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Technical Methods for the Risk Assessment at an Industry System:Review Paper

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***Abstract* --Risk assessment has become extremely important in the world and especially when at the industrial systems. Risk analysis of any plan or project management system is often performed in two different ways qualitative and quantitative. As risk analysis is a collection of essential management become necessary to identify in this paper methods for technical risk assessment in the workplace where hazards may affect the performance of the entire system and the overall performance of the organization. However , it is essential that risk assessment is consistent with the functional requirements and system configuration in which it is used . The purpose of this study is to present the risk assessment procedures that have been successfully implemented. Although these studies have a different methods to solve the problems of industrial risks.**

Keywords: Quantitative and Qualitative Risk Analysis, Risk Analysis, Risk Assessment Uncertainty, Probabilistic Risk Assessment, fuzzy logic.

I. INTRODUCTION

The growing complexity of current systems, in particular industrial systems, due to an increasing power and progress of our technology has led to a proliferation of hazardous situations which have the potential to affect human beings, property and the environment. Note that this damage can be caused either during phases of normal operations or following the occurrence of accidental events which are becoming increasingly catastrophic. Therefore, sustainable development becomes an important issue for the deployment of a thoughtful and coherent strategy to coordinate action plans to ensure the sustainability of any system. This need, for sustainable development, generates a strong requirement in methodologies, techniques and tools to assist decision makers in their choices related to design, development or exploitation phases of products and systems. The use of risk analysis has become increasingly important in the onshore and offshore industry in the world.

Quantitative Risk Assessment (QRA) is an essential part of risk analysis, and it is a tool to determine which systems of prevention and mitigation are desired, and what should be loads and design requirements. QRA method in the industrial system can still ongoing in the optimal level of safety from prevention, mitigation and protection that is required for scenarios of industrial facilities. The use of quantitative risk assessment for these projects could achieve profitable concept, and can illustrate some goals for quantitative risk assessment is generally important for many ways by developing new skills management proposals security.

Risk assessment is a critical step in the prevention process. It is the starting point. The identification, analysis and classification of risk used to define the most appropriate preventive actions, covering technical, human and organizational dimensions. The risk assessment must be renewed regularly and the most important Assessing risk can be sorted solution for problems that cannot be avoided and it is one of the general principles of prevention in the present

Labor Code. It is a key component of any prevention approach. Indeed, how to fight effectively against the risks if we do not know exactly?

In this study focuses on the most important methods that are used to solve the risk assessment problems.

II. APPLICATIONS OF RISK ASSESSMENT

The application of risk assessment covers almost all application areas and is far from complete. The following areas illustrate their's relations with risk assessment:

A. Defense and Defense Industry

Risk assessment was developed as a scientific discipline after World War II. The first standard for a reliability and risk analysis method, the MIL-STD-1629 for method Failure Mode and Effects Analysis (FMEA). The purpose of this standard was to integrate risk and reliability considerations into the development of new products, to avoid failures and failure effects in the practical use of the products. The Fault Tree Analysis (FTA) method was developed by Bell laboratories in 1962 for safety analysis and Fault tree analysis (FTA) was then used by the Boeing Company to study the Minuteman missile system and also in the design of commercial aircraft. The system safety standard MIL-STD-882, System Safety Program Requirements, in 1969 and based partly on the requirements on the Minuteman missile system.

Nowadays, the defense industry applies risk assessment for several different purposes. The defense industry has a responsibility of care to its workers, the general public, and the wider environment, Marvin, (2011).

B. Nuclear power industry

Nuclear plants in the first were used for weapon production and were located away from densely populated areas. Quantitative Risk Assessment has become usual for all phases of the life of a nuclear power plant, including design, construction, operation, and decommissioning. Quantitative risk assessments in the nuclear power industry are called Probabilistic Risk Assessments (PRAs). Fault Tree Analyses usually use for detailed and which allow to reach uncertainty of the result relatively small. The first level PRA will normally include at least: Event tree analysis, human readability assessment, common-cause failure analysis, fault tree analysis of all relevant TOP events, importance measures for basic events and uncertainty analysis, Marvin, 2011.

C. Process industry

The usage and a development of risk assessment in the process industry has been driven mainly by many accidents. Directive Seveso II (EU, 1996), all enterprises within the EU that produce or stock big quantities of dangerous chemicals are obliged to follow the requirements in the directive Seveso II. As of the inherent potential for major accidents associated with large-scale chemical processes. The main aim of the Seveso II directive (EU, 1996) is to prevent major accidents and delimit their consequences. Several important reports related to risk assessment and the Seveso II directive have been developed. Among these are:

- Accidental risk assessment methodology for industries (ARAMIS, 2004),
- Guidelines for Quantitative Risk Assessment (VROM, 2005).
- Quantitative Risk Assessment (Borysiewicz et AI., 2007).

