Evaluation of the Risk Management Maturity Level of the Bandung Husein Sastranegara International Airport Development Project

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Abstract. The Husein Sastranegara International Airport Development Project in Bandung city is owned by PT Angkasa Pura II (Persero). Risk management has been implemented but there were some shortcomings. In order to carry out the improvements effectively, the project needs to know in advance the maturity level of the risk management carried out in this project using Project Risk Maturity Model (Project RMM) proposed by Hopkinson (2011). Results of assessment found that the maturity level of Risk Response perspective is 66.7%, Risk Identification is 51.8%, Stakeholder is 48.4%, Risk Analysis is 45.9%, Risk Management Culture is 45.7%, and Project Management is 33.4%. The overall maturity level of the project is determined by the lowest percentage, which is 33.4% and is at level 2 (Novice). This indicates that there is a need to increase the maturity level to overcome the shortcomings.

Key words: Risk management, Risk maturity level, Project risk management, Project risk maturity model, ROC

1 Introduction

Husein Sastranegara International Airport in Bandung is one of the airports managed by PT Angkasa Pura II (Persero). By 2013, the number of passenger movements has increased to 2.46 million passengers which is about 300 percent of its capacity. To overcome this problem, at the end of 2013, PT Angkasa Pura II (Persero) launched a construction project for the renovation and expansion of this airport to fulfill passengers demand in the future. This project was undertaken in two stages namely construction of a new terminal for domestic flights and renovation of the existing terminal for international flights. When the construction is completed, the airport can accommodate 3.4 million passengers per year increasing the terminal area form 5,000 m2 to 17,000 m2. The total value of the construction project is ±140 billion Rupiah and the construction of the domestic terminal has been completed and started operating on April 1, 2016 while the renovation of the existing terminal which will be used as an international terminal was completed in September 2016.

This project was a design-build project through a tender process and the contract was awarded to a joint operation (consortium) of PT Waskita Karya (Persero) and Yodya Karya (Persero) in terms of project planning, both are state owned construction companies. In addition, this project

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also involved PT Laras Respati Utama as a construction management consultant. With a design-build delivery system, the contractors possess the greatest risk because they area responsible for the entire planning and implementation phase.

Risk management process has been implemented in this project, but there are still some shortcomings according to the officer in charge of project risk management. For example, the project location close to the airfield made the building often hit by jet blasts so that it interferes with building work. This was not predicted beforehand in the risk identification process so the response to this risk was not planned. Initially, the new terminal construction project was also predicted to be completed in September 2015. However, the completion was delayed from September 2015 to January 2016 until finally the new project was completed in April 2016. This delay occurred due to unexpected technical and administrative risks. This shows that the risk management process that has not been fully implemented has an effect on the project schedule. In addition, there were other unpredictable risks that affect the cost of the project, one of which was the project design, where the actual cost exceeded the planned budget.

The Husein Sastranegara International Airport Development Project does not yet have a perfect risk management process and hence improvements need to be made in order to fully support the achievement of project objectives. The aim of this research is to evaluate the project risk maturity level so that improvements can be proposed and used in future projects.

2 Literature Review

The concept of maturity in the organization refers to a condition where the entity in it has perfect conditions to achieve its goals [1]. The risk management process in the project has an important role in achieving project objectives in accordance with the expected time, cost, and performance. Therefore, having a mature risk management process in practice will make the project objectives achieved according to plan

The general risk management maturity model is derived from the general risk management maturity framework Risk Maturity Model (RMM) developed by [2]. In adapting a specific RMM for a project, [3] uses several sources, namely:

- Standard guidelines for risk management, mostly from the Project Risk Analysis Management (PRAM) Guide (1997) published by the Association for Project Management (APM) [4].
- The Turnbull Guidance (1999) – Internal Control: Guidance for Directors on Combined Code issued by the Institute of Chartered Accountants of England and Wales (ICAEW) [5]
- Risk management consultant working on HVR Consultancy Service.

Since it was first published, Project RMM has been continuously developed and improved in response to experience in its implementation. Other changes were also made in accordance with the new literature related to the risk management process.

