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Prioritization of Reputation Loss Factor Subject to Pipeline Explosion

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ABSTRACT

The impact of onshore oil and gas pipeline accident i.e., explosion varies depending on the pipeline location, transported product, proximity of residential areas and etc. Pipeline owner's reputation is threatened once an accident takes place, which influences stakeholders' perceptions consequently. This study focuses on prioritizing the importance of the reputation loss factors according to the experts' judgments. Twenty two reputation loss factors were identified from 10 major pipeline explosion post-accident case studies. Nine experts were interviewed to rate importance level of the reputation loss factors using 10-point Likert scale rating method. The significance difference was obtained by the implementation of statistical analysis. Relative Importance Index (RII) was used to identify the importance level of the factor and Analytical Hierarchy Process (AHP) method for prioritization process with the aid of Super Decisions software. Results show that all reputation loss factors are categorized within index number 4-10. The first factor with the highest importance value and priority vector corresponds to each stakeholder for both RII and AHP methods are similar, i.e., A2 "Services or sales progress disturbed", B1"Loss of customer confidence", D3 "Severity of accident" and C4 "CEO refuses to take responsibility". "Job application for positions reduced" is the least priority. Thus, understanding the importance of the reputation loss factors and identifying the priority of which factor to be taken care of are suggested to the pipeline operators in the post-accident responses. Hence, the reputation loss impact can be reduced and annual profit margin is secured.

Key words: Risk assessment, risk consequences, pipeline integrity, Fuzzy AHP framework

INTRODUCTION

Onshore oil and gas pipeline explosion is a catastrophic event; it causes fatality and injury, massive environmental damages and bad economic losses. These may endanger pipeline operator's reputation owing to degradation of confidence among the stakeholders i.e., investor, customer, employee and public (Noor *et al*., 2008). This impact requires the owner to implement risk assessment on the pipeline in order to lower the impact so that optimum inspection and maintenance schedule can be obtained (Noor *et al*., 2011). Table 1 shows a commonly used 5x5 PAER model risk assessment matrix in the pipeline integrity management, whereas the Probability Of Failure (POF) and Consequence Of Failure (COF) ratings are plotted in ascending manner in y and x-plane, from bottom to top and from left to right, respectively. Risk assessment can be implemented qualitatively, semi-quantitatively and fully quantitatively. Semi-quantitative method is implemented regularly in the pipeline integrity management due to the nature of the available data.

Table 1: A sample of PAER model risk assessment matrix for oil and gas pipeline management

Consequence of failure					
People (P)	Slight Injury	Minor Injury	Major injury	Single fatality	Multiple fatalities
Asset (A)	Slight damage	Minor damage	Local damage	Major damage	Extensive damage
Environment (E)	Slight effect	Minor effect	Localized effect	Major effect	Massive effect
Reputation (R)	Slight impact	Local impact	Industry impact	National impact	International impact
Severity rating	1 Negligible	2 Minor	3 Moderate	4 Major	5 Catastrophic
Probability of failure					
Likelihood rating					
E very likely to happened					
Happens several times per year at location	Moderate	High	High	Very high	Very high
D likely to happened					
Happens several times per year in company	Low	Moderate	High	High	Very high
C Possible to happened					
Incident has occurred in company	Low	Low	Moderate	High	High
B Unlikely to happened					
Heard of incident in industry	Very low	Low	Low	Moderate	High
A very unlucky to happened					
Never heard of in industry	Very low	Very low	Low	Low	Moderate

The impact of an accident is preferably measured in terms of monetary value for the pipeline COF assessment. Instead, the impact on reputation is taken lightly because it is difficult to quantify (Khan and Haddara, 2004; Arunraj and Maiti, 2009); it relies on the criticalness of the event (De Bie, 2006; Dunbar and Schwalbach, 2000) and it is time-dependent. These reasons has made operator simplifies the reputation loss evaluation by observing the level of public concern and the range of media coverage on the event. Another effort to quantify the reputation loss of a company who involved in an industrial accident is done by measuring the company stock market value for a period of time after the loss event e.g. airlines crashed, Exxon Valdez accident, deepwater horizon disaster and etc. (Fombrun, 1996; Way, 2013). However, both methods do not approximately portray the reputation definition-the beliefs of the stakeholders towards a company and its attributes (Fombrun, 1996; Firestein, 2004).

