B success factors in Malaysia's construction industry. This paper aims to determine the main factors attributing to the successful application of the D-B method for public projects in Malaysia's construction industry. Specifically, this paper answers the main research question of "What are the success factors of the D-B project delivery method in Malaysian public-sector projects?". To achieve that objective, this study involves interviewing industry practitioners that have direct hands-on experience in managing D-B public sector projects in Malaysia. The interview data are analyzed to identify the D-B success factors in construction projects. The findings suggest that the underlying factors for successful D-B public project include client capabilities, competency of the construction leader, competency of the consultant team, organizational behavior, and effective project management system. The success factors in each underlying categories are discussed in the paper. This paper contributes a better understanding of the D-B project success factors in Malaysia's construction industry.

1. Introduction

The construction industry is a significant contributor to Malaysia's economy. Numerous studies have suggested that the construction industry play a significant role towards a nation's Gross Domestic Product (GDP), economic activity, government revenue, private investment, and employment [1,2,3,4]. In Malaysia, the construction industry contributes about 5.4% of the country's annual Gross Domestic Product (GDP) in 2018. Based on the data generated by the Central Bank of Malaysia in 2018, the highest National GDP was recorded in 2014 (6.0%), while the GDP attributed to the construction industry was 18.1% in 2012. The construction industry in Malaysia has grown consistently from 2011 until Q1 2018, inclusive of its rapid growth noted in 2012. These GDP values are shown in Table 1. In other words, the construction industry is vital to a nation's economy, and Malaysia is no exception. While the construction industry plays a vital role in Malaysia's economy, construction projects usually face severe cost and time overruns [5,6]. Projects fall behind schedules because of various reasons, but the most exceptional causes are poor site management and supervision, the project team's slow rate in making decisions, changes in job scope, financial conditions, lack of planning skills, and changes in the design made by



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clients [7,8,9,10]. Therefore, identifying approaches to improve the construction industry is crucial to support Malaysia's economic growth.

Table 1: National GDP and Construction GDP in Malaysia from 2011-2018

Year	2011	2012	2013	2014	2015	2016	2017	Q1 2018
National GDP (%)	5.3	5.5	4.7	6.0	5.0	4.2	5.9	5.4
Construction GDP (%)	4.6	18.1	10.6	11.7	8.2	7.4	6.7	5.5

The Design and Build (D-B) method is one of the alternative approaches for delivering construction projects. It is a procurement method in which one entity is contractually responsible for both the design and construction of the project [11,12,13,14,15]. This established procurement approach was introduced and developed to cope with the complexity of construction projects [16]. In developed countries such as the United Kingdom, 42% of its total projects are procured using D-B [16]. However, the D-B implementation in Malaysia has been inefficient, mainly due to the unfamiliarity and inexperience of the project team in dealing with such an innovative approach [17]. Also, project clients in Malaysia are still clueless about the numerous procurement methods that are available and must be carefully selected at the start of the project [18]. Besides that, the lack of project management knowledge, the project size, and the diversity of the construction industry, together with the lack of skills and expertise to conduct a thorough assessment of available procurement systems are other issues that have been associated with D-B in Malaysia [19]. Hence, there is a need to identify elements that can improve the success rate for implementing D-B in Malaysia. The above discussion highlights the significant differences in construction industries based on different economic, management, and people attributes. Following that, the objective of this study is to identify the key success factors for implementing public sector D-B projects in Malaysia. To achieve this objective, this paper addresses the main research question, "What are the success factors for implementing the "Design-Build" project delivery method in Malaysian public-sector projects?" This study categorized the D-B success factors based on responses from individual interviews with industry practitioners. The similarities and differences from the feedback obtained are segregated into main themes. This paper contributes a better understanding of the success factors for implementing the D-B project delivery method in the Malaysian construction industry.

