Provide guidance to choose appropriate method to evaluate human error

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Abstract: To reduce human error in the context of the need for a separate risk assessment to assess the risks arising from human error that this need can be identified using the techniques of human error and human reliability analysis provided. In this paper, an overview of the methods of analysis paid to human error. The aim of this study is to provide guidance to select the appropriate method for determining human error in the workplace, according to the circumstances, needs and limitations for each person is performing. Data collection methods in the study of literature and case studies carried out in this field. 10 techniques that are used to select high accuracy using criteria that are commonly used for the analysis and systems are important to choose the right method (eg, comprehensiveness, accuracy, consistency and output methods) are compared with each other. For comparison criteria used by professionals, human reliability analysis and human factors are important for meaningful review and analysis techniques, human error is proven. The results of this research can be a fast and logical model to select the appropriate method for the analysis of human errors on different working environments to be used.
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1. Introduction

Despite progress in the field of safety and process design, catastrophic events, or with low loss also occurs in various industries. Most of these events are due to human error leading to incidents such as Bhopal, Three Mile Island and Chernobyl [1], [2]. Today, many of the quantitative risk assessment is not only a hardware defect and environmental events that affect the risk to be investigated, it is also considered the role of human error. So the topic of a separate risk assessment required for the proper evaluation of the risk of human error and reduce damage to the system than there are errors and it's important to assess human reliability is achieved [3]. Assessment of human reliability in many fields such as design, installation and implementation is applicable. Many methods for quantifying human performance and human error have been calculated. THERPA method is the first generation to second generation methods, such as CREAM and then developing ways ATHENA is like they are trying to reach the hardest part quantitative assessment of the risk of human reliability analysis [4].

This paper examines the different ways human error (HEI), to select the appropriate method by analyzer according to the conditions and resources, as well as output data to assess the risks and reduce errors. 10 of the most common methods of various factors which are discussed below can be compared. But even before that the requirements for quantitative assessment of risk and reliability analysis of the human rights standards that the comparison should be examined in order to determine them.

1. Human Reliability Analysis (HRA) on the risk assessment:

Analysis of human reliability is a major issue in the field of risk assessment and safety engineering respectively. Many methods for analyzing human error and human reliability by teams of engineers and psychologists have been provided. Human Reliability Analysis is an essential element in the quantitative assessment of risks as a tool to study the various aspects of human performance and their impact on risk. The quantitative assessment of the risk of negative effects on the immune system, such as human error can be examined to determine the risk of a particular system. In the early stages of the development of risk assessment, were not present when the design and safety engineering improvements of hardware defects and environmental factors associated with errors, While today many of these problems is engineering the main focus has shifted to human error risk that quantitative assessment of human reliability analysis needs, determining and quantifying the likelihood of errors, and if the calculated risk is too high, reducing the possibility of human error by the means and methods Reliability [5], [6].

2. The history of human reliability analysis methods:

The purpose of human reliability analysis predicts a possible failure in performing a task is due to human error. There are many methods for this

purpose, they can be based on expert judgment, simulation techniques, and methods of assessment are mathematical. The primary method of HRA in the 1970s and 1980s, the first generation HRA methods known as such, THERPASEP, SLIM, HCR and HEART, an electrical or mechanical be seen as a component that can be a congenital defect. The features that one should do the job, the main role in predicting the risk of human error while working in the environmental impacts are less important [7], [8]. The limitations of the first generation can only focus on the inherent defect, regardless of the decision of the individual and environmental factors affecting human performance etc [9], [10]. Over time, and with the arrival of the second generation of human capabilities, including evaluation methods, MDTA, SPAR-H, ATHEANA, CREAM above problems were solved. The importance of the second generation of the focus on the environment and involving them in calculations predict human error.

3. The criteria for choosing a suitable method for the determination of human error:

The importance of identifying human error if there are more than a little of it can be considered at least as much. Human error is not known if other No matter how precise and accurate method of quantifying it. The main criteria for choosing a suitable method for determining human error, at least in terms of its comprehensive crisis are serious errors. Generally, the criteria set out in this article to compare methods used include human error [11].

