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Assessment of External Risk Factors on Construction Project Schedule Using Risk Importance Index (RII)

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ABSTRACT

External risk factors influence the project objectives, especially project scheduling. Some risks may occur frequently but have low impact, while others may have both high frequency and high severity. The linkage between risk frequency and impact needs to be assessed to understand the significance of a risk variable. This study was aimed to examine the significance of risk related to the probability of occurrence and the magnitude of impact on the project schedule. The study focused on external risk factors (sociopolitical, government policy, natural disasters, and monetary). Survey questionnaires were sent to 20 targeted contractor companies in the area of Aceh Province, Indonesia with a response rate of (60%). Using Risk Importance Index (RII), the significant risk variables that hindered the achievement of project achievement in Period I have been identified as follows: cultural conditions and local customs near project site (K4), social issues/surrounding environment (K5), increased fuel prices (L4), uncertain weather conditions (M1). In addition, the emergence of L4 variable in Period I was due to temporary security conditions, while in Period II due to the conditions of supply and demand. The results of this study are intended to contribute to the application of risk to practitioners and governments.

Keywords: Construction project, contractor, external risk, project schedule, risk importance

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INTRODUCTION

During the implementation of a construction project, project management must minimize risks to achieve project objectives and avoid negative impacts, such as cost overruns, time delays, and quality deterioration. The risk is minimized by selecting corrective actions using decision-making based on an analysis of the various risk factors. In a construction project, the inherent risk factor is uncertainty, which is related to the risk of an event. The risk is a consequence (or outcome) of activity as determined by human judgment (Aven & Renn, 2009). Risk as the concept of an opportunity is defined as unexpected events that may occur with various consequences resulting in delays or even failures in a project (Gray & dan Larson, 2000). Risk can also be seen as an event that, if it occurs, will impact the project outcome (Clayton, 2011) by causing a failure to achieve the planned goals regarding cost, time, and project performance (Kerzner, 2009).

The uncertainties are potentially minimized by performing a risk analysis to identify the possibility of occurrence of risk factors in the project implementation. Construction project risk can arise from various sources namely internal factors or external factors (Akintoye & MacLeod, 1997; Ward & Chapman, 2003). Internal risk factors can be derived from project resources factors (Husin et al., 2018; Husin et al., 2017; Zhao et al., 2013), financial factors (Fachrurrazi et al., 2018; Farrel, 2003), project managerial and operational factors (Latham & Braun, 2008), design and contract factors (Moazzami et al., 2011), while external risk factors come from socio-political (Khodeir & Mohamed, 2015), government policy (Banaitiene & Banaitis, 2012; Pheng et al., 2008), natural disasters, and monetary (Mubarak et al., 2017).

The appearance of risk to a construction project can be associated with the condition of a region related to the potential of disasters (Moe & Pathranarakul, 2006; Christoplos et al., 2001) or vulnerabilities (Zhang, 2007; Fidan et al., 2011). The vulnerability conditions can be shown by learning from the situation in the Aceh-Indonesia. The province experienced political upheavals and tensions with the central government over the past 15 years and experiencing the earthquake and tsunami disaster. During the years, Aceh Province has recently experienced three important periods (Zeccola, 2011). The periods defined as the Period I, the period of political and military conflict; Period II, the period of rehabilitation and reconstruction post-tsunami disaster; and Period III, the period of post-rehabilitation and reconstruction. These periods have different characteristics between one another.

The previous studies indicated that risks related to project resources and external factors tend to have the high frequency of occurrence and impact to project cost (Husin et al., 2017; Mubarak et al., 2017). Discussion of risk related to project completion time is required in further study to understand the significance of risk factors and variables. The appearance of risk variables to the project completion time often results in delays and possibly affecting project postpone. Based on these conditions, this study aimed to assess the potential risks that might affect project schedule completion. The assessment focused on external factors consisting of socio-political factors, government policies, natural disasters, and monetary factors. This study examined the significance of risk importance related to the probability of occurrence and impact magnitude to the achievement of the project due date.

METHODS

Data Collection

This study began with primary data collection using a questionnaire instrument. Questionnaires were prepared to provide three types of information: (1) information related to the characteristics of respondents, (2) information related to the frequency of risk factor occurrence, and (3) information related to the impact on the completion of construction. Four external risk factors were the focus of this research: socio-political (seven variables), government policy (five variables), natural disaster (nine variables), and monetary (five variables) as mentioned in Table 1. To analyse the risk variables, quantitative and qualitative mix methods were used.

