Development of Risk-Based Standardized WBS (Work Breakdown Structure) for Quality Planning of Flyover Works

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Abstract

Work Breakdown Structure (WBS) is a breakdown of project works into smaller components so it can be better managed. It is also known that the quality of project works is also important to controlled in order to avoid mismatch. The approaches of risk considerations are now required for the whole process on quality management. Therefore, the development of risk-based standardized WBS is proposed for quality planning of flyover works. The conducted research consists of several stages with qualitative risk analysis method. The result indicate that standardized WBS consists of 5 primary levels and 2 complementary levels, with 5 dominant risk variables on quality performance and recommended risk responses as the development of standardized WBS.

Keywords:
Flyover, Project,Quality, Risk,WBS

1. Introduction

Construction activity is an important element in development. In developing countries, in order to improve the standard of living of their people, the demand for construction project activities will be felt. The rapidly growing construction project demands the importance of building on demand from the owner, where the flyover building (Flyover) is part of the construction industry that is influenced by economic parameters and psychological parameters. . The contribution of the construction sector to the formation of gross domestic product (GDP) is also quite significant, is 10.38 percent, ranks fourth after the industrial, agricultural and trade sectors. and placed this activity as one of the economic supporters of the capital [1].

In the current development of the construction world, there are a lot of projects emerging in various types, especially in the field of infrastructure, such as the construction of toll roads, flyovers (Flyover), and tunnels. Construction of the construction project requires knowledge, expertise, insight, and experience in the construction world is not small. This should all be owned

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by all parties involved in the construction of a construction project for planners, project leaders, construction managers, and contractors. One of the most important things to be done in the early stages of planning a construction project is to plan the resources to be used based on the Work Breakdown Structure [2].

Due to its complexity, the successful management of construction projects from the perspective of the contractor or project implementer depends on the maturation of the planning [3]. Significance of the importance of Work Breakdown Structure, as follows [4]:

1. The description of the program as a summary of the small parts
2. Planning.
3. Networking and supervision planning.
4. Division of responsibilities.

The need for standardized WBS is critical, as it will present an integrated approach to project management and present the basis for performance measurement [5]. Therefore, the development of a standard WBS risk-based standard flyover work designed for quality planning is proposed.
The purpose of this research to the following:

1. Make WBS Standards in flyover work.
2. Identify the implementation methods and technologies used of each flyover work package.
3. Identify activities based on the WBS-based method of implementing flyover work.
4. Identify resources based on activities on flyover work packages.
5. Identify risk-based activities and resources that affect the quality performance of each flyover package.

The scope of the study is limited to the following:

1. The research is done from the internal side of the contractor.
2. The project under study is a project that has been implemented from 2010 to 2017.
3. Research location in Jabodetabek, Indonesia.
4. WBS developed standards are items that have a high risk on flyover work.
5. This flyover work using the box girder**.**
6. Quality planning referred to in the research is planning on flyover work.

2. WBS Flyover Risk-Based for Quality Planning

2.1 Standard WBS Flyover

As a technical reference for the implementation of road and bridge project works within the Directorate General of Binamargayang applicable in Indonesia, there is a document of the general specification of road and bridge construction works as part of contract documents of road and bridge construction work used to achieve a product of work from the preparation process, methods of implementation, materials, equipment, quality control, and payment procedures.
The General Specification of Binamarga 2010 has its third revision valid since November 12, 2014, since the issuance of the Director General of Highways No. 10 / SE / Db / 2014 regarding

the Submission of Standard Procurement Document and General Specification 2010 (Revision 3) for Road and Bridges Construction Works.
The General Specification Binamarga 2010 consists of 10 divisions, to the following:

1. Division 1 General
2. Division 2 Drainage
3. Division 3 Land Works
4. Division 4 Widening of Pavement and Shoulders
5. Division 5 Concrete Pavement and Concrete Pavement Pavement
6. Division 6 Asphalt pavement
7. Division 7 Structure
8. Division 8 Refund conditions and Minor works
9. Division 9 Daily Jobs
10. Division 10 Routine Maintenance

Meanwhile, as a technical reference for the implementation of freeway and toll road projects within the Directorate General of Binamarga, both for the National Road Implementing Agency (BPPN / BPJN) and Toll Road Enterprises (BUJT) applicable in Indonesia, there is a Special Specification of Road Frequency and Toll Roads that have been in force since March 13, 2017, since the issuance of the Director General of Highways No. 02 / SE / Db / 2017 concerning the Submission of Technical Specifications and Special Specifications of Highway and Toll Road 2017 in the Directorate General of Highways.
The Special Specification of Freeway and Toll Road consists of 17 general divisions and 3 special divisions, to the following:

1. Division 1 General
2. Division 2 Cleaning the Workplace
3. Division 3 Demolition
4. Division 4 Land Works
5. Division 5 Galian Structure
6. Division 6 Drainage
7. Division 7 Preparation of Ground
8. Division 8 Aggregate Base
9. Division 9 Pavement
10. Division 10 Concrete Structure
11. Division 11 STr structural Steel Works
12. Division 12 Other Jobs
13. Division 13 Lighting, Traffic Light and Electrical Works
14. Division 14 Plaza Tol
15. Division 15 Transfer and Protection of Existing Equipment
16. Division 16 Toll Offices and Facilities
17. Division 17 Daily Jobs
18. Division of SKh 1.09 Office and Field Facilities
19. Division of SKh 1.16 Traffic Management
20. Division of SKh 1.20 Mobilization

2.2 WBS Risk-Based Official Standards

Project risk is the possibility of events that bring undesirable consequences for the project objectives. If an event occurs then it may affect the scope of the project, schedule, cost, or quality. Risk can be prioritized by assessing the probability of occurrence and its impact through qualitative risk analysis [6]. Since WBS ordinary standards may not consider the project risk response, standards-based WBS based risk is the improvement of WBS standards coupled with the risk response associated with the project objectives and targets, in this study is the risk response to quality performance.