The Project Risk Maturity has four levels of capability structure, they are [3]:

- LEVEL 1 – *NAÏVE:* At this maturity level the project has initiated a risk management process, but the design and application are flawed so that the risk management process does not add any value.
- LEVEL 2 – NOVICE: the project risk management process influences the decisions made by the project team. These decisions tend to lead to improved performance as measured against project objectives.
- LEVEL 3 – NORMALISED: The project risk management process has been formalized and implemented systematically. Effective management response is implemented in overcoming sources of uncertainty that can affect the achievement of project objectives. The risk management process supports the achievement of project objectives.
- LEVEL 4 – NATURAL: risk management process results in strategic and risk efficient choices when setting project objectives or when selecting solutions in projects. Sources of uncertainty that can affect the achievement of project objectives are managed systematically, in the sense that the team culture is conducive to optimizing project outcomes.

The project risk maturity is measured using 6 perspectives which is the basic structure of *Project RMM*, they are: 1) Project stakeholders, 2) Risk identification. 3) Risk analysis, 4) Risk response, 5) Project management, and 6) Risk management culture [3]. Each of the perspectives is measured using a predetermine questionnaire.

The results of the maturity assessment will be presented in the form of a bar chart. Each question on the questionnaire has a scale of A (level 4) to D (level 1). If there are questions that are not relevant to the project being assessed, then the question is neutral (not applicable). If all the answers to the questions are A, then all the bars will touch the top of the chart, and vice versa. Calculation of risk management maturity in this model uses weights that reflect the relevance of each question to one or several perspectives. The relative importance of the questions in each perspective is also reflected by the weights.

The maturity level for the entire risk management process is the same as the lowest value from the six perspectives of Project RMM. This is because the process capability from each perspective of the RMM Project is critical to the overall risk management process. The six perspectives influence each other. For example, when risk responses are not carried out, risk identification and risk responses will be in vain (useless).

In this study, ROC (Rank Order Centroid) was chosen because it will make it easier for respondents to give weights with many criteria but the results will remain accurate compared to other methods such as AHP [6]. Rank Order Centroid (ROC) provides a weight estimate that will minimize the maximum error of each weight. If the weight ranking of each criterion is known but there is no quantitative information about the weights, it can be assumed that the weights are uniformly distributed on the simplex of the rank order weights ($w_{r_1} \geq w_{r_2} \geq \cdots \geq w_{r_n}$), where $w_{r_1} + w_{r_2} + \cdots + w_{r_n} = 1$ and r_k is the ranking position of w_{r_k}). As an example, when n=2 then $w_{r_1} \geq w_{r_2}$ which means $\frac{1}{2} \leq w_{r_1} \leq 1$. When the respondent does not know anything about w_{r_1}, then it is assumed that probability distribution of w_{r_1} is uniform between $\frac{1}{2}$ and 1. Based on this, the expected value of $E(w_{r_1}) = \frac{3}{4}$ dan $E(w_{r_2}) = \frac{1}{4}$. The ROC can be calculated as follows:

$$w_j(ROC) = \frac{1}{n}\sum_{k=j}^{n}\frac{1}{r_k} \quad (1)$$

The weighting method is called the rank order centroid (ROC) weighting method because the resulting weight reflects the centroid (center of mass) of the simplex defined by the criteria. With this method, the more criteria, the fewer errors from each criterion [6].

3 Methodology

The Project RMM consists of 50 questions where 25 questions are required to ensure the validity of the instrument in measuring the maturity of risk management of a project, while the remaining 25 questions can be instrumental in measuring the maturity of risk management of a project. Each question may affect more than one perspective. The following figure shows an example of a question.

B3: Identification of Non-compliance Risks

How effectively does the project identify risks associated with compliance?	
E	Not applicable
D	Risks associated with compliance have not been identified, even though they may exist.
C	Some aspects of compliance have been considered for the purposes of risk identification, but only on an ad hoc basis.
B	The identification of compliance risks has been addressed, but this process may have omitted some significant risks that are relevant.
A	Responsibilities for risk identification have been allocated through the project team to ensure that all sources of compliance risk have been addressed systematically.
Perspectives affected: Risk Identification	

Fig 1. Sample question [3]

