

ANALYSIS OF NON VALUE ADDED ACTIVITIES (NVA) IN RESIDENTIAL PROJECTS

Nurlaelah^{1,2}, Jati Utomo DH³, Rusdi HA⁴

¹ Civil Engineering Doctoral Program, Engineering Faculty, Diponegoro University

² Lecturer at Azzahra University

³ Vice Dean for Research and Innovation, Engineering Faculty, Diponegoro University

⁴ Engineering Faculty, Lambung Mangkurat University

Abstract

Based on a report from the Indonesian Consumers Foundation (2017) that many homes have been purchased by consumers, but not occupied, because of poor housing quality, such as defects, which do not only occur in subsidized housing (simple housing), but also occurs in middle and luxury housing. This is caused by the many activities that do not bring value (Non Value Adding Activities / NVA) in the process of carrying out the construction of houses in housing. The results of the NVA Relative Importance Index (RII) analysis in the four housing projects that were used as research case studies showed that there were 27 NVAs that had to be the attention of the developer to be immediately reduced. In addition, it is also necessary to integrate the Lean Construction principles as a solution and NVA recommendations on housing projects.

1. Introduction

According to [1], Non Value Adding Activities / NVA is classified as waste, and is used to differentiate between waste in the scope of construction physically (Physical Construction Waste with other waste that occurs during the construction process. The results show that some activities that do not bring value (NVA) to construction companies in Indonesia and Australia are design changes, lack of skills in trading, slow decision making, poor coordination between project partners, poor planning and scheduling, delays in material delivery to the site, inappropriate construction methods, poor design, poor quality site documentation, slow image revision and distribution, unclear site images and unclear specifications, especially in Indonesia, NVA that is common in construction projects is repair work (repair), schedule delays, waiting for material, design changes, low labor skills, and slow decision making. Furthermore, it is said that NVA has properties that do not provide added value but can affect the performance of construction projects. According to [2], the construction industry only produced 10% of value-added activities (VA), 57% non-value added activities (NVA) and 33% supporting activities (SA). In contrast, the manufacturing industry is 62% for VA, and NVA is 26% and SA is 12%, as shown in Figure 1 below:

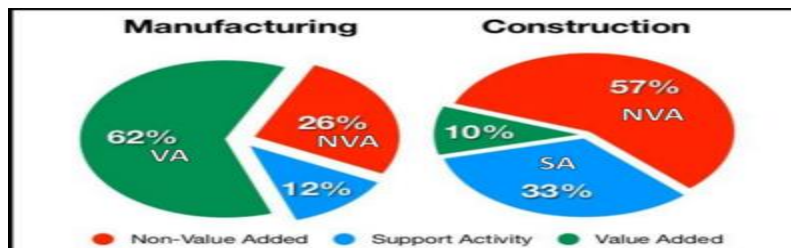


Figure 1. Construction industry vs. Manufacturing industry (Worcup, 2016)

From Figure 1 above, it can be seen that NVA in the construction industry is very important to analyze. Given that the NVA has a negative impact on construction productivity [3]. 49.6% of construction time is devoted to NVA, such as overtime which has a negative impact on productivity and can increase fatigue, incidents and accidents which can ultimately increase costs and time spent on construction projects [4]. And if left unchecked, NVA can have severe consequences for organizational competitiveness and the productivity of the construction industry [5]. Such conditions can disrupt the smooth process carried out so that it can have a negative impact on the performance of housing projects. Therefore, it is necessary to conduct an in-depth analysis of the NVA in housing projects which are also the objectives of this paper.

2. Literature Review

A. Definition of NVA

According to [6], construction activities can be divided into value-added activities (VA), Value Supporting Activities (VSA), and non-value added activities (Non Value Adding Activities / NVA). VA is an activity carried out to realize project requirements defined in the contract, VSA is an effort that supports activities, but does not directly add value, but supports VA realization. While the NVA is a futile effort that spends time and resources both directly and indirectly. According to [7], activities that do not provide added value (NVA) will directly affect the construction and project processes but can be avoided by properly executing work, close monitoring, control and planning. Everyone involved in the construction process has the potential to contribute to the NVA. Therefore, NVA can be referred to as activities that consume direct and indirect costs, time, resources, labor and space, but do not provide added value to anyone involved during the construction process. Meanwhile, according to [1], NVA terminology is used to distinguish between physical and non-physical waste that occurs during the construction process. Meanwhile, according to [8], non-value-added activities (NVA) are pure waste during the construction process. However, most construction practitioners do not realize that most of the activities carried out during the construction process do not provide value to their projects.

