

# A Review on Causes of Cost Overrun in the Construction Projects

A M Faten Albthouse<sup>1</sup>, S I Doh<sup>2</sup>

<sup>1,2</sup> Faculty of Civil Engineering & Earth Resources  
Universiti Malaysia Pahang, 26300 Gambang, Pahang, Malaysia

**Abstract-** Cost overrun is a frequent phenomenon in the construction projects in all countries, whether it developed or developing country. This problem is critical issues that affect project success. Thus it requires serious attention from all participants in construction projects to keep the projects in safe mode, to be completed within its limited cost, time and quality. Cost overrun have negative impact in performance of construction projects, that because construction industry is huge and complex. Any problem occurs through the life cycle of project lead to other problem in different parts of project. Through literature review many researchers studies cost overrun and indicated the most causes of cost overruns according to their studies. The current study aims to highlight the most causes of cost overrun in construction projects. These causes are classified into ten main groups according to their sources, namely: Design and contract related factors, Estimation related factors, Planning and Schedule related factors, Project Management related factors, Labor related factors, Financial related factors, Material and Machinery related factors, Construction Phase related factors, Communication Related Factors, External related factors. The importance of current research is to summarize the most important causes of cost overruns in construction projects, thus helping project participants to identify the sources of these factors to address them and mitigate their negative effects.

**Keywords –** Construction Project, Cost Overrun, Project Management

## I. INTRODUCTION

Construction industry is important in all countries of the world, whether they are developed or developing. The construction industry is important source of employment and investments. In addition to that, it provides job opportunities for various industrial occupations. Thus, Construction industry is necessary in every country to provide physical developments which help in improving social and economic needs of country [1]. However, the construction industry facing from different problems that affect in its success and achieving its objectives. The main problem in construction industry as agreed by various numbers of studies is cost overrun. It effect in all phases within project life cycle from first to end. So cost overrun is serious issue in construction projects which need serious attention from all participates in projects. Thus, it is necessary to search about the causes of cost overrun in construction projects to improve the cost performance. Most researchers agreed that cost overrun result from poor cost management. Cost management is important part in construction management, it help the project manager to complete the project within its limited budget. In addition to that it helps to indicate any causes of cost overrun through the life cycle and take the decision to solve it with minimum effect. There are different numbers of causes affected in cost overrun from different origins, which prompted researchers to classify the causes of cost overrun in different groups to make it easy to study. The aim of current paper is to categorize the causes of cost overrun in construction projects through various literature reviews.

## II. LITERATURE REVIEW

### 2.1 Causes of cost overrun in construction projects –

Construction can be considered as a dynamic industry which is constantly facing uncertainties, because building project is multidisciplinary which involved many parties as the project owner and various professionals, contractors and suppliers, manpower and subcontractors, these uncertainties and the many stakeholders in these kinds of projects make the management of costs quietly difficult which consequently causes cost overruns [2]. Cost overrun is the difference between the original cost estimate of the project and actual construction cost on completion of the work [3]. And it can simply explain as a result of one or a combination of several causes which are very important to identify for cost-effective performance [4]. Cost overrun is a major problem in the construction industry where 9 of 10 projects are faced by these overruns which commonly range between 50 to 100% [5].

Cost overrun fluctuated from project to other, this variation due to the fundamental project costs and based on the actual cost of the land, materials, equipment, and labors in the region where the project is being carried out [6]. The results revealed that 9 out of 10 construction projects experienced cost overrun with an average budget overrun of 28% [5]. In Germany, the average cost overrun was 78% [7]. In Canada, the percentage of cost overruns more than 82% [8]. Another study in South Africa reported that cost overrun ranging from 5% to 94% according to their results

[9]. In Zambia, [10] revealed that road project faced by cost overrun with percentage more than 50%. The average cost escalation in Europe was 25.7%, North America 23.6% and other geographical areas was 64.6% [5]. These high percentages encourage many researchers to study about cost overruns and its causes to be managed through the life cycle of construction project to be reduced in the future.

Construction projects suffering from cost overruns, in spite of availability and use of different project management methods and software packages [11]. One of the problems found in construction projects was that most project managers and contractors find difficulty in controlling costs on their construction sites due to a number of problems which include poor project preparation, gaps in management and control, over budgeting, poor materials, labors shortages, increased cost of materials, delays in deliveries, wastage of materials, unexpected weather changes, loss of materials, insecurity and poor communication. This results into cost variation of projects [12]. According to Amoa-Abban & Allotey, the basic costs in construction projects will vary depending on the following factors: The project specification, Location of the building project, New buildings or refurbishment, Timescale, Site characteristics, Inaccurate or poor estimating of original cost, Inflation of project costs, Fluctuation in price of raw materials, Unforeseen site conditions, Insufficient funds, Construction cost under-estimation, Change in foreign exchange rates [6].