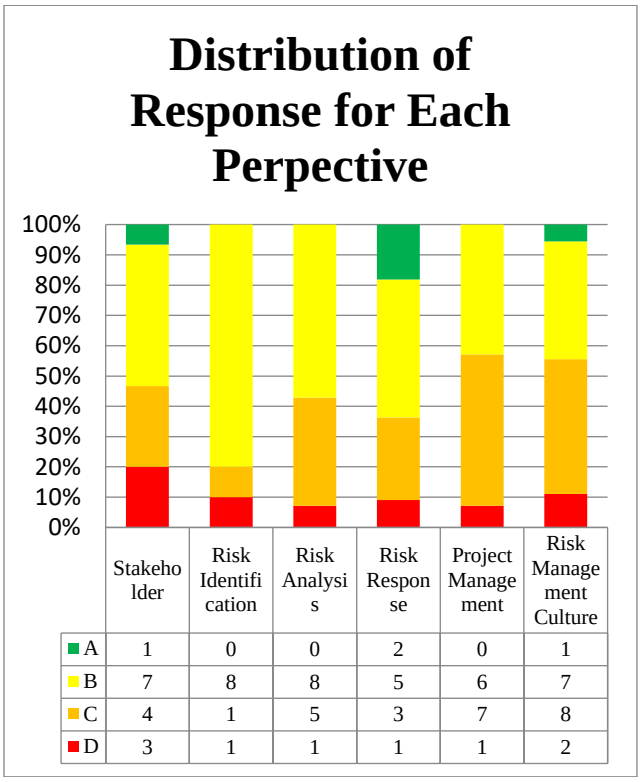
Each question is translated to Indonesian language as the respondents are not fluent in English and then validated by the officer in charge for the risk management of the project. From 50 questions only 49 are valid as one question (E3) is only valid for the initial phase of the project and therefore was deleted. As all of the 49 questions are valid then option E (not applicable) from the questionnaire were deleted. Questionnaire data was collected using the group self-assessment method. The group method was chosen because the risk management of the Husein Sastranegara International Airport Development Project involves several parties who were actively involved in risk management

In Project RMM, [3] recommends those who are most familiar with the risk management implementation process on the project may be chosen as respondents for the questionnaire or assessor. In this research there were 4 respondents selected: the Project Manager, the Risk Manager for this project, Site Manager and the Head of the Project Implementation Unit (PIU) of the Husein Sastranegara International Airport Development Project. The questionnaires were given to these respondents after briefing were conducted to introduce them to the questionnaire, so all respondents understand about what to do. They were given enough time to fill in the questionnaire according to their time availability in the period of 2 weeks.

Answers to the measurement questionnaires obtained from the four respondents were very diverse, so validation is needed. Researchers as independent assessors have a role in the validation process by checking the results of the questionnaire and making conclusions about the answers to each question that are objective. The validation process was carried out with the Risk Manager and the Head of the Project Implementation Unit.

4 Results

Figure 2 showed the distribution of the answers to the questions that affect the measurement of the maturity of each perspective.



	Stakeholder	Risk Identification	Risk Analysis	Risk Response	Project Management	Risk Management Culture
A	1	0	0	2	0	1
B	7	8	8	5	6	7
C	4	1	5	3	7	8
D	3	1	1	1	1	2

Fig 2. Responses to the questionnaire

As has been mentioned before, each question may affect more than on perspective, then respondents were also asked to rank the questions from each perspective according to the number of the questions. The rankings then were processed using the ROC method. Results of the ROC is shown in Appendix.

Data processing to determine the level of risk management maturity of the Husein Sastranegara International Airport Development Project is carried out using Microsoft Excel software. The calculation is done by multiplying the value of the weight of each question with the value of the

answers to each question that has been validated. In the questionnaire, each question has 4 answer options, namely A, B, C, and D. Answers A to D indicate the level of risk management maturity (A represents level 4, B represents level 3, C represents level 2, D represents level 1). The score for each answer is as follows: A is worth 1, B is worth 0.6, C is worth 0.3 and D is worth 0. These values were confirmed directly to Martin Hopkinson as the model developer through email correspondence. The range of values for answers A and B is 0.1 greater than the range of other answers. This is because the biggest difference in criteria at the maturity level of the RMM Project is between level 3 and level 4 [3].

The value of the multiplication of each question with its weight is added up based on the perspective that is affected to get the maturity value from each perspective and then converted into a percentage to determine the maturity level of risk management. The percentage range of the risk RMM Project management maturity level set by [3] is as follows:

- Level 1: Naive with a maturity value range of 0-25%.
- Level 2: Novice with a maturity value range of 25%-50%.
- Level 3: Normalized with a maturity value range of 50%-75%.
- Level 4: Natural with a maturity value range of 75%-100%.