Thus, the identification of the importance of factors contribute to the loss of pipeline owner reputation is crucial in order to reduce or to restraint the company from the risk of bad reputation. It depends on the stakeholder preferences and expectations towards the company. Experts' opinions are required as well in the endeavors to pinpoint other intangible aspects of reputation loss factors in an accident of pipeline failure event. The level of reputation can be measured by the level of perceptions of the stakeholders (Fombrun, 1996). It can be measured using index-based method (Cravens *et al*., 2003). It is vital to most organizations because it affects company's profit margin (Cravens *et al*., 2003; Money and Hillenbrand, 2006). Thus, this study aims to identify the importance of the reputation loss factors according to experts' judgments which eventually assist the oil and gas pipeline risk assessment authorities to prioritize which factor to be taken care of first if accident takes place.

MATERIALS AND METHODS

Reputation loss factor derivation: The reputation loss factors were derived from the selected worst oil and gas pipeline explosion event from 1965-2014 (Zardasti *et al*., 2015), of which data is available and publicized. The events were chosen if it achieves one of these criteria: Multiple fatalities, total loss or severe damage for offshore units, approximately 100 million US dollar property damage for onshore units and 1000 barrel of oil spilt (OGP., 2010).

Data collection: Nine experts of the pipeline integrity management department personnel of oil and gas company in Malaysia were chosen to be interviewed face-to-face to minimize misinterpretation of the questions to achieve the objective of the study. They have more than 10 years of working experience in the oil and gas industry. The questionnaire is required to be tested for Cronbach alpha to obtain high reliability of the data; hence pilot questionnaire was distributed to six respondents to investigate the reliability of the data. A value of 0.70 and above is sufficient for all new research (Mukesh *et al*., 2013). Seven questions are designed to obtain qualitative responses from the experts regarding the level of importance of the reputation loss factors in regards to onshore oil and gas pipeline explosion. The 10-point Likert scale is used to rate the importance of reputation loss factor. Sampling of the experts consists of several categories: gender, job position, working experience, company sector, nationality and company name.

Relative importance index: Relative Importance Index (RII) can be calculated to categorize the index of importance for each reputation loss factors. The formulation of RII is given in Eq. 1.

$$\text{Relative Impotance Index} = \left[\frac{10n_{10}+9n_9+8n_8+7n_7+6n_6+5n_5+4n_4+3n_3+2n_2+n_1}{10\left(n_{10}+n_9+n_8+n_7+n_6+n_5+n_4+n_3+n_2+n_1\right)}\right]\times 100 \quad (1)$$

where, n is the frequency of the responses given for rating i = 1, 2, 3, ... , 10, noting that higher rating scale indicating that the factor consists of higher importance among others, e.g., 1 for "not important at all" and 10 for "crucial". The value of the index group can be determined based on the mean value of the indicator. The minimum value of the index is 1 if all experts answered "not important at all" and the maximum is 10 if all answered "crucial". It is necessary to determine the rating scale due to the mean values obtained in terms of decimal numbers. Table 2 shows the categories of the level of importance based on the index group.

Statistical analysis: Statistical analysis was used to test the significance difference of the ratings of the level of importance of the reputation loss among the sample. The non-parametric test of Mann-Whitney was utilized for this purpose. It is also known as the Wilcoxon Rank Sum test, which ordinal scale is sufficient to measure variable. The Mann-Whitney tests the null hypothesis that ratings of the level of importance of reputation loss factor do not differ between two groups of independent samples. The significance level is set at 0.05 for this paper with 95% level of confidence. For the significance of the sum ranks, it can be obtained by transforming the score to

Table 2: Level of importance based on the index group

Scale range	Level of importance	Index group
10-19	Not important at all	1
19-28	Extremely low importance	2
28-37	Very low importance	3
37-46	Low importance	4
46-55	Slightly important	5
55-64	Neutral	6
64-73	Moderately important	7
73-82	Very important	8
82-91	Extremely important	9
91-100	Crucial	10

Adapted from Shah and Pitroda (2013) and Vagias (2006)

Table 3: Reputation loss factors due to pipeline explosion events (Zardasti *et al*., 2015)