2.3 WBS Benefits for Quality Planning

The quality plan should determine the size and procedure (tests, inspections, reviews, etc.) to assess the conditions and progress towards the preconditions to be achieved. [7]. To produce the output there are several inputs in conducting the quality planning process according to PMBOK as follows

Figure 1. Stage Research Process
Source: PMBOK, 2013 [6].

3. Research Methodology

This study used a qualitative approach to achieve the formulation of WBS standards for flyover projects. Secondary data analysis was conducted using Bill of Quantity of 7 flyover projects. Surveys and interviews were also conducted using structured questionnaires for experts with more than 10 years of experience in the flyover project. Risk identification was derived from the standard WBS category and the variables were obtained from literature analysis, archival analysis, then questionnaires distributed to respondents such as engineers, supervisors , and the project manager of the ongoing flyover project. Of the 42 returned questionnaires, qualitative risk analyzes were performed using the risk probabilities of PMBOK and the impact matrix to find the dominant risk variable.

Level 1 is the name of the project itself, level 2 is a clump of work. Level 3 is for the type of work, Level 4 is the work package. Decomposition continues with activity and resources for the next level. After obtaining the wbs standard, the next process is to identify risks based on the work plan and its activities from WBS standards. An extensive literature review was conducted to identify common risk factors that may occur in construction projects that affect costs performance. The category or group of risk factors is the work package, including its activities and resources. This resulted in the identification of 42 factors categorized in the group as 1) Work

Package 2) Alternative Method / Design 3) Activity 4) Material 5) Equipment 6) Labor, 7) Environment. Risk-Based Above, the risk variables used in this study are as follows:

Table 1
Risk Variables That Influence The Performance Of Flyover Projects

WBS LVL	CATEGORY	RISK VARIABLES THAT INFLUENCE THE PERFORMANCE OF FLYOVER PROJECTS	
4	WORK PACKAGE	X1	The realization of unit price of each work package is not as planned
		X2	The realization of the volume of the work pack does not fit the plan
		X3	The results of the work are not in accordance with the requirements
		X4	Work is not on schedule
		X5	Subcontract productivity is not as planned
4	METHOD	X6	Aspects or methods (aspects or methods) can not be applied in the field
5	ACTIVITY	X7	Installation is not in accordance with the specifications or images planned
		X8	The erection precast activity does not match the specification or the planned image
		X9	Identify incomplete project activity
6	RESOURCES: MATERIAL	X10	Changes in specifications and material types
		X11	The scarcity of materials as per the job planning specifications
		X12	Changes in the condition of the material source to the project site
		X13	Material quality does not match job planning specifications
		X14	The use of materials in the field exceeds the planned volume
		X15	Substitution (replacement) material that does not comply with specifications
6	RESOURCES: EQUIPMENT	X16	Bad tool condition
		X17	Faulty equipment
		X18	The equipment is not working properly
		X19	The productivity of the planned equipment is not as needed
		X20	The equipment used is not in accordance with the planned implementation method
		X21	Equipment specifications are not in accordance with the planning
		X22	Equipment quality is low
6	RESOURCES: LABOR	X23	Work area is limited
		X24	Number of manpower not according to plan
		X25	Job quality tolerance is exceeded
		X26	Lack of communication (lack of communication)
		X27	False perception in reading of Fig
		X28	Poor quality control qc / qa
		X29	Reworking
		X30	Lack of major equipment maintenance by workers
		X31	Realization of labor productivity is not in accordance with the plan
		X32	The type and amount of labor required is not available
		X33	Lack of field workers
		X34	Labor Disputes
		X35	Worker productivity is less than planned
		X36	Labor accidents

WBS LVL	CATEGORY	RISK VARIABLES THAT INFLUENCE THE PERFORMANCE OF FLYOVER PROJECTS	
		X37	The quality of the workforce is not as planned
		X38	The division of duties and authority is not understood by the worker
6	**ENVIRONMENT**	**X39**	There is no working procedure
		X40	No WI (work instruction)
		X41	Changes in work schedules do not take into account the weather
		X42	No waste management is planned
		X43	Documents of subsurface geological conditions are incompatible with actual field conditions
		X44	Document The subsurface hydrological conditions are not in accordance with actual field conditions
		X45	Natural disasters

