Developing Objective-Quantitative Risk Management Information System

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Abstract**—Subjectivity, qualitative analysis, and ineffective time arrangement are classical problems in the risk management. Risk management, nowadays, should be more accurate, unique, and faster. Accuracy intended to objective means. Unique means having quantitative result. Fast shows no limit in both space and time. Some enterprise business processes constrain to have limited data record. The data could only be explored from their expert.**

The risk management information system could be an effective solution for the problems. This information system will be supported by some simple methods to reduce subjectivity and qualitative result. Delphi method is used to reduce subjectivity while consequence code and ordinal matrix are used to give quantitative result. The combination of these methods will support the information system.

Index Terms**—risk management, delphi method, consequence code, information system**

I. INTRODUCTION

SOME institutes or enterprises have problems related to the risk management. First is the difficulty in getting the data. There are two conditions influence the problems: environment and habit. The unique business environment forced them not to record the data. Governmental institute or public service, for example, usually revises the document directly without any record that may have been saved for months or even years. This condition will cause no data recorded. In addition, habit problem means that they actually unusual to record the data. It is a psychological problem.

Second problem is the difficulty in defining the probability (likelihood) and consequence level objectively. There are some theories of probability that can be used. In the last 350 years, the theory of probability has evolved to explain the nature of chance and how it can be studied [1]. However, it will become disorder if the data record unavailable. This condition is in line with the consequence definition. Some public sectors, that are cost centered enterprise, are not allowed to get profits. The budget is centered on the holding. This condition emerges consequences that cannot be measured by the cost.

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The effectiveness is not measured by cost anymore. Paul R. Garvey [1] said that risks are events that, if they occur, will cause unwanted change in the cost, schedule, or technical performance of engineering system. However, how much is the cost? How long is the deviation of the schedule and how is the performance quality? They should be decided objectively.

Qualitative report is often related to subjectivity result [2]. When the data is unavailable well, the data can be reached from the expert adjustment; however this method is subjective.

The last problem is ineffective time of preparation [2]. The risk identification, risk analysis, and risk evaluation have not integrated yet, so the preparation will need more time. The main problems in risk analysis can be seen in fig.1.

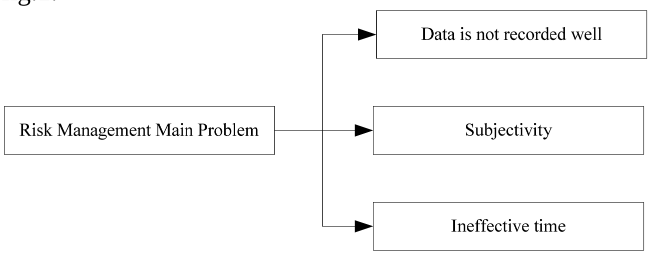

Fig. 1. The Main Problems In Risk Analysis

Based on those problems, the risk management information system is proposed to be implemented. This paper will examine some methods that can be used to support this information system. The Data Flow Diagram is also arranged to give the illustration about the data flow.

There are some methods that can be used in the risk identification, risk analysis, and risk evaluation [3], but there is no integrated method that can be used to support the information system which can result less subjectivity and less qualitative. Nugraheni Marisa, 2010, used Delphi method to lessen subjectivity [4]. But the method is only solving limited problem, which is not related to the risk management information system. The development of information system in this paper is limited to the initial design and not to the implementation.

This information system is designed as a type of expert system based on intelligent information systems knowledge and experience. These knowledge and experience are exploited from each user and recorded in a database of risk maps. The database can be accessed as a consultant on the preparation of risk management. An Expert System (ES) is a knowledge-based information system that uses its knowledge about a specific, complex application area to act as an expert consultant to end users [5].

II. METHOD AND ANALYSIS

The risk management process has 5 activities; communication and consultation, establishing the contex, risk assesment, risk treatment and risk monitoring, and review [3]. The processes can be seen in Figure 2. This paper will explain the risk identification, risk analysis, and risk evaluation.