Stakeholders	Factors contributing to pipeline operator reputation loss
A: Investors	A1: Sudden drop of share price and market capitalization
	A2: Services or sales progress disturbed
	A3: Ranking downgraded
	A4: Reduction of credit rating
	A5: Loss of new pipeline contracts
	A6: Loss of sponsorship opportunity
B: Customers	B1: Loss of customer confidence
	B2: Bad word-of-mouth among customers
C: Employees	C1: CEO responds with unreasonable actions towards victims
	C2: CEO neglects victims' welfare
	C3: CEO hides facts about the accident
	C4: CEO refuses to take responsibility
	C5: CEO mismanages allocations to lobby politicians
	C6: Employees demotivated
	C7: Job applications for position reduced
	C8: Skilled worker resignations
	C9: Employee(s) caused accident
D: Communities	D1: Recurrence of similar accident
	D2: Loss of public trust
	D3: Severity of accident
	D4: Mishandling public reports
	D5: Negative media report

a standard normal deviate, z. If the sum ranks significance value is greater than significance value set level, do not reject the null hypothesis. In conclusion, there is no significance difference of ratings among two independent variables/groups. In addition, if the significance difference is to be tested among three groups, then Kruskal-Wallis an analysis of variance test is used. It tests the null hypothesis that K-samples i.e., K for three or more groups, do not differ on the level of importance of the reputation loss factors rating. If the significance of H obtained using Chi-square statistics is greater than significance value set level, do not reject the null hypothesis. In conclusion, there is no significance difference of ratings among K independent variables/groups.

Analytical hierarchy process method: The reputation loss factors obtained from 10 selected oil and gas pipeline explosion are arranged into AHP framework according to its corresponding stakeholder's preferences as shown in Table 3.

A hierarchical structure was constructed with attention to creating hierarchical influence between the goal (to prioritize the importance of reputation loss factors), the criteria (stakeholders) and the subcriteria (reputation loss factors corresponding to the stakeholders) as shown in Fig. 1. Based on this structure, questionnaire was designed and a structured face-to-face interview was done with the experts to achieve the goal, which aims to identify the importance of the reputation loss factors.

The experts' responses were stored in the Super Decisions software. The respective importance of the reputation loss factors were done by pairwise comparison between reputation loss factor, e.g. A1, A2, A3,..., D5 with respect to stakeholders, e.g. A, B, C, D. Similarly, pairwise comparison between stakeholders with respect to goal, e.g., G1 is required. The comparison of the stakeholder's node was carried out according to their influence on the reputation loss factor. For example, investors as a primary standard were denoted as A and the corresponding reputation loss factors were written as Ai for i = 1, 2, 3, ..., 6 as secondary standards as shown in Fig. 2. An example of a

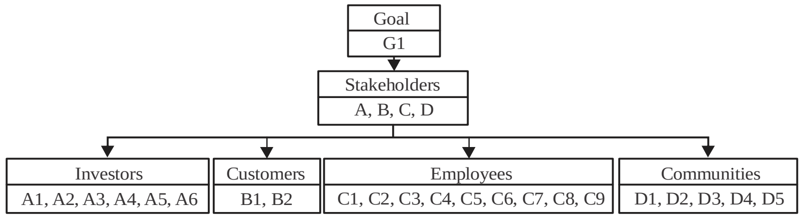

Fig. 1: Analytical hierarchy process structure (Zardasti *et al*., 2015)

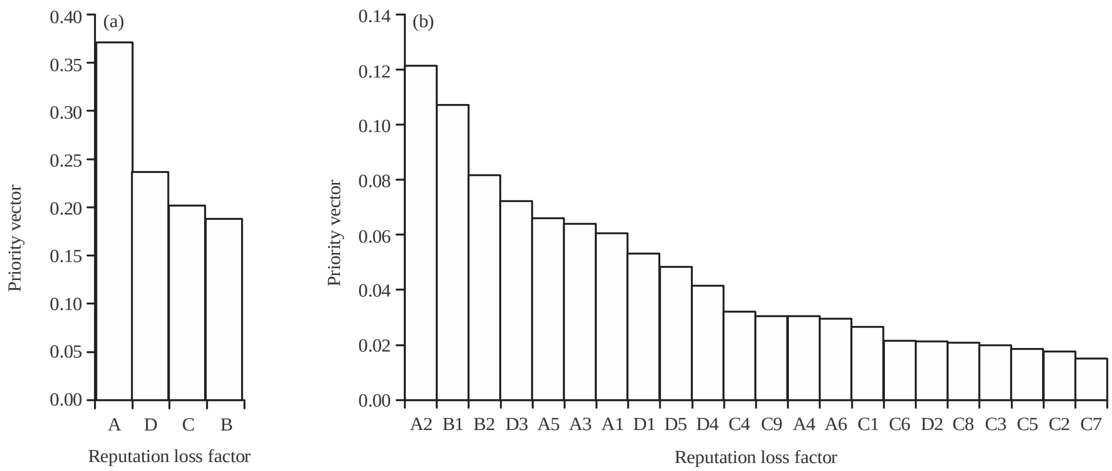

Fig. 2(a-b): Graph of priority vector for (a) Criteria and (b) Subcriteria

Table 4: Pairwise comparison matrix between reputation loss factor corresponds to investor