2. Literature Review

A contractor's expertise and performance significantly impact the successful delivery of a project [20]. While clients strive to make the best decisions in selecting the right contractor for the right job, a clear understanding of the underlying attributes associated with contractor selection, in the context of achieving successful project outcomes, is critical. The increasing globalization of projects and project management add to a diverse mix, creating intercultural challenges for project managers [17]. There is growing recognition that different types of projects require different approaches to their management and management procedures that are tailored to the needs of the project [20], as well as the selection of project managers with the right competencies [17,21]. Therefore, it is crucial to identify project success factors so that project owners and managers are provided with a specific and measurable framework for tracking key project outcomes [22,23]. The crucial success factors for project delivery include front-end planning and project definition, on-time performance, on-cost performance, and projects that fit the work program [24]. For example, a study in Vietnam showed that the construction parties' capabilities played an essential role in determining the success or failure of D-B projects [24]. In addition, the results of causality from the study highlighted six success factors, which significantly

affected D-B project performance, including resolving conflicts quickly; effective overall managerial actions in planning, organizing, leading and controlling; project participants' satisfaction with the financial return from the project; competent multidisciplinary project team; project team members' good and active attitudes toward the job; and adequate funding throughout the project. They also found no significant difference between the project performances of public and private sector D-B projects [17]. Therefore, identifying success factors are crucial for construction projects.

Every construction project is unique and comprises unique complexities and risks across the various levels of the construction process. The increasing complexity in design and the involvement of a multitude of stakeholders in modern construction projects further add pressure for both clients and contractors to match required skills and capabilities so that the project is successfully delivered [21]. Incorrect selection of a contractor for a given project may potentially lead to a bad legacy of failure coupled with consequences such as poor business practices or bankruptcy [21]. Studies suggest that the stakeholders, including clients, contractors, and consultants, have a major impact on the success factors of D-B projects in the public sector. Additionally, the people and operational are also the main criteria determining the success of D-B public projects. Finally, the implementation of D-B method in public projects has been identified in developed countries such as the United States of America, the United Kingdom, China, Japan, and Singapore. For instance, a construction project is considered successful when it is completed within the given time and budget, and is to the client's satisfaction [17]. Additionally, the project success is defined as the ability of the project to meet the objectives of time, cost, and quality, as well as satisfying the project stakeholders [22]. In developed Western countries, project success is defined as an intangible perceptive feeling, which varies with different management expectations, among persons, and with the phases of the project [25]. Meanwhile, in Asia, the measures of project success should also include the satisfaction of project team members [17]. Most studies use success factors as a tool to determine the performance of a project [21,26]. Project success factors refer to a set of circumstances, facts, or influence, which contribute to the project outcomes. The project manager's managerial skills, team members' commitment and their technical background, project attributes, and environmental factors are all critical project success factors [24]. In summary, various studies have shown that a successful project meets all four crucial objectives including cost, time, people or satisfaction, and quality of construction. Hence, these objectives are also the success criteria that must be identified to rectify failure and to improve the construction project's productivity deficiency during liability periods as a result of defects. The previous studies concluded that key success factors identified during the construction stage would strengthen the project management skills of the project leader. To further improve D-B adoption, understanding the success factors that influence the client decision in accepting the D-B method is crucial. To provide this knowledge, the success factors that suit the project characteristics of Malaysia's construction industry such as fragmentation, complexity, dynamism, and lack of standardization should be identified for the construction project success [27]. Thus, this study will address this gap by identifying the key success factors for implementing D-B public sector projects in Malaysia.

3. Methodology

The data collection is based on the qualitative approach of individual interviews. Also, data analysis involves content analysis. Figure 1 outlines this study's methodology. The following subsections discuss the methods used to collect and analyze the data.

3.1. Data Collection

The interview sessions were conducted with relevant industry practitioners such as clients and consultants, and contractors. The main reason for conducting the interview is to understand the actual practice of D-B in the Malaysia construction industry. The data collection involves 20 interviewees that hold at least senior management positions with direct hands-on experiences on D-B public sector projects in Malaysia. The interviewees' average working experience in the construction industry is around 12 years. Thus, their opinions and findings are considered representative, reliable, and valid for this study. Open-ended questions were provided to the participants because it allows the solicitation of

actual information by encouraging the interviewees to express their issues or areas of concern freely. The main question during the interview was, “What are the success factors for implementing the D-B method in Malaysian public-sector construction projects?”. Follow-up questions relating to the subject matter were also provided during the discussion. After each interview session, the responses were summarized and returned to the interviewee for verification and approval. The interview process was conducted in the first quarter of 2019.

