

# The Implementation of Earned Value Management (EVM) to Control Project Performance in the Construction Industry in Sumatera Utara

Muhammad Athallasyah, Dwifitra Jumas\*, Wahyudi P Utama, Martelius Peli, Khadavi  
Master of Civil Engineering, Faculty of Civil Engineering and Planning, Bung Hatta University  
\*Correspondence author: dwifitraj@bunghatta.ac.id

**Abstract**— One of the vital activities contributing to economic development in the province of North Sumatra is the construction industry. The construction industry includes the construction of structures such as roads, bridges, repair work, and maintaining building safety. Additionally, this construction industry involves metal work, electrical, mechanical, architectural, and other related projects to ensure each project can be completed according to its main objectives. This research aims to analyze the obstacle factors in implementing the earned value management method on construction projects at the North Sumatra Province Highways and Construction Department and to analyze the determining factors for the success of implementing the earned value management method on construction projects at the North Sumatra Province Highways and Construction Department. The research method used is a combination of quantitative methods and qualitative methods by collecting data through questionnaires and then exploiting them descriptively to analyze the data. The number of respondents was 76 people with several job criteria. The results of the analysis can be concluded that the most dominant obstacle factor is the lack of adequate training and experience for project managers, with an average value of 4.02 and a standard deviation of 0.87. The highest success factor in implementing EVM in the region is “efficient procedures & processes for EVM implementation”, which received a mean value of 4.39 and a standard deviation of 0.86.

**Keywords**—Earned Value Management, Construction Projects, North Sumatra.

## I. INTRODUCTION

The construction industry is one of the vital activities contributing to economic and social development in North Sumatra. As reported in the 2023 North Sumatra Central Statistics Agency report, the economy of North Sumatra in the third quarter of 2023 experienced growth of 2.00 percent compared to the previous quarter. In terms of production, the highest growth was in the Construction Business Field at 4.46 percent. In terms of expenditure, the goods and services export component was the component that experienced the highest growth at 6.14 percent.

The construction industry is one of the main contributors to the country's economy. The construction industry includes building structures such as roads, bridges, repair work, as well as maintaining the safety of buildings. In addition, this construction industry involves metal work, electrical, mechanical, architectural and other related projects to ensure each project can be completed according to its main objectives (Zulkefli et al., 2017).

However, projects may face obstacles and pressure due to various factors, such as project time, costs that exceed budget, and safety, health and environmental issues (Zulkefli et al., 2017). Projects are carried out within time, budget and quality constraints, so project managers must control and manage the project to ensure project completion within predetermined limits (Nkiwane et al., 2016). Project managers must understand key indicators of success and failure as a guide in analysis and prevention for future projects (Gomarn & Pongpeng, 2018). Additionally, lack of effective monitoring and control will affect overall project performance. Therefore, an accurate and useful approach is needed that takes uncertainty

into account as a warning to detect problems during project progress (Ibrahim et al., 2019).

EVM is a method used to determine the progress of a project that is greater or smaller than the budgeted budget or faster or slower than a predetermined schedule. Apart from that, EVM can also provide information regarding the position of project progress within a certain time period and can estimate project progress in the next period both in terms of costs and project completion time. It is hoped that by using EVM the project can be completed on time and according to the budget. The concept of earned value (Earned Value Management) is a development of the Concept of Variance Analysis. In Variance Analysis, only some of the work results at the reporting time are shown compared to the budget or schedule. The weakness of the Variance Analysis method is that it only analyzes cost and schedule variations separately so that it cannot reveal performance problems on a project. Meanwhile, using the Results Value Concept method, the performance of activities being carried out can be known and can increase effectiveness in monitoring project activities. Currently, many large projects in Indonesia are experiencing problems during their implementation. During project work, control is needed regarding the time and cost aspects of planning. Therefore, this is the background for the writer to raise this problem as the topic of this final assignment.

## II. RESEARCH METHODS

This research uses quantitative, qualitative and mixed methods methodology which explains the involvement of numerical data which generally interprets mathematical formulas to test theories and hypotheses about nature (Ahmed et al., 2016). The selection topic will determine the use of

quantitative methods. Researchers must narrow it down and focus on the problem; it requires a careful review of the literature and developing hypotheses generally derived from social theory (Choy, 2014).