Investors	A1	A2	A3	A4	A5	A6	Priority vector
A1	1	2	1/2	1	1	1/2	0.135
A2	1/2	1	1/3	1/2	1/2	1/3	0.075
A3	2	3	1	2	2	1	0.259
A4	1	2	1/2	1	1	1/2	0.136
A5	1	2	1/2	1	1	1/2	0.136
A6	2	3	1	2	2	1	0.259

pairwise comparison matrix is given in Table 4. The local priority vector was obtained using the principal eigenvector of a comparison matrix. After all priority vectors are calculated, multiplying the criteria-specific priority vector of the alternatives with the corresponding criterion weight and summing up the results obtained the overall priorities for the reputation loss factor with respect to the goal.

It can be used for the purpose of reducing numbers of question in the questionnaire and the quantity of pairwise comparison is decreased as well, i.e., n(n-1)/2 where n is number of factor to be compared. The Super Decisions software eases the process of pairwise comparison as it was designed by AHP factor prioritizing method founder, T. L. Saaty. It will automatically discard the overlapping pairwise comparison of the same factor e.g., pairwise comparison between factor A1 with A2 and A2 and A1, where Super Decisions neglects the second pair of the comparison. The pairwise comparisons data calculated using method for each expert is then inserted into Super Decisions software, which the AHP framework of the reputation loss factors corresponds with stakeholder was drawn earlier. Finally, priority vector for all factors are provided once all data input accomplished. Consistency Ratio (CR) is provided in this software to check the consistency for each set pairwise comparison. Consistency of the pairwise comparison matrix is considered satisfactory when the value of CR is less than 0.1 or 10% of inconsistency is permissible.

Data analysis

Relative importance index: To test the reliability of the data, Cronbach alpha of 0.716 was achieved for the Criteria level and 0.911 for the Subcriteria level, both exceeds the requirement of 0.70 to conclude that the data collected is reliable and sufficient. The frequency and percentage for different category of sampling is tabulated in Table 6.

Experts in oil and gas pipeline integrity management are mostly male. They are oil and gas pipeline engineer and inspector who worked in the industry within 10 years and above, which considered knowledgeable in pipeline integrity management. Most of the experts are Malaysian who worked with PETRONAS, a Malaysian government-owned oil and gas company and they are believed to have better views on reputation loss of pipeline owner subject to local condition based on their experiences managing pipeline integrity. These experts are the employees of various oil and gas company sector e.g. producer, service provider and fabricator, which enhance the variety of expert view from different company background and interest.

Ten cases of natural gas pipeline accidents initiated by corrosion in various countries were studied and identifies a number of 22 factors contribute to pipeline owner reputation loss due to pipeline failure related to explosion were identified (Zardasti *et al*., 2015). These factors were then sorted according to their corresponding stakeholders and labeled as indicated earlier in Table 3.

The RII of the reputation loss factors are listed in the Table 7. From the table, the range of index of the factors lies between 4 and 10. In the subcriteria level, the lowest score of relative

Table 5: Analytical hierarchy process fundamental scale

Definition	Equally importance	Moderately importance	Strongly importance	Very strong importance	Extremely importance	Intermediate values
Intensity of importance	1	3	5	7	9	2, 4, 6, 8

Table 6: Frequency and percentage for experts' sampling

Sampling and category	Frequency	Percentage
Gender		
Male	8	88.9
Female	1	11.1
Job position		
Authority	1	11.1
Engineer	7	77.8
Inspector	1	11.1
Working experience		
10 years or less	2	22.2
More than 10 years	7	77.8
Company sector		
Producer	7	77.8
Service provider	1	11.1
Fabricator	1	11.1
Nationality		
Malaysian	8	88.9
Others	1	11.1
Company		
PETRONAS	7	22.2
Others	2	77.8