The cost overrun is a result of one or a combination of several causes which are very important to identify for cost-effective performance [13]. While the impact factors on cost performance of the project and cause cost overruns are present from the estimating stage to the completion stage of the project [14]. The major causes of the cost overrun in many projects are ineffective construction management and poorly established cost control systems [15]. Poor management considered as one of the most significant resources, it's like men, material and money [16]. Upcoming issues which will increase cost as reported by Peter et al are, the shortage of labor as more and more skilled worker are retiring without new workers to replace them [17]. The causes of cost overrun occurring in a construction project are: Ineffective project governance, management and oversight, Unanticipated site conditions, Late design/poor project definition, Inadequate communications and slow decision making, Weak/ambiguous contract terms and lack of incentive to control costs, In effective decision – making process, Poor risk identification, management and response strategy, Imposed constraints and delayed payment, Skilled labor availability, In experienced management team, Design errors and omissions leading to scope growth and/or re-work, Poor project controls (cost & schedule), Insufficient planning and in accurate estimating [18].

The cost overruns can be classified to a number of factors that are either uncontrollable or, that to are unmanageable in a varying degree, which are as the following: (1) Accuracy of original cost estimate; (2) Degree of government regulation and control; (3) Construction completion delays; (4) Number of design changes; and (5) Labor related matters such as: (a) Availability; (b) Skills, and (c) Increases in fringe benefits [19]. While Saidu et al classified the causes of cost overrun into four groups namely: causes by contractor, causes by consultant, causes by client and other/external causes [20]. Pall et al however classified the causes into two groups namely: non-compensable factors (unavoidable circumstances faced by the project parties due to involvement of external parties or environment) and (ii) compensable factors (circumstances that can be avoided by parties from causing cost overrun) [21]. In addition to that there is another study classified the causes of cost overrun into another two groups as: (i) internal cause and (ii) external cause [22]. Table 1 summarized the groups of causative factors of cost overrun in construction projects from different studies.

Table -1 Group of Causative Factors of Cost Overrun in Construction Projects from Literature Review

Researchers	No. in Groups	Groups of causative factors
[23]	6	Owner, consultant, contractor, material /labor, project and external
[24]	5	Environmental, construction, construction item, cost estimation and financing
[25]	4	Owner, designer, contractor, miscellaneous
[26]	5	Cost estimation, construction item, project participant, environmental and financing
[27]	5	Financial related factors, factors related to construction parties, factors related to construction items, environmental related factors and politics related factors.
[28]	7	Construction phase factors, design factors, financial management related factors, communication related factors, human resource (Labour) related factors, materials and equipment related factors,

		project management related factors.
[29]	7	Client- related factors, Consultant related group, Contractor related factors, Financial management related factors, and Resources (labor, material and equipment) related factors, External factors.
[30]	7	Contract related factors, Time related factors, Cost related factors, Quality related factors, Human related factors, Communication related factors and Risk related factors.
[31]	8	Contractor's site management, Information and communication, Project management and contract administration, Labor related factors, Materials and machinery, External factors, Design and documentation and Financial management.

The current research select ten groups from literature reviews as shown in Figure 1, which namely: design and contract related factors, estimation related factors, planning and schedule related factors, project management related factors, labor related factors, financial related factors, material and machinery related factors, construction phase related factors, communication related factors, external related factors. The discussion of each group summarized in the following sections.