The information collected was related to the condition of the study area as described by Zeccola (2011). The periods and year ranges were divided into Period I (the year 2000-2004), Period II (the year 2005-2009), and Period III (the year 2010-2015). This study involved a number of respondents from 15 local contractor companies with large qualifications in Aceh Province. The respondents were personnel in construction companies with positions of directors, managers, and senior engineers.

Table 1

List of project external risk factors and variables

Risk Factor	Code	Variable
Social politics	K1	Riot
	K2	Sabotage of facilities or materials
	K3	Demonstration at the project site
	K4	Cultural conditions and local customs near the project site
	K5	Social issues/surrounding environment
	K6	Conflict with project stakeholders
	K7	Religious holidays or other holidays
Government policy	L1	Government policy changes or revisions that halt the project
	L2	Changes in government regulations
	L3	Late permissions and licenses (pre-implementation)
	L4	Increased fuel prices
	L5	Project cancellation by government

Table 1 (Continued)

Risk Factor	Code	Variable
Natural disasters	M1	Uncertain weather conditions
	M2	The uncertainty of field conditions
	M3	War
	M4	Revolution
	M5	Fire
	M6	Environmental pollution
	M7	Disease epidemic
	M8	Flooding
	M9	Earthquake
Monetary	N1	Monetary instability
	N2	Fluctuations in bank loan interest rates
	N3	Long-term currency inflation, deflation, and devaluation
	N4	Short-term currency fluctuations
	N5	Economic crisis

Sample Adequacy Test

The theory that is widely used in determining sample size is the Slovin formula (Ariola, 2006; Eduardus & Hamsa 2013):

$$n = \frac{N}{1 + N\,(e)^2} \tag{1}$$

Where n is the number of samples, N is the population, and e is the accuracy of sampling errors (0.1 or 10% for the large population; and 0.2 or 20% for the small population).

Questionnaire Response Tests

The questionnaire response validity was tested using the Pearson product moment correlation (Equations 2), and its reliability was tested using the *Cronbach-alpha* (*C-alpha*) method (Smith, 2015). The decision criteria for determining the validity of the item was based on the following conditions:

If $r_{stat} > r_{sig}$, then the question item is declared valid.

If $r_{stat} < r_{sig}$, then the question item is declared invalid.

$$r = \frac{n\,(\sum xy) - (\sum x \,.\, \sum y)}{\sqrt{\{n \sum x^2 - (\sum x)^2\}\{n \sum y^2 - (\sum y)^2\}}}\ , \tag{2}$$

where r is a correlation coefficient, Σx is the total item score, Σy is the total score, and n is the number of respondents.

The reliability test *(r)* is analyzed with Equations 3, 4, and 5 (Bland & Altman, 1997), and the feasibility indicator coefficient uses of *C-alpha* ≥ 0.6 with the significance level (α) of 5%.

$$r = \frac{k}{(k-1)}\left[1 - \frac{{\sigma_b}^2}{{\sigma_1}^2}\right], \quad (3)$$

$${\sigma_b}^2 = \frac{JK_i}{n} - \frac{JK_S}{n^2}, \quad (4)$$

$${\sigma_1}^2 = \frac{\sum {x_t}^2}{n} - \frac{(\sum x_t)^2}{n^2}, \quad (5)$$

Where r is the instrument reliability, k is the number of questions, ${\sigma_b}^2$ is the item variance, ${\sigma_1}^2$ is the total variance, Σx_t is the total number of respondent answers, $\sum {x_t}^2$ is the squared of total number respondent answers, Jk_i is the sum of squares for whole items, and Jk_s is the sum of squares for subjects.

Analysis of Frequency Index (*FI*)

The frequency index (*FI*) is used to measure the risk variable frequency. The *FI* assessment was classified according to the five-level Likert scale as shown in Table 2 and analyzed by using Equation 6 (Majid & McCaffer, 1997).

$$FI = \frac{\sum_{i=1}^{5} a_i n_i}{5N}, \quad (6)$$

Where i is the index scale of the response, a_i is the weight of the i-th response, n_i is the frequency of the variable in all responses, and N is the total number of respondents.

