RELIABILITY IN MAN – MACHINE SYSTEM

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ABSTRACT

The purpose of this work is to provide the reader with a survey of the reliability in man – machine systems with special focus on human reliability assessment (HRA). First part of this paper outlines some approaches of error identification and human reliability assessment and second part proposes a systematic process for classification human reliability in human – vehicle system.

1. INTRODUCTION

One of the most interesting questions might be why to investigate human reliability. For answering this question we take a closer look at error analysis in some domains.

For example, an analysis by the institute of Nuclear Power Operations (INPO) of 180 significant events in 1984 and 1985 happened in nuclear power plants showed that more than 90% of all incidents were traceable to human performance problems (faulty procedures, equipment failure, communication breakdown, poor training and other problems). The situation in other domains is similar to situation in nuclear power plants.

However, one of the most hazardous domain, the human – vehicle interaction was missed out in last few years. The first step of this work is to analyse human error and erroneous actions leading to unreliability in this system and then the second step is to make systematic process for quantification human reliability, using existing methods (more in Chapter 2).

2. HUMAN RELIABILITY ASSESSMENT (HRA)

HRA represents a specific scientific discipline, which combines the knowledge and experience of psychology, ergonomics (human factors), and engineering [1]. The aim of HRA is to assess and predict human erroneous actions in a given context. The result of such an assessment is important in the determination of the overall safety of a system.

2.1. HUMAN RELIABILITY APPROACHES TO RISK ASSESSMENT

Most of the methods were made for specific problem such as nuclear power plants or air traffic control. Due to a large number of different approaches, we need to choose only approaches which are retrainable to our problem such as:

CREAM – consistent error clasification system which integrates individual, technological, and organisational factors and provide a step by step description of how the taxonomy can be applied to analyse as well as predict performance using a context dependent, cognitive model [2].

ATHEANA, SHARP and others approaches.

2.2. DEFINING AN APPROACHE FOR HUMAN – VEHICLE SYSTEM

For my work I've created some categories which represent the phases of human reliability assessment:

QUALITATIVE ANALYSIS:

- First phase is to create task analysis, which contains a description or representation of system that make up the plant, including in particular a description of the interactions between the vehical and human.
- Then we need to define performance shaping factors (Classification structure of performance shaping factor is on figure 1) for our system.
- In this phase is necessary to choose (from PSF) the accident sequences that will lead to specific hazards. Such sequences are in our method described as event or fault trees.

QUANTITATIVE ANALYSIS:

- Evaluate the consequences of the accident sequence i.e., of sequences that lead to failures. This means the probabilistic assignment to accident sequences depending on their occurrence.