B. Causes of NVA

[8] Stated that according to [9], [10] and [11], the lack of skills by subcontractors and traders is one of the causes of NVA. In addition many NVAs are also caused by design changes, poor coordination, weather, poor planning and scheduling, poor supervision, design changes, slow decision making, lack of trade and subcontractor skills, wrong construction methods, material delays, communication disruptions, lack of coordination and lack of trust between several parties. Whereas based on research conducted by [1] found that documentation of poor site quality, weather, unclear site drawing equipment, poor design, design changes, slow image revision and distribution, unclear specifications, management, information and resources are one of the important factors of NVA. All of the above causes can be categorized into 8M, namely management (Management), measurement (Measurement), method (Method), human (Man), Nature (Mother Nature), material (Material), machine (Machine) and money (Money) For example, poor coordination, poor planning, poor scheduling, and poor supervision are included in the category of 'Management', while the lack of trade and subcontractor skills falls into the category of 'Man'.

3. Methodology

Based on the results of observations in 4 housing as study cases (housing D'Marco, Erfina Kencana, Pondok Afi 2, and Sambeng Village), NVA was identified in the house construction process. Then brainstorming was carried out on the parties directly involved in the process of building houses such as project leaders, foremen, site managers, and others to find out the causes of NVA. The brainstorming results are then formulated into NVA factors in housing projects. The next step is to distribute the questionnaire again to

find out their perception of the dominant NVA factors whose results are then analyzed using the Relative Importance Index (RII) method. The Formula RII used is:

$$RII = \frac{5n_5 + 4n_4 + 3n_3 + 2n_2 + 1n_1}{5N}$$

Where :

- 5n = Number of respondents who answered "Never"
- 4n = Number of respondents who answered "Ever"
- 3n = Number of respondents who answered "Rarely"
- 2n = Number of respondents who answered "Often"
- 1n = Number of respondents who answered "Very Often"

4. Results

From the 60 (sixty) questionnaires distributed, the number of questionnaires collected was 54 respondents. Respondents who were collected were the same respondents during brainstorming to determine NVA factors, parties who did NVA and the causes of NVA. The recapitulation of the results of the determination of RII based on the 10 highest ranking is:

Table 1. Ranking of NVA factors in housing projects

| No | NVA factors in housing projects | RII | Rank |
|----|--|------|------|
| 1 | Performing repair and rework after the construction of the house is completed (3 months retention period) due to a defect in the consumer home building. | 0,82 | 1 |
| 2 | Performing repair and rework after the construction of the house is completed (3 months retention period) due to changes in the design of the house from the consumer. | 0,79 | 2 |
| 3 | Performing repair and rework when the house construction process is still underway due to changes in home designs from consumers. | 0,79 | 2 |
| 4 | The completion of part or all of the work is not timely due to unclear and incomplete work directives from the contractor / developer. | 0,76 | 3 |
| 5 | The report on the completion of the construction of the house is not timely due to the delay in the progress of the construction of the house by construction workers. | 0,71 | 4 |
| 6 | The completion of part or all of the work is not timely due to Waiting for the direction of work of the foreman. | 0,70 | 5 |
| 7 | The report on the completion of the construction of the house is not timely due to the delay in the progress of the construction of the house by construction workers. | 0,69 | 6 |
| 8 | The completion of part or all of the work is not timely due to Waiting for the direction of work of the foreman. | 0,69 | 6 |
| 9 | The unclear and incomplete design and layout of the house is caused by limited number of planner personnel. | 0,69 | 6 |