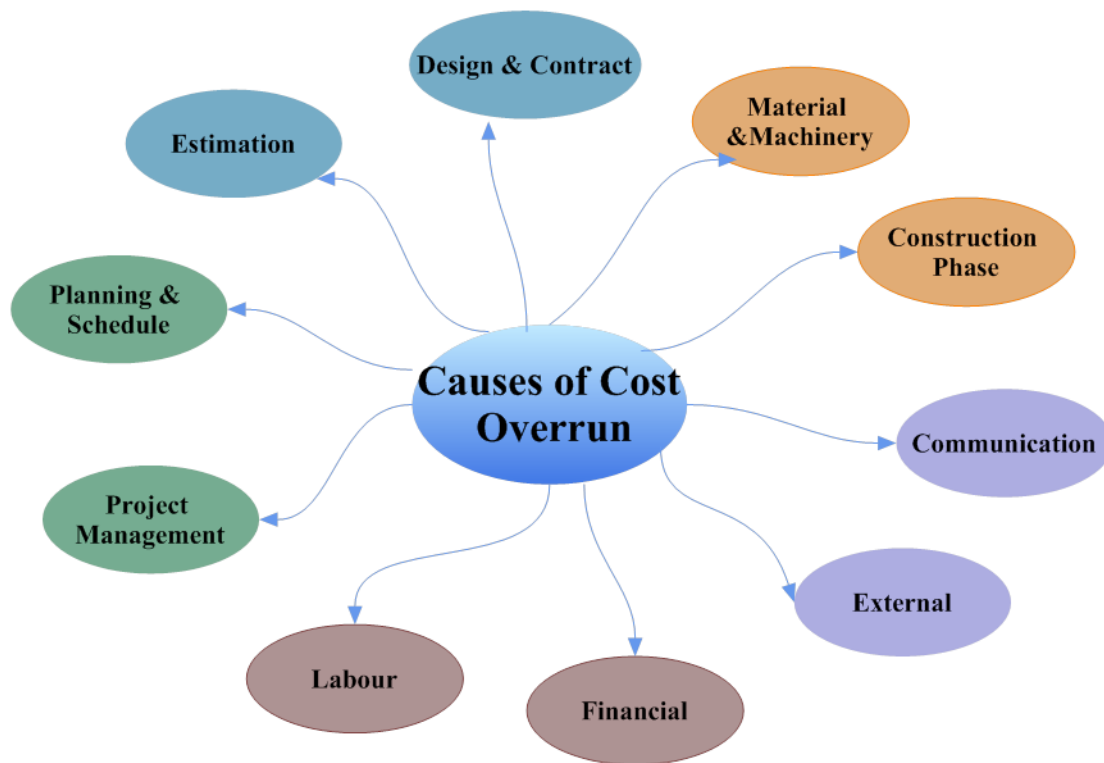


Figure 1. Groups of causes of cost overrun in construction projects

## 2.2. Design and contract related factors –

Design phase is a stage of a project where detailed plan and drawings are prepared [32]. Because of this most researches considered the design stage as important stage through the lifecycle of construction project. Serious attention given to the design stage to avoid cost overrun in construction stage, it have important role in cost performance of projects. The causes of cost overrun due to design plan or project management problems are avoidable because they could have reasonably been foreseen and prevented [33]. Different studies found various number of causes of cost overrun related to design stage, as: mistakes in design [34, 35], frequent design changes [11, 29, 36, 37, 38], design development and incomplete design at the time of tender [39], an inadequate pre-construction study [40], lack of coordination at design phase [41], lowest bidding procurement method [33, 42], short bid preparation time [43]. The critical factors of cost overrun in the design phase are: inadequate planning and

scheduling, lack of experience, lack of communication between parties, change in the scope of the project, and delays in decision making [32].

### *2.3. Estimation related factors –*

Estimation is defined as a process of predicting and forecasting the time, cost and other resources needed to accomplish the project objective [44]. Estimation is a technical process of predicting the cost of implementing activities in order to accomplish the set objectives of the construction project within a particular time period [45]. The cost and time of the construction projects should be estimated to plan the funds of project. Estimation process needs efficient information about the project and its need in addition to good background about the cost of material, equipment and labor. The accuracy estimate is important to give realistic estimate of cost and time. Accuracy of estimation affected by a number of factors that recommended by Azman et al are: project size, number of bidders, location and types of project, contract period, design scopes, cost data, location, and others [46]. According to the various studies the causes of cost overrun result from estimation process summarized as: underestimate project duration [47], poor estimation of the original project cost [34], wrong method of estimation [48, 49], inaccurate quantity take-off [50, 51, 52], underestimate the construction cost by quantity surveyors [34]. Alumbugu et al [53] stated that the most influencing factor affecting the accuracy of pre-tender cost estimate is the experience and skill level of the estimator.

### *2.4. Planning and schedule related factors –*

Project need planning involves all process in construction project through all stages in lifecycle of project in preconstruction and construction stages. Planning of project have seven process, which are: defining project objectives, identifying activities, establishing precedence relationships, making time estimates, determining project completion time, comparing project schedule objectives and determining resource requirements to meet objectives [54]. The main objective of the project planning is to achieve a number of common factors including the production of realistic schedules and costs, the completion of a project to defined standards of quality, design criteria, project resources, health and safety, and meeting project stakeholders' expectations [55]. To ensure the success of construction project planning there are three factors influencing planning as pointed by [56], which are: (1) investing enough planning time before work on-site, (2) reduce emphasis on developing schedules for monitoring and controlling of project progress, and (3) increase emphasis on developing operational plans for project implementation. The causes of cost overrun related to planning and schedule as stated by a number of researchers are: inadequate planning by constructor [57], lack of cost reports planning/ monitoring during pre and post contract stages [58], inadequate planning and scheduling [29, 33, 35, 4], planning and scheduling deficiencies [59], lack of cost planning and monitoring of funds [60]. A study in Oman addressed a number of construction projects were also found to be subject to schedule delays by more than 40% beyond their original schedule plans [61].