The hazard and operability (HAZOP) method was developed in the 1960s and became a standard method for most companies involved in the design of chemical processes (Kletz, 1999; Crawley et aI,2000) and the following analytical methods suggested in the standard: What-if, Checklist, What-if and checklist (SWIFT), Hazard and operability study (HAZOP), Failure mode and effect analysis (FMEA), Fault Tree Analysis (FTA), or An appropriate equivalent methodology,Salvi and Debray,2006.

D. Offshore Oil and Gas Industry

Risk Assessments in the offshore oil and gas industry appeared when The industry exposed to a number of additional hazards compared to onshore plants. Quantitative Risk Analyses are carried out according to standard of NORSOK Z-013 (2010), the safety requirement must be demonstrated through a safety case.

Quantitative Risk Assessment is the most important technique used to identify major accident hazards with ALARP, a study of approaches and methods may also be found on the web site for the International Association of Oil & Gas Producers (OGP), (Marvin, 2011).

E. Space Industry

National Aeronautic and Space Administration (NASA) have had a restrained view on probabilistic risk analyses. NASA relied mainly on worst-case failure modes and effects analysis (FMEA), even if an FMEA is mainly qualitative and has several weaknesses, such as focusing on single items and not being able to aggregate risk at the system level. The PRA guideline probabilistic risk assessment procedures guide for NASA managers and practitioners was issued in 2002 and comprehensive PRAs have been used regularly since 2003, Marvin, 2011.

Currently, NASA is using PRA in a wide range of situations. The most extensive PRA conducted is the full-scope PRA, which models all the potential scenarios that may lead to undesired end events, such as loss of crew and potential injury to the public.

F. Aviation

The aviation industry has traditionally used FMEA and fault tree analysis and established detailed fault trees for each possible system failure (e.g., total failure of an engine), but has not combined these fault trees with event tree analysis to develop accident scenarios, (Marvin, 2011).

The risk is often quantified relative to flight hours or to the number of takeoffs. A risk measure that is commonly used is the Fatal Accident Rate (FAR), which for aviation is defined as: FAR = number of fatal accidents per 100000 flight, the Norwegian research organization, has carried out a detailed risk assessment of helicopter transportation from land to offshore oil and gas installations (Herrera et AI., 2010).

G. Railway transport

Risk analyses in railway operations are of relatively recent date (beginning of the 1990s), motivated by some major organizational changes, increased technical complexity, accidents, and general knowledge of modern safety management. As for most other application areas, the development of safety legislation and requirements for risk assessments have been driven by several major accidents, (EU, 2004) (Marvin, 2011).

H. Marine transport

Maritime operations are international by nature, and safety is therefore regulated primarily by the International Maritime Organization (lMO). Until recently, the safety regulation has been ruled-based, and new rules have emerged based on the frequent accidents. Therefore, IMO has initiated a risk-based approach and developed a risk analysis approach that is known as formal safety assessment (FSA).

FSA can be used as a tool to help evaluate new regulations or to compare proposed changes to existing standards, (Marvin, 2011).

I. Machinery systems

Risk assessment of the machinery equipment is required, the assessment must be carried out according to ISO 12100 (2010). The main difference is ISO 12100's extra focus on the operators' ability to escape an accident scenario under development.

The risk has to be analyzed for all the relevant life phases of the equipment:

1. Construction
2. Transport
3. Assembly, installation, and commissioning
4. Setting, teaching and programming
5. Operation
6. Cleaning and maintenance
7. Fault finding and troubleshooting

8. Decommissioning and dismantling, (Macdonald, 2004).

J. Environmental risk

Potential harm to the environment should be dealt with in all risk assessments and is covered in the risk assessment approach. An alternative risk assessment approach has been developed, The main steps of this approach are: Asset characterization, threat characterization, consequence analysis , vulnerability analysis, threat assessment, risk assessment, risk management, Marvin (2011).

The figure (Figure.1) shows a comparison between different type of industrial with illustration the percentage events for each kind for 12 years ago.

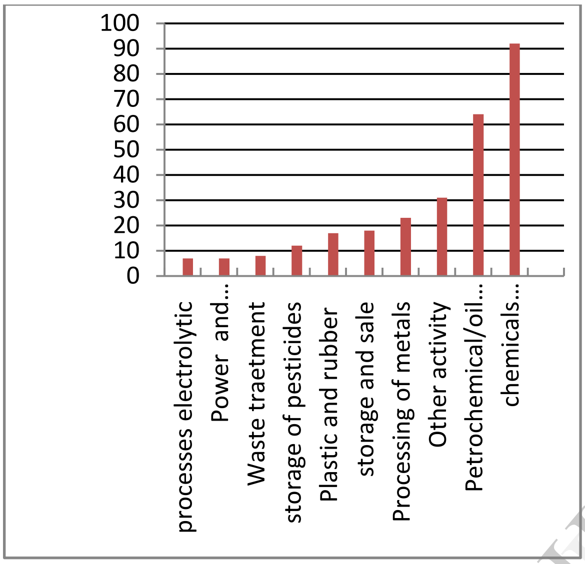

Figure.1 Events per industry type (2000-2012)

III. Risk Assessment Process

Risk assessment is the purpose for both quantitative and qualitative value of risk related to a real situation and a recognized hazard. Quantitative risk assessment involves calculations of risk : The probability (p), and the consequence that the loss will occur. The industries , nuclear, aerospace, oil and rail military have a long history of dealing with risk assessment, (Lacey, 2011). Methods for assessment of risk may vary between industries and whether it pertains to general financial decisions or environmental, ecological, or public health risk assessment, in this study we will show some of these methods which allow us to assess the risk.