Analysis of Severity Index (*SI*)

This study used a severity index (*SI*) to represent the severity of risk impact for all observed variables. The *SI* assessment levels were classified according to the five-level Likert scale, as shown in Table 3. The formula to calculate the *SI* (Majid & McCaffer, 1997) is in Equation 7.

$$SI = \frac{\sum_{i=1}^{5} a_i n_i}{5N}, \quad (7)$$

Where i is the index scale of the response, a_i is the weight of the i-th response, n_i is the impact of the variable occurrence in the total response, and N is the total number of respondents.

Table 2

The *FI Assessment Criteria and Scales*

Subjective Frequency	Likert Scale	Assessment Scale
Very rarely	1	$0 \leq FI \leq 0.125$
Rarely	2	$0.125 < FI \leq 0.375$

Table 3

SI Assessment Criteria and Scales

Subjective Frequency	Likert Scale	Assessment Scale
Very low	1	$0 \leq SI \leq 0.125$
Low	2	$0.125 < SI \leq 0.375$
Medium	3	$0.375 < SI \leq 0.625$
High	4	$0.625 < SI \leq 0.875$
Very high	5	$0.875 < SI \leq 1.000$

Analysis of Risk Importance Index (*RII*)

The risk importance index (*RII*) is a method for measuring the importance of risk based on its frequency and severity, as represented by Equation 8. The importance of risk is analyzed for each external risk variable.

$$RII = FI \; X \; SI, \qquad (8)$$

The *RII* risk scale is mapped onto a risk scale matrix (Figure 1). These values are compared with the scale to identify qualitative risk cells. Risk assessment is based on the matrix scale of the value of the risk importance index, where the lowest is 0 and the highest is 1. The scale is divided into five categories, where the range of each category is low (L), medium (M), high (H), significant (S), and extreme (E).

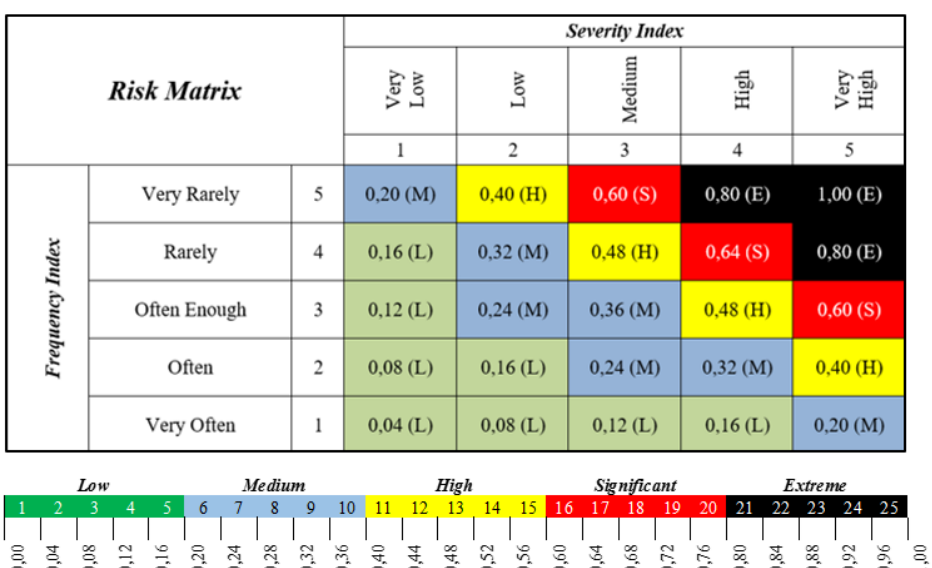

Figure 1. Risk matrix and classification of *RII*

RESULTS AND DISCUSSION

Characteristics of Respondents

The characteristics of respondents involved in gathering information in this study are presented in Table 4. Personnel involved as respondents were representatives of 15 large qualified contracting companies domiciled in Aceh Province. Most of the respondents in this study are directors and company managers with work experience of more than seven years. The number of projects that have been handled by the contractor in the conflict period is less than the next two periods. The projects handled are generally road and bridge projects with a value of 10 billion to 50 billion in Indonesian Rupiah (IDR).