- The accuracy in determining the major risks: Accuracy of critical errors in determining effective risk assessment system can be considered as the most important criterion. The method of determining human error to determine significant errors in fact have little value because they omit that looks small compared to what is real is the risk of the system. The accuracy of the part of it that is of greater importance because it is evaluated as a separate is measured.

- Comprehensive method: The importance of identifying human error if there are more than a little of it can be considered at least as much. Human error is not known if other No matter how precise and accurate method of quantifying it. The main criterion for choosing a suitable method for determining human error, at least in terms of its comprehensive crisis is serious errors. Means the comprehensive of the scope to cover all forms of error include errors originating from the skill, the knowledge and the ability to identify all possible errors and work to be considered. The accuracy of the part of it that is of greater importance because it is evaluated as a separate measure is considered.

- Compatibility: The degree to which the use of a method to find similar results. The method used is only provided by some experts or only at some times be accurate and complete results with limited practical application and this reflects the fact that the determination of human errors is more art than science.

- The resources needed to run: The number of people and time needed to implement the technique. If you spend a lot of time to perform the procedure or the number of people involved can come to the company that is popular in the assessment of human error be down. It is also a factor for the person performing the procedure often faced with time constraints and the number of partners is of great importance.

- Output during the period of analysis:

Job description: a description of the work or task being carried out human error in its assessment done. There are many different ways to analyze the task. One of the most common in many evaluation methods used by HTA is human error.

Describe the context or environment (such as performance factors shaping PSF):

This definition can be defined in a number of environmental factors and calibration is performed. It describes in some ways be considered as the basis for assessment.

For example, environmental factors as factors shaping the way CREAM 9 (CPC) (such as the level of organization, the level of employee engagement, training, etc.) are described as the definition and level.

Diagnostic model: a description of how to think about the person or people involved in the process.

The output of the analysis:

Outputs include: the type of error (the error/ violation)

Prioritize errors or sensitivity analysis:

Outcomes (results) errors or defects:

Psychological considerations:

The possibility of human error:

Risk or success/ failure process:

Opportunities to compensate for the error:

Proposals or strategies to reduce and prevent errors [12].

Table 1

Short name of method	Full name of method	General structure of method	Name of the person or the institution create methods
ATHENA	A technique for human error analysis	This method determines unsafe acts and to quantify the probability of human error. This information can be used in the quantitative analysis of risk.	US Nuclear Regulatory Commission in 2000
APJ	absolute probability judgment	The possibility of errors identified a number of estimates and the implementation of the results at a meeting or rally can be calibrated mathematical.	
CREAM	Cognitive reliability and error analysis method	Using a classification system involve risks and environmental conditions, including organizational, technological and personal risk of human error and the amount of control that people have over their work estimates	
GEMS	generic error modeling system	For errors caused by mismatch between the expected behavior and the behavior shown by the analysis of the diagnostic process is expected	
HAZOP	hazard and operability analysis/method	This method identified all deviations system using key words such as less than, greater than the output of each of them and causes them to make them.	
HEART	human error assessment and reduction technique	Quick way to assess human reliability on the factors that have a significant effect on human performance focus. The assumption is that the reliability of the method depends on the nature of the task that the person.	Jeremy Williams-England
SHERPA	systematic human error reduction and prediction approach	Uses a task analysis and classification tasks and errors using error modes determined. The results and methods of recovery will be achieved.	Amiri - 1986
SRK	skill, rule, knowledge	Using a flowchart showing the psychological mechanisms errors specifically related to the different types of errors they make a situation analysis	
THERP	technique for human error rate prediction	The event tree analysis to provide job done	

Table 2

Methods									Graded	Criteria	
THERP	SRK	SHERPA	HEART	HAZOP	GEMS	CREAM	APJ	ATHENA			
									High	Collectivity	
									Ave.		
									Low		
									High	Accuracy	
									Ave.		
									Low		
									High	Compatibility	
									Ave.		
									Low		
√		√	√		√	√			1*	Number of people	Resources
	√			√				√	2*		
									3*		
									4*		
			√				√		Low	Time	