Source: Self-processed, 2017

The data were collected using a questionnaire survey to find out the practitioners' perceptions of risk factors. The target respondent is an experienced practitioner in the apartment construction project. Five likert scale points were selected to obtain the probability of risk factors in the construction project identified in the literature review. The 5-point Likert scale is adopted, where 1) represents "rare" 2) "occasionally" 3) "rather often" 4) "often", and 5) "very often". Likewise, likert scale is also chosen to get the impact of risk factors where 1) is represented "very low", 2) "low" 3) "Medium" 4) "high" and 5) "very high". Once the probability and impact are determined, the risk score can be calculated by the following expression:

$$R = P \times I$$

Where R = risk factor, P = probability and I = impact. The probability matrix and the impact or risk-level matrix (Table 2) illustrate risk ranking for risk factors. The risk matrix represents a combination of impact and probability as shown below:

Table 2
Risk Level Matrix

			Impact				
			Very Low 1	Low 2	Med 3	High 4	Very High 5
Probability	Very frequent	5	5	10	15	20	25
	Frequent	4	4	8	12	16	20
	Somewhat frequent	3	3	6	9	12	15
	Occasionally	2	2	4	6	8	10
	Rare	1	1	2	3	4	5

Source: PMBOK, 2013 [6].

Each of the risks placed on the table will fall under one of the categories in different colors. Here are some details about each category:

1. Height: the risk of falling on a cell is marked in red, is the most critical risk and it is should be handled on a high priority basis. The Project team must be prepared to act immediately to eliminate the risk completely.
2. Medium: the risk of falling in one yellow cell, may affect cost performance, is handled directly at the project level (project manager).
3. Low risk: the risk of falling in a little blue cell effect on cost performance and handled directly by engineers or related parties

To develop risk-based WBS, the highest ranking risk variables are analyzed for their preventive and corrective actions through pattern recognition, as well as through the RBSxWBS matrix. The RBSxWBS matrix is a Risk Breakdown Structure mapping that affects WBS items. The matrix uses the dominant risk variable for RBS input, and the Pareto method as the approach to selecting a particular job is dominant at 80% of project cost for WBS item input. The result of the risk responses from interviews 7 experts from construction practitioners and academics with more than 10 years of experience used to develop WBS standards.

4. Results and Discussion

4.1. Demography Result

There are 42 respondents have been re-received. Profile of respondents as summarized in the table below:

Table 3 Category Type of Respondent Institution

No	Agency	Sample
1	Contractor A	13
2	Contractor B	7
3	Contractor C	7
4	Owner D	8
5	Contractor E	7

Source: Self-processed, 2017

Table 4 Respondent Education Category

No	Education	Sample
1	D3	7
2	S1	29
3	S2	6

Source: Self-processed, 2017

Table 5 Position Category / Position of Respondents

No	Job title	Sample
1	Supervisor	9
2	Engineer	24
3	Project Manager	2

Source: Self-processed, 2017

Table 6 Work Experience Category

No	Jabatan Pekerjaan	Jumlah Sampel
1	<5 tahun	8
2	6-10 tahun	13
3	11-15 tahun	10
4	16-20 tahun	4
5	>20 tahun	7

Source: Self-processed, 2017

And illustrated as shown below :

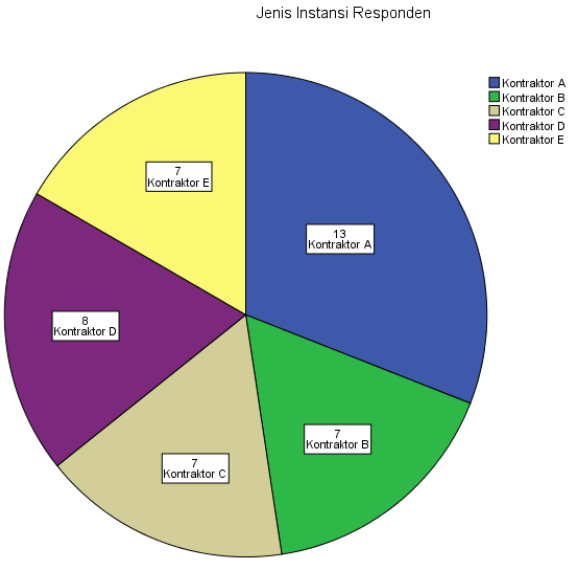

Figure 2 Data Distribution Diagram by Type of Institution
Source: Self-processed, 2017

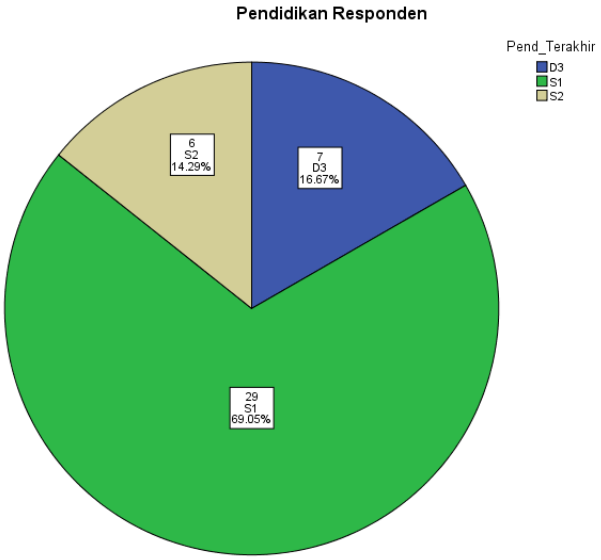

Figure 3 Data Distribution Diagram by Education
Source: Self-processed, 2017

Figure 2 indicates that the most respondets were contractor A . As shown in figure 3, shows that majority (73%) of respondent had Bachelor degree 69,05%.