### *2.5. Project management related factors –*

Project management tools and techniques play an important role in the effective management of a project [62]. Through literature review it is appear that project management responsible about success of project in construction industry. Construction project have huge works which needed huge numbers of equipment, materials and labours. All these need to manage and control. Cost management is important part to improve the cost performance in construction projects. Cost management considered as vital part in project management that targeted to achieve efficient cost performance through efficient project planning and execution within the limited budget of the project [63]. Causes of cost overrun related to management identified by different researchers as: poor site management and supervision [23, 37, 38, 4], poor contractor management [48, 59, 64], lack of project management support [37], consultant poor contract management [23], availability of management finance and plans [65], poor contract management practices [66], contract management [48]. Another study by Qureshi et al [67] commented that project management leadership has a significant impact on project management performance.

### *2.6. Labor related factors –*

Building project is multidisciplinary which involved many parties as the project owner and various professionals, contractors and suppliers, manpower and subcontractors, as confirmed by Arcila [2] construction can be considered as a dynamic industry which is constantly facing uncertainties, these uncertainties and the many stakeholders in these kinds of projects make the management of costs difficult which consequently causes cost overruns. A number of researchers indicated different issues causes cost overrun in construction projects related to labour as: wages of labour and services [6], poor performance of subcontractors [11, 4], shortage of site workers and labour productivity [38, 68], shortage of skilled labour [9], unavailability of competent personnel [68], poor relationship

between top management & labors [13]. Peter & Morris reported that, upcoming issues which will increase cost are, the shortage of labor as more and more skilled worker are retiring without new workers to replace them.

### *2.7. Financial related factors –*

Clients sometimes do not have enough funds to complete their projects and more often than not, do not pay contractors on time as agreed in the contract agreement [6]. Inadequate funds for project financing as one of factors affected in cost overrun [34]. In addition to that, there are different factors affected in cost overrun which related to financial issue as: delay in progressive payment [36, 68, 69], economic stability [24], mode of financing [24], consultant financial difficulties of owner [23, 37], inconsistent cash flows [35], payment problems faced by contractor [70], funding problems were critical for causing cost variation [25], foreign currency fluctuations [71], monthly payment difficulties [59].

### *2.8. Materials and machinery related factors –*

Construction materials account for over half of the final cost of house building while the cost of labor account for less than third, and overheads and profit stand for the rest [72]. Inflation of materials, equipment and labour costs may vary geographically within the country and contracts between sub-contractors and suppliers may involve different inflation protection terms as agreed with the client. As inflation increases, interest rates also increase and the project costs will also increase [6]. The factors affected in cost overrun related to materials and machinery as stated by various studies are: fluctuations in the cost of building materials [27, 29, 48, 49, 58], fund constraints by government party [73], material cost increase by inflation [29, 52], high cost of machineries [33], supply of raw materials and equipment by contractors and project materials monopoly by some suppliers [50].

### *2.9. Construction related factors –*

Construction projects go through a continuous cycle of creation, storage, manipulation, transmission, reformation, revision and application of information [74]. Construction process can prove to be a difficult task due to frequent exchanging of information between major team professionals such as project managers, architects, contractors, quantity surveyors and engineers because of the geographical locations between project and professional team [75]. Through construction stage there are a number of causes of cost overrun indicated by different studies, which are: delay in construction [76], complexity of works [11], mistakes during construction [38], changes in scope of the project [60, 77, 78], additional works [79], additional costs due to variations work [80], lack of experience of technical consultants Schedule delay and change [81], lack of monitoring of work progress by contractor [47], errors during construction process resulting reworks [13], poor construction adopted by constructor [68], high transportation cost [82]. The major factors affecting the construction phase are communication across the board, contractor experience, management and supervision of the project activities, poor labour skill and productivity, change in design and material specifications during the construction process, and conflict of interest between professionals [83].

### *2.10. Communication related factors –*

Communication skills is one of the skills that the team involved in the construction management of the project, must ideally have it. Construction projects have a large number of human sources which need good process of communication between all parties involved within it to avoid any conflicts that may influence in construction project. Communication is one of the major factors affecting the construction phase [75, 83, 84, 85, 86]. In addition to other factors stated by various studies as: lack of communication and coordination among key construction stakeholders [47, 68, 69], poor communication between construction parties [69], poor communication [52], conflict among project participants [43].

### *2.11. External related factors –*

Construction projects affected by a number of external factors which influencing in cost overrun as mentioned by various researchers which summarized as: unpredictable weather conditions [52, 58]; delay in forest clearance [73], fund constraints by government party [57], frequent stormy weather due to heavy rains and the resulting floods [10], terrain conditions and emergency works [87], fraudulent practices [24, 49], unsupportive government policies [33], bribery and corruption [88], political instability [71], land acquisition and resettlement [35], delay in forest clearance [57].

