An Analysis of Passengers' Safety Risk at the Infrastructure Improvement Project of Railway Station

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Article Info	ABSTRACT
	Constructing the elevated track at the Manggarai Railway Station has risk which potentially endangers the passengers' safety due to its construction process is carried out within passengers' activities around the railway station. This research aims to identify the hazard and risks, analyze the level and control the risk. Moreover, this study also aims to arrange the priority of serial alternative solutions regarding the handling the risk within the construction process of elevated track. This study used methods as follows: Hazard Identification, Risk Assessment, And Risk Control (HIRARC) and Analytical Hierarchy Process (AHP). In addition, data triangulation was also done by involving three respondents in keeping with to ensure the validity. The analysis of HIRARC generated 11 hazards and risks namely 6 are classified into extreme risks, 4 are rated high risk and 1 is categorized as medium risk. The method of AHP is used to analyze the alternative ways of handling the risks and to find out the priorities above some alternative ways of handling the risks. The sequence of the alternative ways of handling the risks based on the top priority is as follows: (1) first priority by applying the switch over 5, (2) second priority by adding the KLB feeder, (3) third priority by increasing the service facility.

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1. INTRODUCTION

The railway station of Manggarai which is located in South Jakarta is one of the busiest railways stations in Jakarta and planned to become a central stasion by 2025 [1]. The railway station of Manggarai serves the Commuter Line (CL) train with the routes heading to Jatinegara, Tanah Abang, Bogor, Bekasi dan downtown of Jakarta and it also serves the route to the airport [2]. In Indonesia, the first elevated track was operated since

1992 [3]. In the recent time, the railway station of Manggarai has elevated track and it has started the operation since September 25th 2021. The elevated track is maximized for use of CL route Bogor to downtown Jakarta, and conversely [4] and it is still in the construction process of phase 1 which consists of 4 tracks. The railway station of Manggarai is extended to fit the necessity and now the construction of double track of route Manggarai to Cikarang is going on [5]. Besides, the elevated track construction process for phase 2 is also on going where it consists of 6 tracks. The elevated track is built with the goal to remove the conflict point between railway and road users and it is certainly also useful to separate the conventional railway tracks from the commuter line track [6]. The construction of new tracks is expected to make railway station of Manggarai becomes central railway, creates integrated mass transportation, and it is hopefully reliable for everyone especially passengers [7].

There are three main causative factors in construction works namely human factors, environmental factors and instrumental factors, and human factors provide the biggest probability [8]. The safety standard is requirement, guidance or reference to avoid the risk of accidents [9]. Risk is incident which potentially occurs and obviously causes loss for company [10]. Furthermore, accident is occurrence which causes injury/wound, harms the health and sometimes fatally causes the death [11].

To understand the situation of safety during the construction of elevated track at the railway station of Manggarai, here below are results based on interview to respondents. The findings as follows:

Table 1 - Potential of Risk and Incident

Year	Type	Description
2020	Potential risk	The worker of construction doesn't move the steel on the railroads.
2020	Incident	Glass Falls
2020	Incident	Mortar falls
2022	Potential Risk	Train Platform becomes narrow
2022	Potential Risk	Get on and off Passengers' activities are ruined.
	Total	5

Table 2 - Accidents

Year	Accident Type	Description	Victims	
			Non-Human	**Human**
2019				9 people
2020	Passenger slip	Light injury	-	5 people
2021				3 people
2021	Paint falls onto the airport train's body.	Damage on the airport train's body	1 Delay of airport trains' departure	-
Total	2		1	17 people

The potential risk, incident, and accident maybe repeated due to the elevated track is still going on. The aim of this study is to analyze the impact of passengers' safety regarding the construction of elevated track viewed from the hazard of it, risk level, risk controlling, and alternative ways of handling risk to reduce the negative impact during the elevated track construction is going on.