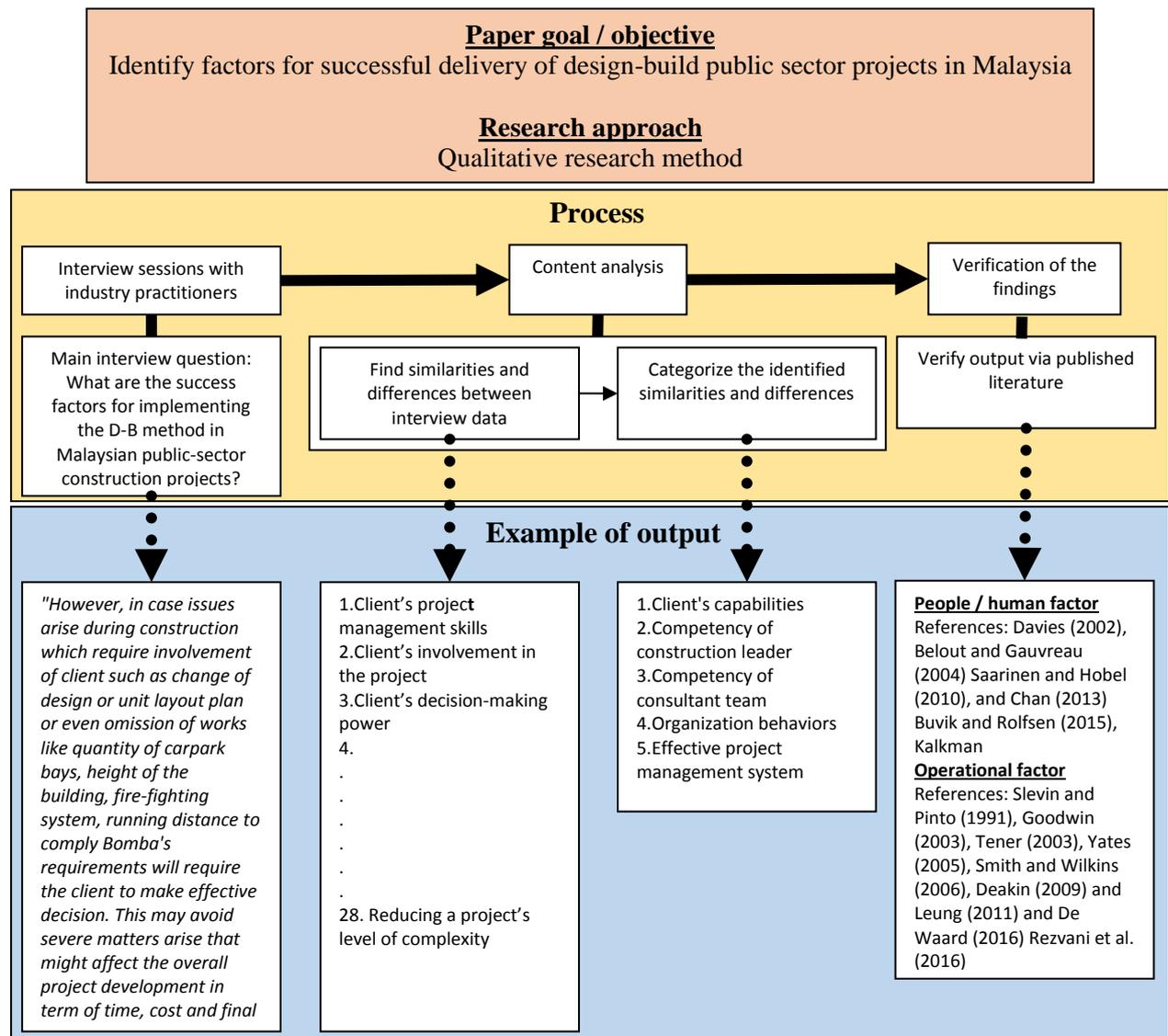


Figure 1: Overview of this study's methodology

3.2. Data Analysis

The data analysis involves content analysis. Six stages of content analysis were applied in this study: (1) formulate the research questions; (2) decide the interview dialogue to be examined; (3) decide the size or type of response to be counted in the analysis; (4) develop a sampling plan; (5) determine the categories from the responses to be divided; and (6) verify the process data based on a reliability check. By elaborating on this process, the data obtained from the in-depth interviews were archived in a Microsoft Excel workbook for subsequent analysis. The interview dialogues were duly analyzed based on the concepts of content analysis in a matrix table format whereby each question was posed against the answers of each interviewee. The interview dialogue could be classified and reduced into more relevant and manageable data as subject themes [28,29]. This method can be applied in a

situation in which information and understanding of issues relevant to the general aims and specific research objectives have been obtained [30]. Hence, for this study, the answers were classified into different groups according to the nature of the content and by capturing the similarities and differences as the main theme. Specifically, this study categorized the identified parties into three main groups, “client,” “contractor,” and “consultant” during the data analysis because these stakeholders play a significant role in delivering a successful project, especially in decision-making and in terms of technical expertise [31].