### III. CONCLUSION

Cost overrun in construction projects was a result of various numbers of causes from different sources. These causes of cost overrun found in all phases through the lifecycle of construction projects. The current study collected the most causes of cost overrun in various researches, the result of the study classified the causes of cost overrun into ten groups, namely: design and contract related factors, estimation related factors, planning and schedule related factors, project management related factors, labor related factors, financial related factors, material and machinery related factors, construction phase related factors, communication related factors, external related factors. The results of current study will help to indicate the source of the causes of cost overrun, and then take the suitable decisions to reduce or avoid it within its source in construction projects.

### IV. REFERENCES

- [1] M. Abedi, M. F. Mohamad, and M. S. Fathi, "Major Mitigation Measures for Delays in Construction Projects", *The First Iranian Students Scientific Conference in Malaysia, UPM., Malaysia*, 2011.
- [2] S. G. Arcila and M. Newton, "Avoiding Cost Overruns in Construction Projects in the United Kingdom," Master thesies, University of Warwick Warwick Manufacturing Group, 2012.
- [3] I. Choudhury, and O. Phatak, "Correlates of Time Overrun in Commercial Construction," ASC Proceedings of the 40th Annual Conference Brigham Young University - Provo, Utah April 8 - 10, 2004.
- [4] I. Abdul Rahman, F. H. Memon and A. T. Abd Karim, "Significant factors causing cost overruns in large construction projects in Malaysia", *Journal of Applied Science*, 13(2), 286-293., 2013.
- [5] B. Flyvbjerg, H. Skamris, K. Mette, & S. L. Buhl, "How Common and How Large are Cost Overruns in Transport Infrastructure Projects?", *Transport reviews*, 23(1), 71-88, 2003.
- [6] K. Amoa-Abban and S. Allotey, "Cost overruns in building construction projects: A case study of a government of Ghana project in Accra", *Developing Country Studies*, 4(24), 54-64, 2014.
- [7] G. Kostka and J. Fiedler, "Large infrastructure projects in Germany: A cross-sectoral analysis", Springer, 2016.
- [8] O. James, "Do reforms reduce the magnitudes of cost overruns in road projects? Statistical evidence from Norway", *Transportation Research Part A: Policy and Practice*, 65, 68-79, 2014.
- [9] L. Baloy and M. Bekker, "Causes of construction cost and time overruns: The 2010 FIFA World Cup stadia in South Africa," *Acta Structilia*, 18(1), 51-67, 2011.
- [10] C. Kaliba, M. Muya and K. Mumba, "Cost escalation and schedule delays in road construction projects in Zambia", *International journal of project management*, 27(5), 522-531, 2009.
- [11] Y. A. Olawale, & M. Sun, "Cost and Time Control of Construction Projects: inhibiting factors and mitigating measures in practice", *Construction Management and Economics*, 28(5), 509-526, 2010.
- [12] M. P. S. Chougule, D. Desai & A. Gupta, "A Review Paper on the Analysis of Cost Variation Between Estimated Cost and Actual Cost of Building Project", *Imperial Journal of Interdisciplinary Research*, 3., 2017.
- [13] A. H. Memon, I. A. Rahman, A. A. Aziz, V. Kumarason, & N. I. M. Hanas, "Identifying Construction Resource Factors Affecting Construction Cost: Case of Johor", *Paper presented at the Malaysian Technical Universities International Conference on Engineering & Technology*, 2011.
- [14] D. Baloi & A. D. F. Price, "Modelling global risk factors affecting construction cost performance", *International Journal of Project Management*, 21, 261-269, May, 2003.
- [15] I. R. Endut, "Framework for minimising time overruns of Malaysian construction projects", Glasgow Caledonian University, 2008.
- [16] S. Durdjev, S. Ismail & N. A. Bakar, "Factors Causing Cost Overruns in Construction of Residential Projects: case study of Turkey", *International Journal of Science and Management*, 1, 3-12, 2012.
- [17] P. Morris & W. F. Willson, "Measuring and Managing Cost Escalation", *AACE International Transactions CSC*, 6, 2006.
- [18] C. Ramanathan, S. P. Narayanan & A. B. Idrus, "Construction Delays Causing Risks on Time and Cost-a critical Review", *Construction Economics and Building*, 12, 37-57, 2012.
- [19] P. Reina & W. J. Angelo, "Megaprojects Need More Study up Front to Avoid Cost Overruns", *ENR*, 249, 2002.
- [20] I. Saidu & W. Shokantun, "An Investigation into Cost Overruns for Ongoing Building Projects in Abuja, Nigeria", *Acta Structilia*, 24(1), 53-72, 2017.
- [21] G. K. Pall, A. J. Bridge, M. Skitmore & J. Gray, "Comprehensive Review of Delays in Power Transmission Projects", *IET Generation, Transmission & Distribution*, 10(14), 3393-3404, 2016.
- [22] S. M. Ahmed, S. Azhar, P. Kappagantula & D. Gollapudil, "Delays in Construction: A brief Study of the Florida Construction Industry", *Paper presented at the Proceedings of the 39th Annual ASC Conference, Clemson University, Clemson, SC*, 66, 2003.
- [23] L. Le-Hoai, Y. D. Lee & J. Y. Lee, "Delay and cost overruns in Vietnam large construction projects: A comparison with other selected countries", *KSCE Journal of Civil Engineering*, 12(6), 367-377, 2008.
- [24] O. J. Ameh, A. A. Soyngbe & K. T. Odusami, "Significant Factors Causing Cost Overruns in Telecommunication Projects in Nigeria", *Journal of Construction in Developing Countries*, 15(2), 49-67, 2010.
- [25] R. F. Aziz & S. M. Hafez, "Applying Lean Thinking in Construction and Performance Improvement", *Alexandria Engineering Journal*, 52(4), 679-695, 2013.
- [26] Z. T. Zewdu & G. T. Aregaw, "Causes of Contractor Cost Overrun in Construction Projects: The case of Ethiopian construction sector", *International Journal of Business and Economics Research*, 4(4), 180-191, 2015.
- [27] M. A. Kasimu, "Significant Factors that Causes Cost Overruns in Building Construction Project in Nigeria", *Interdisciplinary Journal of Contemporary Research in Business*, 3(11), 775-780, 2012.
- [28] O. Maki, "Causes of Cost-overrun in Construction Projects", *Qatar University. Unpublished thesis*, 2016.
- [29] G. A. Bekr, "Identifying Factors Leading to Cost Overrun in Construction Projects in Jordan", *Journal of Construction Engineering, Technology and Management Vol 5:3*, 2015.