A. Risk Analysis

Risk analysis is a systematic and comprehensive methodology to analysis risks associated with a complex engineered technological entity. Probabilistic Risk Assessment (PRA) is a possible detrimental outcome of an activity or action. In a PRA, risk is considered by two quantities: likelihood of occurrence and severity of consequence (Marvin, 2011). Probabilistic Risk Assessment generally answers three basic questions: what can go wrong? and what are the undesirable starting events that lead to adverse consequence(s)?

- Risk identification

Risk identification is the step after establishing the context in the process. Risk identification can start with the foundation of our problems and those of our benefit. Risk sources are internal or external to the system that is the target of risk management and problem analysis are related to identified threats. The method selected for risk identification depend on industry characters, (Marvin, 2011).

Risk Definition: Definition of risk events as "potentially unwanted events that negatively affect the project defined resulting negative impacts on cost, schedule, safety, performance, or other characteristics of systems, but does not include the minor variance inherent cost base " Molenaar (2005). The Association for the Advancement of Cost Engineering (AACE) (2007) (international recommended practice No. 10S-90) defines" risk "as follows:

(i) The grade of dispersion or variability round the expected value.

(ii) An ambiguous term that can mean at least one of the following situations: 1. All uncertainty; or 2. Downside uncertainty; or 3. The net impact or effect of uncertainty (threats – opportunities)”.

(iii) Probability of an undesirable outcome, and the figure (Figure.2) shows information on the evolution of risk in 25 years ago.

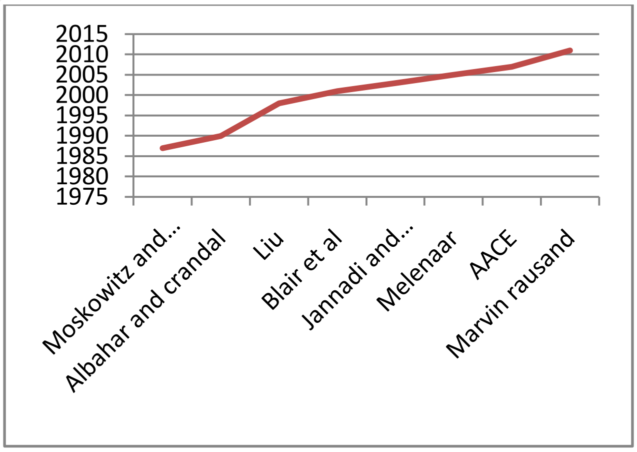

Figure.2 Evolutuin of risk analysis vs years (1987-2011)

a. Acceptable risk: Acceptable Risks considered insignificant and not justifying further effort to reduce them. The risk that is understood and agreed to by the researchers; concern project, government, task directorate, also other customer(s) such that no further specific mitigating action is required (HSE, 2001; NASA, (2009). A risk which is accepted in a given context based on the current values of society and in the enterprise. The residual risk after controls have been applied to to many steps which can allow accept this risk the most important steps in this area to decide is identified, quantified, analyzed, communicated, and accepted after proper evaluation.

b. Barrier: Barrier is Physical or engineered system or human action (based on specific procedures or administrative controls) that is implemented to prevent, control, or impede released energy from reaching the assets and causing harm. (Marvin, 2011)
c. Frequency: is the number of occurrences per unit time (e.g., per year), (Marvin, 2011)
d. Frequentist probability: An approach to probability that concerns itself with the
e. Frequency of events in a long series of trials, or are based on a data set, (Marvin, 2011).
f. Hazard: A source of danger that may cause harm to an asset, a source of potential harm or a situation with a potential to cause loss, an uncontrolled exchange of energy any real or potential condition that can cause injury, illness, or death to personnel; damage to or loss of a system, equipment or property; or damage to the environment (MIL-STD-882D, 2000). A potential to threaten human life, health, property, or the environment (IMO, 2002).
g. Hazard analysis: The process of describing in detail both the hazards and accidents associated with a system, and defining accident sequences (DEF-STAN 00-56, 2007).
h. Hazard identification: The process of identifying and listing the hazards and accidents associated with a system (DEF-STAN 00-56, 2007).
i. Incident: Unplanned, uncontrolled event, which under different circumstances could have resulted in an accident (RSSB, 2007). An unplanned and unexpected event that mayor may not result in damage to one or more assets. (Marvin, 2011)
j. Probability: Probability is a real number in the scale 0 to 1 attached to a random event. It can be related to a long-run relative frequency of occurrence or to a degree of certainty that an event will occur. For a high degree of belief, the probability is near 1. (Marvin, 2011)
k. Qualitative risk analysis A risk analysis in which probabilities and consequences are determined only qualitatively. (Marvin, 2011)
l. Quantitative risk analysis A risk analysis that provides numerical estimates for probabilities and/or consequences rarely along with associated uncertainties. (Marvin, 2011)
m. Reliability: The ability of an item to perform a required function, under given environmental and operational conditions and for a stated period of time.