		√		√					Ave.		
√	√				√	√		√	High		
√	-	√	√	√	√	√	√		Yes	Job descriptions	Output method
								√	No		
					√		√	√	Yes	Describes the background	
						√			No		
					√			√	Yes	Diagnostic Model	
									No		
					√			√	Yes	Scenario descriptions	
									No		
					√				Yes	Task Analysis	
								√	No		
									Yes	Tree Event	
					√			√	No		
									Yes	Fault Tree	
					√			√	No		
					√			√	Yes	Error type	
									No		
					√				Yes	Outcomes (results) errors	
								√	No		
					√			√	Yes	Psychological considerations	
									No		
									Yes	possibility of human error	
					√				No		
									Yes	Risk status / fault process	
					√				No		
					√				Yes	Opportunities to compensate for error	
									No		

1* only one Analyst
2* a certain number of people who can be involved in individual
3* the simultaneous activities in one place
4* team is required but unknown number of people

4. Techniques used to determine human error

8 techniques continue to investigate to determine the human error that can be applied to human reliability assessment paid. For each, the basic mechanics and advantages and disadvantages of each method and in accordance with the criteria are checked.

The 10 techniques are:

1. Method to predict the rate of human errors (THERP)

This is mainly because of its little known techniques to evaluate the reliability of human error is determined in several ways. The simplest type of error in the determination of the 3 categories: error remove (drop), error performance and error outside (external) at any stage of the process is working.

This method can be used in situations of complex work. There are many types of human errors that the potential event could be identified in this way, provided that a good knowledge of the work is done and the interaction between the system and have the operator.

Pathways to detect error-correction (ways in which the error is identified and resolved) to the main part of the route taken by the judge analyzer is important. In addition, the method performance factors shaping (PSFs) a lot of the risk of human error increases (such as problems related to illness, poor education, etc.) as well as checks. Finally, information Tables human error in this procedure a classification of good recipes and offers a wide range of human error.

2. Behavior based on knowledge and skills of law (SRK)

Rasmussen presented a classification model and influence for all kinds of errors, and the way paved for a couple of ways that will be explained later. The method is to see human behavior as a hierarchy. The easiest time behavior (behavior based on skills) in situations where the need to conduct a lot done with a minimum of conscious control is automatic. The most useful aspect of this method for predicting human error flowchart used to determine the psychological mechanism malfunctions, which can be extracted from the man. In relation to the three basic criteria, with the aim of using predictive models have been created for use as a means of determining human error, but is expected to be greatly developed and comprehensive. Also, this method can provide useful information and documentation in order to reduce the possibility of error.

3. Process and potential risks to human study (HAZOP)

Another method that has been building over the territory to the realm of psychology is HAZOP method. HAZOP a popular technique in audit planning and risk assessment engineering commonly used in the early stages of design, which can also be used in the current system or repair made. HAZOP main advantage of doing it in the early stages, as well as errors are identified in a knowledge system This means that errors in the early stages to identify and eliminate the costs of design and costs are minimized.

The disadvantage of this method is the most used resources and the expertise of the team in the analysis is very impressive. Also, if you are not an expert on human factors in the implementation of the present method is not very effective execution method for HAZOP may reduce errors by offering training procedures like the design, but can not remove it.

A description of the job duties and a scenario in which the techniques used, the introduction of a system failure or obstacles set by the system (for example, physical handicap start event), and the consequences of error are system outputs.

4. General error modeling system (GEMS)

It was created by Rizen to help understand the errors that may occur; especially when the operator enters the realm of behavior based on knowledge of the law and will be used. GEMS errors divided into two categories: the slip (eg, unintentional act of pressing the wrong button) and error (forgetting to push a button) on one level and wrong on the other (recently Rizen violation as a separate group and add errors are considered) slip occurs at the level of basic skills.

However, a mistake by a higher-level rule-based and knowledge occurs. In this regard, slip or inadvertent errors can be considered while a mistake or (misdemeanor) in terms of range of an error in judgment or perception of a risk or in other cases the results of a deliberate error that will be used to improve the error more difficult.

Since Sherpa is an essential Gems with only the errors on the law and was skillfully designed. Instead Gems accurate diagnostic errors in the field of knowledge-based behavioral deals.

Be comprehensive in any way to determine the problem is misdiagnosis. Although a great number of defect detection Gems today to review the judgment on the usefulness of Gems due to the inherent complexity of errors that are difficult to assess is formatted. For example, the solution to an inadequate mental model is not an easy one, because education changes the process and may be included in the design.