- [30] G. Polat, F. Okay & E. Eray, " Factors Affecting Cost Overruns in Micro-scaled Construction Companies ", *Procedia Engineering*, 85, 428-435, 2014.
- [31] A. A. Ade, H. M. Aftab, A. Ismail & T. A. Ahmad, " Controlling Cost Overrun Factors in Construction Projects in Malaysia ", *Journal of Applied Science, Engineering and Technology*, 5, 2621-2629, 2013.
- [32] N. Roslan, N. Y. Zainun and A. H. Memon, " Relevancy of Factors and Mitigation Measures in Controlling Time and Cost Overrun Towards Malaysian Environment ", *Applied Mechanics and Materials*, 773, 1007-1011, 2015.
- [33] N. Azhar, R. U. Farooqui & S. M. Ahmed, " Cost overrun factors in construction industry of Pakistan ", *First International Conference on Construction In Developing Countries (ICCIDC-I)* "Advancing and Integrating Construction Education, Research & Practice, 4-5, 2008.
- [34] A. S. Ali & S. N. Kamaruzzaman, " Cost Performance for Building Construction Projects in Klang Valley ", *Journal of Building Performance*, 2010.
- [35] A. R. Nasir, H. F. Gabriel, & R. M. Choudhry, " Cost and Time Overruns in Highway Projects of Pakistan ", *Sixth International Conference on Construction in the 21st Century, Kuala Lumpur, Malaysia*, 2011.
- [36] A. Alghonamy, " Cost Overrun in Construction Projects in Saudi Arabia: Contractors' Perspective", *International Journal of Engineering & Technology, IJET-IJENS*, 15(4), 35-42, 2015.
- [37] N. D. Long, S. Ogunlana, T. Quang & K. C. Lam, " Large Construction Projects in Developing Countries: A case Study From Vietnam ", *International journal of project management*, 22(7), 553-561, 2004.
- [38] H. A. M. Abusafiya & S. M. A. Suliman, " Causes and Effects of Cost Overrun on Construction Project in Bahrain: Part I ", *Modern Applied Science*, 11(7), 20, 2017.
- [39] S. Jackson, " Project Cost Overruns and Risk Management ", *Proceedings of Association of Researchers in Construction Management 18th Annual ARCOM Conference*, Newcastle, Northumbria University, UK, 2002.
- [40] Y. I. Park & T. C. Papadopolou, " Causes of Cost Overruns in Transport Infrastructure Projects in Asia: their significance and relationship with project size ", *Built Environment Project and Asset Management*, 2(2), 195-216, 2012.
- [41] H. Danso & J. K. Antwi, " Evaluation of the Factors Influencing Time and Cost Overruns in Telecom Tower Construction in Ghana ", *Civil and Environmental Research*, 2(6), 15-25, 2012.
- [42] R. F. Aziz, " Factors Causing Cost Variation for Constructing Wastewater Projects in Egypt ", *Alexandria Engineering Journal*, 52(1), 51-66, 2013.
- [43] K. C. Iyer & K. N. Jha, " Factors Affecting Cost Performance: Evidence from Indian Construction Projects ", *International Journal of Project Management*, 23, 283-295., 2005.
- [44] E. W. Larson & C. F. Gray, " Project Management: The Managerial Approach ", *McGraw-Hill*, 2011.
- [45] A. Akintoye, " Analysis of Factors Influencing Project Cost Estimating Practice ", *Construction Management & Economics*, 18(1), 77-89, 2000.
- [46] M. A. Azman, Z. Abdul-Samad & S. Ismail, " The Accuracy of Preliminary Cost Estimates in Public Works Department (PWD) of Peninsular Malaysia ", *International Journal of Project Management*, 31(7), 994-1005, 2013.
- [47] A. H. Memon, I. R. Rahman, M. R. Abdullah & A. A. A. Azis, " Factors Affecting Construction Cost Performance in Project Management Projects Perspective of Project Management Consultant ", *Int. J. Sustain. Constr. Eng. Technol*, 1, 30-35, 2010.