- Risk estimation

Two methods for risk assessment qualitative and quantitative, quantitative risk assessment is a mathematical calculation based on security metrics on the asset . The qualitative classification is done followed by a quantitative evaluation of the highest risks for achieve the best results , the following steps proposed for risk estimation: assessment of the likelihood, assessment of the consequence, assessment of the risk.

B. *Risk Evaluation*

The Figure below shows the process for risk evaluation, whereas the main objective of Risk evaluation is to compare each risk level in the industry with the risk acceptance criteria and prioritize the risk list with risk treatment indications.

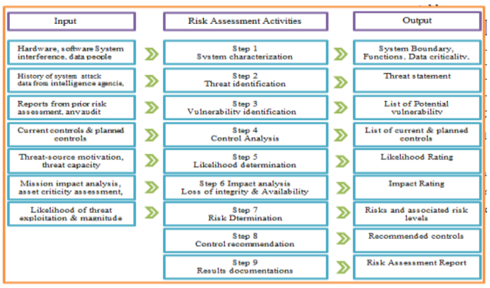

Figure.3 Risk assessment methodology

IV. RISK METHODS

A. *Risk Matrix*

- Identification:

A risk matrix is used in the risk assessment to define the different levels of risk that the product in assessing the probability of occurrence and impact to calculate the magnitude of the risks. It is a simple mechanism to increase the visibility of risks and decision support management, each risk event is assigned to a grid with a probability (P) along one axis and the impact on the other axis. After the events of risk have been identified, they are analyzed for the probability of occurrence and impact by choosing from a pre-identified the linguistic scale of probability and impact. Table 1 shows both the probability (P) and the impact in terms of schedule (IS) and also cost (IC), the matrix used to calculate the magnitude of the risk.

Table1. Probability of occurrence and impact table

Term	Probability (P)	Schedule (IS)	**Cost impact (IC)**
Very low	<1% chance	Critical path unaffected	**< 1%**
Low	1≤ P <20% chance	< 2% Critical path	**1≤ IC <2%**
Medium	20≤P<50% chance	2%≤IS<5% increase in duration	**2≤IC<5%**
High	50≤P<85% chance	5%≤IS≤8% increase in duration	**5≤IC≤10%**
Very high	Over 85% chance	>8% increase in duration	**>10%**

The risk matrix in Table.2 shows three levels of risk represented by white, dark gray and light gray. Haifang et al (2009) used the risk matrix to identify key risk events for private companies involved in government projects, and provide a basis for risk prevention, Abdelgawad and Fayek (2010). The essential matrix can be used as a screening tool in identifying risk events that require a more quantitative assessment. However, this method is primarily qualitative, which can be a disadvantage. USDD (2006), NASA (2009) and ISO 17666 defined a risk matrix that is used in the risk assessment to define the different levels of risk as the product of the probability of risk categories and categories of severity of harm. It is a simple mechanism to increase the visibility of risks and management decision making.

Table2. Risk matrix

		Threats					Opportunities				
Impact	VH(8)	8	16	24	32	40	40	32	24	16	8
	H(6)	6	12	18	24	30	30	24	18	12	6
	M(4)	4	8	12	16	20	20	16	12	8	4
	L(2)	2	4	6	8	10	10	8	6	4	2
	VL(1)	1	2	3	4	5	5	4	3	2	1
RM		VL	L	M	H	VH	VH	H	M	L	VL
		1	2	3	4	5	5	4	3	2	1
		Probability of Occurrence									

- Limitations of risk Matrix:

In the other hand, there are limitations for the risk matrix method. These as follows:

- This technique can't be used alone to determine the required amount of risk premium and also can't support risk-based multi-criteria decision.
- Effective allocation of resources for reducing the risk cannot be based on the categories provided by risk matrices.
- Categorizations of severity cannot be made accurately for uncertain consequences.

These limitations advise that risk matrix should be used with carefulness, and only with cautious explanations of embedded judgments.

B. Analytical Hierarchy Process (AHP)

- Identification:

The analytic hierarchy process begins with the decision problem represented as a hierarchical structure, where the highest level of the hierarchy reflects the overall goal. The factors affecting the decision are represented in the intermediate and the so-called decision criteria, while the lowest level includes alternatives to the decision, Dey, 2003. Experts are required to give priority elements at each level of the hierarchy using the scale pairwise comparison shown in Table.3 elements at each level are compared in pairs with respect to their importance in the decision making.

Table.3. Analytical Hierarchy Process pairwise comparison scale and definition (adapted from Saaty 1982).