Table 7: Relative importance index of reputation loss factors

Parameters	Factor	Relative importance score	Index group
Criteria	A	82.22	9
	B	66.67	7
Sub-criteria	A1	76.00	8
	A2	91.11	10
	A3	73.33	8
	A4	54.44	5
	A5	70.00	7
	A6	40.00	4
	B1	77.78	8
	B2	64.44	7
	C1	67.78	7
	C2	66.67	7
	C3	64.44	7
Criteria	C	67.78	7
	D	65.56	7
Sub-criteria	C4	74.44	8
	C5	65.56	7
	C6	67.78	7
	C7	45.71	4
	C8	63.33	6
	C9	71.11	7
	D1	80.00	8
	D2	54.44	5
	D3	88.89	9
	D4	75.56	8
	D5	77.78	8

importance goes to factor A6 "Loss of sponsorship opportunity" with 40.00, grouped into the "Low importance" index group of number 4. In the same group, factor C7 "Job applications for position reduced" scored 45.71. From experts' point of view, these factors are considered the least factors that influence the reputation loss of the pipeline owner once an event of explosion occurred on their asset. Both factors do not attract the interest of the major stakeholders and their perceptions towards jeopardizing pipeline owner's reputation. In contrast, the highest score of relative importance of reputation loss factor gained by factor A2 "Services or sales progress disturbed" with 91.11 and index 10 "Crucial". This factor affecting various stakeholders, e.g., investor, customer and employee, the production of the transported substances, employees bonuses affected, customer demands unachieved and it became worst when investor believes towards the integrity of the company is tarnished. It is proven when factor A "Investor" obtained the highest value of relative importance score with index 9 "Extremely important" in the criteria level. It indicates that expert believes investor is the main reason of loss of pipeline owner reputation after an explosion event. Other stakeholders are considered equally important among customer, employee and communities with the scores within range of 64-73, level of importance for these stakeholders are "Moderately important" with the index of 7. The same index was found as the maximum index in the subcriteria level. Of 22 factors of reputation loss, eight are grouped in index 7. It can be seen that A2, B1, C4 and D3 are the highest scores of importance of reputation loss factors corresponds to each stakeholder. For example, A2 "Services or sales progress disturbed" scored index of 10 "Crucial" for Criteria A "Investor"; B1 "Loss of customer confidence" for B "Customer" scored index of 8 "Very important", as well as C4 "CEO refuses to take responsibility" for C "Employee" and index 9 "Extremely important" score for D3 "Severity of accident" of D "Communities". As a conclusion, all reputation loss factors importance levels are above the index of 4 "low importance" with the relative important score of 39 and above. However, the expert given ratings are required to be tested in order to identify significance of the factors between different samples to increase the level of confidence, so that these factors are can be concluded as statistically significant.

The null hypothesis for the tests is that there is no significant difference between samples in terms of ratings given for the importance of reputation loss factors. The first sample tested is between the differences in years of working experience, i.e., less than 10 years and more than 10 years. With the aid of SPSS software, the value of asymptotic significance value can be obtained. Null hypothesis is rejected if the significant level set for this paper exceeds this asymptotic significance value $p<0.05$. Table 8 shows the asymptotic significant value and Mann-Whitney z-value for reputation loss factor by the years of working experience. Consequently, null hypothesis cannot be rejected. Hence, there is no significance difference in ratings between samples of working experience in oil and gas industry.

The next test is the sample of difference sector of company business, i.e., producer, services provider and fabricator. The same procedure with the first sample is used but different testing method, which is Kruskal-Wallis testing for K (more than two) independent samples is implemented. According to Table 9, value of Kruskal-Wallis Chi-squared, χ^2 is stated. It clearly shows that null hypothesis cannot be rejected because the asymptotic significant value exceeds significance level of 0.05. As a conclusion, there is no significance difference in ratings between samples of company sector in oil and gas industry.