2. RESEARCH METHOD

This study used method of Hazard Identification, Risk Assessment, and Risk Control (HIRARC) to evaluate the risk and used the method of Analytical Hierarchy Process (AHP) to analyze the priority scale (ranking) on the alternative ways of handling the risks. To obtain valid data from the respondents, the triangulation was conducted [12]. Respondents were selected by purposive sampling method based on criteria the ones who know, experience [13] and are in charge in the elevated track construction at the railway station of Manggarai. Respondents chosen were Station Master (SM), Vice Station Master (VSM) and Quality Control (QC).

2.1. Hazard Identification, Risk Assessment, and Risk Control (HIRARC)

Method of HIRARC has 3 phases [14] they are:
a. Hazard Identification

This phase is defined as the process of identification on any possible probabilities of potential danger of a certain process so that the risks can be found.

b. Risk Assessment

After finding out the hazarad and its risk, afterwards, the risk assessment is conducted. Within the risk assessment, there are 2 parameters, namely (1) likehood, and (2) consequences, yielded in the table, refers to AZ/NZS 4360:2004 [15] and the description for each parameters is synchronized based on the condition in the field [16].

Table 3 - Likelihood

Score	Criterion	Description
5	Almost certain	Almost occur at all times
4	Likely	Often occur, for instance once in a week
3	Possible	Sometime happens
2	Unlikely	Happens rarely
1	Almost never	Happens very rarely

Table 4 - Consequences

Score	Criterion	Description
1	Insignification	1. Does not cause loss and casualty 2. Does not cause the lack of working hours 3. Very little scale of material lost
2	Minor	1. Cause light wound which needs care by first aid kit. 2. The working activities are going on 3. Little material lost
3	Moderate	1. Cause minor injury 2. Temporarily suspended from work, usually within or less than 3 days. 3. A lot of material are lost
4	Major	1. Can cause heavy injury 2. Laid off from work, more than 3 days. 3. A lot of material are lost
5	Catastrophic	1. Cause dead casualty 2. Permanently fired 3. Lost of many materials

c. Risk rate

Risk rate is defined as the level of risk, to value or evaluate the risk that possibly happen [11], The risk rate can be calculated by using the formula as follows [17]

$$RR = C \times L \tag{1}$$

Note:

RR : Risk Rate

C : Consequence

L : Likelihood

The matrix of scoring on risk is yielded on the table based on AZ/NZS 4360:2004 [15] and it also synchronizes into the condition in the field [18].

Table 5 - Matrix of Risk Evaluation

Likelihood	Consequences				
	1	2	3	4	5
	Insignification	Minor	Moderate	Major	Catastrophic
5 (Almost certain)	5	10	15	20	25
4 (Likely)	4	8	12	16	20

Likelihood	Consequences				
	1	2	3	4	5
	Insignification	Minor	Moderate	Major	Catastrophic
3 (Possible)	3	6	9	12	15
2 (Unlikely)	2	4	6	8	10
1 (Almost never)	1	2	3	4	5

Table 6 - Color Description

Tingkat Risiko	Action
Extreme	Must give repair action or controlling immediately
High Risk	Reduction reaches to the acceptable level
Moderate Risk	The work can be done
Low Risk	No need additional handling

d. *Risk Control*

Risk control is handling and controlling the risk. When the high risk or extreme risk happens, then the controlling is urgently needed to lower the level of risk. There are 5 hierarchy of the handling the risk, they are elimination, substitution, engineering control, administration control and Personal Protective Equipment or PPE [18].

2.2. *Analytical Hierarchy Process (AHP)*

Steps of Analytical Hierarchy Process (AHP) are as follows [19].
1. Describing the problems and determining the goals
2. Arranging the structure of hierarchy, started from main goal, criteria and alternatives.
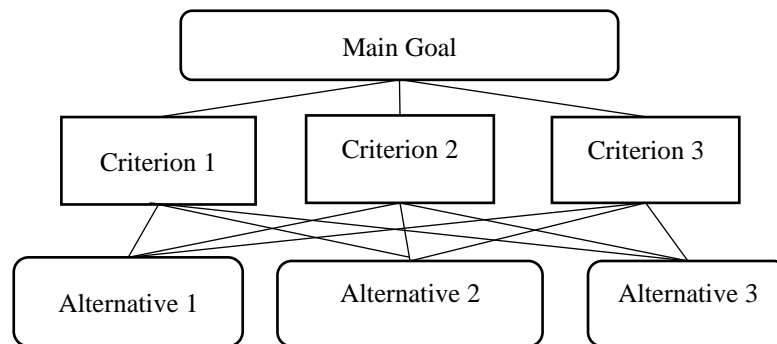