Scale	Definition
1	Equal importance
3	Slightly favors one over another
5	Strong importance of one over another
7	Demonstrated importance of one over another
9	Extreme importance of one over another
2,4,6,8	Intermediate values

- Methodology:

The approved methodology in this method is to analyze the effect of risk factors that lead to the failure of each section. AHP is characterized as a problem of multi-criteria decision allowing a subjective and objective assessment of factors, while providing an environment of systematic thinking. Zeng et al (2007),

Noted that experts sometimes find it difficult to choose a single number for comparison, and argued the advantage of allowing a range value for comparison. In addition, the resulting output from this tool is an issue of scale, which can only help the decision maker to assess the risk level of the project, but can be used to provide an estimate of the risk premium required and this model can't be calibrated if a new case of risk must be added to the model and calculations are required to be conducted all over again.

The figure (Figure.4) shows the evolution of method Analytical Hierarchy Process for solving problems in risk analysis almost in 30 years ago.

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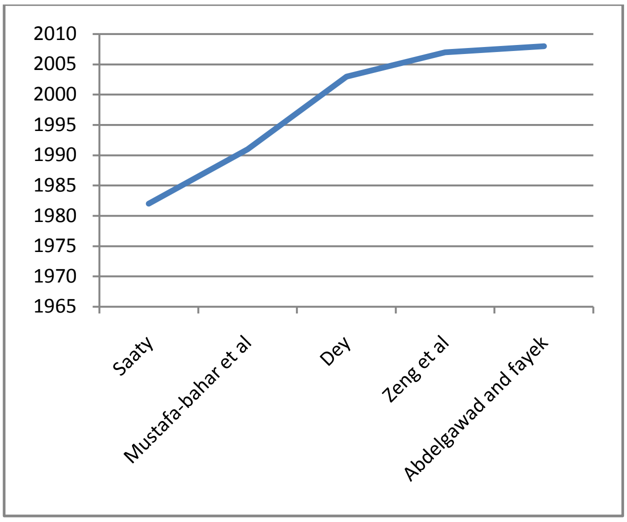


Figure.4 Evolution of Analytical Hierarchy Process (1982-2008)

C. Decision Tree

- Identification:

Decisions trees are widely used to explore alternative mitigation vary in a tree arrangement and choose the best alternative mitigation given the likelihood and consequences of each solution (Akintoye and Macleod 1997). Established a system of decision support to carry out a risk assessment for a pipeline project by Dey (2002). The methodology adopted by Dey (2002) is to decompose the project using the work breakdown structure , the identification of batches of critical work , achieving risk identification using brainstorming sessions , conducting analyzes Analytical Hierarchy Process (AHP) calculate

the impact of each risk event in terms of cost and time, brainstorm various response strategies for each risk factor risk estimates associated with each intervention strategy risk cost establishing a decision tree structure for the problem, the calculation of the expected monetary value , and choosing the best option. decision trees have several advantages, including quantitative risk analysis in this study. The decision algorithm developed by this method is more realistic and will improve the quality of the decision tree, Buca,2012.

The figure 6 shows steps of the Decision Tree is construction of problem hierarchy. Minimal number of hierarchy levels for multiple attribute decision-making is three. The first level represents goal of problem solving. The second level represents the criteria and the third level represents alternatives

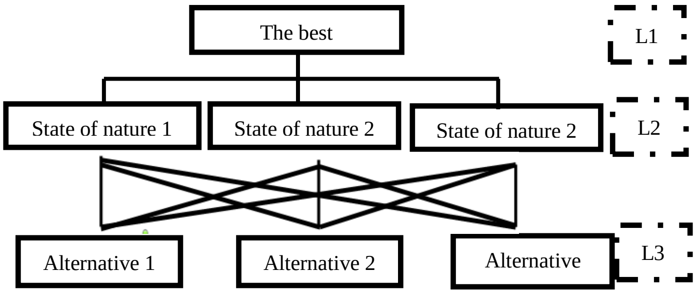


Figure.6 Hierarchy of Decision Tree

The expected monetary values are established for each alternative in a decision tree framework and subsequent analysis using probability to make the right decision in risk management, Dey,2002. The figure 5 shows the analytic hierarchy process with decision tree in twenty years ago for analytic the problems that can happen.

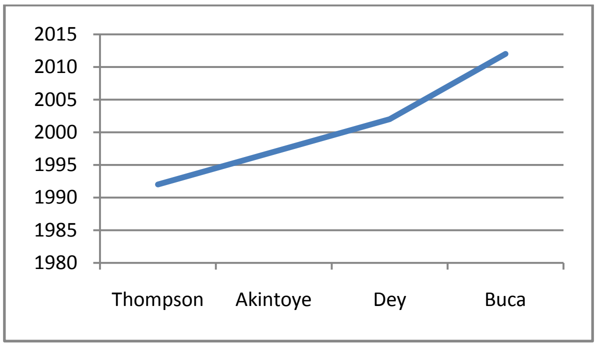


Figure.5 Evolution of Decision Tree (1992-2012)

- Limitations of Decision Tree (DT):

Although DT has been used in many applications of sectors, There is several limitations,Thompson and Perry (1992), reported that:

- Data are rarely available to calculate the exact probability values for the decision points , making it difficult to conduct a decision tree analysis , especially if the numerical value for one or more significant are not available .
- The proposed model does not explain how lots of critical work can be identified because they do not establish an approach for assessing the criticality risk .
- the proposed model does not investigate the root causes of various risk.