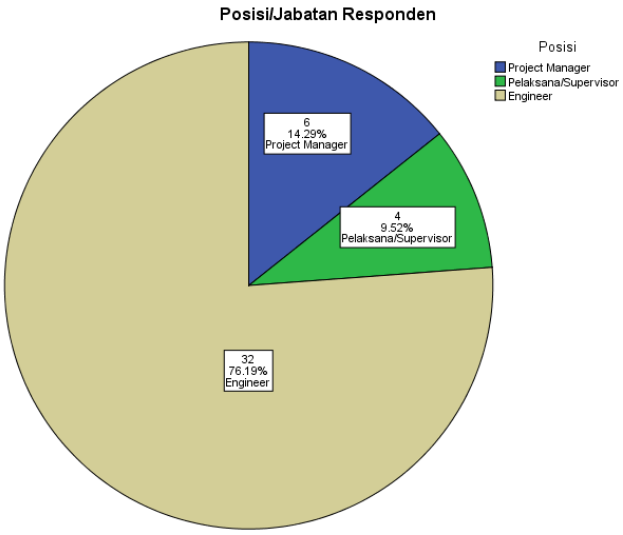

Figure 4 Data Distribution Diagram based on Job Position
Source: Self-processed, 2017

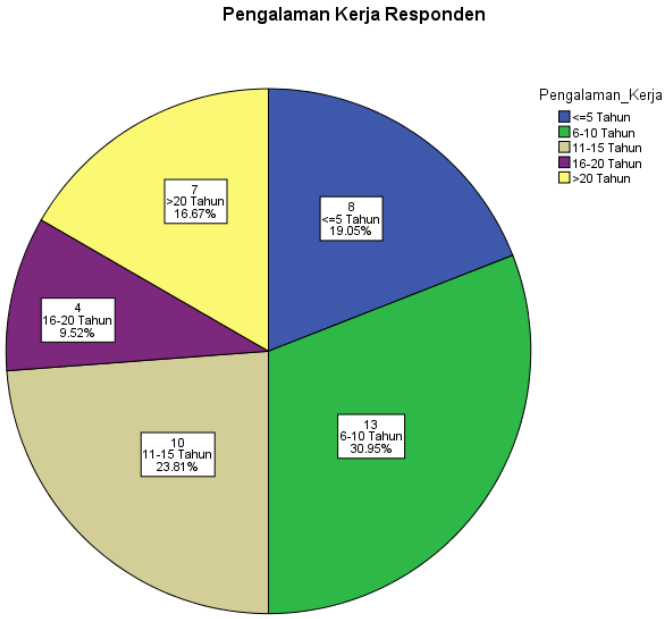

Figure 5 Data Distribution Diagram based on Work Experience

Source: Self-processed, 2017

Figure 4 indicates that the most respondets were engineers 76,19%, PM or managers 14,29% and staff 9,52%. As shown in figure 5, the respondents had various lengths of years of experience in handling flyover works. Figure 5 shows that majority (30,95%) of respondent had working experience 6-10 years; while 23,81% of respondents had working experience of 11 – 15 years; 19,05% of repondents had below 5 years working experience; 16,67% of respondent had working experience above 20 years and 9,52% of the respondents had working expeerience of 16-20 years.

Based on the above results, it appears that all variables meet the null hypothesis (Ho) because it meets the Asymp value. Sig (2-tailed) is greater than the 0.05 level of significance (α) so there is no significant difference of perception for all responses to the work agency, education, occupational background, and work experience.

5.2. Test Validity and Reliability

Test Validity is used to find out how precisely a measuring instrument capable of performing functions. Measuring tool that can be used in testing the validity of a questionnaire is the number of correlation results between the score statement and the overall score of statement respondents to the information in the questionnaire. While the reliability test is used to determine the consistency of the measuring instrument, that is how the gauge can be reliable and remain consistent if the measurement is repeated. Test Validity and reliability are used to determine the consistency of answers. Testing the validity and reliability of this software using SPSS version 22.

Validity test uses corrected total correlation value using r value from table. In this study r table is seen at 95% confidence level or 5% significance for 2 side test with 42 respondents, so the degree of freedom (df) = N-2 = 40, for df = 40 has r table value 0, 3044.

While the reliability test using cronbach's alpha method. Research is said to be reliable if the value of alpha is greater than the critical product moment r value. The conditions for test reliability with cronbach's alpha method are as follows:

- The Cronbach Alpha value ≤ 0.6 indicates that the research questionnaire is not reliable.
- The Cronbach Alpha value ≥ 0.6 indicates that the research questionnaire is reliable.

Here are the results of the validity and reliability test of the questionnaire 42 respondents.