The next test utilized the same method as the previous test due to the sample categories of job position are more than two, i.e., authority, engineer and inspector. As listed in Table 10, the

Table 8: Differences of level of importance of reputation loss factors by the years of working experience

Parameters	Factors	Mann-Whitney z-value	Significance	Factors	Mann-Whitney z-value	Significance
Criteria	A	-1.047	0.295	C	-1.489	0.137
	B	-0.590	0.555	D	-0.598	0.550
Sub-criteria	A1	-0.298	0.766	C4	-0.463	0.643
	A2	-1.450	0.147	C5	-0.596	0.551
	A3	-1.645	0.100	C6	-0.148	0.882
	A4	-0.748	0.455	C7	-1.196	0.232
	A5	-0.596	0.551	C8	-1.802	0.072
	A6	-1.212	0.225	C9	-1.482	0.138
	B1	-0.901	0.368	D1	-1.202	0.230
	B2	-1.047	0.295	D2	-0.886	0.376
	C1	-0.593	0.553	D3	-0.321	0.748
	C2	0.000	1.000	D4	-1.196	0.232
	C3	-0.449	0.654	D5	-0.307	0.759

Table 9: Differences of level of importance of reputation loss factors by the company sector of oil and gas industry

Parameters	Factors	Kruskal-Wallis χ^2-value	Significance	Factors	Kruskal-Wallis χ^2-value	Significance
Criteria	A	0.636	0.728	C	0.276	0.871
	B	0.174	0.917	D	0.159	0.924
Sub-criteria	A1	2.571	0.276	C4	0.857	0.651
	A2	5.172	0.075	C5	0.709	0.701
	A3	3.140	0.208	C6	0.361	0.835
	A4	2.236	0.327	C7	1.709	0.425
	A5	0.709	0.701	C8	1.624	0.444
	A6	3.592	0.166	C9	1.182	0.554
	B1	0.180	0.914	D1	0.180	0.914
	B2	1.252	0.535	D2	0.620	0.734
	C1	0.860	0.651	D3	3.291	0.193
	C2	0.785	0.676	D4	2.544	0.280
	C3	1.431	0.489	D5	2.810	0.245

Table 10: Differences of level of importance of reputation loss factors by the job position

Parameters	Factors	Mann-Whitney z-value	Significance	Factors	Mann-Whitney z-value	Significance
Criteria	A	0.089	0.956	C	0.355	0.837
	B	1.492	0.474	D	1.948	0.378
Sub-criteria	A1	2.217	0.330	C4	1.280	0.527
	A2	2.124	0.346	C5	1.695	0.429
	A3	2.544	0.280	C6	2.061	0.357
	A4	2.127	0.345	C7	1.709	0.425
	A5	1.695	0.429	C8	3.248	0.197
	A6	2.571	0.276	C9	1.065	0.587
	B1	1.724	0.422	D1	1.724	0.422
	B2	2.544	0.280	D2	2.247	0.325
	C1	2.266	0.322	D3	0.823	0.663
	C2	2.596	0.273	D4	0.457	0.796
	C3	1.431	0.489	D5	2.024	0.364

Table 11: Priority vector of the importance of reputation loss factors by super decisions

Parameters	Factors	Priority vectors	Ranks	Factors	Priority vectors	Ranks
Criteria	A	0.3717	1	C	0.2029	3
	B	0.1885	4	D	0.2368	2
Sub-criteria	A1	0.0606	7	C4	0.0322	11
	A2	0.1214	1	C5	0.0186	20
	A3	0.0640	6	C6	0.0216	16
	A4	0.0303	13	C7	0.0153	22
	A5	0.0658	5	C8	0.0208	18
	A6	0.0297	14	C9	0.0304	12
	B1	0.1072	2	D1	0.0534	8
	B2	0.0813	3	D2	0.0211	17
	C1	0.0264	15	D3	0.0722	4
	C2	0.0177	21	D4	0.0416	10
	C3	0.0199	19	D5	0.0485	9

significance level 0.05 is lesser than the obtained asymptotic significant value. Thus, it can be concluded that there is no significance difference in ratings between samples of job position of the expert in the oil and gas company. Null hypothesis is accepted. As a conclusion, since there is no significance difference between samples of tests, the ratings provided by the experts can be considered as statistically significant.

Priority vector: The index of factors is unable to define the prioritization of factors according to level of criteria, as well as subcriteria. Moreover, the subcriteria priority vectors are relative to the criteria. For this purpose, the AHP method is one of the solutions. From the Super Decision software, the priority vector for all factors of reputation loss importance subject to oil and gas pipeline explosion accident event are tabulated in the Table 11 and depicted into two set of graph for importance of reputation loss factors categorized into criteria and subcriteria.