Figure 1. Structure of Hierarchy Achieving the main goal Utama

3. Developing a matrix of comparison in pair [19] by using parameters of score of Saaty comparison scale [20].

Table 7 - Matrix of Comparison in Pair

Criterion	K1	K2	K3	Kn
K1	K11	K12	K13	K1n
K2	K21	K22	K23	K2n
K3	K31	K32	K33	K3n
Km	Km1	Km2	Km3	Kmn

Table 8 - Saaty Comparison Scale (Saaty scale)

Intensity of Significance	Description

1	Two factors are equally significant
3	One factor is slightly less significant than another one.
5	One factor is more significant than another one.
7	One factor is much more significant than another one
9	One factor is extremely significant than another one
2,4,6,8	Two factors have closely same score

4. Data normalization

   Normalized data are obtained by dividing the score of each factor within the matrix by total score of matrix within one column to attain normalized score (Wij). At the end, the total amount of each column in the normalized matrix is same with 1 [19].

$$\text{Wij} = \frac{Matrix\ of\ comparison\ (Sij)}{Amount\ of\ column\ matrix\ (\sum Sij)} \tag{2}$$

5. Calculating the *eigen vector* (λ).

   Eigen vector is score of average from normalized matrix and it is calculated for each line [19].

$$\lambda i = \overline{W}_{ij} \tag{3}$$

To simplify the analysis, all steps mainly step 2 up to step 5 can be summarized in the table as follows.

Table 9 - Matrix of Comparison

Criteria/alternative	S_1	S_2	S_3	Normalization			Amount	Eigen vector(λ)
S_1	S_{11}	S_{12}	S_{13}	W_{11}	W_{12}	W_{13}	$\sum W_{1j}$	$\overline{W}_{1j}$
S_2	S_{21}	S_{22}	S_{23}	W_{21}	W_{22}	W_{23}	$\sum W_{2j}$	$\overline{W}_{2j}$
S_3	S_{31}	S_{32}	S_{33}	W_{31}	W_{32}	W_{33}	$\sum W_{3j}$	$\overline{W}_{3j}$
Total	$\sum S_{i1}$	$\sum S_{i2}$	$\sum S_{i3}$	$\sum W_{i1}=1$	$\sum W_{i2}=1$	$\sum W_{i3}=1$		$\sum \overline{W}_{ij}=1$

6. Calculating the *eigen vector maximum* [19].

λ_{max} = (Total of Column 1 x eigen vector line 1) + (Total of columns 2 x eigen vector line 2) + (Total column x eigen vector line 3) and so on.

$$= (\sum S_{i1}\ x\ \overline{W}_{1j}) + (\sum S_{i2}\ x\ \overline{W}_{2j}) + (\sum S_{i3}\ x\ \overline{W}_{3j}) \tag{4}$$

Note:

λ_{max} = *eigen vector maximum*

7. Testing the consistency by using *Consistency Index* [19].

$$CI = \frac{(\lambda max - n)}{(n-1)} \tag{5}$$

Note:

CI : *Consistensy Index*
n : Amount of matrix

8. Calculating of *Consistency Ratio* [19].

$$CR = \frac{CI}{RI} \tag{6}$$

Note:

CR : *Consistency Ratio*
RI : *Random Consistency Index*

[5]

Score RI is taken from the table of random consistency index by considering the matrix scale. If the score of CR ≤ 10% the data is rated consistent and acceptable but, if CR >10%, the data is considered inconsistent and unacceptable [20].