Table 4
Characteristics of respondents

	Characteristic	Category Measurement	Amount	(%)
Personnel Profile	Position Respondents	Director	5	33,3
		Manager	7	46,67
		Others	3	20,00
	Respondents Experience	>2-4 years	1	6,67
		>4-7 years	1	6,67
		>7 years	13	86,67
Companies Profile	Total of contractors based on the number of projects handled	Period I		
		1-3 projects	3	20.00
		>3-6 projects	5	33.33
		>6-10 projects	4	30.00
		>10 projects	3	40.00
		Period II		
		1-3 projects	1	6.67
		>3-6 projects	5	33.33
		>6-10 projects	3	20.00
		>10 projects	6	40.00
		Period III		
		1-3 Projects	2	13.33
		>3-6 projects	2	13.33
		>6-10 projects	5	33.33
		>10 projects	6	40.00

Table 4 (Continued)

Characteristic	Category Measurement	Amount	(%)
Types of projects handled	Building	11	73.33
	Roads and bridges	14	93.33
	Water constructions	9	60.00
Average of Contract Price Yearly (in IDR)	<10 Billion	2	13.33
	10 Billion-50 Billion	8	53.33
	>50 Billion	2	13.33

The Result of Sampling Adequacy, Validity and Reliability Tests

The population of the study was restricted to local contractor companies with large qualifications and had been established before the year 2000 in Aceh Province. According to the data obtained from the Construction Services Development Board (2016), the total companies are 20 companies. This study applied population data from 20 companies and 20% sampling errors for small populations. Based on these data, this study sets a minimum sample size of 12 companies. With a total sample of 15 respondents, the adequacy of the data could be stated to have been fulfilled.

The validity test in this study based on instrument testing result of $r \geq r_{sig}$ is a valid instrument, while the instrument with $r \leq r_{sig}$ is invalid. The r_{sig} of 0,514 referred to Pearson product-moment values for a significance level of 95% and the total sample number (n) of 15 (Husin et al., 2018). Thus, the result of the validity test for both the frequency and severity of 24 risk variables are respectively summarised in Tables 5 and 6.

The result of the reliability test indicates that the C-alpha values for all variables of labor risk factors, materials, and project equipment for data frequency and severity were higher than 0.6. The frequency and severity data for validity test results are summarised in Tables 7 and 8, respectively.

Risk Assessment

When analyzed based on risk variables, three variables stood out on the frequency scale, namely K1 (riot), K4 (cultural conditions and local customs), and K5 (social issues) (Table 9). The K5 variable was a consistent variable appearing with frequent results for all three study periods, while the K1 and K4 variables only appeared in period I. Among government policy factors, only one variable – L4 (fuel prices) – appeared with a frequency of “often,” and it appeared in all three phases of the study. Among natural disaster risk factors, three variables appeared with a frequency of “often”: M1 (weather conditions), M3 (war), and M8 (flooding). The M1 variable appeared “frequently” in all three periods, while the M3 and M8 variables only appeared in one study period each, periods I and III, respectively.

Among the monetary risk factors, only one variable – N5 (economic crisis) – appeared with a frequency of "often" and only in Period I.

Table 5
Results of validity test of frequency data

Variable Code	The range of r_{stat} Value per Period			Result
	Period I	Period II	Period III	
K1; K2; K3; K4; K5; K6; K7	0,593; 0,743; 0,894; 0,542; 0,557; 0,825; 0,541	0,782; 0,760; 0,761; 0,460; 0,613; 0,761; 0,549	0,841; 0,793; 0,862; 0,548; 0,706; 0,794 0,540	Valid
L1; L2; L3; L4; L5	0,933; 0,921; 0,854; 0,551; 0,535	0,946; 0,963; 0,689; 0,560; 0,570	0,909; 0,933; 0,801; 0,525; 0,560	Valid
M1; M2; M3; M4; M5; M6; M7; M8; M9	0,528; 0,861; 0,578; 0,826; 0,878; 0,739; 0,743; 0,667; 0,909	0,530; 0,793; 0,700; 0,833; 0,774; 0,828; 0,831; 0,516; 0,561	0,578; 0,701; 0,759; 0,806; 0,856; 0,848; 0,864; 0,645; 0,861	Valid
N1; N2; N3; N4; N5	0,531; 0,936; 0,917; 0,859; 0,558	0,656; 0,880; 0,887; 0,737; 0,689	0,655; 0,922; 0,903; 0,760; 0,680	Valid