Table 7 Validity Test Results

		N	%
Cases	Valid	42	100.0
	Excluded[a]	0	0.0
	Total	42	100.0

Source: Self-processed, 2017

In the table above shows that the value of N for the validity level is 42, it can be concluded that the respondents reviewed amounted to 42 respondents and already valid 100%. After that the reliability test is done with the following conditions:

- • If the value of r alpha positive ≥ r table, then reliable
- • If the value of r alpha negative ≤ r table, then not reliable

Table 8 Validity Test Results

Cronbach's Alpha	N of Items
.943	45

Source: Self-processed, 2017

In the table above shows that the value of cronbach's alpha of 0.943 with the number of research variables as many as 45 units. Thus, it can be concluded that the questionnaire tested is reliable because the value of cronbach's alpha = 0.943 is greater than 0.6. To be able to know the reliability of the questionnaire by looking at the value of cronbach's alpha, can be seen in the following table :

Table 9 *Cronbach's Alpha*

Alpha	Reliability Level
0.00 s/d 0.20	Less Reliable
> 0.20 s/d 0.40	Somewhat Reliable
> 0.40 s/d 0.60	Quite Reliable
> 0.60 s/d 0.80	Reliable
> 0.80 s/d 1.00	Very Reliable

Source: : Ridwan, 2006 [8].

From the value of cronbach's alpha obtained that is equal to 0.943. then according to the table can be concluded that the reliability of the instrument is very reliable. Furthermore, the validity test. In the Item Total Statistics in the validity test, the R table value for the 2-sided test at the 95% confidence level or 5% significance with the number of respondents 42, has degrees of freedom (df) = N - 2 = 42 - 2 = 40. R value of two-sided tables at df = 40 and P = 0.05 is 0.3044. The requirements for assessing the validity of variables are as follows:

• If corrected item total correlation> r table, then variable is valid
• If corrected item total correlation <r table, then variable is invalid

Here are the results of the validity test of 45 research variables

Tabel 10 *Item-Total Statistics*

Variable	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted	Conclusion
X1	240.3571	9857.162	0.461	0.942	Valid
X2	235.7857	9533.977	0.438	0.943	Valid
X3	241.119	9640.107	0.542	0.941	Valid
X4	234.8095	9564.158	0.395	0.943	Valid
X5	237.8333	9437.411	0.509	0.942	Valid
X6	240.9762	9622.804	0.683	0.941	Valid
X7	241.619	9603.851	0.598	0.941	Valid
X8	237.4762	9575.085	0.391	0.943	Valid
X9	242.0476	9799.559	0.531	0.942	Valid
X10	240.7143	9657.575	0.632	0.941	Valid
X11	241.381	9713.656	0.487	0.942	Valid
X12	242.0476	9897.461	0.395	0.942	Valid
X13	239.5952	9655.613	0.464	0.942	Valid
X14	239.4524	9850.205	0.343	0.942	Valid
X15	241.7619	9828.527	0.563	0.942	Valid
X16	241.2381	9847.552	0.422	0.942	Valid
X17	239.5952	9628.393	0.62	0.941	Valid
X18	239.2381	9607.405	0.614	0.941	Valid
X19	240.0476	9657.607	0.658	0.941	Valid
X20	241.5714	9783.324	0.708	0.941	Valid
X21	240.0952	9676.43	0.448	0.942	Valid
X22	241.5238	9673.182	0.658	0.941	Valid
X23	241.8571	9774.125	0.478	0.942	Valid
X24	237.6905	9636.316	0.614	0.941	Valid
X25	241.3571	9749.308	0.548	0.941	Valid
X26	241.619	9564.242	0.653	0.941	Valid
X27	241.7381	9684.93	0.61	0.941	Valid
X28	237.881	9533.132	0.502	0.942	Valid
X29	241.4524	9710.937	0.627	0.941	Valid
X30	241.7143	9553.477	0.598	0.941	Valid
X31	237.6429	9368.869	0.669	0.94	Valid
X32	242.119	9676.546	0.693	0.941	Valid
X33	239.6667	9618.472	0.431	0.942	Valid
X34	242.619	9781.12	0.567	0.941	Valid
X35	240.0952	9725.552	0.544	0.941	Valid
X36	240.9286	9738.995	0.468	0.942	Valid
X37	240.8095	9807.816	0.432	0.942	Valid

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Variable	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted	Conclusion
X38	242.5476	9770.888	0.649	0.941	Valid
X39	242.5	9785.72	0.617	0.941	Valid
X40	242.4286	9799.178	0.56	0.941	Valid
X41	240.9286	9384.166	0.55	0.942	Valid
X42	242.3333	9773.789	0.532	0.942	Valid
X43	237.381	9500.827	0.391	0.944	Valid
X44	240.9524	9584.388	0.485	0.942	Valid
X45	242.3095	9753.097	0.561	0.941	Valid

Source: Self-processed, 2017

Based on the Corrected Item-Total Correlation value, it is concluded that all variables are valid, then all the variables can continue to be included in the risk level analysis.

5.3. Ranking of Risk Factors Study

This stage of risk level analysis uses the Perform Qualitative Risk Analysis process in PMBOK 5th Edition as a guide. The way to conduct a qualitative risk analysis is to use a probability and impact matrix. Here are the frequency and impact scores for each risk factor variable according to PMBOK 5th Edition:

Therefore, to be able to identify risks, the categorization of the WBS framework that is produced in the first research objectives, starting from the Work Package, Method / Design, Activity, to Material Resources, Tools and Labor as Risk Category or risk event categories affect the purpose, ie the performance of flyover quality work. Furthermore, from the identification of risk based on the category generated from the WBS Standard level, it was found that the dominant risk arose from the questionnaire of respondents as follows.