Qualitative methods obtain information from non-numerical forms such as focus group diaries (Ahmed et al., 2016), open questionnaires, unstructured interviews and unstructured observations (Abas, 2015; Choy, 2014). Usually descriptive data is difficult to analyze compared to quantitative data. Usually used for case studies, it helps researchers to find out more about the actual situation at the location (Ismail, 2018). Quantitative methods also allow researchers to access participants' thoughts and feelings based on their experiences (Sutton & Austin, 2015). However, it is challenging to identify patterns and sequences (Buchanan & Bryman, 2007).

This method is a combination of quantitative and qualitative methods in a single study (Ahmed et al., 2016), which potentially provides a better opportunity to achieve greater insights (Buchanan & Bryman, 2007). After the data is collected through a questionnaire, it is exploited descriptively to analyze the data. Macdonald & Headlam, (1999), describes statistical analysis as a mathematical method of interrogative data, to summarize and analyze data obtained from questionnaires to make it more useful and reliable. In general, there are two types of statistical analysis such as descriptive and inferential. Descriptive statistics will check things like mean and standard deviation. It is used to determine the important features of the population, intended sample or calculated obtained sample. Inferential statistics are used to establish relationships between variables and draw conclusions based on a sample to the population (Sekaran, 2003).

For this study, descriptive statistics were used to describe respondent characteristics and answer specific research questions. Ordinal data should not be treated as interval data and a recorded hierarchy is considered appropriate for the descriptive nature of the results (Emuze, 2011). The Statistical Package for the Social Sciences (SPSS) was used to produce statistical analyzes for this study. Demographic analysis is used to produce data for part (A) which consists of respondent information by producing data through frequency tables and graphs. For part (B) the table will use descriptive analysis and explain the mean and standard deviation for each component and finally a reliability test will be obtained to ensure data consistency. The level of agreement on the barriers and success factors of Earned Value Management (EVM) was interrogated via a Likert scale. Next, the average score is calculated based on the scores answered by respondents. In addition, the average score presents an overview of the data by measuring the average score and central tendency (Sekaran, 2003). The Likert scale is an instrument used to record respondents' level of agreement or disagreement which can range between 1-5 according to the statement/question/item being measured (Murray, 2013). It is a popular instrument for measuring constructs such as attitudes, images and opinions collected from respondents (Wu, 2007).

Likert scale data produces an average score for each answer responded to by the respondent. The average score presents an overview of the data with the average score and central tendency (Sekaran, 2003).

Interpretation Table of Likert Scales for Agreement

Interpretation	Scale	Calculation Average Range	Average Range
Strongly Disagree	1	$\frac{1+2}{2} = 1.50$	1.00-1.50
Disagree	2	$\frac{2+3}{2} = 2.50$	1.51-2.50
Somewhat Disagree	3	$\frac{3+4}{2} = 3.50$	2.51-3.50
Agree	4	$\frac{4+5}{2} = 4.50$	3.51-4.50
Strongly Agree	5	$\frac{5}{1} = 5.00$	4.51-5.00

### III. FORMULATION OF THE PROBLEM

1. What are the obstacles in implementing the earned value management method on construction projects at the North Sumatra Province Highways and Construction Department.
2. What are the success factors in implementing the earned value management method on construction projects at the North Sumatra Province Highways and Construction Department.

### IV. RESEARCH PURPOSES

1. Analyze the obstacle factors in implementing the earned value management method on construction projects at the North Sumatra Province Highways and Construction Department.
2. Analyze the determining factors for the success of implementing the earned value management method on construction projects at the North Sumatra Province Highways and Construction Department.

### V. RESULTS AND DISCUSSION

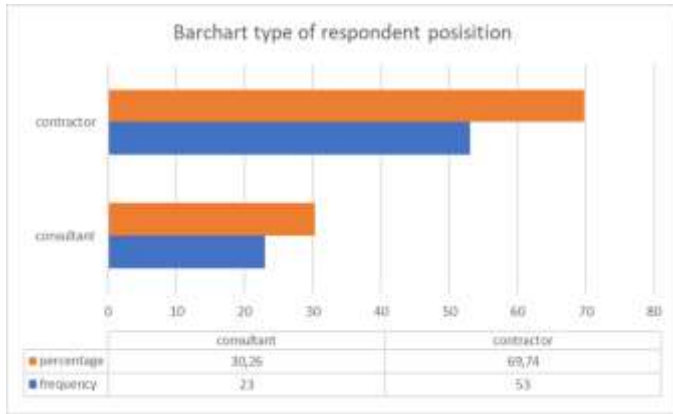
A total of 251 questionnaires were distributed via various types of social media such as "WhatsApp", "Facebook", and via email to consultants and contractors in North Sumatra Province (44 sets to consultants and 44 sets to contractors). The survey was conducted within one week, starting from 11 May 2024 to 17 May 2024. Respondents were reminded via message and email. At the end of the survey period, a record 76 sets of valid questionnaires were completed by respondents, giving a response rate of 30%.