- [48] F. P. Eshofonie, " Factors Affecting Cost of Construction in Nigeria ", *Unpublished M. Sc. thesis, University of Lagos, Akoka*, 2008.
- [49] A. Omoregie & D. Radford, " Polycentric Cultural Framework for Infrastructure Procurement in Nigeria ", *Proceedings 22nd Annual ARCOM Conference. Association of Researchers in Construction Management*, 2006.
- [50] A. Enshassi, J. Al-Najjar & M. Kumaraswamy, " Delays and Cost Overruns in the construction projects in the Gaza Strip ", *Journal of Financial Management of Property and Construction*, 14, 126-151, 2009.
- [51] A. S. Belachew, W. J. Mengesha, & M. Mohammed, " Causes of Cost Overrun in Federal Road Projects of Ethiopia in Case of Southern District ", *American J. Civil Engineering*, 5, 27, 2017.
- [52] G. J. Sweis, R. Sweis, M. A. Rumman, R. A. Hussein & S. E. Dahiyat, " Cost Overruns in Public Construction Projects: the case of Jordan ", *Journal of American Science*, 9, 134-141, 2013.
- [53] P. O. Alumbu, W. A. Ola-awo, I. Saidu, M. M. Abdullahi & A. Abdulazeez, " Assessment of the Factors Affecting Accuracy of Pre-tender Cost Estimate in Kaduna State, Nigeria ", *J Environ Sci, Toxicol Food Technol*, 8, 19-27, 2014.
- [54] R. S. Russell & III. B. W. Taylor, " Operation Management ", Fourth. In: NJ: Prentice Hall, 2003.
- [55] A. Baldwin & D. Bordoli, " Handbook for Construction Planning and Scheduling ", John Wiley & Sons, 2014.
- [56] O. O. Faniran, J. O. Oluwoye, & D. J. Lenard, " Interactions Between Construction Planning and Influence Factors ", *Journal of Construction Engineering and Management*, 124(4), 245-256, 1998.
- [57] A. A. Salunkhe & R. S. Patil, " Effect of Construction Delays on Project time Overrun: Indian Scenario ", *Int. J. Res. Eng. Technol*, 3(1), 543-547, 2014.
- [58] G. V. Naveenkumar & V. Prabhu, " Factors Influencing Time and Cost Overruns in Construction Projects ", *International Journal of Innovative Research in Science, Engineering and Technology* 5 (4), 6468-6473, 2016.
- [59] Y. Frimpong, J. Oluwoye & L. Crawford, " Causes of Delay and Cost Overruns in Construction of Groundwater Projects in a Developing Countries; Ghana as a case study ", *International Journal of Project Management*, 21(5), 321-326, 2003.
- [60] M. S. Ramabodu & J. J. P. Verster, " Factors Contributing to Cost Overruns of Construction Projects ", *Proceeding of the 5th Built Environment Conference*, 2010.
- [61] A. S. Alnuaimi & M. Mohsin, " Causes of Delay in Completion of Construction Projects in Oman ", *International Conference on Innovations in Engineering and Technology*, 2013.
- [62] Y. Frimpong & J. Oluwoye, " Significant Factors Causing Delay and Cost Overruns in Construction of Groundwater Projects in Ghana ", *Journal of Construction Research*, 4(02), 175-187, 2003.
- [63] K. Divakar & J. Britto, " Factors Affecting Effective Implementation Of Cost Management Process In Construction Industry ", *International Research Journal of Engineering and Technology*, 2018.
- [64] P. A. Koushki, K. Al - Rashid & N. Kartam, " Delays and Cost Increases in the Construction of Private Residential Projects in Kuwait ", *Construction Management and Economics*, 23, 285- 294, 2005.
- [65] Z. S. Al-Khaldi, " Factors Affecting the Accuracy of Construction Costs Estimating in Saudi Arabia ", *King Fahd University of Petroleum & Minerals*, 1999.
- [66] N. R. Mansfield, O. O. Ugwu & T. Doran, " Causes of Delay and Cost Overruns in Nigerian Construction Projects ", *International Journal of Project Management*, 12(4), 254-260, 1994.