Table11 Dominant Risk to Quality Performance

RISK VARIABLES THAT INFLUENCE PROJECT QUALITY PERFORMANCE		RISK VALUE	SEQUENCE RISK	RISK LEVEL
X4	Work is not on schedule	0.219	1	High
X2	The realization of the volume of the work pack does not fit the plan	0.197	2	High
X43	Documents of subsurface geological conditions are incompatible with actual field conditions	0.158	3	High
X8	The erection precast activity does not match the specification or the planned image	0.151	4	High
X5	Subcontract productivity is not as planned	0.144	5	High

Source: Self-processed, 2017

From the validation of the experts in this study also found that some quite frequent risk variables in structural work, among others: X4. Work is not on schedule, X2. Realization volume of work package not according to plan, X43. Document of subsurface geological conditions not in accordance with actual field conditions, X8. The erection precast activity does not match the specification or the planned image, X5. Subcontract productivity is not as planned.

It also generates a number of preventive and corrective actions that the project implementer must take into account in planning and implementation for all work.

Table 12 Development for Non-WBS Structure items

CODE	PREVENTIVE/ CORECTIVE ACTIONS	RECOMMENDATIONS
TP1	Prior to commencement of work, at the commencement of the necessary checks / reviews of the critical point on the ground	Contract Items / WBS Preparation: Document & Project Administration
TP2	Detailed investigation of utility maps, if there is a difference then there is potential claims from the beginning that will be as early as possible to be submitted to the owner	Contract Items / WBS Preparation: Document & Project Administration
TP3	Conduct periodic monitoring and evaluation on a more stringent schedule of subcontractors with schedule time of implementation	Managerial Item
TP4	Prepare the following Quality Work Instruction or Work Instructions	Managerial / WBS Item Preparation: Project & Engineering Team
TP5	Conducting training on mastery of specifications, project locations, drawings, and implementation schedule for estimators	Managerial / WBS Item Preparation: Project & Engineering Team
TP6	Using certified labor	Managerial / WBS Item Preparation: Project Document & Administration
TP7	Dig information based on historical data	Managerial Item
TP8	Multiply the data bank for job type specifications	Managerial Item
TP9	Monitoring and evaluating periodically more strictly on resource schedules (labor, equipment, materials) with schedule time of implementation	Managerial Item
TP10	Need to make detailed design so that the planned method is the same as in the field	Managerial / WBS Item Preparation: Project Document & Administration
TP11	Changes in method due to adjustment of implementation shall be controlled and controlled in relation to the quality requirements concerned	Contract Item / RKS
TP12	Membuat *mock up* pekerjaan yang dipantau kualitas dan produktivitasnya	Contract Item / RKS
TP13	Establish specific qualification criteria for subcontractor selection (not only administration but also work experience, funding ability, ISO certificate, specialist certification, work method proposal)	Contract Item / RKS
TP14	Reviewing labor procurement based on competency	Item WBS Preparation
TP15	Planning for subcontracting selection based on specific qualification criteria (not only administration but also work experience, funding ability, ISO	Item WBS Preparation

CODE	PREVENTIVE/ CORECTIVE ACTIONS	RECOMMENDATIONS
	certificate, specialist certification, work method proposal)	
TP16	Agree on specifications or alternatives of equivalent specifications	Item Manajerial / Item WBS Persiapan: Site Management
TP17	Ensure that workers are equipped with equipment	Item WBS Preparation: Document & Project Administration
TP18	Carry out routine maintenance of equipment	Contract Item / RKS
TP19	Arrange alternative scheduling equipment	Managerial Items / WBS Preparation: Tools & Materials
TP20	Propose alternative methods with available equipment	Managerial Item
TP21	Conduct regular labor training and results assessment	Managerial Item
TP22	Conducting coaching / guidance and control over subcontractors	Managerial Item
TK1	Carry out rework on the part of the problem or entirely	Managerial Item
TK2	Evaluate the use of equipment and the combination of equipment with the realization of the needs of workers	Managerial Items / WBS Preparation: Tools & Materials
TK3	Reviewing the procurement of labor based on the evaluation of the workforce	Managerial Items / WBS Preparation: Tools & Materials
TK4	Carry out a less applicative review procedure	Item Manajerial / Item WBS Persiapan: Site Management
TK5	Replace subcontractors after selection	Managerial Item
TK6	Conducting rescheduling based on the results of field monitoring and evaluation without changing implementation schedule	Managerial Item
TK7	Replacing workforce with a more competent and high productivity	Managerial / WBS Item Preparation: Project & Engineering Team
TK8	Conduct review and efficiency of residual work	Contract Item / RKS
TK9	Carry out on the spot workforce training	Managerial / WBS Item Preparation: Project & Engineering Team
TK10	Create shop drawing for job reference	Managerial Item
TK11	Replace the tool with equivalent specifications	Managerial Item
TK12	Melakukan uji coba alat baru	Managerial / WBS Item Preparation: Project & Engineering Team

Source: Self-processed, 2017

5.4. Proof of Hypothesis

The hypothesis in this study is: "with the development of risk-based WBS standards, will be able to improve the quality planning of the flyover project". The identification of WBS standards of structural work results in a WBS framework that is categorized as risk to analyze the dominant risk occurring in flyover project construction and yields the highest risk. It also obtained one type of dominant work on the 80% cost resulting from the pareto analysis on flyover construction

elements, namely Structural Work. Analysis of Causes, Impacts, Preventive Actions and Corrective Actions against these dominant risks generates recommendations or additional activities for the Structure underlying the importance of developing the WBS Risk-based standards, since responses to those risks can be recommendations for action on improvements to WBS in project management .