According to Fincham (2008), response rates for email or online surveys have been declining since the late 1980s. The average response rate is only around 25%-30%. However, a response rate of 25%-30% is considered acceptable and satisfactory for online surveys (Pan et al., 2013; Nulty, 2008). For example, (Ismail & Yusof, 2016) obtained a response rate of 28% and believed that the data collected from these respondents was representative of the population as a whole. Therefore, a response rate of 30% in this study is considered acceptable and representative of the population.

Respondent characteristics are an important part of this research. There are three parts to the questionnaire. Part A provides basic information from the respondents. The first part asks respondents to indicate the respondent's job group.

Table of Respondents Based on Position Type

No.	Type	Frequency	Percentage
1	Consultant	23	22,55%
2	Contractor	53	53,44%
<b>Total</b>		76	100%



The next part of the questionnaire asked respondents to indicate the position of 76 respondents who had various positions in construction projects, especially in implementing Earned Value Management (EVM).

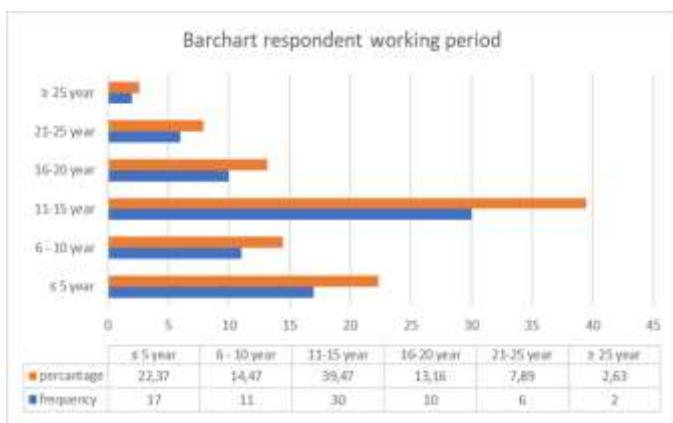
Table of Respondents Based on Position

No.	Position	Frequency	Percentage
1	Site Engineer	4	5,26
2	Civil Engineer	5	6,58
3	Inspektor	14	18,42
4	Field Supervisor	18	23,44
5	Site Manager	18	23,44
6	Project Manager	17	22,37
<b>Total</b>		76	100%

In addition, this research evaluates the characteristics of respondents based on length of service or experience in the construction sector, namely as follows:

Table of Working Period

No.	Working Period	Frequency	Percentage
1	≤ 5 Years	17	17,10
2	6 - 10 Years	11	11,40
3	11-15 Years	30	30,40
4	16-20 Years	10	9,50
5	21-25 Years	6	5,70
6	≥ 25 Years	2	1,90
<b>Total</b>		76	100%



The first question in Part B of the questionnaire was designed to determine respondents' agreement regarding eleven (11) types of barriers to implementing EVM that contribute to

poor construction project performance. This question was rated using a 5-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree). The results for this section are presented in the form of average scores and percentages as follows:

Percentage Range Interpretation Table

Interperation	Scale	Average Range
Strongly Disagree	1	1,00-1,50
Disagree	2	1,51-2,50
Somewhat Disagree	3	2,51-3,50
Agree	4	3,51-4,50
Strongly Agree	5	4,51-5,00

The research results show that the main obstacles in implementing EVM in North Sumatra construction projects include a lack of understanding of EVM, resistance to change, and limited resources. On the other hand, critical success factors for EVM implementation include top management support, ongoing training and education on EVM, and appropriate use of technology.