4. Results and Discussion

Figure 2 illustrates the success factors for implementing D-B public-sector construction projects in Malaysia. In summary, a total of 30 independent variables (i.e., success factors) were identified. Based on the data analysis, the success factors can be categorized into five categories (i.e., underlying factors): ‘client capabilities,’ ‘competency of the construction leader,’ ‘competency of the consultant team,’ ‘organizational behaviour,’ and ‘effective project management system.’ Finally, the five underlying factors can be associated with either “people” or “operational.” Specifically, “people” relates to client capabilities, competency of the construction leader, and competency of the consultant team. Meanwhile, “operational” relates to organizational behavior and effective project management system.

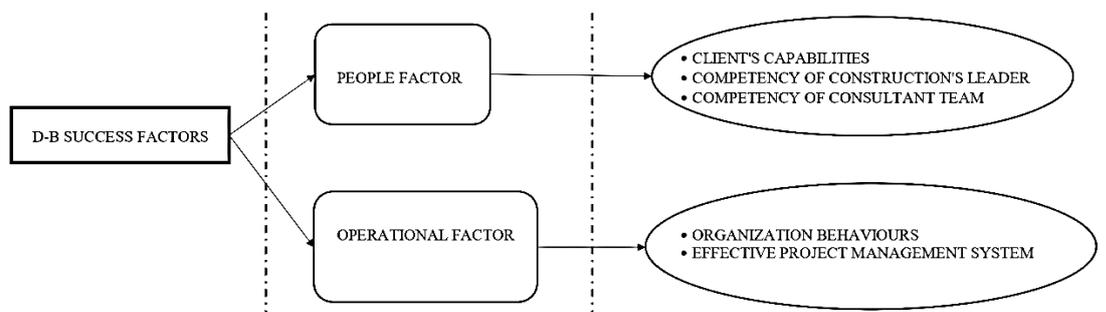


Figure 2: The underlying factors for successful D-B public sectors projects

4.1. Data Analysis

The client can be defined as the person or firm responsible for commissioning and paying for the design and construction of a facility [32]. Clients are also parties that initiate the projects, make decisions, create project objectives, and encourage others to achieve project goals. Therefore, clients play a vital role in determining the successful outcome of a project [40]. The success factors under “client capabilities” are: (1) client’s project management skills; (2) client’s involvement in the project (3) client’s decision-making power; (4) client’s experience and technical skills; (5) client’s ability to brief the project team; (6) client’s ability to provide clear objectives; (7) client’s ability to transfer risk to single point; (8) client’s ability to understand economic factors such as market demand; and (9) client’s knowledge on government policies. The client capabilities are defined as the skills, abilities, and processes needed to develop close relationships with project stakeholders in construction projects [33]. It consists of effective project management skills, the level of involvement in the project, the decision-making power, experience, technical skills, emphasis on the fundamental project criteria such as time, cost and quality, the determination to transfer risk to other party, and the ability to understand the government policy relating to the construction industry. The conception of construction briefs is an essential issue in the construction industry, as the unproductive preparation of briefs significantly increases the total cost of a building. A lack of knowledge of the briefing process has rendered some clients incapable of describing their requirements, resulting in uncertain project objectives [7,34]. Poor decisions during briefings include inadequate involvement of project participants and insufficient time for briefing, which causes delays in the project [35]. Delays are generally regarded as the most common, complex, risky, and most frequently encountered problem in a construction project [35]. Hence, to overcome delay issues, most studies suggested that clients should be able to deliver a good project brief and must be prepared to take an active role in the construction process to prevent gaps

between the requirements that they set and that of other project team members [22]. Other necessary skills required by the client are project management skills to lead, plan, and organize, as well as coordinating skills [7,34,36]. However, any poor decisions made by the project client will cause a delay in the construction works and lead to bad relations between project parties as well as increased costs of the construction project. In other words, client involvement in project decision-making is vital for the smooth running of project activities and is crucial to prevent unnecessary changes to the project. These suggest client capabilities play a crucial role in ensuring the success of implementing D-B in public sector construction projects.

