Early risks identification on sources and causes waste road construction project materials

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Abstract. Waste material affects the road construction project consisting of ready mix concrete, lean concrete, B aggregate, landfill and cement. Identify risks by looking at the source and causes of waste material in the five materials. The source and causes of waste material for road construction do not yet exist. So it is necessary to take literature from a simplified building project so that it can be used for road construction projects with the help of experts. Risk identification is carried out with primary data, namely the questionnaire, then consulted by experts with the Delphi Method with three stages. The results of the Delphi method produce each of the causes of waste material for road construction projects that result in the identification of Early Risks.. Ready Mix concrete has 8 sources of waste material and 21 causes of waste material. Concrete Concrete has 7 sources of waste material and 18 causes of waste material. Aggregate B has 7 sources of waste material and 15 causes of waste material. Landfill has 8 sources of waste material and 26 causes of waste material. Cement has 7 sources of waste material and 31 causes of waste material.

1. Introduction
Waste material is a term from the large percentage of waste material occurs and is one of the serious problems in the implementation of the road construction project(waty et al,2018) Waste material is influences the contractor's profit by producing a Road Development Project regression model that produces three waste materials which have the effect of aggregate B, Ready Mix Concrete and Lean Concrete(waty et al. 2018). Likewise, waste material that influences contractor's profit on road improvement projects also results in three waste materials which are influential namely cement, aggregate B, and landfill (waty et al,2018). So there are a total of five waste materials that are influential in road construction projects. The number of types of waste material that occurs, causing researchers to risk management of the source and causes of waste material. Risk management is carried out by identification, analysis, risk response and administration system (Al Bahar and Crandall, 1990) which aims to minimize waste material in construction projects the road that has never been done so far. The first step taken is to identify risks first. Risk identification is defined as: a systematic process and continuous identification, categorizing and assessing the early significance of the risks that join a construction project. (Al-Bahar and Crandall, 1990). Risk identification “is the process of determining which risks may affect the project and documenting their characteristics” (Project Management Institute [PMI], 2008). Early Risk Identification by examining the sources and causes of waste material by searching for previous literature.
2. Literature Review
In the previous literature there were several opinions from the authors relating to the sources and causes of waste material. The source and causes of the waste material that comes from the source and causes of the building project material, because indeed there has been no reference to the source and material causes of the road construction project. After combining several opinions, it is obtained the grouping of sources and causes of waste material into nine sources and 91 causes of waste material.

3. Delphi Method
The Delphi Method is a systematic method of collecting opinions from a group of experts through a series of questionnaires, where there is a feedback mechanism through 'rounds' / rounds of questions held while maintaining the respondent's anonymity, namely experts (Foley et al, 1984). The Delphi method is a structured communication technique, originally developed as a method that predicts interactively and relies on a number of experts. (Lindstone, 1975). The Delphi method is implemented by inviting and asking for opinions from competent experts in the civil field consisting of one academician and consultant and four executing contractors and two person from the owner of the Public Works Agency. The average experience is above 15 years and knows the condition of the project East Kalimantan road well. The total experts contacted were seven person.

4. Research Methodology
Research Methodology is done by looking for sources and causes of waste material with several phase At the initial phase, there are 91 causes of waste material and 9 waste material sources. Then do the Delphi method which is assisted by experts. After the Delphi method is applied, new results are obtained to identify the Early Identification Risks. Research locations were conducted in the provinces of East Kalimantan and North Kalimantan.

5. Discussion and Results
Step of the method of the Delphi Method in this study is:
1. Development first questionnaire and test (First Phase)
   a. In accordance with the reference opinion of the beginning of the questionnaire that will be made using nine sources and 91 causes of waste material.
   b. The sample size is carried out in groups of around 10-15 respondent
      In carrying out the questionnaire one was carried out on ten or fifteen respondent which included 91 causes and 9 sources and tried to ask the respondents.
      This results are mostly confused, there are also many who do not answer or answer soberly because of confusion and phase one can be seen in table 1. (only examples from one source and its causes).