Table 10 - Random Consistency Index (RI)

Scale of Matrix	Score RI
1 & 2	0,00
3	0,58
4	1.90
5	1,12
6	1,24
7	1,32
8	1,41
9	1,45
10	1,49

9. Arranging the priority (ranking). The priority is decided based on the total of score (weighting) the highest multiplication between on the each criterion and alternatives which is obtained from the output of analysis AHP[19].

3. RESULTS AND DISCUSSION

3.1 Hazard and Risk Identification

Based on the observation and interview in the field by considering the standard of operating procedure on the developing the elevated track, it was found an activity with potential danger and potential risk which ruins the passengers' safety. The result of identification on potential danger and potential risk from the infrastructure process of elevated track at the railway station of Manggarai are illustrated as follows.

Table 11. Identification on the Potential Danger and Risk on the construction of Elevated Track

No	Condition in the Field	Potential danger	Risk
1.	Train platform becomes *temporary platform*	1. The activity of getting on and off of passengers are hampered. 2. Distance between CL and platform train is not suitable	1. The overloaded passengers cause the temporary platform passes minimum number of passengers and it may affect the platform broken. 2. It may cause the passengers fall down/stumble between gaps of platforms and CL
	The length of platform in the north side is not suitable with the length of train carriage	3. It is dangerous if the passengers don't know about it	3. It may cause the passengers fall down on the track of train
3.	The width of temporary platform is very narrow	4. It endangers the passengers when they walk on it.	4. The overloaded passengers in the temporary platform may cause the passengers fall down from the platform
4.	No warning (banner) for passenger's safety	5. Passengers do not notice and do not know so they are less aware when being around the construction project.	5. Material and heavy tools of construction may hit the passengers.
5.	Excavator operates in area nearby the passengers'	6. Endanger the safety of passengers who are waiting for commuter line	6. Material brought by excavator can hit the passengers. 7. Can endanger the railway accident

No	Condition in the Field	Potential danger	Risk
	mobility and railway operation.	7. Endanger and ruin the railway mobility.	
6.	Mixer truck pass by the track of crossing	8. Endanger and disturb the passengers' safety and the railway trip.	8. May cause accident of railway and mixer truck can hit the passengers of railway
7.	Used wood are not moved relocated yet by the officer in the track VII with the direction to Tenggulun.	9. Endanger and disturb the passengers and railway trip.	9. Can cause accident of railway
8.	Heavy equipment pass by right on the crossing of passengers	10. Endanger the safety of passengers who are walking in the crossing line	10. Mortar can fall on the passengers.
9.	*Tower crane* brings iron passes on the active track.	11. Endanger and ruin the passengers' safety and the train mobility.	11. Iron can befall the passengers and railway.

Based on the table 10, in the construction process there are 9 conditions, 11 dangerous potentials and 11 threatening risk which endanger the passengers' safety.

3.2 Risk Assessment
After identifying the dangers and risk, the next step is doing an analysis on the risk assessment to discover the level of risk.

Table 12 - Risk Assessment

No	Potential Danger	Risk (R)	Likeli hood (L)	Conse quenc e (C)	*Score (S) = (L)*(C)*	*Level of Risk*
1.	The activity of getting on and off of passengers is obstructed	Passengers' accumulation/overloaded inside of the temporary platform can make the platform fall down and broken.	2	4	8	**High**
	Distance between CL and platform is not suitable	Can cause the passengers fall down/ stumble within the platform-CL gaps	4	4	16	**Extreme**
2.	If the passengers don't know, it can endanger them	Can make passenger fall down right on the track.	3	3	9	**High**
3.	Endanger the passengers when they are walking on it	Passengers accumulation/overloaded inside the temporary platform can make them fall down from the platform.	3	4	12	**Extreme**
4.	The passengers have lack of information so they are less careful when passing the area of construction	Can cause the passengers be hit by materials and heavy equipment of construction	2	3	6	**Moderate**