The priority vector of factor A "Investor" achieve the highest value given by the Super Decision software, similar to the score calculated using method of RII in the criteria level. The same behaviour occurred in the subcriteria level too, the factor of A2 "Services or sales progress disturbed", B1 "Loss of customer confidence", D3 "Severity of accident" and C4 "CEO refuses to take responsibility" are the factor corresponds to each stakeholder, i.e. A "Investor", B "Customer", D "Communities" and C "Employee", which first appeared in the graph priority. It can be concluded that the priority vector for factors with the highest value corresponds to each stakeholder is equal. However, RII is incapable to distinguish the priority among factors in the same index group.

Table 12: Difference of ranking between relative importance score and priority vector

Parameters	Factors	Relative importance score	Ranks	Priority vector	Ranks	Factors	Relative importance score	Ranks	Priority vector	Ranks
Criteria	A	82.22	1	0.3717	1	C	67.78	2	0.2029	3
	B	66.67	3	0.1885	4	D	65.56	4	0.2368	2
Sub-criteria	A1	76.00	6	0.0606	7	C4	74.44	8	0.0322	11
	A2	91.11	1	0.1214	1	C5	65.56	15	0.0186	20
	A3	73.33	9	0.0640	6	C6	67.78	13	0.0216	16
	A4	54.44	20	0.0303	13	C7	45.71	21	0.0153	22
	A5	70.00	11	0.0658	5	C8	63.33	18	0.0208	18
	A6	40.00	22	0.0297	14	C9	71.11	10	0.0304	12
	B1	77.78	5	0.1072	2	D1	80.00	3	0.0534	8
	B2	64.44	17	0.0813	3	D2	54.44	20	0.0211	17
	C1	67.78	13	0.0264	15	D3	88.89	2	0.0722	4
	C2	66.67	14	0.0177	21	D4	75.56	7	0.0416	10
	C3	64.44	17	0.0199	19	D5	77.78	5	0.0485	9

The difference of ranking by relative importance score and priority vector are shown in Table 12. Although, the relative importance scores are provided and ranking of the score can be calculated, the rankings are in fact relative to the responses of the experts. In contrast, priority vector from AHP method is obtained relative to the priority value of the factor in the preceding level i.e., criteria, which disperses the priority values between the factors in the lower level i.e. subcriteria. Hence, the prioritization of the reputation loss factors is best identified using AHP method.

RESULTS AND DISCUSSION

Expert ratings of importance level are tested and it is statistically proven to be significant due to the significant different between samples for three different demographic criterions: years of working experience; company sector and job position are not available. Range of relative importance index for 22 factors contributing to reputation loss of pipeline owner subject to pipeline failure is between 4 and 10. The factors are categorized above “low importance” with the RII score of 40 for factor “Loss of sponsorship opportunity” A6. The most important or “crucial” factor gained by “Services and sales progress disturbed” with the symbol of A2 with the total score of 91.11.

Priority vector obtained by the implementation of AHP shows that “Investor” and “Services and sales progress disturbed” ranked in the first place for criteria and subcriteria level, respectively. Both method have successfully identified factor A, “Investor” and A2, “Services and sales progress disturbed” which are considered as the most important and the highest priority. These factors are the first concern of the pipeline operator in the pipeline post-accident responses, which parallel with reviews from several chief executive officers or the CEO (Murray and White, 2004). However, the factor A1, “Sudden drop of share price and market capitalization” is much less priority as compared to the first. It agrees that the short-term share price deviation does not change the investor emotion towards the company immediately (Helm, 2007).

The factor B1, “Loss of customer confidence” is second priority among reputation loss factor. However, the factor B, “Customer” is the least priority among the stakeholders. Nevertheless, their perceptions are among the highest priority, which approve the reason of the degradation of a company reputation will affect its profit (Cravens *et al.*, 2003; Money and Hillenbrand, 2006). Furthermore, customers’ affective feelings towards the company are reason towards their loyalty (Zhang, 2004).

Among the “Public” factor, D, the “Severity of accident” D3 scored the highest priority. The severity of the accident includes the numerous fatalities and injuries in a pipeline accident. This fatal probability can cause compensation up to 1 million pound sterling as required by Health and

Safety Executive in London (Woodruff, 2005). Unfortunately, this "domino effect" of fire and explosions may occur due to malfunction of equipment components and/or minor negligence of personnel during operation and maintenance work (Khan and Abbasi, 1999).

The factor C4, "CEO refuses to take responsibility" notched the most priority among other factor contributed by "Employee". The company reputation is dependent on the reputation of the CEO (Murray and White, 2004). It certainly approves the reason of highest priority of this factor. In contrast, the factor C6, "Job applications for position reduced" is the least priority of reputation loss factor. It can be considered the least importance as it nominated as the second last factor by RII. Reputation of the pipeline owner is less influenced by this factor due to affective commitment is most strongly inclined with pride despite the job satisfaction (Helm, 2011).