The process of breaking down the risk and handling it from developing this WBS standard can help project implementers to become the basis for quality planning, identifying jobs to the smallest items and setting each quality or quality objective in more detail, accurate, and specific. Risk responses are also considered so that risk-based WBS can be used as a control tool to ensure work has already considered the requirements to respond to quality-related risks. Then the proven research hypothesis.

6. Conclusion

The purpose of this research are:
1. Make WBS Standards in flyover work.
2. Identify the implementation methods and technologies used of each flyover work package.
3. Identify activities based on the WBS-based method of implementing flyover work.
4. Identify resources based on activities on flyover work packages.
5. Identify risk-based activities and resources that affect the quality performance of each flyover package.

The first research objective indicate that standardized WBS consists of 4 primary level and 2 complementary level; The second research objective generates 5 dominant risks towards quality performance after qualitative risk analysis, the highest risk score obtained from the category of WBS Level 7 Labor Resources. The third research objective shows that not every risk responses can be adopted directly into related WBS structure. Risk-based standardized WBS can be utilized for the basis of quality planning, helping project executor identifies project works to the smallest items and setting quality objective for each items in greater accuracy as a tool to ensure every work has considered the requirements to respond quality-related risks.

References

Asiyanto, *Manajemen Produksi Untuk Jasa Konstruksi*, Pradnya Paramita, Jakarta, 2005.

Asiyanto, *Manajemen Risiko untuk Kontraktor*, Pradnya Paramita, Jakarta, 2009. [2]

Badan Pusat Statistik Provinsi DKI Jakarta, Statistik Daerah DKI Jakarta 2016, Katalog BPS: 1101002.31, 2016.[1]

Biffi, M. H., Linking the Estimate, the Schedule and the Cost Control through a Standardized WBS, *AACE International Transaction*, 2008.

Brotherton, S. A., Fried, R. T., & S. Norman, E., Applying the Work Breakdown Structure to the Project Management Lifecycle, *PMI Global Proceedings*, 2008.

Burghate, S., Burghate, M., & Burghate, N., Work Breakdown Structure: Simplifying Project Management, *International Journal of Computing Technology, Volume 2, Issue 12*, 511-515, 2015.

Devi, T. R., & Reddy, S., Work Breakdown Structure of the Project. *International Jornal of Engineering Research and Applications Volume 2 Issue 2*, 683-686, 2012.

Edward, S., & Gaspersz, V., *Total Quality Management*, Gramedia Pustaka Utama, Jakarta, 2008.

Eriyanto,. *Teknik Sampling: Analisis Opini Publik*, LKis Pelangi Aksara, Yogyakarta, 2007.

F.D. Postula, WBS Criteria For Effective Project Control, AACE Tran, **16**, 1-7 ,1991. [3]

Halpin, Daniel W., *Construction Management*, John Willey &Sons. Inc, United States, 1998

Hans, R. T., WBS a tool for software project scope variation. *International Journal of Software Engineering & Application*, 2013..

Ibrahim, Y. M., Kaka, A. P., Trucco, E., Kagioglou, M., & Aouad, G., Semi Automatic Development of the Work Breakdown Structure (WBS) for Construction Projects. *International Built and Human Environment Research*, 2007. [5]

Irdemoosa, E. S., Dindarloo, S. R., & Sharifzadeh, M., Work Breakdown Structure (WBS) Development for Underground Construction. *Automation in Construction*, 85-94, 2015.

Jing-jing, Z., Guo-qing, W., & Wei, Z., Research on Four-Electrical Railway Project Cost Estimate Based on the WBS Standard Templates. *International Conference on Management Science & Engineering, Vol 20*, 720-726, 2013.

Jung, Y., Moon, B. S., Kim, Y. M., & Kim, W., Integrated Cost and Schedule Control Systems for Nuclear Power Plant Construction, *Science and Technology of Nuclear Installations*, 2015.

K. Yin, Prof.Dr. Robert, *Studi kasus desain & metode*, PT Raja Grafindo Persada, Jakarta, 2013.

Kenley, R., & Harfield, T., Reviewing the IJPM for WBS: the Search for Planning and Control. *Procedia - Social and Behavioral Sciences 119*, 887-893, 2014.

Khera, R., Ransom, P., & F. Speth, T., Using work breakdown structure models to develope treatment costs, *American Water Work Association*, E628-E641, 2013.

Kumar, Ranjit, *Research Methodology a step-by-step guide for beginners 3rd edition*, SAGE Publications Ltd., California, 2011.

Lai, S. T., A WBS-Based Plan Chengeability Measurement Model for Reducing Software Project Change Risk, *Lecture Notes on Software Engineering, Vol. 2, No. 1*, 94-99, 2014.

Li, D., & Lu, M., Automated Generation of Work Breakdown Structure and Network Model for Earthwork Project Planning : A Flow Network-Based Optimization Approach. *Construction Egineering Mangement*, 2016.