No	Potential Danger	Risk (R)	Likeli hood (L)	Conse quenc e (C)	Scor e (S) = (L)*(C)	Level of Risk
5.	Endanger the safety of passengers who are waiting for the arrival of CL	Passengers can be hit by material brought by excavator, even hit by excavator itself.	3	3	9	**High**
	Endanger and ruin the trip of railway	Can cause the accident of train	2	5	10	**Extreme**
6.	Endanger and ruin the safety of passengers and the trip of railway	Can trigger the accident of train and truck mixer possibly can hit the passengers.	2	4	8	**High**
7.	Endanger and ruin the safety of passengers and the trip's train	Can cause train accident	4	5	20	**Extreme**
8.	Endanger the safety of passengers who are walking on the crossing line	Passengers can be hit by the mortar	3	4	12	**Extreme**
9.	Endanger and ruin the safety of passengers and the trip of train	The iron of construction can fall on to the passengers and the train.	2	5	10	**Extreme**

Based on the table 11, in the construction process there are 6 extreme risk, 4 high risks and only 1 moderate risk.

3.3 Risk Controlling

Based on the interview and consideration of risk controlling, the respondents stated that the suitable risk controlling are as follows:
1. Elimination
    a) Applying switch over 5 or synchronizing the timetable of train's arrival and departure, where the overall operation pattern of railway trip changes, and it affects to the passengers who cannot pass the area of construction.
2. Substitution
    a) Increasing the service facility so that the passengers can feel comfortable and secured although they are in the condition of railway station is under construction process.
    b) Operating KLB feeder (extra train) to fasten the process of passengers' mobility so they don't wait for long time at the railway station of Manggarai.
3. Engineering control
    a) Roof installation above the area of crossing so the passengers are secured and safe from things fall down from above of construction heavy equipments.
    b) Installing the safety line in the area of construction of elevated track.
4. Administration control
    a) Conducting join inspection regularly and carrying the supervision and giving briefing to the officers and workers of railway station and construction project when the potential danger arises.
    b) Giving a large banner in the area of construction project so that the passengers are careful and aware of dangers.
    c) Instructing the officer of announcer to remind and warn the passengers to be careful when they pass the area of construction.
    d) Conducting the safety briefing right before the job is getting started. This action is aimed to build the officers' and workers' awareness to prioritize the safety during working.

5. Personal Protection Equipment (PPE)
   Requiring the officers and workers to wear Personal Protection Equipment (PPE) so that they are safe when something wrong meets them during working. This effort can minimize the risk.

3.4 Analytical Hierarchy Process (AHP)

To get the best way of handling the risk, there are 3 significant criteria to handle the risk, they are; passengers' safety (A1), Passengers' convenient (A2) and passengers' security (A3). From the risk control above, the respondents stated that 3 alternative ways are suitable with the 3 criteria. The alternative ways based on their statements are applying switch over 5 (E1), Improving the facility service (E2) and operating KLB Feeder (E3).
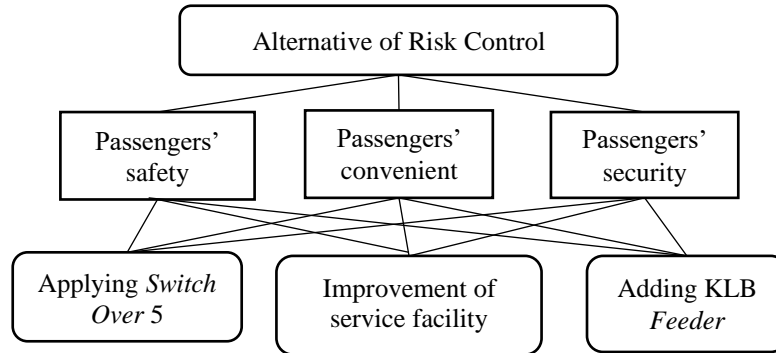

Figure 2. Hierarchy of alternative on handling the risk of passengers' safety

Comparison in pair is conducted by using Saaty scale on the criteria and alternatives. Here below are statements of respondents regarding their preferences on criteria.

Table 13 - Respondents' Preferences on Criteria

	SM	VSM	QC
A1→A2	7 times more important	5 times more important	7 times more important
A1→A3	3 times more important	Equally important	3 times more important
A3→A2	3 times more important	3 times more important	5 times more important

Note: preference A1 on A2 (Example= 7) is effectively applied for the contrary A2 on A1 (Example= 1/7)

SM stated that A1 = 7 times more important compared to A2, A1 = 3 times more important than A3 and A3 = 3 times more important than A2. Here below is the result of analysis of comparison in pair on the criteria based on perspective SM.