| | | | |
|----|---|------|----|
| 10 | The implementation of part or all of the construction work of the house does not meet the specifications caused by the construction worker is not skilled and inexperienced. | 0,69 | 6 |
| 11 | Material orders with specifications and quantities that are unclear and incomplete to the supplier are caused by human resources who make material orders are not expert and inexperienced. | 0,68 | 7 |
| 12 | Distribution of materials to housing units from the logistics department is not timely due to delays in the delivery of materials from suppliers. | 0,68 | 7 |
| 13 | The use of some / all of the material that is not according to specifications is caused by the foreman / assistant foreman not / lacking coordination with construction workers. | 0,68 | 7 |
| 14 | Distribution of materials to housing units from the foreman / assistant foreman is not timely due to delays in the delivery of materials from suppliers | 0,67 | 8 |
| 15 | The handover of the house to the project leader / field implementer is not timely due to the completion of part or all of the work is not on time. | 0,67 | 8 |
| 16 | Payment of fees to construction workers from the foreman / assistant foreman is not timely due to the developer's company policy. | 0,67 | 8 |
| 17 | The completion of part or all of the work is not timely due to the location of the supplier away from the housing project. | 0,67 | 8 |
| 18 | Waiting for material from suppliers at the project location is caused by delays in the delivery of materials from suppliers. | 0,67 | 8 |
| 19 | Performing repair and rework after the construction of the house is completed (3 months retention period) due to unclear and incomplete work direction from the foreman. | 0,66 | 9 |
| 20 | Payment of invoices for workers' fees is not timely from the developer / project leader due to the developer's company policy | 0,65 | 10 |
| 21 | Payment of fees to construction workers from the foreman / assistant foreman is not timely due to the non-current development company Cashflow | 0,65 | 10 |
| 22 | The use of part / all material that does not meet specifications is caused by the availability of materials at the project site. | 0,65 | 10 |
| 23 | The completion of part or all of the work is not timely due to the delay in delivery of material by the supplier. | 0,65 | 10 |
| 24 | Difficulties in ensuring the availability of material at the project site in accordance with the needs caused by the lack of coordination with the contractor / developer. | 0,65 | 10 |
| 25 | The appointment of a limited number of field supervisors / QCs is due to the efficiency of the development company. | 0,65 | 10 |
| 26 | Inadequate storage of material due to the foreman / assistant foreman does not have the knowledge of the correct way to store material. | 0,65 | 10 |
| 27 | Performing repair and rework when the house construction process is still ongoing due to a defect in the consumer's house building. | 0,65 | 10 |

5. Discussion

Based on the table above, it can be seen that there are 27 (twenty seven) NVA factors in housing projects. NVA is more prevalent in the implementation of work which entails construction work and foremen in the field (19 NVA). While those who do not deal directly with the work are 8 NVAs, so it can

be concluded that the NVA which must be immediately carried out elimination and minimization measures is the execution of work at the project site. Therefore, the contractor who is responsible for this matter must always carry out monitoring and evaluation periodically, so as not to get stuck in the implementation.