2. Develop one questionnaires and test (Second Phase)
   Because of confuse for the first phase so researcher go to expert to revise. In the second questionnaire after revision, experts produced questionnaires from 91 causes to 52 causes for ready mix concrete waste materials. Similarly for others. The test was carried out using a two questionnaire and was carried out for about 10 to 15 people and resulted in some respondents' doubts in filling in, so it was necessary to revise the source and causes of waste material. Of the 91 causes that were changed to 52 causes and occurrence of each waste material that was not the same cause as in Table 2 (which is one example of five waste materials)

3. Develop third questionnaires and test (Third Phase)
   For advance the questionnaire because of confuse for the second phase so researcher go to expert to revise again. Developing from the simplified third questionnaire was tried out to the respondents. And the result is that respondents are easier to do and do not raise doubts about the question because of the fewer number of questions in the language that is easily understood by the respondents.
4. Final Report (Final Result)
The final report in the form of causes that have been simplified into and can be seen in the example as in Table 3, which is Early Identification Risk

**Table 1. Sources and Causes of Waste Materials (First Phase)**

| No | Sources | Causes of Waste Material | References |
|----|---------|--------------------------|------------|
| 1  | Design  | Error in Contract Document | Bossink, 1996 |
| 2  | Design  | Incomplete contract documents | Bossink, 1996 |
| 3  | Design  | Change in Design | Bossink, 1996 |
| 4  | Design  | Select product specifications | Bossink, 1996 |
| 5  | Design  | Choose low quality products | Bossink, 1996 |
| 6  | Design  | Not paying attention to the size of the product used | Bossink, 1996 |
| 7  | Design  | Designers do not know the type of products used by | Bossink, 1996 |
| 8  | Design  | Details of the complicated picture of | Bossink, 1996 |
| 9  | Design  | Information on drawings of incomplete road design | Bossink, 1996 |
| 10 | Design  | Less coordinating with contractors and less knowledgeable about construction | Bossink, 1996 |
| 11 | Design  | Lack of complete information on problem types and material sizes in design documents | Ekanayake, 2000 |
| 12 | Design  | Planning for imperfect construction | Polat and Ballard, 2004 |

**Table 2. Second Source Questionnaire and Causes of Ready Mix Concrete Waste Materials (Second Phase)**

| No | Causes of Material Waste | Sources |
|----|--------------------------|---------|
| 1  | Error in contract documents | Design (Gavilan and Reynold, 1994) |
| 2  | Not complete contract documents | Design (Gavilan and Reynold, 1994) |
| 3  | Select product specifications | Design (Gavilan and Reynold, 1994) |
| 4  | Choose low quality products | Design (Gavilan and Reynold, 1994) |
| 5  | Not paying attention to the size of the product used | Design (Gavilan and Reynold, 1994) |
| 6  | Designers are not familiar with other types of products | Design (Gavilan and Reynold, 1994) |
| 7  | Information on pictures of road designs that are not complete | Design (Gavilan and Reynold, 1994) |
| 8  | Less coordinating with contractors and less knowledgeable about construction | Design (Gavilan and Reynold, 1994) |
| 9  | The lack of complete information about the type and size of the material in the design document | Design (Gavilan and Reynold, 1994) |
| 10 | Orders cannot be made in small quantities | Material Procurement (Gavilan and Reynold, 1994) |
| 11 | Suppliers of goods senders that do not meet specifications | Material Procurement (Gavilan and Reynold, 1994) |
| 12 | Insufficient understanding of alternative products | Material Procurement (Gavilan and Reynold, 1994) |
| 13 | Waiting for material | Material Procurement (Gavilan and Reynold, 1994) |
| 14 | Damage due to transportation to / at the project site | Material Procurement (Gavilan and Reynold, 1994) |
| 15 | Scattered on the road | Material Procurement (Gavilan and Reynold, 1994) |
| 16 | Materials sent are lacking | Material Procurement (Gavilan and Reynold, 1994) |
| No | Causes of Material Waste                                                                 | Sources                                      |
|----|------------------------------------------------------------------------------------------|---------------------------------------------|
| 17 | The attitude or actions of the project team and workers who are not friendly / rude       | Material Handling                           |
| 18 | Theft (Can be sold on the street)                                                         | (Gavilan and Reynold, 1994)                 |
| 19 | Damage to material in place (slow cutting of fc ’30 MPa)                                  |                                             |
| 20 | Errors in the preparation of material in the field                                         |                                             |
| 21 | Errors caused by labor Implementation                                                      |                                             |
| 22 | Equipment that does not function properly                                                 |                                             |
| 23 | Bad weather                                                                               |                                             |
| 24 | Work accidents in the field                                                               |                                             |
| 25 | Use of the wrong material in the aggregate mixture so that it needs to be unloaded        |                                             |
| 26 | Errors due to negligence                                                                   |                                             |
| 27 | Damage due to less skilled workers                                                        | Implementation                              |
| 28 | Repair of finishing work                                                                   | (Gavilan and Reynold, 1994)                 |
| 29 | Schedule delays                                                                           |                                             |
| 30 | Slow / ineffective repairman                                                               |                                             |
| 31 | Lack of supervision / poor quality                                                        |                                             |
| 32 | Improvements to structural work                                                            |                                             |
| 33 | Improvements to formwork work                                                              |                                             |
| 34 | Waiting for workers                                                                       |                                             |
| 35 | Unreliable equipment                                                                      |                                             |
| 36 | Repair of foundation work                                                                  |                                             |
| 37 | Waiting for instructions                                                                   |                                             |
| 38 | Design changes and slow revision and distribution images                                   |                                             |
| 39 | Waste material due to the Residual use process                                            | Residual (Gavilan and Reynold, 1994)        |
| 40 | Poor control of material in the project and management planning for the waste material    | Miscellaneous (Gavilan and Reynold, 1994)   |
| 41 | Lack of attitude initiatives                                                               |                                             |
| 42 | Doubts reduce the waste material                                                          |                                             |
| 43 | Lack of knowledge of residual values, consequences of residual material, ways to reduce residual material, and responsibility for waste material | Attitudes (Loosemore and Teo, 2001)        |
| 44 | Believing that waste material cannot be avoided                                           |                                             |
| 45 | Pragmatic culture Subjective                                                               |                                             |
| 46 | Culture of waste                                                                          | Subjective Norms                            |
| 47 | Waste material that is not clear                                                           | (Loosemore and Teo, 2001)                  |
| 48 | waste material is the last priority                                                        |                                             |
| 49 | Management commitment that is lacking                                                      |                                             |
| 50 | Lack of consultation                                                                      |                                             |
| 51 | Material scheduling control irregularities                                                  | Behavior Controlling                        |
| 52 | Material cost control deviations                                                          | (Loosemore and Teo, 2001)                  |
Table 3. Early Risk Identification of Sources and Causes of Ready Mix Concrete Waste Materials (Third Phase)