D. Neural Networks

- Identification:

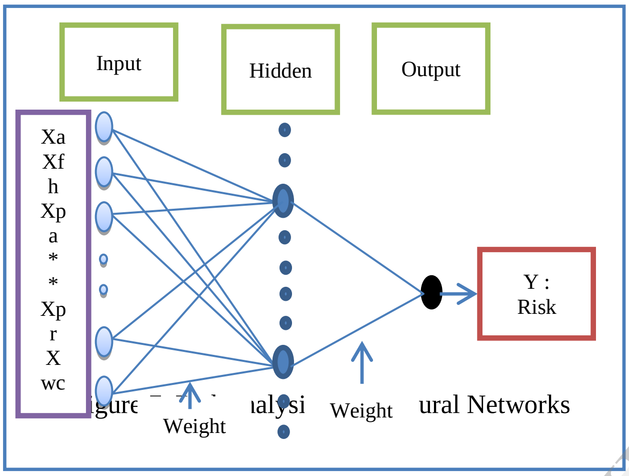
The model is designed to help owners of the building to assess the probability of failure of entrepreneurs and help the bid to the most reliable contractor. Al-Sobiei et al (2005) introduced a neural networks and genetic algorithm technique to predict the probability of default of the contractor. Twenty-three risk factors were identified and ranked according to the overall health of the contractor, the contract specifications and the nature of the project. Probability of the twenty-three risk factors represents the input pairs, while the output is in a binary format defined by fault /no fault. The strategy of genetic information is added to make the NN works best, especially when training data are scarce.

- Evaluation of NN:

Network performance was evaluated by measuring the R-squared, and the figure 7 shows the process of relation between input, hidden and output by Neural Networks for risk analysis, A scale of 0 to 100 was created to assess the risk factors 17 of sixteen projects. Twelve projects were used to train the neural network model (NN), while the remaining four projects were used for testing. The total risk (TR) (output) was obtained using equation (1) as follows:

$$\mathrm{TR} = \frac{\text{Business Costs} - \text{Total profit}}{\text{Total production Cost}} 100 \qquad (1)$$

The results indicated that NN was able to recognize a pattern between the inputs and outputs, even with a very small data set. The results also show that the NN model obtained is capable of producing the total risk (TR) for new projects. The authors noted that the main constraint with the NN model is linked to the data for training and testing. Having a small set of data increases the chances of NN fail to recognize a pattern between the inputs and outputs.



The maximum R-squared was achieved when fourteen hidden neurons were used in a hidden layer, Alejandro (2007).

E. Regression Analysis

- Identification:

Development of a model for risk analysis of construction market which based on questionnaire surveys and the use of regression analysis was by Fang et al (2004). The methodology in this study was follow these steps:

(1) Questionnaires for collecting different risk events on the construction market.
(2) Collect data using the questionnaire in step 1.
(3) Review the results obtained in step 2 and make a first selection of risk events, which will be included in the risk assessment model. Analysis of cross bivariate and univariate logistic regression tables was used to identify variables that can enter the final regression analysis. Based on the conduct of the analysis, six independent variables were identified.
(4) Establish the final model of risk assessment using a multivariate regression analysis. Equation (2) and Equation (3) show the results of this study.

$$\text{Risk Value} = \frac{e^{x}}{1 + e^{x}} \qquad (2)$$

$$X = 14.33 - 12.73 * x_1 - 13.50 * x_2 - 13.90 * x_3 - 12.84 * x_4 - 0.674 * x_5 + 11.31 * x_6 \qquad (3)$$

Where x_1 =1 if the capital project owners comes mainly from their own funds and 0 otherwise; x_2=1 if contractors and owners have previously collaborated and 0 otherwise; x_3=1 if competitive bidding is fierce relatively moderate and 0 otherwise; x_4=1 if the offer price is reasonable and 0 otherwise; x_5=1 if the company fully supports the project team and 0 otherwise; x_6=1 if the owner is a company civil-run and 0 otherwise. The model obtained the robust it can help to build confidence interval results. Though, this technique requires sufficient data to establish the regression model, which is difficult to obtain in the field of construction. Moreover, the analysis must start from scratch, if a new case of risk must be added to the regression equation, which makes the static and time-consuming technique, Abdelgawad et al (2010). Additionally, equation (2) is a qualitative equation and can be used for comparisons between projects perform to identify whether a project is more favorable than the other.