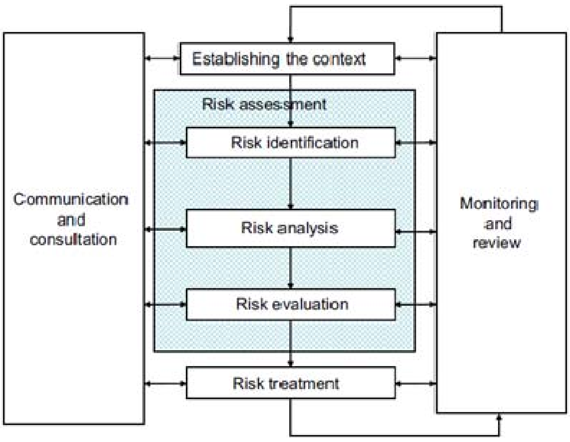

Fig. 2 Risk Management Process [3]

A. *Risk Identification*

The first process in the risk assesment is the risk identification. Some risk variables were gathered and corrected with delphi technique. This method is an approaching research used to gain consensus through a series of round of questionnaire surveys, usually two or three, in which the information and result are fed back to the panel members among each round. Delphi method is a tool served as a medium of indirect discussions of experts (virtual discussion) [4] so it can be used to decrease subjectivity in decision making.

Delphi method is used to identify the risks that has inadequate data. This method could reduce subjectivity because it is an expert agreement virtually. In other word, delphi method is a collective subjectivity assesment from some experts.

The first round is to get the idea about the risks which was gathered by researcher from the expert correspondence members. At this round, the correspondents could accept or refuse the proposal risks. The second round is to give a feedback on a correspondence based on their answer in the first round. All of the answers in first round is shown in the second round. The correspondent could edit their first answer after considering other correspondent answer. The consensus of the correspondence idea will be achieved by Likert Scale.

Likert scale is a psychometric scale commonly used in the questionnaire and the most widely used in the form of survey research [5]. In statistic, data is a characteristic, symbol or number of variable measured. There are four scale measurement data;

1. Nominal Scale; this scale only distinguishes the object or event based on the name / predicate, for example; man is symbolized by 1 and woman is symbolized by 2. It does not mean that woman is more or better than man. Aritmatic operation like addition or multiplication can not be prevailed.
2. Ordinal Scale; this scale is usually used to determine the level of rank, for example is the student score that can be expressed in letter A, B, C, D and E. In this scale, the range between first rank and second rank is not equal with the second and the third level.
3. Interval Scale; this scale have the same range in each rank, but have no absolute zero. Addition and substraction are allowed in this scale, for example is the range of the temperature. The range between 250F to 500F is equal with 750F to 1000F
4. Ratio Scale; this scale is like interval scale but it has absolute zero, so multiplication and division are allowed, for example is body weight, body height, income, etc.

Likert Scale is a nominal scale, so it needs to be changed into interval scale. Usually, Likert scale provides five options; strongly disagree, disagree, neither agree nor disagree, agree, and strongly agree. These options are symbolized by number 1-5. Number 1 represents strongly disagree while number 5 represents strongly agree. The correspondents will choose the option for each question. The answer of this question will be counted statistically. The consensus is achieved based on Inter Quartile Distance (IQD) which has value [0,1] where 0 expresses no agreement/consensus while value 1 expresses absolutely agreement/consensus [4]. In case value of IQD $\leq$ 1, the consensus will be achieved [4]. Then the consensus risks will be analyzed. The result of the analysis will be interpreted and be evaluated with ordinal matrix.

B. *Risk Analysis*

Delphi method is also used to determine probability and impact range. A risk assesment will be fair if it has the same parameter. In this paper, all of the risks will be analyzed in three impact factors; *cost*, *schedule* and *performance* (Figure 3).

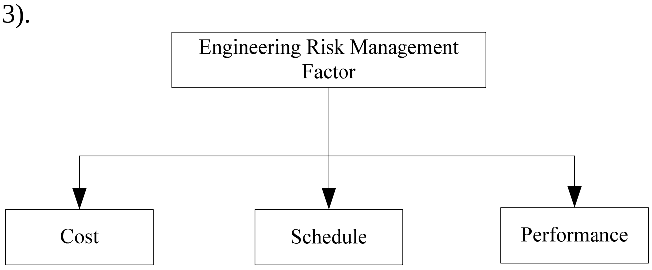

Fig 3. Three Impact Factors

The probability and the impact of the risk will be assessed by the correspondence using the delphi method. The result of this assesment will be placed into an ordinal matrix.