REFERENCES

- [1] S. Alwi, K. Hampson, S.C. Mohamed, 2002, *Factors influencing contractor performance in Indonesia: A study of non-value adding activities*, International Conference on Advancement in Design, Construction, Construction Management, and Maintenance of Building Structure, Bali: ADCCMBS, pp. 20-34, 2002.
- [2] Robert Warcup, PhD (2016)
http://c.yecd.com/sites/www.nasfa.net/resource/resmgr/Learning_Series/Intro_to_Lean_Construction_&.pdf
- [3] R.H. Abdel-Razek, H. Abd Elshakour M, M. Abdel-Hamid, 2007, *Labour productivity: Benchmarking and variability in Egyptian projects*, International Journal of Project Management, **vol. 25**, no. 2, pp. 189-197.
- [4] M.J. Horman, R. Kenley, 2005, *Quantifying levels of wasted time in construction with meta-analysis*, Journal of Construction Engineering and Management, **vol. 131**, no. 1, pp. 52-61.
- [5] A. Koskenvesa, L. Koskela, T. Tolonen, S. Sahlstedt, 2010, *Waste and labour productivity in production planning: case Finnish construction industry*, 18th Annual Conference of the International Group for Lean Construction Proceedings, Haifa: IGLC, pp. 477-486.
- [6] S. Han, S. Lee, M.G. Fard, F. Pena-Mora, 2007, *Modelling and representation of non-value adding activities due to errors and changes in design and construction projects*, 40th Annual Winter Simulation Conference Proceedings, Washington DC: IEEE, pp. 2082-2089.
- [7] P. Josephson and L. Saukkoriipi, 2007, *Waste in construction projects call for a new approach*, "Chalmers University Technology, pp. 1-57.
- [8] Ismail, H and Mohd Yusof, Zakaia, 2016, *Perceptions Towards Non-Value-Adding Activities During The Construction Process*, mateconf/2016MATEC Web of Conferences 66 6 IBCC 2016, 600015.
- [9] J. Felipe, P. Achell, and M. B. Bonet, 2012, *A preliminary proposal for a waste-based management approach to improve performance in construction*, Proceeding IGLC-21, July 2013, Fortaleza, Brazil, pp. 115-124.
- [10] A. O. Ralph and R. Iyagba, 2012, *Factors Affecting Contractor Performance : A Comparative Study of Non Value-Adding Activities in Nigeria and Indonesia*, **vol. 3**, no. 5, pp. 467-474.
- [11] J. Arleroth and H. Kristensson, 2011, *Waste in Lean Construction*, Chalmers University of Technology.

ANALYSIS OF NON VALUE ADDED ACTIVITIES (NVA) IN RESIDENTIAL PROJECTS

by Nurlaelah , Jati Utomo Dh, Rusdi Ha

Submission date: 20-Jul-2021 09:17PM (UTC+0700)

Submission ID: 1621976991

File name: PAPER_ICSI_2018.pdf (432.44K)

Word count: 2312

Character count: 12244

ANALYSIS OF NON VALUE ADDED ACTIVITIES (NVA) IN RESIDENTIAL PROJECTS

Nurlaelah^{1,2}, Jati Utomo DH³, Rusdi HA⁴

¹ Civil Engineering Doctoral Program, Engineering Faculty, Diponegoro University

² Lecturer at Azzahra University

³ Vice Dean for Research and Innovation, Engineering Faculty, Diponegoro University

⁴ Engineering Faculty, Lambung Mangkurat University

Abstract

Based on a report from the Indonesian Consumers Foundation (2017) that many homes have been purchased by consumers, but not occupied, because of poor housing quality, such as defects, which do not only occur in subsidized housing (simple housing) but also occurs in middle and luxury housing. This is caused by the many activities that do not bring value (Non Value Adding Activities / NVA) in the process of carrying out the construction of houses in housing. The results of the NVA Relative Importance Index (RII) analysis in the four housing projects that were used as research case studies showed that there were 27 NVAs that had to be the attention of the developer to be immediately reduced. In addition, it is also necessary to integrate the Lean Construction principles as a solution and NVA recommendations on housing projects.

1.Introduction

According to [1], Non Value Adding Activities / NVA is classified as waste, and is used to differentiate between waste in the scope of construction physically (Physical Construction Waste with other waste that occurs during the construction process). The results show that some activities that do not bring value (NVA) to construction companies in Indonesia and Australia are design changes, lack of skills in trading, slow decision making, poor coordination between project partners, poor planning and scheduling, delays in material delivery to the site, inappropriate construction methods, poor design, poor quality site documentation, slow image revision and distribution, unclear site images and unclear specifications, especially in Indonesia, NVA that is common in construction projects is repair work (repair), schedule delays, waiting for material, design changes, low labor skills, and slow decision making. Furthermore, it is said that NVA has properties that do not provide added value but can affect the performance of construction projects. According to [2], the construction industry only produced 10% of value-added activities (VA), 57% non-value added activities (NVA) and 33% supporting activities (SA). In contrast, the manufacturing industry is 62% for VA, and NVA is 26% and SA is 12%, as shown in Figure 1 below:

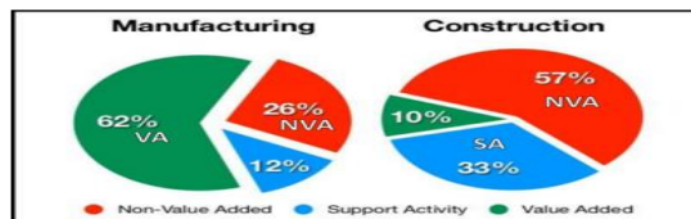


Figure 1. Construction industry vs. Manufacturing industry (Worcup, 2016)

From Figure 1 above, it can be seen that NVA in the construction industry is very important to analyze. Given that the NVA has a negative impact on construction productivity [3], 49.6% of construction time is devoted to NVA, such as overtime which has a negative impact on productivity and can increase fatigue, incidents and accidents which can ultimately increase costs and time spent on construction projects [4]. And if left unchecked, NVA can have severe consequences for organizational competitiveness and the productivity of the construction industry [5]. Such conditions can disrupt the smooth process carried out so that it can have a negative impact on the performance of housing projects. Therefore, it is necessary to conduct an in-depth analysis of the NVA in housing projects which are also the objectives of this paper.

2. Literature Review

A. Definition of NVA

According to [6], construction activities can be divided into value-added activities (VA), Value Supporting Activities (VSA), and non-value added activities (Non Value Adding Activities / NVA). VA is an activity carried out to realize project requirements defined in the contract, VSA is an effort that supports activities, but does not directly add value, but supports VA realization. While the NVA is a futile effort that spends time and resources both directly and indirectly. According to [7], activities that do not provide added value (NVA) will directly affect the construction and project processes but can be avoided by properly executing work, close monitoring, control and planning. Everyone involved in the construction process has the potential to contribute to the NVA. Therefore, NVA can be referred to as activities that consume direct and indirect costs, time, resources, labor and space, but do not provide added value to anyone involved during the construction process. Meanwhile, according to [1], NVA terminology is used to distinguish between physical and non-physical waste that occurs during the construction process. Meanwhile, according to [8], non-value-added activities (NVA) are pure waste during the construction process. However, most construction practitioners do not realize that most of the activities carried out during the construction process do not provide value to their projects.

B. Causes of NVA

[8] Stated that according to [9], [10] and [11], the lack of skills by subcontractors and traders is one of the causes of NVA. In addition many NVAs are also caused by design changes, poor coordination, weather, poor planning and scheduling, poor supervision, design changes, slow decision making, lack of trade and subcontractor skills, wrong construction methods, material delays, communication disruptions, lack of coordination and lack of trust between several parties. Whereas based on research conducted by [1] found that documentation of poor site quality, weather, unclear site drawing equipment, poor design, design changes, slow image revision and distribution, unclear specifications, management, information and resources are one of the important factors of NVA. All of the above causes can be categorized into 8M, namely management (Management), measurement (Measurement), method (Method), human (Man), Nature (Mother Nature), material (Material), machine (Machine) and money (Money). For example, poor coordination, poor planning, poor scheduling, and poor supervision are included in the category of 'Management', while the lack of trade and subcontractor skills falls into the category of 'Man'.

3. Methodology

Based on the results of observations in 4 housing as study cases (housing D'Marco, Erfina Kencana, Pondok Afi 2, and Sambeng Village), NVA was identified in the house construction process. Then brainstorming was carried out on the parties directly involved in the process of building houses such as project leaders, foremen, site managers, and others to find out the causes of NVA. The brainstorming results are then formulated into NVA factors in housing projects. The next step is to distribute the questionnaire again to

find out their perception of the dominant NVA factors whose results are then analyzed using the Relative Importance Index (RII) method. The Formula RII used is:

$$RII = \frac{5n_5 + 4n_4 + 3n_3 + 2n_2 + 1n_1}{5N}$$

Where:

5n = Number of respondents who answered "Never"

4n = Number of respondents who answered "Ever"

3n = Number of respondents who answered "Rarely"

2n = Number of respondents who answered "Often"

1n = Number of respondents who answered "Very Often"