- [67] T. M. Qureshi, A. S. Warraich & S. T. Hijazi, " Significance of Project Management Performance Assessment (PMPA) Model ", *International Journal of Project Management*, 27(4), 378-388, 2009.
- [68] D. S. Tejale, S. D. Khandekar & J. R. Patil, " Analysis of Construction Project Cost Overrun by Atatistical Method ", *International Journal of Advance Research in Computer Science and Management Studies*, 2015.
- [69] A. Alhomidan, " Factors Affecting Cost Overrun in Road Construction Projects in Saudi Arabia ", *International Journal of Civil & Environmental Engineering*, 13, 1-4, 2013.
- [70] A. Manthar, S. A. Mangi, S. Sohu, Q. B. Jamali & K. Ullah, " Major Factors of Budget Overrun in Construction of Road Project of Sindh, Pakistan ", *Engineering Science and Technology International Research Journal*, 2017.
- [71] S. A. Ahmad, U. H. Issa, M. A. Farag & L. M. Abdelhafez, " Evaluation of Risk Factors Affecting Time and Cost of Construction Projects in Yemen ", *International Journal of Management (IJM)*, 4(5), 168-178, 2013.
- [72] P. A. Stone, & W. J. Reiners, " Organization and Efficiency of the House-building Industry in England and Wales ", *The Journal of Industrial Economics*, 2(2), 118-134, 1954.
- [73] A. A. Salunkhe, & R. S. Patil, " Effect of Construction Delays on Project Time Overrun: Indian scenario ", *Int. J. Res. Eng. Technol*, 3(1), 543-547, 2014.
- [74] D. Scott, M. Cheong, & H. Li, " Web-based Construction Information Management System ", *Construction Economics and Building*, 3(1), 43-52, 2012.
- [75] S. L. Chan, & N. N. Leung, " Prototype Web-based Construction Project Management System ", *Journal of Construction Engineering and Management*, 130(6), 935-943, 2004.
- [76] A. Enshassi, M. Kumaraswamy, & J. Al-Najjar, " Significant Factors Causing Time and Cost Overruns in Construction Projects in the Gaza Strip ", *Contractors' perspective. International Journal of Construction Management*, 10(1), 35-60, 2010.
- [77] L. J. Khabisi, " Causes and Effects of Cost Overruns in Public Sector Construction Projects in South Africa.", *University of Johannesburg*, 2013.
- [78] J. K. Lee, " Cost Overrun and Cause in Korean Social Overhead Capital Projects: Roads, Rails, Airports, and Ports.", *Journal of Urban Planning and Development*, 134(2), 59-62, 2008.
- [79] A. S. T. Chang, " Reasons for Cost and Schedule Increase for Engineering Design Projects.", *Journal of Management in Engineering*, 18(1), 29-36, 2002.
- [80] F. Nega, " Causes and Effects of Cost Overrun on Public Building Construction Projects in Ethiopia..", *Unpublished doctoral dissertation, Addis Ababa University, Ethiopia*, 2008.
- [81] A. S. Belachew, W. J. Mengesha & M. Mohammed, " Causes of Cost Overrun in Federal Road Projects of Ethiopia in Case of Southern District.", *American J. Civil Engineering*, 5, 27, 2017.
- [82] Y. K. Patil & P. P. Bhangale, " Investigation of Factors Influencing Cost Overrun in High Rise Building Construction.", *Int. J. Latest Trends in Engineering and Technology*, 6, 338, 2016.
- [83] A. Dubois & L. E. Gadde, " The Construction Industry as A loosely Coupled System: Implications for Productivity and Innovation.", *Construction Management & Economics*, 20(7), 621-631, 2002.
- [84] S. Bertelsen, " Construction Management in a Complexity Perspective.", *1st International SCRI Symposium, Salford, UK*, 2004.
- [85] S. Cicmil, & D. Marshall, " Insights into Collaboration at the Project Level: Complexity, Social Interaction and Procurement Mechanisms.", *Building Research & Information*, 33(6), 523-535, 2005.
- [86] P. F. Kaming, P. O. Olomolaiye, G. D. Holt & F. C. Harris, " Factors Influencing Construction Time and Cost Overruns on High-rise Projects in Indonesia.", *Construction Management & Economics*, 15(1), 83-94, 1997.
- [87] N. Al-Hazim & Z. A. Salem, " Delay and Cost Overrun in Road Construction Projects in Jordan.", *International Journal of Engineering & Technology*, 4(2), 288, 2015.
- [88] O. A. M. El Nawawy & A. M. Abdel-Alim, " Identification and Assessment of Risk Factors Affecting Construction Projects.", *HRBC Journal*, 13(2), 2017.