Table 14 - Analysis on Criteria Comparison

Matrix of Criteria Comparison (Respondent: SM)								
Criteria	**A1**	**A2**	**A3**	**Normalization**			**Amount**	**Eigen Vector**
A1	1	7	3	0.677	0.636	0.692	2.006	0.669
A2	0.143	1	0.333	0.097	0.091	0.077	0.265	0.088
A3	0.333	3	1	0.226	0.273	0.231	0.729	0.243
Total	1.476	11	4.333	1	1	1	3	1

$$W1 = \frac{A11}{\text{Amount of column A1}}$$

$$W1 = \frac{1}{1.471}$$

$$= 0.677, \text{ and so on.}$$

$\lambda max = \sum$ (Sum of normalization column x eigen vector)
$= (1.476 \times 0.669) + (11 \times 0.088) + (4.333 \times 0.243)$
$= 3.011$

$$CI = ((\lambda max-n)) / ((n-1))$$
$$= (3.01078491 - 3) / (3-1)$$
$$= 0.005$$

$$CR = \frac{CI}{RI}$$
$$= \frac{0.005}{0.58}$$
$$= 0.0093$$

Score CR = 0.0093 < 0,1 or 10% Therefore the calculation on the criteria is considered consistent. By using the same way, the result of analysis on the criteria comparison viewed from VSM and QC, comprehensively the result are drawn as follows:

Table 15 - Analysis on Criteria Comparison Based on 3 Respondents

Criteria	EV (SM)	EV (VSM)	EV (QC)
A1	0.669	0.480	0.643
A2	0.088	0.115	0.074
A3	0.243	0.405	0.283
λmax	3.011	3.036	3.097
CI	0.005	0.018	0.048
CR	0.009	0.031	0.083
Note	Consistent	Consistent	Consistent

EV= *eigen vector*

Moreover, conducting an analysis on each alternative option of each criterion based on respondents' point of view namely SM, VSM, and QC. In terms of A1, A2 and A3 on each E1, E2, and E3, the respondents stated of relationship as follows:

Table 16 - Respondents' Preference on each alternative option and each criterion.

	SM			VSM			QC		
	A1	**A2**	**A3**	**A1**	**A2**	**A3**	**A1**	**A2**	**A3**
E1→E2	7x*	5x	7x	7x	5x	7x	5x	5x	7x
E1→E3	3x	3x	1x	5x	1x	3x	3x	3x	1x
E3→E2	5x	1x	3x	3x	3x	3x	3x	3x	3x

*Note: 7x means E1 is 7x more important than E2.

By using the same method as shown in the table 14, comparison analysis of alternatives E was conducted on criteria A. The result of analysis as follows:

Table 17. Comparison Analysis of Alternative E on Criterion A for 3 Respondents.

	SM			VSM			QC		
Criterion/ Alternative	**A1**	**A2**	**A3**	**A1**	**A2**	**A3**	**A1**	**A2**	**A3**
EV E1	0.643	0.655	0.511	0.724	0.480	0.669	0.633	0.633	0.511
EV E2	0.074	0.158	0.100	0.083	0.115	0.088	0.106	0.106	0.100
EV E3	0.283	0.187	0.389	0.193	0.405	0.243	0.260	0.260	0.389
λmax	3.097	3.043	3.104	3.111	3.036	3.011	3.055	3.055	3.104
CI	0.048	0.022	0.052	0.056	0.018	0.005	0.028	0.028	0.052

Criterion/ Alternative	SM			VSM			QC		
	A1	A2	A3	A1	A2	A3	A1	A2	A3
CR	0.083	0.037	0.089	0.096	0.031	0.009	0.048	0.048	0.089
Note	C	C	C	C	C	C	C	C	C

EV= *eigen vector, C = consistent*

Furthermore, analysis was done to determine the priority (ranking), of available alternatives based on each criterion. The biggest weighting is decided as prime or main priority (top ranking).