For example, question A2 of the measurement questionnaire affects stakeholder perspectives and risk management culture. Question A2 has an importance weight of 0.099 for the stakeholder perspective while for the cultural risk management perspective this question has a weight of 0.043. This numerical weight value is then multiplied by the questionnaire answer value for question A2, which is 0.6 so that the end value is 0.133 for the stakeholder perspective and 0.117 for the risk management culture perspective. This multiplication is done on all questions that affect the stakeholder perspective and risk management culture then all the multiplication scores on each question are added up based on their perspective to get the maturity value of each perspective. This maturity value is then converted into a percentage. **Figure 4** is a bar chart of the results of the calculation of the risk management maturity level of the Husein Sastranegara International Airport Development Project based on the data obtained.

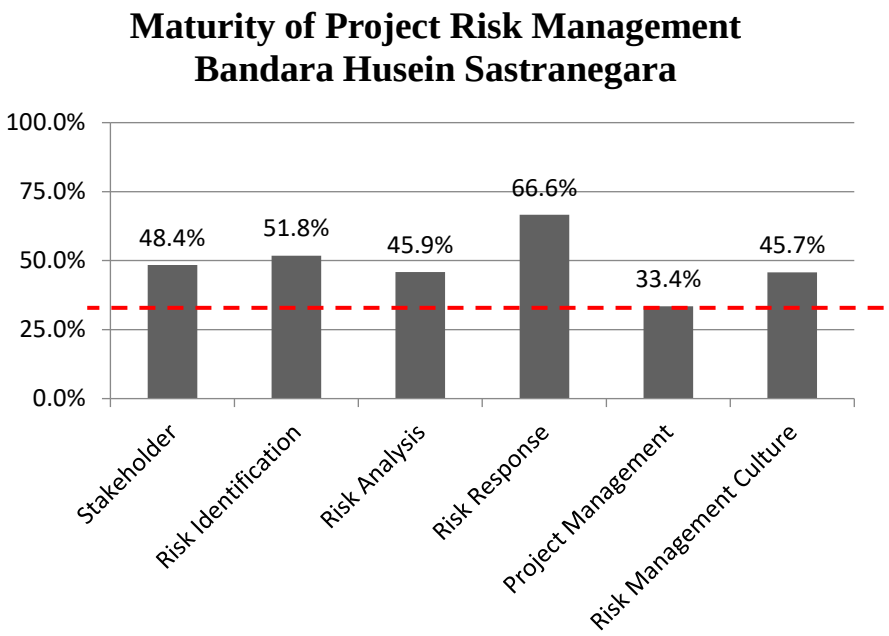


Fig 4. Project Risk Management Maturity

From **Figure 4**, it can be seen that the percentage of the lowest value from all perspectives of Project RMM is 33.4% for Project Management perspective. This indicates that the overall risk management maturity level of the Husein Sastranegara International Airport Development Project is at level 2 (Novice) where the lowest perspective is project management. Stakeholder perspectives, risk analysis, and risk management culture are also in the level 2 range (Novice) and the risk identification and project management perspectives are in the level 3 range (Normalized). The highest maturity level was achieved by the risk response perspective with a percentage of 66.7%.

5 Discussion and Analysis

The group self-assessment method produced different answers for most questions. This can be caused by the different knowledge and experience of each respondent about project risk management and the lack of open communication on the project (as can be seen from the criteria of the stakeholder perspective which is still low). To overcome this problem, researchers acted as independent assessors and validations were conducted with the Risk Manager and Head of Implementation Unit. In addition, answers to questions were confirmed based on concrete evidence from both project actual progress experienced and formal project documents. This can be done because each answer to the Project RMM questionnaire questions has certain conditions so that it can be validated to what was going on in the project.

Based on the calculation of the risk management maturity level, the Husein Sastranegara International Airport Development Project is at maturity level 2 (Novice). The maturity level at

level 2 indicates the risk management process on this project is carried out to support the achievement of project objectives. Risk management is considered to be able to add a certain value, but deficiencies in the procedure or in its application may result in the added value cannot be realized significantly. The project management perspective has the lowest maturity value so that it becomes the main priority for improvement. This is surprising as all contractors involved in this project are construction company where they have done so many construction projects. The continuous improvement process is the best way to improve project risk management capabilities so that it will be better if improvements are carried out gradually and continuously [3]. Immediate improvements on all perspectives are needed in order overall maturity level may reached level 3 where at this level the risk management process is more aimed at supporting the achievement of project objectives.