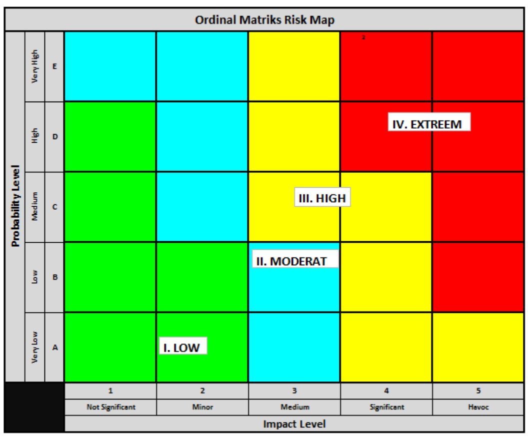

Fig 4. Risk Ordinal Matrix [6]

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C. *Risk Evaluation*

Ordinal matrix is also used to evaluate the risks. This process is to make risk priority. While the correspondence asses the risk, the probability level will be faced one of the three impacts level. The problem is that it is difficult to determine which factors that has the biggest impact.

There are two approaches that could be used to determine the highest factors impact [1]. They are the maximum value approach and consequence code approach.

Maximum value approach is used to take the maximum impact (consequence) level from across the three factors. Therefore, the overall impact level can be determined as follows :

$$\text{Overall Impact Level} = \text{Max}\ \{cost, schedule, performance\} \quad (1)$$

When the frequency counts across impact criteria is composed into a real number, we call this number as a consequence code approach.

$$\text{Cons code} = f_5 x10.000 + f_4 x1.000 + f_3 x100 + f_2 x10 + f_1 x1 \quad (2)$$

Where:

f_5= The 5th level Impact factor frequency
f_4= The 4th level Impact factor frequency
f_3= The 3rd level Impact factor frequency
f_2= The 2nd level Impact factor frequency
f_1= The 1st level Impact factor frequency

When probability level is equal to the impact level, the more consequence code, the more priority risks will be.

D. *Expert System*

Expert system is a computer program designed to model the problem-solving ability of a human expert [7]. Expert system is built to resemble the human ability to solve the problem heuristically. Human expert is not sustainable. It is possible to dissappear because of death or retirement. Somehow the decision of human expert depends on some factors that could influence it. Expert system give the more consistant and sustainable result [8].

Expert system is a knowledge basic system which resembles human expert logic. This system uses human knowledge to solve the problem that require expert expertise. Therefore, the expert system is not only can store the data, but also can search the answer of the problem [8].

The objectives of the expert system are [8] :

1. Human expert is possible to be sick, die or retire.
2. Expert system can reach the location that cannot be reached by human expert, for example isolated and danger area.
3. The number of human expert is limited while the problem is on the contrary.
4. Expert system provides more data storage facilities than human expert.
5. The core of the expert system is to help the lay people to use the expert knowledge to solve the problem.
6. Expert system increases productivity and improves the desicion quality taken by human expert.

E. *Data Flow Diagram*

A Data Flow Diagram is a tool that depicts the flow or data through a system and the work or processing performed by the system [9]. In this paper, the Data Flow Diagram of the system is arranged to illustrate the flow of the data, the process and the database that will be designed. There are only three symbols and on connection in DFD [9];

1. The rounded rectangles represent process or work to be done.
2. The squares represent external agents which are the boundary of the system.
3. The open – ended boxes represent data stores, sometimes called files or databases.
4. The arrow represents data flows, or input and output, to and from the processes.

III. System Information Design

To illustrate the system, there was a simulated risk analysis on the Indonesian Power and Electrical Research and Development. It analyzed the risks that potentially hamper the research and development. The initial risk identifications were explored from some literatures, brainstorming, and focus group discussion. These identifications result 26 risks. These risks were virtually discussed by the expert correspondence through the Delphi method. They had a discussion using the 1st Delphi questionnaire. The expert correspondence could accept or refuse the risks. From this 1st Delphi questionnaire, the expert correspondences suggested 17 additional risks, so the total 43 risks had been identified. These risks were reviewed by the expert correspondences through the Likert Scale. They should rank the importance of the risks in 1-5 range. The value 1 means strongly unimportant risk while value 5 means strongly important risk.