4. Results

From the 60 (sixty) questionnaires distributed, the number of questionnaires collected was 54 respondents. Respondents who were collected were the same respondents during brainstorming to determine NVA factors, parties who did NVA and the causes of NVA. The recapitulation of the results of the determination of RII based on the 10 highest ranking is:

Table 1. Ranking of NVA factors in housing projects

| No | NVA factors in housing projects | RII | Rank |
|----|--|------|------|
| 1 | Performing repair and rework after the construction of the house is completed (3 months retention period) due to a defect in the consumer home building. | 0,82 | 1 |
| 2 | Performing repair and rework after the construction of the house is completed (3 months retention period) due to changes in the design of the house from the consumer. | 0,79 | 2 |
| 3 | Performing repair and rework when the house construction process is still underway due to changes in home designs from consumers. | 0,79 | 2 |
| 4 | The completion of part or all of the work is not timely due to unclear and incomplete work directives from the contractor / developer. | 0,76 | 3 |
| 5 | The report on the completion of the construction of the house is not timely due to the delay in the progress of the construction of the house by construction workers. | 0,71 | 4 |
| 6 | The completion of part or all of the work is not timely due to Waiting for the direction of work of the foreman. | 0,70 | 5 |
| 7 | The report on the completion of the construction of the house is not timely due to the delay in the progress of the construction of the house by construction workers. | 0,69 | 6 |
| 8 | The completion of part or all of the work is not timely due to Waiting for the direction of work of the foreman. | 0,69 | 6 |
| 9 | The unclear and incomplete design and layout of the house is caused by limited number of planner personnel. | 0,69 | 6 |

| | | | |
|----|---|------|----|
| 10 | The implementation of part or all of the construction work of the house does not meet the specifications caused by the construction worker is not skilled and inexperienced. | 0,69 | 6 |
| 11 | Material orders with specifications and quantities that are unclear and incomplete to the supplier are caused by human resources who make material orders are not expert and inexperienced. | 0,68 | 7 |
| 12 | Distribution of materials to housing units from the logistics department is not timely due to delays in the delivery of materials from suppliers. | 0,68 | 7 |
| 13 | The use of some / all of the material that is not according to specifications is caused by the foreman / assistant foreman not / lacking coordination with construction workers. | 0,68 | 7 |
| 14 | Distribution of materials to housing units from the foreman / assistant foreman is not timely due to delays in the delivery of materials from suppliers | 0,67 | 8 |
| 15 | The handover of the house to the project leader / field implementer is not timely due to the completion of part or all of the work is not on time. | 0,67 | 8 |
| 16 | Payment of fees to construction workers from the foreman / assistant foreman is not timely due to the developer's company policy. | 0,67 | 8 |
| 17 | The completion of part or all of the work is not timely due to the location of the supplier away from the housing project. | 0,67 | 8 |
| 18 | Waiting for material from suppliers at the project location is caused by delays in the delivery of materials from suppliers. | 0,67 | 8 |
| 19 | Performing repair and rework after the construction of the house is completed (3 months retention period) due to unclear and incomplete work direction from the foreman. | 0,66 | 9 |
| 20 | Payment of invoices for workers' fees is not timely from the developer / project leader due to the developer's company policy | 0,65 | 10 |
| 21 | Payment of fees to construction workers from the foreman / assistant foreman is not timely due to the non-current development company Cashflow | 0,65 | 10 |
| 22 | The use of part / all material that does not meet specifications is caused by the availability of materials at the project site. | 0,65 | 10 |
| 23 | The completion of part or all of the work is not timely due to the delay in delivery of material by the supplier. | 0,65 | 10 |
| 24 | Difficulties in ensuring the availability of material at the project site in accordance with the needs caused by the lack of coordination with the contractor / developer. | 0,65 | 10 |
| 25 | The appointment of a limited number of field supervisors / QCs is due to the efficiency of the development company. | 0,65 | 10 |
| 26 | Inadequate storage of material due to the foreman / assistant foreman does not have the knowledge of the correct way to store material. | 0,65 | 10 |
| 27 | Performing repair and rework when the house construction process is still ongoing due to a defect in the consumer's house building. | 0,65 | 10 |

5. Discussion

Based on the table above, it can be seen that there are 27 (twenty seven) NVA factors in housing projects. NVA is more prevalent in the implementation of work which entails construction work and foremen in the field (19 NVA). While those who do not deal directly with the work are 8 NVAs, so it can

be concluded that the NVA which must be immediately carried out elimination and minimization measures is the execution of work at the project site. Therefore, the contractor who is responsible for this matter must always carry out monitoring and evaluation periodically, so as not to get stuck in the implementation.