The stakeholder perspective has a maturity percentage of 48.4% which is still at the Novice maturity level (level 2). The followings are some improvements that can be made to increase the maturity of risk management from a stakeholder perspective based on the results of the questionnaires:1) Fostering an atmosphere of trust and openness between the Joint Operation and the project owner, 2) Provision of training for parties who have a core role in the risk management process, 3) Periodic assessment of project risk management capabilities, and 4) Undertake management capability audits on sub-contractors.

The risk identification perspective has a maturity percentage of 51.8%. This indicates that the risk identification perspective is in the Normalized level (level 3). Several proposed improvement can be made for this perspective, they are: 1) Expanding the scope from risk identification to the termination phase 2) Identify risks with a top-down approach such as the Risk Breakdown Structure, 3) Involve project owners actively in the risk identification process, 4) Provide training to the project team on risk identification techniques, 5) Use past experiences as a guide for project risk identification (lesson learnt), 6) Use services of consultant to identify and quantify important risks, and 7) Regularly update the risk register.

Risk analysis perspective was at Novice level with a percentage of 45.9%. This makes the risk analysis perspective at maturity level 2 (Novice) and has the third priority for improvement and some suggestions to improve this level are: 1) Use software program to document risk records dan risk documentation, 2) Adding several criteria such as variability, urgency, familiarity, controllability, linkage with other risks, level of ownership ambiguity, response effectiveness to determine risk priority, 3) Provide training in writing risk descriptions together with experts and create a simple dictionary on how to write risk descriptions with risk meta language to serve as a guide for risk managers.

Risk response perspective has the highest percentage of maturity value, which is 66.7% but still at the Normalized level (level 3). The following are suggestions for improvement: 1) Taking the capabilities of each risk owner into consideration in determining the obligation to take risks and conduct an analysis for the cost of risk response contingencies, 2) Choose the most realistic, effective risk response and have the least negative impact on achieving project objectives, 3) Ensure all risk responses are actually implemented where supervision of risk response can be carried out by central management and carried out periodically, 4) Moral support from the project manager or project owner for those responsible for the risk response process.

The project management perspective has the lowest percentage (33.4%) and at the Novice level so that the project management perspective is at the Novice maturity level (level 2) and has the first priority for improvement. Improvements need to be made as follows: 1) Use of quantitative techniques for risks related to the project schedule, 2) Educate all project members about the importance of their role in project risk management and the benefits of project risk management, 3) Reporting process should be clearer and more detailed or using software assistance such as GRC Cloud, JCAD Core, Optial SmartStart, A1 Tracker, and others, the selection of software can be tailored to the needs of the project, 4) Undertake periodic risk management capability assessments, 5) Provide a risk review agenda before the risk is implemented for risk review participants, 6) Determine risk priorities based on broader components, and 7) Improve the usability, accessibility, and simplicity of risk database tools.

The risk management culture perspective has a maturity percentage of 45.7%. This indicates that the risk management culture perspective is at level 2 maturity (Novice). The following are improvements that can be made to increase the maturity value of risk management culture based on criteria that have low scores: 1) Provide education about the importance of the role of each project member in the risk management process and the importance of risk management to achieve project objectives and foster a sense of openness and honesty among project team members, 2) Foster an atmosphere of openness, trust and kinship among stakeholders, especially between the Joint Operation and the project team, as well as increasing awareness that this project is of common interest and ultimate objective, 3) Consider and make a list of threats and opportunities for all risk responses that will be carried out.

6 Conclusions and Recommendations

Based on the findings the Husein Sastranegara International Airport Development Project is still at the Novice level (level 2) for its overall Project Risk Management Maturity. The maturity level at level 2 indicates that the risk management process on this project has been carried out with a view to achieving project objectives. Risk management is considered to be able to add a certain value, but deficiencies in procedures or applications can make the added value cannot be realized significantly. The risk management process carried out tends to be lightly and casually.