5. Systematic way to predict and reduce human error (SHERPA)

This method was developed in 1986 by Amiri. It consists of an account of the normal flow of questions and answers that similar errors at every step of the process Analytics recognizes job. Types of errors detected by both methods are SRK and GEMS. The main advantage SHERPA Detailed analysis of models and mechanisms outer error scenario is a psychological error. Since the method of analysis of a job and a tabular format human error analysis (HEA) uses a rigorous and useful analysis tool offers. The disadvantages relative difference in results when using two evaluator techniques is different. In fact, contrary to its name, which is systematically evaluated different by two can not is trusted.

This method requires no prior expertise and basic education in psychology error mechanisms can be performed. People who are employed method are necessary before it is familiar with the job. The time required for training for the low and medium defined.

This technique can provide an output that includes job descriptions and analysis and scenario technique that is done, Failure modes defined, prioritized errors, the consequences of error, error recovery situations and strategies and recommendations to reduce the possibility of error.

6. The method of assessing and reducing human error (HEART)

Williams was raised in England in 1985 by management and the evaluation methods reliability is

human. Now the use of this technique in quantifying human errors in England as well as Europe and Scandinavia is very common. This technique is a relatively quick method for assessing the reliability of the design and the factors that have a significant effect on human performance focus. The advantage of this method is very fast and simple and does not need to use too many resources. It also has high flexibility and because the method is based on human action, but not technical process can be used in most industries.

A low cost and also to determine ways to reduce human error helpful. The disadvantage is that it is largely dependent on the discretion of the operator. In this way there is no need to expertise for the implementation of the method. In connection with the time required to perform the technique for 3 to 5 days spent five scenarios.

7. Analysis of reliability and error detection (CREAM)

CREAM method based on the amount of control that the operator is working on the possibility of human error is calculated. This level of control is determined by using the evaluation function. To evaluation function, in this 9 parameter as a function of the current Common Performance Conditions (CPCs) is defined [7].

The main advantage of this technique is the ability to quantify directly the risk of human error. In addition, the environmental condition affecting the error of this approach is more positive.

This feature is also a forward-looking analysis (projections) and is retrospective. The exact method with good structure and a process is determined. The disadvantage of this method requires a lot of resources, including more time to complete it. It also does not provide methods to reduce the error.

This method requires knowledge of human factors and ergonomics diagnostic and looks somewhat complex. The time needed to perform as well as education seems relatively high.

Output stages of analysis techniques, including a description of the job and work environment, diagnostic model, a description of the scenario, job analysis, event tree, error conditions are defined, prioritized errors, the consequences of errors, psychological considerations, factors like performance, and the possibilities of human error. [12]

8. Analysis of human error (ATHEANA)

In this way, a multidisciplinary framework used by human factors and environmental factors are considered influential. In this way the causes of the accident are classified in one of the following groups: organizational effectiveness, performance form factors, mechanisms of error, unsafe practices, human failure events, and achievements unacceptable.

The main advantage of this method is more secure and more accurate understanding of the field of human factors involved in an accident than other methods first generation gives us. Using this method, the probability of human error can be obtained with respect to various factors. It is also compared to other methods of human reliability analysis explores a wider range of factors shaping performance [19].

The shortcomings of this approach is that, despite the division involved in an accident details of the relationship between these factors together to get to the root of the main events do not offer.

As of HAZOP team of various experts to perform these techniques, it has been proposed. It is time to complete it.

This technique, such as a description of the circumstances, diagnostic model describing the scenario, the introduction of the system, defining the error, psychological considerations, factors like performance, the possibilities of human error and failure or success of the offers [20].

5. Conclusion:

In this paper, a comparison of the number of the most common methods of detection and analysis of human error that can be considered as a framework to select a suitable method for the detection of human error that results can be used to assess quantitative risk. This framework includes factors that may be important for the analyzer to select the appropriate method such as the time required to perform the technique or output that it offers a method of classification errors or environmental factors affecting the risk of human error. Therefore the choice of the appropriate method of detecting and analyzing human error should be based on available resources, as well as an analysis of the information needed to be done.

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