CONCLUSION

As a conclusion, RII categorized all factors of reputation loss within index number 4-10 (low to crucial). A2 "Services or sales progress disturbed", B1"Loss of customer confidence", D3 "Severity of accident" and C4 "CEO refuses to take responsibility" are the factors with the highest importance value and priority vector for both RII and AHP methods with respect to pipeline stakeholder, investor, customer, public and employee. The least priority factor of reputation loss is "Job application for positions reduced" and "Services and sales progress disturbed is the highest priority. Thus, understanding the importance of the reputation loss factors and identifying the priority of which factor to be taken care of are suggested to the pipeline operators in the post-accident responses of pipeline failure subject to explosion for pipeline risk assessment. Hence, the impact reputation loss can be reduced and annual profit margin can be secured consequently.

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REFERENCES

Arunraj, N.S. and J. Maiti, 2009. A methodology for overall consequence modeling in chemical industry. J. Hazardous Mater., 169: 556-574.

Cravens, K., E.G. Oliver and S. Ramamoorti, 2003. The reputation index: Measuring and managing corporate reputation. Eur. Manage. J., 21: 201-212.

De Bie, C., 2006. Exploring ways to model reputation loss. Master's Thesis, Erasmus University Rotterdam, Netherlands.

Dunbar, R.L.M. and J. Schwalbach, 2000. Corporate reputation and performance in Germany. Corporate Reputation Rev., 3: 115-123.

Firestein, P.J., 2004. Reputation Assessment: The OPEN Perception Study TM. Global Strategic Communication Inc., New York.

Fombrun, C.J., 1996. Reputation: Realizing Value from the Corporate Image. Harvard Business School Press, Boston, MA., ISBN-13: 9780875846330, Pages: 441.

Helm, S., 2007. The role of corporate reputation in determining investor satisfaction and loyalty. Corporate Reputation Rev., 10: 22-37.

Helm, S., 2011. Employee's awareness of their impact on corporate reputation. J. Bus. Res., 64: 657-663.

Khan, F.I. and M. Haddara, 2004. Risk Based Maintenance (RBM): A new approach for process plant inspection and maintenance. Process Safety Progr., 23: 252-265.

Khan, F.I. and S.A. Abbasi, 1999. Major accidents in process industries and an analysis of causes and consequences. J. Loss Prevent. Process Ind., 12: 361-378.

Money, K. and C. Hillenbrand, 2006. Beyond reputation measurement: Placing reputation within a model of value creation by integrating existing measures into a theoretical framework. J. Gen. Manage., 32: 1-12.

Mukesh, K., A.T. Salim and T. Ramayah, 2013. Business Research Methods. Oxford University Press, Oxford, New York.

Murray, K. and J. White, 2004. CEO views on reputation management. A Report on the Value of Public Relations, as Perceived by Organisational Leaders, September 2004.

Noor, N.M., N. Yahaya and S.R. Othman, 2008. The effect of extreme corrosion defect on pipeline remaining life-time. Malaysian J. Civil Eng., 20: 47-57.

Noor, N.M., K.S. Lim, N. Yahaya and A. Abdullah, 2011. Corrosion study on x70-carbon steel material influenced by soil engineering properties. Adv. Mater. Res., 311-313: 875-880.

OGP., 2010. Risk Assessment Data Directory (RADD-major accident). Report No. 434-17, International Association of Oil and Gas Producer (OGP), March 2004. http://www.ogp.org.uk/pubs/434-17.pdf.

Way, B., 2013. Running head: Quantifying reputational losses-using stock market data to quantify loss of reputation after an industrial loss incident. Memorial University of Newfoundland, Canada.

Woodruff, J.M., 2005. Consequence and likelihood in risk estimation: A matter of balance in UK health and safety risk assessment practice. Safety Sci., 43: 345-353.

Zardasti, L., N.M. Hanafiah, N.M. Noor, N. Yahaya and A.S.A. Rashid, 2015. The consequence assessment of gas pipeline failure due to corrosion. Solid State Phenomena, 227: 225-228.

Zhang, Y., 2004. A study of corporate reputation's influence on customer loyalty based on PLS-SEM model. Int. Bus. Res., 2: 28-35.