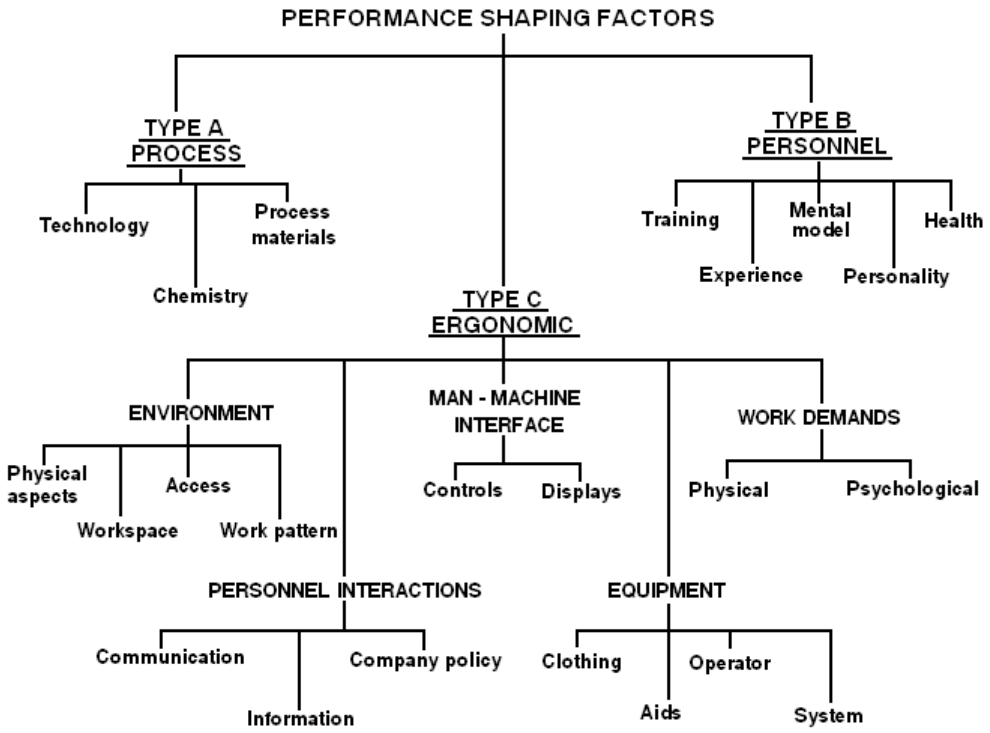


Figure 1: Classification structure of performance shaping factor (Whalley, 1987).

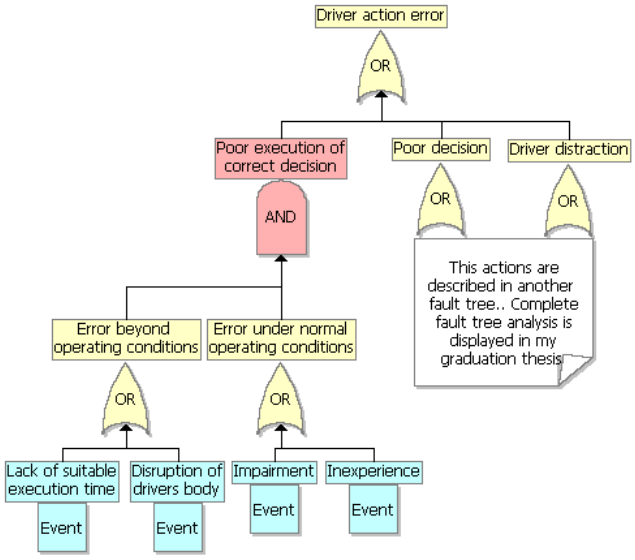
2.3. EXAMPLE OF PERFORMANCE SHAPING FACTORS

I made some kind of research in actual work to find out what are the performance shaping factors in human – vehicle system, leading up to human failure. First of all the driver attention status must be defined [1]:

Attentive, distracted, looked but didn't see, sleepy or fall asleep and unknown status

Then we can distribute driver distraction into following categories (only a demonstration is introduced):

1) Environmental factors (Hydroplaining, extraordinary event, other persons, etc.)
2) Psychological and physiological distresses (Medical problem, absence of judgement, skill, alcohol, drugs, state of mind, etc.)
3) Staff and experience unreliability (Absence of special training, entire lack of knowledge, time, etc.)



After this distribution I am going to use Fault tree analysis (i.e. I take specific failure and find events, that are leading to this failure – short example of fault tree that I have made is on figure 2) in connection with specific HRA approaches to make a systematic process for classification human reliability in human – vehicle system. Fault tree analysis on the picture was made by demo version of RELEX software.

Figure 2: An example of fault tree analysis.

3. CONCLUSION

The purpose of the work is to made a systematic process for classification human reliability in human – vehicle system. Using performance shaping factors I am going to construct event/fault tree analysis (with appropriate software) for our query. Depending on importance of single performance shaping factors I am going to assign probabilities to these factors and then using one of HRA approaches it will be possible to calculate probability of human error for different cases in human – vehicle system.

REFERENCES

[1] Hollnagel, E.: *Human Reliability Analysis context and control*, London, Academic Press, 1993, 327 s., ISBN 0-12-352658-2

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