4.2 Competency of the Construction Leader

The construction leader refers to the person who leads the design and construction of the D-B project. From the results of this study, the success factors related to the competency of construction leader are: (1) leader's project management skills; (2) leader's experience; (3) construction leader's capabilities; (4) construction leader's commitment to the project; (5) construction leader's support system from the upper management. Apart from working within the constraints of the project itself, project team leaders should have certain 'human' skills in dealing with stress, in establishing good relationships among team members, and in developing a harmonious working atmosphere [25,37,38,39]. For example, project team leaders are increasingly required to have team-building skills that can increase the project team's effectiveness [40]. Moreover, project leaders should be adaptable to the rapid change in the industry from developments in technology, construction, and property markets, regulations, and socio-economic factors. Finally, project managers' success at managing the project is suggested to be dependent on their competence, particularly their leadership style comprising emotional intelligence, management focus, and intellect [15,41,42]. These prior findings illustrate that the competencies of a project leader play a vital role in ensuring successful construction projects.

4.3 Competency of the Consultant Team

One of the main stakeholders in a construction project is the consultant, also known as the design team. Although the consultant team can leave most of the responsibilities to the client and contractor to operate the entire project, the consultant team is still required to have sufficient design personnel committed to the project. This study's analysis suggests that the success factors under "competency of consultant team" for D-B projects have consultant teams with the appropriate level of experience, capabilities in design works, project management skills, and commitment towards the project. In a nutshell, the success factors for the 'competency of the consultant team' are similar to the success factors for D- B in Sri Lanka, Africa, China, and Singapore. These similarities suggest that the consultant team plays a crucial role in the success of implementing D-B in construction projects. At the pre-construction stage, the consultant team is required to have sufficient resources to define the project fully and to prepare accurate specifications for the tendering job [43]. During the construction stage, in addition to minimizing design discrepancies, consultant design teams are required to supporting other project teams if any technical errors [44]. In other words, in addition to project leaders with adequate project management skills, consultant teams with in-depth understandings of technical construction activities are necessary.

4.4 Organizational Behaviour

Organizational behavior provides an understanding of why people behave as they do in organizations. From the results of this study, the success factors under organizational behaviour are: (1) project team members working together as a group (2) a harmonious working environment; (3) project team members working with confidence; and (4) organizational structure that allows transferring of the decision-making authority to the top management. The core of all successful organizations is the effectiveness with which people work together. Organizations should be able to manage individuals with differing characteristics and personalities to meeting organizational objectives. Construction projects are usually complex and highly differentiated, with a wide range of specialists with diverse professional skills working in a highly integrated way to deliver projects successfully. Therefore, understanding how the people involved in construction behave and work together is necessary for

projects to achieve successful outcomes [31,32]. In other words, having the right organizational behavior is essential in improving the success rate of delivering projects, including D-B projects.

4.5 Effective Project Management System

The D-B approach encourages the adoption of innovative building techniques, which enable the faster delivery of projects [17]. There is a wide range of variables in a project management system of the project's packages offered by the client. The procurement methods have turned out to be an important subject in the construction industry because construction involves a series of processes that are interrelated and sequential, especially the procurement of construction projects [45,46]. In other words, the success or failure of projects depends on the effectiveness and efficiency by which the project management system executes these processes. The six success factors under effective project management system include having processes for: (1) a systematic up-front planning; (2) effective communication; (3) effective control management system; (4) effective team organization; (5) attractive work packages; and (6) reducing a project's level of complexity. These factors are similar to the findings on the critical success factors for implementing D-B in China and Singapore [44]. These similarities suggest that organizational behavior is a critical underlying factor to implement D-B successfully.

5. Conclusion

This study illustrates the success factors for D-B public sector projects in Malaysia by analyzing individual interviews with industry practitioners that have hands-on experience in managing D-B projects. In conclusion, the success factors for D-B public projects in Malaysia involve three main project parties, which are the client, the contractor, and the consultant. Clients must have a clear understanding of the project scope, develop a clear brief, assess the contractor's proposal thoroughly, and develop a clear understanding between project costs, as well as limit any changes during construction. Meanwhile, the contractor must be capable and experienced in managing D-B projects. For consultants, they must have the experience and the capability for design works. Finally, the satisfaction of the people from the project's stakeholder is vital to enhance the work productivity and growth sustainably by the mode of systematic D-B approach. In a more practical sense, the findings from this study highlighted the importance of the success factors required for fulfilling the user requirements, functionality, and workability of the end-products, the reputation of the project, and meeting the allocated time frame and construction costs. This paper contributes a better understanding of the success factors of the D-B project delivery method in Malaysia.