| No | Causes of Material Waste | Sources |
|----|--------------------------|---------|
| 1  | Design information that lacks design | Design (Gavilan and Reynold, 1994) |
| 2  | Lack of coordination with contractors and lack of knowledge about construction | Material Procurement (Gavilan and Reynold, 1994) |
| 3  | The lack of complete information about the type and size of the material in the | |
| 4  | Orders cannot be made in small quantities | Material Handling (Gavilan and Reynold, 1994) |
| 5  | Damage due to transportation to / at the project site | |
| 6  | Scattered on the road | |
| 7  | Theft (Can be sold on the street) | |
| 8  | Material damage in place (slow cutting of fc’30) | |
| 9  | Errors in the spread of material in the field | |
| 10 | Equipment that does not function properly | |
| 11 | Bad weather | Implementation (Gavilan and Reynold, 1994) |
| 12 | Workplace accident | |
| 13 | Mistakes made by labor | |
| 14 | Unreliable equipment | |
| 15 | Waste material due to the Residual use process material | Residual (Gavilan and Reynold, 1994) |
| 16 | Poor control of material in the project and management planning for the remaining material | Miscellaneous (Gavilan and Reynold, 1994) |
| 17 | Lack of attitude initiatives | |
| 18 | Doubts reduce waste material | Attitude (Loosemore and Teo, 2001) |
| 19 | Lack of knowledge of residual values, consequences of residual material, ways to reduce residual material, and responsibility for residual material | |
| 20 | Emphasizing the timing of Behavioral Control | Behavior Controlling (Loosemore and Teo, 2001) |
| 21 | Emphasis on costs | |

6. Conclusion
The final result shows the results which are the Early risk Identification displayed in the form of recapitulation below. The result is a novelty for the causes of waste material for road construction projects.

Table 4. Recapitulation of Early Risk Identification Expert Phase Sources and Causes of Road Works Projects

| No | Material | Causes Early Literature ( First Phase) | Second Phase | Third Phase | Causes of Early Risk Identification | Sources of Early Risk Identification |
|----|----------|----------------------------------------|--------------|-------------|-------------------------------------|-------------------------------------|
| 1  | Readymix | 91                                     | 52           | 21          | 21                                  | 8                                   |
| 2  | Lean Concrete | 91                                   | 52           | 18          | 18                                  | 7                                   |
| 3  | B Aggregate | 91                                    | 46           | 15          | 15                                  | 7                                   |
| 4  | Landfill | 91                                     | 47           | 26          | 26                                  | 8                                   |
| 5  | Cement   | 91                                     | 50           | 31          | 31                                  | 7                                   |
7. Suggestion
Early Risk identification will be continued by carrying out further research to obtain further risk identification on road construction projects by conducting quantitative measurements.

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