- Limitations:

Although advantages, this model can't be used to assign a monetary value to each event risk, which limits its applicability. And, this model does not take into account the risk mitigation in the analysis of risk events.

F. Monte Carlo Simulation Method (MCSM)

- Identification:

Monte Carlo simulation method has been widely used in many applications related to risk analysis. The simulation process is built on iterations which use random numbers generated internally to generate results. Monte Carlo simulation can be used to calculate the required quantity of risk quality. From this perspective, the identified risk events are given probability distributions to represent the probability (P) and the Impact (I). At each iteration, a randomly generated number (R), which follows a probability distribution of pre-identified, is created to represent the value of (P) and (I), and to calculate the Total Risk Magnitude (TRM). The simulation is repeated several times and the calculated TRM is recorded. Kraemer (1976) applied the Monte Carlo simulation to assess the cost, schedule and technical program aircraft development risks. The proposed program is divided into seven phases, called: air vehicle design, major subcontractors, subtest, soil and wind tunnel testing, and project management. Low-risk elements are evaluated using the subjective evaluation, while high-risk components are evaluated using Monte Carlo simulation. After identifying the high-risk items, risk identification is performed and expert advice is used to define the probability of occurrence and capture an estimate three points (minimum, most likely, and maximum) the impact of risk, represented in terms of time and cost. Experts are then required to estimate the most likely number of risk events that are planned during the time of each element. Poisson distribution, defined according to the most probable number is used to represent the different events monthly event at risk.

- Monte Carlo Simulation with Probability:

Monte Carlo Simulation was performed beginning with the first month then proceeds to the end of the program time. The use the Monte Carlo simulation to estimate and understand the effects of uncertainties in cash flow on the project's feasibility.

Moses and Hooker (2005) developed a model based on Monte Carlo for probabilistic cost and schedule risk assessment for a satellite launcher model. A schedule has been drawn from past similar types of launchers, and consisted of 136 main tasks. Oztas and Ökmen (2005) proposed a method of risk analysis schedule , called the Judgmental Risk Analysis Process (JRAP) is classified as an analysis methodology based on a pessimistic risk Monte Carlo simulation. This pessimism is imposed by equations using the maximum operator to calculate the overall effect of various risk events.

- Monte Carlo Simulation and Uncertainty

The proposed methodology are identified by following these steps:

- Identify critical risks that may affect the duration of activities.
- Assign probability distributions of event risk identified, and set the minimum and maximum duration of each activity using a series of pre-defined equations.
- Set the percentage effect of each risk on each activity.
- Perform a Monte Carlo simulation to calculate the variation in the duration of activity.

Although the Monte Carlo simulation and sensitivity analysis are commonly used for quantitative risk analysis, the risk analysis techniques can not be accurate to predict the effects of human factors due to its complex nature. The evaluation of the correlation between risk factors is as important as the identification of risk and a risk model should consider defining these correlation coefficients, if a correlation exists. Otherwise, the results of the simulation are not realistic. The result obtained using the fuzzy approach had examined all possible combinations of inputs, while in the Monte Carlo scenarios that combine inputs analysis low probability have very little chance of being randomly selected. Failure to consider low probability entries may result in inaccurate, especially for the context of the environment where human health is often risky decisions.

- Limitations of MCSM:

Though there are many benefits for Monte Carlo simulation,

- The reliability of the outputs depends on the accuracy of the range values and the connection designs, that you have quantified during the simulation.
- You must practice extreme caution while identifying the correlations and specifying the range values.

results of the conducted Monte Carlo simulation are shown in the probability density functions of representing the cost and time of the program. Javid and Seneviratne (2000) proposed to

- The complete effort will go waste and you will not get accurate results.

G. Event Tree Analysis (ETA), Fault Tree Analysis (FTA) and Bow-tie analysis

- Identification:

ETA, FTA and bow-tie analysis are graphic methods used for exploring the potential risk of events, specifically where process safety and risk management is a major concern. An event tree analysis construction starts with an unwanted event (initiating event), and works forwards to its consequences; whereas a fault tree analysis starts with an unwanted event (topevent) and works backwards to its causes ,Hauptmanns,1988. Bow-tie diagram, the initiating event and unwanted event are tied to a single common event, the causes presente on the left and consequences are presente on the right sides of the diagram, Markowski et al, 2008.

The quantitative evaluation of ETA estimates the likelihood (frequency or probability of occurrence) of possible outcomes for the initiating event. To the other side, FTA quantitatively measures the likelihood (probability of occurrence) of the unwanted event, as well as the contribution of different causes to that event. FTA, ETA and Bow-tie are a graphical models representing the combinations of parallel and/or sequential events that can lead to the occurrence of the predefined undesired events ,Ericson,1999. Boolean algebras are used to mathematically represent the tree diagram and calculate the output of every logic gate and probability of the undesired events is a function of the reliability data of primary events, which are also known as basic events, Verma,2007. Two types of results can be got from Event Tree Analysis and Fault Tree Analysis, i.e. qualitative and quantitative results.