6. References

- [1] Dlamini S 2012 *Relationship of construction sector to economic growth* Proceedings of International Congress on Construction Management Research 26-29 June 2012 Montreal Canada
- [2] Hassanabadi A, Chang A., Wiewiora A, Ashkanasy N, M Jordan, P J and Zolin R 2011 *Manager emotional intelligence and project success: The mediating role of job satisfaction and trust* International Journal of Project Management 34(7) 1112-1122
- [3] Khann R A 2008 *Role of construction sector in economic growth: Empirical evidence from Pakistan economy* Proceedings of 1st International Conference on Construction in Developing Countries 4-5th August 2008 Karachi Pakistan 279-290
- [4] Wibowo A 2009 *The contribution of the construction industry to the economy of Indonesia: A systemic approach* Monograph, Diponegoro University Indonesia
- [5] Ding R., Chen P H, Chew D A and Teo C C 2011 *Critical project management factors of AEC firms for delivering green building projects in Singapore* Journal of construction engineering and management 137(12) 1153-1163
- [6] Khoo M C and Yong Y C 2014 *Factors contributing to project time and hence cost overrun in the Malaysian construction industry* Journal of Financial Management of Property and Construction 19(1) 55-75
- [7] Abdul-Rahman, H Rahim, F A M and Mohd M S 2007 *A study on quality management during*

- the pre-construction stage of design-and-build projects* In CME 25 Conference Construction Management and Economics 753
- [8] Al-Momani 2002 *Causes of construction delay: traditional contracts* International journal of project management 20(1) 67-73
- [9] Chan A P and Kumaraswamy N 2012 *Analysis of factors critical to construction project success in Malaysia* Engineering, Construction and Architectural Management 19(5) 543-556
- [10] Olawale Y A and Sun M 2010 *Cost and time control of construction projects: inhibiting factors and mitigating measures in practice* Construction management and economics 28(5) 509-526
- [11] Chen H L, Buvik M P and Rolfsen M 2015 *Prior ties and trust development in project teams A case study from the construction industry* International Journal of Project Management 33(7) 1484-1494
- [12] Design-Build Institute of America 2016 *Professional's Guide To Managing The Design Phase* (No.14) The Charles Pankow Foundation
- [13] Fredrickson K 1998 *Design guidelines for design-build projects*: Journal of Management in Engineering 14(2) 77-80
- [14] Kumaraswamy M and Dulaimi M 2001 *Empowering innovative improvements through creative construction procurement*: Engineering, Construction and Architectural Management 8(5) 325-334
- [15] Merchant A and Bajaj D 2002 *An analysis of the use of the "Design-Build" project delivery system by interior design firm and its effectiveness in delivering fit-out projects*: Journal of Construction Procurement 8(1) 17-34
- [16] Chan E H and Yu A T 2010 *Design management in design and build projects: The new role of the contractor* In Construction Research Congress 2005: Broadening Perspectives 1-11
- [17] Chan A P and Tam C M 2012 *Factors affecting the quality of building projects in Hong Kong* International Journal of Quality & Reliability Management 17(4/5) 423-442
- [18] Carvalho M M, Patah L A and De Souza Bido D 2015 *Project management and its effects on project success: Cross-country and cross-industry comparisons* International Journal of Project Management 33(7) 1509-1522
- [19] Khairuddin A 2012 *Design and Build and its significance for Malaysia* Commonwealth-Governance and Growth 54-57
- [20] Adnan H, Azmi, W N, S W M Rashid, Z Z A and Yusuwan N M 2018 *Housing Developer's Perspective on Social Sustainability* Malaysian Construction Research Journal (MCRJ) 63
- [21] Doloi, H. 2010 *Cost overruns and failure in project management: Understanding the roles of key stakeholders in construction projects* Journal of construction engineering and management 139(3) 267-279
- [22] Yu A T, Chan E H, Chan D W, Lam P T and Tang P W 2010 *Management of client requirements for design and build projects in the construction industry of Hong Kong* Facilities 28 (13/14) 657-672
- [23] Khang D B and Moe T L 2008 *Success criteria and factors for international development projects: A life-cycle-based framework* Project Management Journal 39(1) 72-84
- [24] Taherdost J P 2015 *Inter-organisational disaster management projects: Finding the middle way between trust and control* International Journal of Project Management 35(5) 889-899
- [25] Clarke N 2010 *The impact of a training programme designed to target the emotional intelligence abilities of project managers* International Journal of Project Management 28(5) 461-468
- [26] Zawawia E, Kamaruzzaman S, Ithnina Z and Zulkarnaina S A 2012 *"Conceptual framework for describing CSF of building maintenance management* The 2nd International Building Control Conference (1) 18-22
- [27] Hwang B G and Lim E S J 2012 *Critical success factors for key project players and objectives: Case study of Singapore* Journal of Construction Engineering and Management 139(2) 204-215
- [28] Riff D, Lacy S, Fico F, Riffe D and Fico F G 2008 *Analyzing media messages: Using quantitative content analysis in research* Routledge 82-92
- [29] Weber R P 1990 *Basic content analysis* (No. 49) Sage 101-125