Table 6
Results of validity test of severity data

Variable Code	Range of r_{stat} Value per Period			Result
	Period I	Period II	Period III	
K1; K2; K3; K4; K5; K6; K7	0,714; 0,820; 0,816; 0,588; 0,720; 0,800; 0,763	0,816; 0,859; 0,790; 0,559; 0,869; 0,836; 0,820	0,832; 0,831; 0,935; 0,857; 0,887; 0,974; 0,785	Valid
L1; L2; L3; L4; L5	0,870; 0,822; 0,850; 0,802; 0,763	0,761; 0,849; 0,773; 0,870; 0,823	0,916; 0,881; 0,903; 0,843; 0,936	Valid
M1; M2; M3; M4; M5; M6; M7; M8; M9	0,591; 0,937; 0,628; 0,865; 0,908; 0,913; 0,922; 0,658; 0,907	0,568; 0,926; 0,841; 0,896; 0,917; 0,918; 0,946; 0,630; 0,745	0,535; 0,911; 0,853; 0,929; 0,911; 0,945; 0,938; 0,524; 0,908	Valid
N1; N2; N3; N4; N5	0,661; 0,916; 0,943; 0,800; 0,530	0,983; 0,899; 0,944; 0,926; 0,895	0,952; 0,961; 0,948; 0,961; 0,908	Valid

Table 7
Results of reliability test of frequency data

Factor	Questionnaire Reliability Score			Result
	Period I	Period II	Period III	
Social politics	0.83	0.84	0.85	Reliable
Government policy	0.80	0.79	0.77	Reliable
Natural disasters	0.88	0.86	0.89	Reliable
Monetary	0.76	0.79	0.79	Reliable

Table 8
Results of reliability test of severity data

Factor	Questionnaire Reliability Score			Result
	Period I	Period II	Period III	
Social politics	0.78	0.82	0.87	Reliable
Government policy	0.75	0.75	0.81	Reliable
Natural disasters	0.87	0.88	0.89	Reliable
Monetary	0.78	0.81	0.82	Reliable

Table 9

Risk Result for Frequency Index (FI)

Var.	Period I		Period II		Period III	
	FI	Scale	FI	Scale	FI	Scale
K1	0,640	Often	0,533	Somewhat Often	0,347	Rarely
K2	0,360	Rarely	0,333	Rarely	0,307	Rarely
K3	0,360	Rarely	0,293	Rarely	0,360	Rarely
K4	0,720	Often	0,587	Somewhat Often	0,560	Somewhat Often
K5	0,853	Often	0,667	Often	0,627	Often
K6	0,307	Rarely	0,347	Rarely	0,347	Rarely
K7	0,587	Somewhat Often	0,453	Somewhat Often	0,440	Somewhat Often
L1	0,587	Somewhat Often	0,613	Somewhat Often	0,507	Somewhat Often
L2	0,480	Somewhat Often	0,507	Somewhat Often	0,440	Somewhat Often
L3	0,547	Somewhat Often	0,493	Somewhat Often	0,440	Somewhat Often
L4	0,840	Often	0,813	Often	0,627	Often
L5	0,347	Rarely	0,400	Somewhat Often	0,360	Rarely

Table 9 (Continued)

Var.	Period I		Period II		Period III	
	FI	Scale	FI	Scale	FI	Scale
M1	0,800	Often	0,693	Often	0,653	Often
M2	0,413	Somewhat Often	0,373	Rarely	0,347	Rarely
M3	0,627	Often	0,280	Rarely	0,240	Rarely
M4	0,320	Rarely	0,267	Rarely	0,267	Rarely
M5	0,333	Rarely	0,320	Rarely	0,347	Rarely
M6	0,360	Rarely	0,280	Rarely	0,280	Rarely
M7	0,347	Rarely	0,293	Rarely	0,293	Rarely
M8	0,400	Somewhat Often	0,560	Somewhat Often	0,627	Often
M9	0,320	Rarely	0,547	Somewhat Often	0,307	Rarely
N1	0,360	Rarely	0,307	Rarely	0,280	Rarely
N2	0,427	Somewhat Often	0,440	Somewhat Often	0,400	Somewhat Often
N3	0,467	Somewhat Often	0,427	Somewhat Often	0,413	Somewhat Often
N4	0,427	Somewhat Often	0,440	Somewhat Often	0,400	Somewhat Often
N5	0,680	Often	0,373	Rarely	0,480	Somewhat Often