The analysis is restrained in a particular undesired event (accident or incident) defined as the top event for FTA, the synthesis of the results is generally presented in a graphical model organized by the logic of the Boolean algebra and its symbols. Quantitative Risk Assessment (QRA) often make two major assumptions in order to simplify the risk evaluation strategy of the industrial facility. Firstly, the occurrence probability of the basic-events, events or input events is assumed to be crisp and precisely known. Secondly, the interdependencies among all types of input events in FTA, ETA or bow-tie are independent. The figure 8 shows the relations shop between three methods ETA, FTA and BOW-TIE.

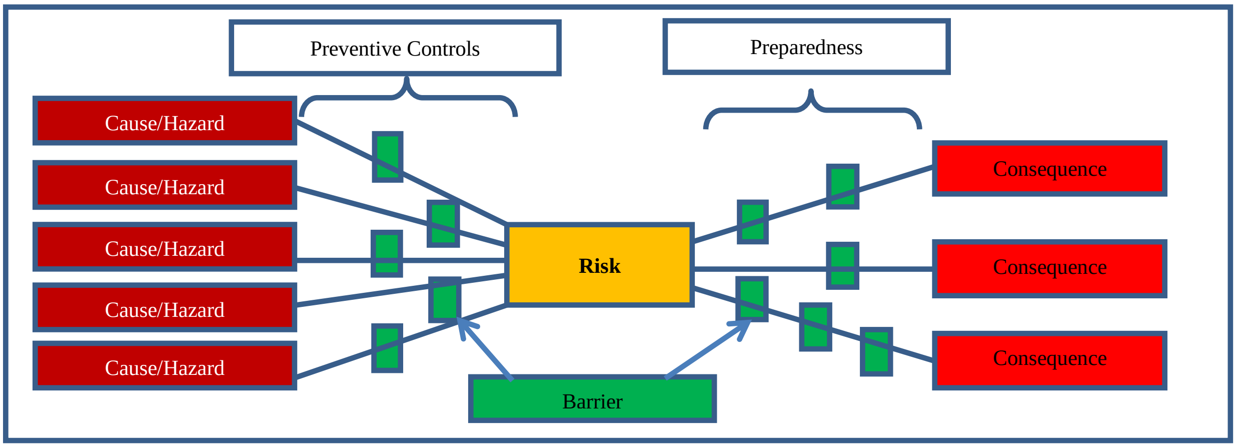


Figure.8 Bow-tie, FTA and ETA Diagram

The use of fuzzy logic provides the possibility of reducing the number of iterations needed to generate the output. The figure 9 shows illustrate the evolution gradually between risk analysis and fuzzy in almost 50 years ago.

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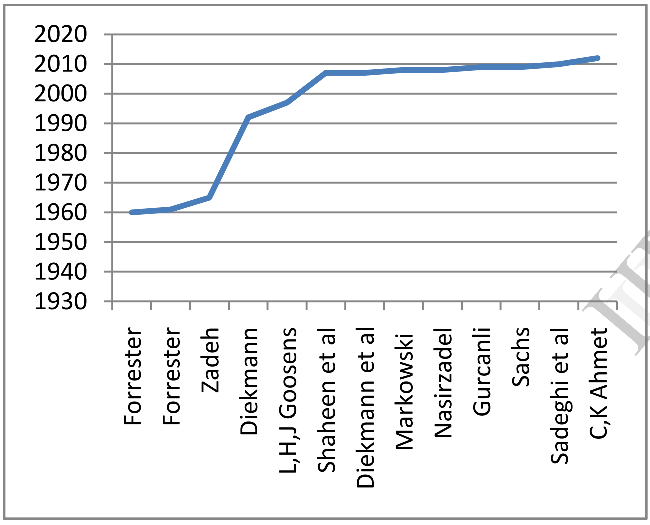

Figure.9 Evolution of risk analysis using fuzzy (1961-2012)

- Limitations:

➢ There is no systematic method to fuzzy system designing. Although there is no systematic approach, we still have some guidelines for choosing the fuzzification method, inferencing, and defuzzification.
➢ Fuzzy control approache are appropriate only for small problems which do not require high correctness.
➢ Fuzzy logic in its basic form is really not suitable for the control of a extremely complex system as usually there isn't sufficient knowledge about the system available.

V. CONCLUSION

As a summary, the risk Assessment has:

➢ An effect on analyzing the results of the drawbacks of the project plan and with methods uncertainty.
➢ The method were used by researchers can achieve the goal, minimize, control the probability and impact of unfortunate events.
➢ Uncertainty and risk are reflected in the definition of a probable range of variation for each component of the initial estimate of the base case. In practice , such an analysis is made for variables that have a significant impact on the workers , environment and economic performance.
➢ The strategies to manage threats for reducing the negative effect or probability of the threat, or actual consequences of a particular threat, and the opposites for opportunities.
➢ Neural network, genetic algorithm, models mathematic and other also used for solve the problems at industrial system, in this paper we mentioned the methods had used more and got best resuls.

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