- [30] Gillham F 2001 *The use of qualitative content analysis in case study research* In Forum: Qualitative Social Research Vol. 7(1) 1-30
- [31] Yong Y C and Mustaffa N E 2010 *Critical success factors for Malaysian construction projects: an empirical assessment* Construction Management and Economics 31(9) 959-978
- [32] Kalkman J P and De Waard E J 2016 *Inter-organisational disaster management projects: Finding the middle way between trust and control* International Journal of Project Management 35(5) 889-899
- [33] Morgan B A, Leonoudakis R and McGraw 2009 *Project Time Management: The Foundation for Effective Resource Management* Available from: http://www.rbryanpeterson.com/files/Project_Time_Management_v2_2_Feb_2009-1.pdf [Assessed on 07/04/2019]
- [34] Slevin J K and Pinto M B 1991 *Determinant of cross-functional cooperation in the project implementation process*: Project Management Journal 22(2) 13-20
- [35] Khairulzan Y and Syahira Nabilah A H 2015 *The significant factors causing delay of building construction projects in Malaysia* Malaysia Construction Journal 20 593-599
- [36] Williams T 2016 *Identifying success factors in construction projects: A case study* Project Management Journal 47(1) 97-112
- [37] Dainty A R, Cheng M I and Moore D R 2005 *Competency-based model for predicting construction project managers' performance* Journal of Management in Engineering 21(1) 2-9
- [38] Edum-Fotwe F T and McCaffer R 2000 *Developing project management competency: perspectives from the construction industry* International Journal of Project Management 18(2) 111-124
- [39] Radzi A R, Bokhari H R, Rahman R A and Ayer, S. K. 2019 *Key Attributes of Change Agents for Successful Technology Adoptions in Construction Companies: A Thematic Analysis* Computing in Civil Engineering 2019: Data, Sensing and Analytics pp. 430-437 Reston VA: American Society of Civil Engineers
- [40] Xia B, Chan A P and Zuo J 2012 *Comparison of Key Competences of Clients and Design-build Contractors in the Construction Market of the People's Republic of China (PRC)* Doctoral dissertation Ceylon Institute of Builders 114-155
- [41] Rahman R A, Alsafouri S, Tang P and Ayer S K 2016 *Building Information Modelling skills for career success* Proceedings of the Academic Interoperability Coalition: 10th BIM Academic Symposium Orlando Florida pp. 35-42
- [42] Rahman R A, Alsafouri S, Tang P and Ayer S K 2016 *Comparing building information modelling skills of project managers and BIM managers based on social media analysis* Procedia Engineering 145 812-819
- [43] Songer A D and Molenaar K R 2010 *Model for public sector design-build project selection* Journal of Construction Engineering and Management 124(6) 467-479
- [44] Palaneeswamy E and Kumaraswamy M 2010 *Knowledge mining of information sources for research in construction management* Journal of Construction Engineering and Management 129(2) 182-191
- [45] Oladinrin T O, Adeniyi O and Eboreime I V 2013 *Analysis of non-excusable delay factors influencing contractors' performance in Lagos state Nigeria* Journal of Construction in Developing Countries 18(1) 53
- [46] Olawale Y A and Sun M 2010 *Cost and time control of construction projects: inhibiting factors and mitigating measures in practice* Construction management and economics 28(5) 509-526

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