REFERENCES

- [1] S. Alwi, K. Hampson, S.C. Mohamed, 2002, *Factors influencing contractor performance in Indonesia: A study of non-value adding activities*, International Conference on Advancement in Design, Construction, Construction Management, and Maintenance of Building Structure, Bali: ADCCMBS, pp. 20-34, 2002.
- [2] Robert Warcup, PhD (2016)
http://c.ymcdn.com/sites/www.nasfa.net/resource/resmgr/Learning_Series/Intro_to_Lean_Construction_&.pdf
- [3] R.H. Abdel-Razek, H. Abd Elshakour M, M. Abdel-Hamid, 2007, *Labour productivity: Benchmarking and variability in Egyptian projects*, International Journal of Project Management, **vol. 25**, no. 2, pp. 189-197.
- [4] M.J. Horman, R. Kenley, 2005, *Quantifying levels of wasted time in construction with meta-analysis*, Journal of Construction Engineering and Management, **vol. 131**, no. 1, pp. 52-61.
- [5] A. Koskenvesa, L. Koskela, T. Tolonen, S. Sahlstedt, 2010, *Waste and labour productivity in production planning: case Finnish construction industry*, 18th Annual Conference of the International Group for Lean Construction Proceedings, Haifa: IGLC, pp. 477-486.
- [6] S. Han, S. Lee, M.G. Fard, F. Pena-Mora, 2007, *Modelling and representation of non-value adding activities due to errors and changes in design and construction projects*, 40th Annual Winter Simulation Conference Proceedings, Washington DC: IEEE, pp. 2082-2089.
- [7] P. Josephson and L. Saukkoriipi, 2007, *Waste in construction projects call for a new approach,* Chalmers University Technology, pp. 1-57.
- [8] Ismail, H and Mohd Yusof, Zakaia, 2016, *Perceptions Towards Non-Value-Adding Activities During The Construction Process*, mateconf/2016MATEC Web of Conferences 66 6 IBCC 2016, 600015.
- [9] J. Felipe, P. Achell, and M. B. Bonet, 2012, *A preliminary proposal for a waste-based management approach to improve performance in construction*, Proceeding IGLC-21, July 2013, Fortaleza, Brazil, pp. 115-124.
- [10] A. O. Ralph and R. Iyagba, 2012, *Factors Affecting Contractor Performance : A Comparative Study of Non Value-Adding Activities in Nigeria and Indonesia*, **vol. 3**, no. 5, pp. 467-474.
- [11] J. Arleroth and H. Kristensson, 2011, *Waste in Lean Construction*, Chalmers University of Technology.

ANALYSIS OF NON VALUE ADDED ACTIVITIES (NVA) IN RESIDENTIAL PROJECTS

ORIGINALITY REPORT

14%

SIMILARITY INDEX

11%

INTERNET SOURCES

12%

PUBLICATIONS

5%

STUDENT PAPERS

PRIMARY SOURCES

| | | |
|---|--|-----|
| 1 | www.matec-conferences.org Internet Source | 9% |
| 2 | Submitted to University College London Student Paper | 1% |
| 3 | www.iglc.net Internet Source | 1% |
| 4 | Submitted to Universiti Teknologi Malaysia Student Paper | 1% |
| 5 | Haryati Ismail, Zakaria Mohd Yusof. "Perceptions Towards Non-Value-Adding Activities During The Construction Process", MATEC Web of Conferences, 2016 Publication | 1% |
| 6 | "Operations Management and Systems Engineering", Springer Science and Business Media LLC, 2021 Publication | <1% |
| 7 | eprints.utm.my Internet Source | <1% |



Exclude quotes On

Exclude matches Off

Exclude bibliography On