Analysis of the SI for external risk factors showed that no variables had a severity scale of "often," but several had a medium severity scale (Table 10). From the socio-political risk factors, four variables had a medium scale: K1 (riot), K4 (cultural conditions and local customs), K5 (social issues), and K7 (holidays). Of these variables, the variables that scored "medium" in all three study periods were K4 and K5. The variable K1 appeared consistently only in periods I and II, while K7 variable appeared only in Period I. Among the government policy risk factors, variables with consistently moderate severity scales were L1 (disruption government policy changes), L3 (license delays), and L4 (fuel prices) during all three study periods. Variable L3 appeared consistently in periods I and II, whereas L1 appeared only in Period I. Among natural disaster risk factors, two variables had a medium risk, M8 (flooding) and M9 (earthquakes). Variable M8 consistently appeared in all three study periods, while M9 only appeared as a medium risk during Period II. Among the monetary risk factors, the variable with medium risk was N4 (currency fluctuations), but it appeared only during Period I.

Table 10

Risk Results for Severity Index (SI)

Var.	Period I		Period II		Period III	
	SI	Scale	SI	Scale	SI	Scale
K1	0,410	Medium	0,410	Medium	0,37	Low
K2	0,310	Low	0,290	Low	0,29	Low
K3	0,270	Low	0,280	Low	0,32	Low
K4	0,520	Medium	0,410	Medium	0,4	Medium
K5	0,550	Medium	0,390	Medium	0,39	Medium
K6	0,320	Low	0,280	Low	0,37	Low
K7	0,410	Medium	0,360	Low	0,32	Low
L1	0,390	Medium	0,320	Low	0,37	Low
L2	0,350	Low	0,360	Low	0,35	Low
L3	0,400	Medium	0,410	Medium	0,36	Low
L4	0,470	Medium	0,450	Medium	0,41	Medium
L5	0,290	Low	0,330	Low	0,32	Low
M1	0,510	Medium	0,430	Medium	0,44	Medium
M2	0,330	Low	0,330	Low	0,29	Low
M3	0,350	Low	0,290	Low	0,28	Low
M4	0,280	Low	0,280	Low	0,29	Low
M5	0,310	Low	0,320	Low	0,32	Low
M6	0,290	Low	0,310	Low	0,31	Low
M7	0,320	Low	0,310	Low	0,32	Low
M8	0,410	Medium	0,450	Medium	0,44	Medium
M9	0,310	Low	0,400	Medium	0,31	Low
N1	0,320	Low	0,290	Low	0,29	Low
N2	0,310	Low	0,290	Low	0,35	Low
N3	0,320	Low	0,280	Low	0,33	Low
N4	0,400	Medium	0,310	Low	0,33	Low
N5	0,370	Low	0,330	Low	0,28	Low

Social Politics Risk Assessment

The calculation of average RII for each period revealed that the socio-political risk factor with the highest RII during all three periods was variable K5 (social issues) (Table 11). The risk of K5 over time tended to decrease successively from Period I (high, 0.469) to Period II (medium, 0.260) to Period III (medium, 0.245).

Table 11
Results of Risk Importance Index (RII) for Social Politics Factors

Variable Code	Period I		Period II		Period III	
	RII	Assessment	RII	Assessment	RII	Assessment
K1	0.262	Medium	0.219	Medium	0.128	Low
K2	0.112	Low	0.097	Low	0.089	Low
K3	0.097	Low	0.082	Low	0.115	Low
K4	0.374	High	0.241	Medium	0.224	Medium
K5	0.469	High	0.260	Medium	0.245	Medium
K6	0.098	Low	0.097	Low	0.128	Low
K7	0.241	Medium	0.163	Medium	0.141	Low

The high risk of variable K4 on Period I was caused by rework that was risky to project delay. This condition is in line with Abeku et al. (2016) who stated that the rework was an unwanted or undesirable of the contractor for works schedule, wastages. The K4 variable in "high" scale had decreased to become "medium" in the following period, due to a lot of training and workshops conducted by the government and NGOs in period II to increase labor capacity in terms of competence and discipline of work. This condition indirectly enhanced culture and customs in Aceh.

The K5 variable had the same pattern as the K4 variable. Variable K5 is a variable that can be caused by the conditions of conflict in Period I and disasters in Period II. However, in Period II there was a decrease caused by the recovery program from the Aceh-Nias NGO and Rehabilitation and Reconstruction Agency (BRR). As stated by Zeccola (2011), NGOs have a significant role in building the character of humanitarianism, especially when natural and political disasters collide, and resolving social problems in the Aceh Province.