This research discussion underscores the importance of management commitment and participation of all stakeholders in the implementation of EVM. It was found that projects that successfully implemented EVM demonstrated improvements in cost and schedule control. This study also suggests that construction companies in North Sumatra increase awareness and knowledge about EVM through training programs and workshops, as well as adopting technology that supports the EVM process to improve overall project performance.

By understanding these critical barriers and success factors, construction companies in North Sumatra can more effectively implement EVM to control project performance, which will ultimately increase the efficiency and productivity of the construction industry in the North Sumatra region.

Based on the results of research on the application of Earned Value Management (EVM) on construction projects in North Sumatra, there are several main obstacles that hinder the effective implementation of EVM. The most dominant obstacle is the lack of adequate training and experience for project managers, with an average value of 4.02 and a standard deviation of 0.87. The majority of respondents agreed that this lack of training and experience is the main obstacle in implementing EVM. Project managers who do not have sufficient knowledge and skills in EVM are unable to apply this method optimally, which ultimately has a negative impact on project control and performance.

The second barrier that has a high level of agreement is the high cost of implementing EVM, with a mean value of 3.93 and a standard deviation of 1.08. Many respondents consider these high costs to be one of the significant obstacles, which makes many companies hesitant to adopt EVM completely. In addition, the use of classic SPI indicators which are considered to provide incorrect and unreliable time estimates towards the end of the project is also an important obstacle with a mean value of 3.90 and a standard deviation of 1.09. Inaccuracy of these indicators can lead to errors in assessing project progress and inappropriate decision making.

To overcome the obstacles in implementing EVM on construction projects in North Sumatra, concrete solution steps

can be implemented. First, training and development of project managers is crucial. By holding regular training and specialized certification in EVM for project managers and project teams, it can be ensured that all team members have a good understanding of EVM concepts and applications. In addition, collaboration with professional educational and training institutions to develop curricula that are relevant to the needs of the construction industry can be a strategic step to improve the competencies and skills of practitioners.

Second, the importance of budget allocation for EVM implementation, with identifying and allocating a specific budget for EVM implementation in the project budget being a crucial step. This includes the investment in software, training, and additional resources needed to implement these methods effectively. In addition, financial support from the government or related institutions to provide subsidies or incentives for companies implementing EVM can help reduce the burden of implementation costs.

Third, efforts to increase the accuracy of performance indicators are also very important. Developing and adopting performance indicators that are more accurate and reliable than the classic SPI will help improve project performance evaluation. Carrying out regular reviews and adjustments to project performance measurement methods is a necessary step to ensure that the indicators used are always relevant and accurate.

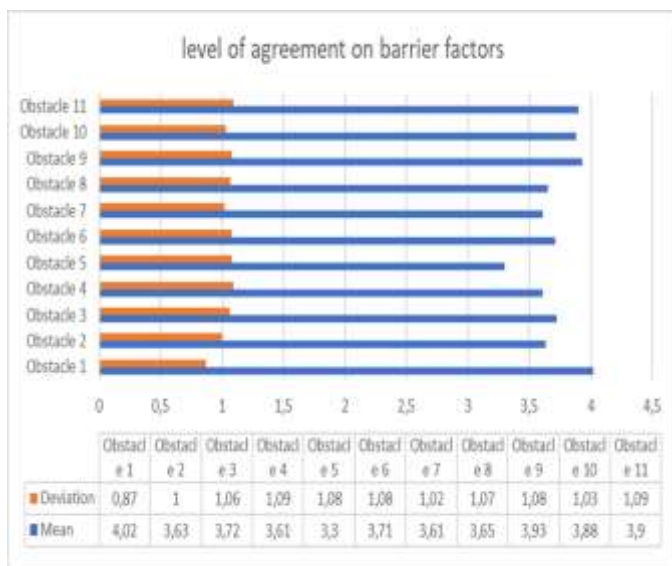
By implementing these steps, it is hoped that obstacles in implementing EVM in North Sumatra can be minimized, so that this method can be used effectively to improve project control and performance. Increased training, financial support and improved performance indicators are key to optimizing EVM implementation in the region.

Based on the results of research on the application of Earned Value Management (EVM) on construction projects in North Sumatra, the dominant factors in the success of this method can be identified. Factor to The highest success in implementing EVM in the region is “efficient procedures & processes for EVM implementation”, which received a mean value of 4.39 and a standard deviation of 0.86. This indicates that respondents strongly agree that efficiency in procedures and processes is the main key to EVM success. Such efficiencies help ensure each step in EVM implementation is carried out in a timely and accurate manner, which in turn can reduce the possibility of errors and increase the reliability of the data produced.