Logawa, Gunawan, *Manajemen Proyek Konstruksi*. Penerbit Universitas Trisakti, Jakarta, 2007.

Martinez, J. M., & Selles, M. E., A fuzzy quality cost estimation method, *Fuzzy Sets and Systems 266*, 157-170, 2015.

Momoh, A., Roy, R., & Shehab, E., A Work Breakdown Structure for Implementing and Costing ERP Project, *Communications of the IBIMA, Vol 6*, 2008.

Nicholas, J. M., *Project Management for Business and Engineering Principles and Practice*, Oxford: Elsevier, 2004 [7]

Permen PUPR No. 19, Peraturan Menteri Pekerjaan Umum dan Perumahan Rakyat No. 19 Tahun 2011 tentang Persyaratan Teknis Jalan dan Kriteria Perencanaan Teknis Jalan, 2011.

Permen PUPR No. 28, Peraturan Menteri Pekerjaan Umum dan Perumahan Rakyat No. 28 Tahun 2016 tentang Pedoman Analisis Harga Satuan Pekerjaan Bidang Pekerjaan Umum, 2016.

Peraturan Gubernur Provinsi Daerah Khusus Ibukota Jakarta Nomor 273 Tahun 2016 tentang Organisasi dan Tata Kerja Dinas Bina Marga. Pemerintah Provinsi DKI Jakarta, 2016.

Polonski, M., Application of The Work Breakdown Structure in Determining Cost Buffers in Construction Schedule. *Archives of Civil Engineering Vol LXI*, 147-161, 2015.

Ponticelli, S., O'Brien, W., & Leite, F., Advanced Work Packaging as Emerging Planning Approach to Improve Project Performance: Case Studies from the Industrial Costruction Sector. *5th International/11th Construction Specialty Conference*, 230-1,230-10, 2015.

Project Management Institute, *Practice Standard for Work Breakdown Structures-Second Edition*, 2006.

Project Management Institute, Project Management Body of Knowledge Guide - Fifth Edition, 2013. [6]

PT PP (persero)-General Contractor, *Buku referensi untuk kontraktor bangunan gedung dan sipil*, Gramedia Pustaka Utama, Jakarta, 2003.

Queensland Government, *Project Management Work Breakdown Structure Guide, Program Management Improvement*, Department of Transport and Main Roads, Queensland, 2007

Rafiq, M. Choudhry, Ph.D., P.E., M.ASCE; and Hafiz Zahoor, *Strengths and Weaknesses of Safety Practices to Improve Safety Performance in Construction Projects in Pakistan*. Journal (ASCE)EI.1943-5541.0000292, 2016

Ridwan, *Skala Pengukuran Variabel-variabel Penelitian*. Alfabeta, Bandung, 2008 [8]

Su, L., WBS-based Risk Identification for the Whole Process of Real Estate Project and Countermeasures. *National Conference on Information Technology and Computer Science*, 2012.

Suanda, B., *Advanced & Effective Project Management, Panduan Lengkap Bagi Praktisi Manajemen Proyek Profesional*, PP Concstruction & Investment, Jakarta, 2016.

Sufren, & Natanael, Y., *Belajar Otodidak SPSS*, PT. Gramedia, Jakarta, 2014.

Sukandarrumidi, Metodologi Penelitian: Petunjuk Praktis untuk peneliti pemula, Gadjah Mada University Press, Yogyakarta, 2006.
Sugiyono, *Metode Penelitian Bisnis*, CV Alfabeta, Bandung, 2001.
Sugiyono, *Statistik Untuk Penelitian*, Alfabeta, Bandung, 2004.
Sugiyono, *Metode Penelitian Kuantitatif, Kualitatif, dan R&D,*Alfabeta, Bandung, 2009.
Sugiyono, *Statistika untuk penelitian*, Alfabeta, Bandung, 2013.
Tan, W., *Practical Research Method*, Pearson Education South Asia Pte Ltd., Singapore, 2011.
Tangoro, D., Somaatmadja, S., & Sukardi, K., *Teknologi Bangunan*, UI Press, Jakarta, 2007.
UU RI No. 2, Undang-Undang RI No. 2 Tahun 2017 tentang Jasa Konstruksi, 2017.
Veronika, A., *Risk Management : The Unknown*, AVENEW Indonesia, Jakarta, 2013.
Wang , Wenbo; Hong Chen; and Jibiao Zhou, Risk Assessment and Early-Warning System for High-Speed Railway during the Construction and Operation of Underpass Bridges. Journal (ASCE) CF.1943-5509.0000717, 2015.
Wulfram, I. Ervianto, Manajemen Proyek Konstruksi, CV. ANDI OFFSET, Yogyakarta, 2005.
Zecheru, V., & Olaru, G., Work Breakdown Structure (WBS) in Project Management. *Review of International Comparative Management Volume 17, Issue 1*, 61-69, 2016.
Zou, P. X., Zhang, G., & Wang, J., Identifying Key Risks in Construction Projects: Life Cycle and Stakeholder Perspectives. *International Journal of Construction Management • February 2014*, 2014.
Zwikael, O., Critical Planning Processes in Construction Projects. *Contruction Innovation Vol 9 No 4*, 372-387, 2009. [4]

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