The key to achieving level 3 maturity is quality and discipline in applying the risk management process by each risk owner. This can be maintained by conducting regular reviews of the risk management process by both PT Angkasa Pura II (Persero) and the Project Manager. As all decisions in the project come from PT Angkasa Pura II (Persero) as the Project Owner. Therefore, PT Angkasa Pura II (Persero) must also be quick in responding to the risks that have been reported by the project team so that the impact does not already spread. In order to facilitate the coordination and management of risk management, projects can use computerized risk database tools that can be accessed by parties involved. In addition, the project owner and the contractor's head office can facilitate project risk management training and counseling to increase awareness of the entire project team on the role of risk management in supporting project performance. Based on the results of the risk management maturity evaluation, the project management perspective is the perspective that becomes the main priority for

improvement in increasing the risk management maturity of the Husein Sastranegara International Airport Development Project.

PT Angkasa Pura II (Persero) is expected to be able to implement improvement recommendations so that the risk management process improvement can be carried out optimally. The most important thing in the improvement process is openness, honesty, moral support, and appreciation for every performance improvement achieved by the project team. In addition, PT Angkasa Pura II (Persero) is also advised to carry out risk management capability assessments on a regular basis on the project team for both this project and future projects using this framework.

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Appendix

Ranking and Numerical Weight

Ranking							**Numerical Weight**						
No	**S**	**IR**	**AR**	**RR**	**MP**	**BMR**	**No**	**S**	**IR**	**AR**	**RR**	**MP**	**BMR**
A1	1					1	**A1**	0,221					0,194
A2	4					9	**A2**	0,099					0,043
A3	3					16	**A3**	0,121					0,010
A4	8			10			**A4**	0,048			0,017		
A5	10						**A5**	0,033					
A6	2						**A6**	0,155					
A7	7						**A7**	0,058					
A8	11						**A8**	0,026					
B1		4			8	6	**B1**		0,110			0,047	0,067
B2		7					**B2**		0,048				
B3		8					**B3**		0,034				
B4		5					**B4**		0,085				
B5		6				12	**B5**		0,065				0,026
B6		10			13		**B6**		0,010			0,011	
B7		2	3				**B7**		0,193	0,125			
B8		3				8	**B8**		0,143				0,050
C1			1	4			**C1**			0,232	0,108		
C2			10	11		18	**C2**			0,030	0,008		0,003
C3	9		5				**C3**	0,040		0,083			
C4			14				**C4**			0,005			
C5			7				**C5**			0,057			
Ranking							**Numerical Weight**						
No	**S**	**IR**	**AR**	**RR**	**MP**	**BMR**	**No**	**S**	**IR**	**AR**	**RR**	**MP**	**BMR**
C6			6		9		**C6**			0,069		0,038	
C7			9			17	**C7**			0,038			0,006
C8			8		7		**C8**			0,047		0,057	
C9			4		6		**C9**			0,101		0,069	
C10			12		14		**C10**			0,017		0,005	
D1	15			8			**D1**	0,004			0,039		
D2	14			2			**D2**	0,009			0,184		

D3				7			**D3**				0,052		
D4				1			**D4**				0,275		
D5				6			**D5**				0,067		
D6	13			3		10	**D6**	0,014			0,138		0,037
D7			11	9			**D7**			0,023	0,027		
E1		9	13		12		**E1**		0,021	0,011		0,017	
E2					1		**E2**					0,232	
E4					11		**E4**					0,023	
E5			2		3	2	**E5**			0,161		0,125	0,139
E6					4		**E6**					0,101	
E7					2		**E7**					0,161	
E8					5		**E8**					0,083	
E9	12				10		**E9**	0,020				0,030	
Ranking							**Numerical Weight**						
No	**S**	**IR**	**AR**	**RR**	**MP**	**BMR**	**No**	**S**	**IR**	**AR**	**RR**	**MP**	**BMR**
F1						3	**F1**						0,111
F2						7	**F2**						0,058
F3	5					15	**F3**	0,082					0,014
F4						11	**F4**						0,031
F5	6	1				5	**F5**	0,069	0,293				0,078
F6						14	**F6**						0,017
F7						4	**F7**						0,092
F8				5		13	**F8**				0,085		0,022

Notes:
S = *Stakeholder*
IR = Identifikasi Risiko/Risk Identification
AR = Analisis Risiko/Risk Analysis
RR = Respon Risiko/Risk Response
MP = Manajemen Proyek/Project Management
BMR = Budaya Manajemen Risiko/Risk Management culture