Descriptive Statistics Table Inhibiting Factor Agreement

No	Statement of Inhibiting Factors	N	Mean	St. Dev
1	Lack of adequate training and experience for Project Managers	76	4,02	0,87
2	Lack of knowledge and information shared	76	3,63	1,00
3	There are contradictions regarding the application of EVM as a control tool	76	3,72	1,06
4	Lack of management support	76	3,61	1,09
5	Poor documentation process	76	3,30	1,08
6	Inaccurate project time assessment	76	3,71	1,08
7	Complicated procedures to follow	76	3,61	1,02
8	Requires a high commitment in terms of time and effort	76	3,65	1,07

9	High implementation costs	76	3,93	1,08
10	Contract parties do not have the same understanding of performance in terms of earned value metrics	76	3,88	1,03
11	Classic SPI indicator, which can provide incorrect and unreliable time estimates towards the end of the project	76	3,90	1,09

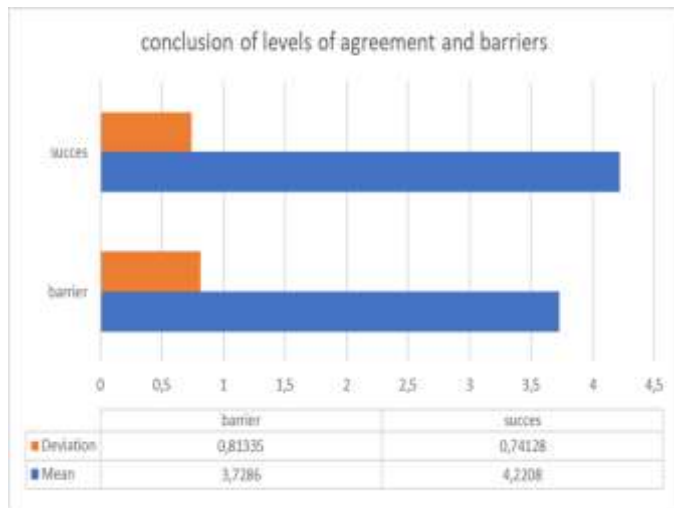


Descriptive Statistics Table Success Factor Agreement Rates

No	Statement Of Success Factors	N	Mean	St. Dev
1	Strong support from top management	76	4,26	0,85
2	High level of acceptance among project managers	76	4,22	0,91
3	Good administrative and technical skills of the project manager	76	4,27	0,85
4	Sufficient organizational resources for EVM implementation	76	4,25	0,92
5	Efficient procedures & processes for EVM implementation	76	4,39	0,86
6	Motivation of team members to use EVM	76	4,21	0,82
7	Adequate computer & software infrastructure	76	4,21	0,93
8	Sufficient training on how to implement EVM	76	3,97	0,92
9	Clear project scope and no target conflicts	76	4,18	0,84



In addition, “good administrative and technical skills of the project manager” also received high marks with a mean of 4.27 and a standard deviation of 0.85. This shows that the project manager's ability to manage the administration and technical aspects of the project plays a very important role in the success of EVM implementation. The third highest factor is "strong support from top management" with a mean of 4.26 and a standard deviation of 0.85, which confirms that the support and commitment of top managers is very important to ensure the smooth implementation of EVM.



To optimize these success factors, concrete solution steps can be implemented. First, the importance of developing efficient procedures and processes for EVM implementation cannot be ignored.

Efforts are needed to develop clear and structured guidelines and procedures so that each stage in implementing EVM can be carried out effectively and efficiently. Second, it is necessary to improve the administrative and technical capabilities of project managers through special training and development. Collaboration with educational and training institutions can also help improve competence in this matter. Third, support and commitment from top management needs to be maintained and increased. This can be done through strong advocacy and outreach regarding the benefits and importance of EVM implementation for the success of construction projects in North Sumatra. By implementing these solution steps, it is hoped that the success factors in implementing EVM can be optimized so that the benefits can be felt optimally in managing construction projects in the region.

## VI. CONCLUSION

1. The most dominant obstacle is the lack of adequate training and experience for project managers, with an average value of 4.02 and a standard deviation of 0.87..
2. The highest success factor in implementing EVM in the region is “efficient procedures & processes for EVM implementation”, which received a mean value of 4.39 and a standard deviation of 0.86.