Government Policy Risk Assessment

The increase in fuel prices (L4) in Aceh Province in both Period I and Period II was local in the context of the Aceh region (Table 12). The variable of increase in fuel prices (L4) occured in the scale of "High" on Period I and Period II, but then it decreased to be "Medium" on the Period III. In Period I, the high risk of time from the L4 variable was caused by scarcity of fuel that occurred due to problems with supply and transportation to the location of the conflict area in Aceh. While in Period II, it was caused by high demand during the post-tsunami rehabilitation and reconstruction phase. The decline in fuel prices to normal in Period III was automatically caused by a decline in demand for fuel in Period III.

Table 12

Results of RII for Government Policy Factors

Variable Code	Period I		Period II		Period III	
	RII	Assessment	RII	Assessment	RII	Assessment
L1	0.229	Medium	0.196	Medium	0.188	Medium
L2	0.168	Medium	0.183	Medium	0.154	Low
L3	0.219	Medium	0.202	Medium	0.158	Low
L4	0.395	High	0.366	High	0.257	Medium
L5	0.101	Low	0.132	Low	0.115	Low

Natural Disasters Risk Assessment

Variable M1 (weather) was a time risk variable that occured in Period I ("High"), the high risk on the project schedule caused by the M1 variable is not related to the condition of the conflict, but only coincidentally in Period 1 it was caused by global weather as well could occured in other regions, other than in Aceh Province (Table 13). Ballesteros-Perez (2018) stated that the variable M1 was unintentionally delays realized by the contractors, and other stakeholders, which as an excusable delay to some extent for a range of time allowed.

Table 13

Results of RII for Natural Disaster Factors

Variable Code	Period I		Period II		Period III	
	RII	Assessment	RII	Assessment	RII	Assessment
M1	0.408	High	0.298	Medium	0.287	Medium
M2	0.136	Low	0.123	Low	0.101	Low
M3	0.219	Medium	0.081	Low	0.067	Low
M4	0.090	Low	0.075	Low	0.077	Low
M5	0.103	Low	0.102	Low	0.111	Low
M6	0.104	Low	0.087	Low	0.087	Low
M7	0.111	Low	0.091	Low	0.094	Low
M8	0.164	Medium	0.252	Medium	0.276	Medium
M9	0.099	Low	0.219	Medium	0.095	Low

Monetary Risk Assessment

Among monetary risk factors, the variable with the highest RII in Period I was N5 (economic crisis), in Period II was N4 (currency fluctuation), and in Period III was N3 (long-term valuation changes). Based on these conditions, it can be seen that these variables play an essential role in the delay of construction projects during all three study phases, as shown in Table 14.

Table 14
Results of RII for Monetary Factors

Variable Code	Period I		Period II		Period III	
	RII	Assessment	RII	Assessment	RII	Assessment
N1	0.115	Low	0.089	Low	0.081	Low
N2	0.132	Low	0.128	Low	0.140	Low
N3	0.149	Low	0.120	Low	0.136	Low
N4	0.171	Medium	0.136	Low	0.132	Low
N5	0.252	Medium	0.123	Low	0.134	Low

CONCLUSIONS

Risk schedule is influenced by variations in the frequency and severity described in the important scale. Risk variables with high scale can be considered as risk variables to be used as input in accessing risk schedule projects. This study has identified risk variables K4 (cultural conditions and local customs near project site), K5 (social issues/surrounding environment), L4 (increased fuel prices), M1 (uncertain weather conditions) as risk variables that hinder the achievement of project schedules in Period I. Variables L4 also need to be considered in Period II. The emergence of L4 variables in Period I was due to temporary security conditions, while in Period II due to the conditions of supply and demand.

Risk variables can appear at different periods, both in consecutive periods and over specified periods. The characteristics of the period influence the emergence of risk variables in these periods. Period I has security characteristics that are different from Period II which have project intensity characteristics as well as Period III which do not have the two previous characteristics, or we call them the "normal period". However, the same risk variables can appear in different periods that are influenced by different causes.

The results of this study are intended to contribute to the application of risk to practitioners and governments. This research also provides ideas that can be used as a basis for evaluating the risks trend in further research for the other researchers.

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