The consensus of the expert correspondence was determined by Inter Quartile Distance (IQD). From 43 risks that were identified, only 23 risks which the consensus achieved, so, these risks then were analyzed using the ordinal matrix by the maximum value approach and consequence code approach. These 23 risks were stored in the "risk bank" as the risk storage of the system. After the risks were analyzed, 4 risks were indicated the extreme level, 11 risks were indicated high level, 7 risks were indicated moderate level and only 1 risk that was indicated have low level. The summary of these analyze can be seen on following diagram:

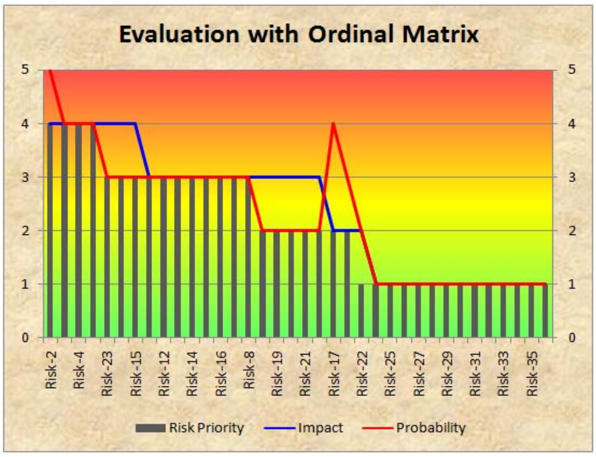

Fig 5 Summary of Risk Evaluation With Ordinal Matrix

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The risk analysis model as explained before was the initial design for the risk management information system. All of decisions that involve subjectivity will be facilitated by the delphi method while the ordinal matrix will be used to monitor the risk with maximum value and consequence code approach. The data flow diagram risk management information system can be seen in figure 6.

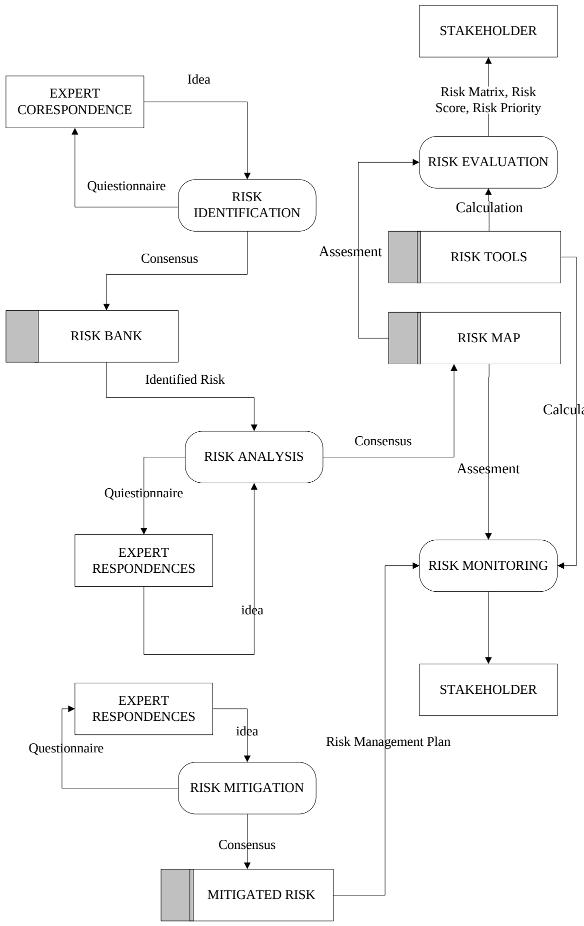

Fig. 6 Data Flow Diagram Risk Assessment Information System

The diagram shows that the first database which should be built is the risk database or risk bank. This risk bank contains the number of risks that the consensus had achieved. The consensus will be achieved by the expert correspondence through the Delphi method. Each risk that the consensus achieved will enrich the risk bank. So it can be up dated frequently through the information system.

The risks that consensus achieved mean the identified risks. It will become a data input for the risk analysis. Risks which are analyzed by expert result the risk map database. Through the tools of the risk analysis (maximum value approach and consequence code), this risk matrix can be evaluated directly to rank or levelize the risk.

This evaluation can be seen directly by the stakeholder as the ordinal matrix and evaluation report through the information system. It also can be monitored to decrease the level of risk with some risk mitigations and risk treatments. The mitigations and treatments also will involve some expert so the result can be more objective.

IV. Conclusion

Risk management information system can help the risk owner to arrange the report of the risk management fast, uniquely and less subjectivity. It also can be updated and monitored by stakeholder every time and everywhere. This system information can also solve some problems in the risk management by the simple integrated method. Subjectivity will be accommodated by the Delphi method while qualitative result will be accommodated by the maximum value approach and consequence code. By integrating these simple methods in one system as viewed in Data Flow Diagram, it is possible to arrange the risk management report faster so the system can be constructed soon.

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