## VII. SUGGESTION

1. The North Sumatra provincial government must collaborate with professional education and training institutions to provide special training and certification in EVM for project managers and project teams. This program will increase practitioners' understanding and skills regarding EVM
2. The North Sumatra provincial government should allocate a special budget for the implementation of EVM in construction projects in North Sumatra, including investment in software, training and additional resources. Policy for determining budget allocations in the RPJMD which considers funding needs for EVM implementation in construction projects in North Sumatra. Additional financial support can be provided through subsidies or incentives for companies implementing EVM.

## REFERENCES

1. Abas, N. (2015). Research methodology (pp. 1–36).
2. Ahmed, V., Opoku, A., & Aziz, Z. (2016). Choosing an appropriate research methodology and method (Issue July, pp. 33–47). Routledge Taylor & Francis Group.
3. Buchanan, D. A., & Bryman, A. (2007). Contextualizing Method Choice in Organizational Research. *SAGE Publication*, 10(3), 483–501.
4. Choy, L. T. (2014). The Strengths and Weaknesses of Research Methodology: Comparison and Complimentary between Qualitative and Quantitative Approaches. *Journal Of Humanities And Social Science*, 19(4), 99–104
5. Fincham, J. E. (2008). Response rates and responsiveness for surveys, standards, and the Journal. *American Journal of Pharmaceutical Education*, 72(2), 43.
6. Gomarn, P., & Pongpeng, J. (2018). Project failure Indicators: Perceptions of Thai and Malaysian engineers. *MATEC Web of Conferences*, 192, 4–7.
7. Ibrahim, M. N., Thorpe, D., & Mahmood, M. N. (2019). Risk factors a ff ecting the ability for earned value management to accurately assess the performance of infrastructure projects in Australia. *Construction Innovation*, .<https://doi.org/10.1108/CI-07-2018-0058>
8. Ismail, H., & Yusof, Z. M. (2016). Perceptions Towards Non-Value-Adding Activities during the Construction Process. *MATEC Web of Conferences*, 66, 0–7. <https://doi.org/10.1051/mateconf/20166600015>
9. Jaapar, A., Zawawi, M., Ahmad Bari, N. A., & Ahmad, N. (2011). Value Management in the Malaysian Construction Industry: Addressing a Value Management in the Malaysian Construction Industry: Addressing a Theory and Practice Gap. *Asia Pacific International Conference on Environment-Behaviour Studies*, 757–763. <https://doi.org/10.1016/j.sbspro.2012.02.146>.
10. Macdonald, S., & Headlam, N. (1999). *Research Methods Handbook*. CLES limited.
11. Nkiwane, N. ., Meyer, W. G., & Steyn, H. (2016). The use of Earned Value Management for initiating directive project control decisions: A case study. *South African Journal of Industrial Engineering*, 27(1), 192–203. <https://doi.org/10.7166/27-1-1260>
12. Nulty, D. D. (2008). The adequacy of response rates to online and paper surveys: What can be done? Assessment and Evaluation in Higher Education, 33(3), 301–314. <https://doi.org/10.1080/02602930701293231>
13. Pan, B., Woodside, A., & Meng, F. (2013). How Contextual Cues Impact Response and Conversion Rates of Online Surveys. *Journal of Travel Research*, 53(1), 58–68. <https://doi.org/10.1002/jtr.2230>
14. Sekaran, U. (2003). *Research Methods for Business - A Skill Building Approach*. In John Wiley & Sons. John Wiley & Sons, Ltd. <https://doi.org/http://dx.doi.org/10.1108/17506200710779521>
15. Sutton, J., & Austin, Z. (2015). Qualitative research: Data collection, analysis, and management. *Canadian Journal of Hospital Pharmacy*, 68(3), 226–231. <https://doi.org/10.4212/cjhp.v68i3.1456>
16. Wu, C.-H. (2007). An Empirical Study on the Transformation of Likert-scale Data to Numerical Scores. *Applied Mathematical Sciences*, 1(58), 2851–2862.
17. Zulkefli, N. S., Waris, M., Firdaus, K., Khan, A., & Adeleke, A. Q.



(2017). Exploring The Perception Of Earned Value. International Economics and Business Management Conference, 337–346.