Table 18 - Analysis On Weighting and Ranking of Alternatives E on Criteria A Based on Perspective of SM

Criterion/ Alternative	EV A1= 0.669	EV A2= 0.088	A3 EV= 0.243	WEIGHTING			Rank
EV E1	0.643	0.655	0.511	(0.669x0.643) + (0.243+0.511) = 0.612	(0.088x0.655)	+	1
EV E2	0.074	0.158	0.100	(0.669x0.074) + (0.243+0.100) = 0.088	(0.088x0.158)	+	3
EV E3	0.283	0.187	0.389	(0.669x0.283) + (0.243+0.389) = 0.300	(0.088x0.187)	+	2

Tale 18 shows that the perspective of SM, from 3 criteria namely the passengers' safety (A1), the passengers' convenience (A2) and the passengers' security (A3) shows as follows:
1. The best alternative is switch over 5 (E1)
2. The second best alternative is operating KLB Feeder (E3)
3. The last alternative is improving the facility of service (E2).

TABLE 19. Analysis of Weighting and Ranking of Alternatives E on the Criteria A from the perspective VSM

Criteria/ Alternative	EV A1= 0.480	EV A2= 0.115	A3 EV= 0.405	WEIGHTING			Rank
EV E1	0.724	0.480	0.669	(0.480x0.724) + (0.405x0.669) = 0.674	(0.115x0.480)	+	1
EV E2	0.083	0.115	0.088	(0.480x0.083) + (0.405x0.088) = 0.089	(0.115x0.115)	+	3
EV E3	0.193	0.405	0.243	(0.480x0.193) + (0.405x0.243) = 0.238	(0.115x0.405)	+	2

Table 19 shows that perspective VSM, from 3 criteria namely the safety of passengers (A1), the convenience of passengers (A2), and the security of passengers (A3) shows findings as follows:
1. The best alternative is switch over 5 (E1),
2. The second alternative is operating KLB feeder (E3)
3. The last alternative is improvement of service facility (E2)

Table 20 - An Analysis on the Weighting and Raking of Alternatives E on the Criteria A from the perspective QC

Criteria/ Alternative	EV A1= 0.643	EV A2= 0.074	A3 EV= 0.283	WEIGHTING			Rank
EV E1	0.633	0.633	0.511	(0.643x0.633) + (0.283x0.511) = 0.598	(0.074x0.633)	+	1
EV E2	0.106	0.106	0.100	(0.643x0.106) + (0.283x0.100) = 0.104	(0.074x0.106)	+	3

Criteria/ Alternative	EV A1= 0.643	EV A2= 0.074	A3 EV= 0.283	WEIGHTING	Rank
EV E3	0.260	0.260	0.389	(0.643x0.260) + (0.074x0.260) + (0.283x0.389) = 0.297	2

Table 20 shows that perspective QC, from 3 criteria namely the passengers' safety (A1), the passengers' convenience (A2) and passengers' security (A3), infers as follows:
1. The best alternative is switch over 5 (E1),
2. The second alternative is operating KLB feeder (E3)
3. The last alternative is increasing the service facility (E2)

Result of analysis AHP from those three respondents above stated that the best alternative way in the risk controlling in the elevated project construction is by applying the switch over 5

4. CONCLUSION

1. Based on the result of identification, there are 11 hazards with different level of risks namely 1 hazard is graded as average, 4 hazards are categorized into high risk and 6 hazards are rated extreme risk. The relevant handling risk to be given is by applying switch over 5, putting up a banner for danger warning and cautions, implementing safety briefing routinely right before the work is getting started, doing joint inspection routinely, adding KLB feeder, making safety line in the area of construction and giving mandatory to worker to wear Personal Protective Equipment or APD during working.
2. By considering the passengers' safety, passengers' convenient, and passengers' security, then the best alternative ways of handling risk is by implementing switch over 5. Another alternative way based on priority to be applied is by adding KLB Feeder and increasing the service facility.

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