

# Natural Language Tools for Human Reliability Analysis



#### **Virtual Raphael**

Human Reliability Analysis (HRA) involves the use qualitative and quantitive methods to identify and analyse the human contribution to risk, which can be incorporated into overall system safety analysis.

## Why is HRA important?

Reliability is a major requirement in safety-critical systems such as nuclear power plants. Evidence from past accidents shows that human errors are common contributors to accidents in such systems. HRA can be applied to systematically identify and analyse human error – related events. It offers opportunities to improve human-machine interfaces, reliability, and safety.

### **Al Human Factors Classificator**

To read and classify one accident report, it takes an experienced expert around 3 days. This takes time away from value added mitigation activities; reduces the rate at which the databases (MATA-D) could



## The problem of data

Data are scarce and with different level of accuracy and confidence



#### Multi-attribute Technological Accidents Dataset (MATA-D)

- 238 accident reports classified by risk experts
- Use a framework of organisational, tecnological and human errors, based on Hollnagel's Cognitive Reliability and Error Analysis Method (CREAM)
- Across 31 industrial sectors including oil & gas, aviation, chemical, nuclear, etc.)
- 23 major incidents from the Nuclear industry, such as Fukushima 2011, Kyshtym Disaster 1957 and more

### Accident Report Summarizer

expand to improve learning opportunities.

#### Solution

Train machines to help an expert classify reports and detect possible triggers for human errors. Using modern Natural Language Processing models, such as BERT (Bidirectional Encoder Representations from Transformers), fine tuned on MATA-D.





It is challenging to explain and identify the computers decision making process with information extracted automatically, models based on 'black-box' machine learning, and large complicated reports/data.

#### Solution

Identifying the key data used by the computer, and in turn providing a summarized report of the human role that supports the model, provides decision makers with the understanding and confidence necessary. Key target sections are identified based on a confidence scoring system, along with any sentences containing pronouns, or human related nouns. These are then input to BART, which performs abstractive summarization and outputs an overview of the human role in the incident.



### **Case Study**

Fatality on Platform P-19 in August 2022, when CO2 firefighting system was spuriously activated

#### Summarised report

Firefighting system designed to safeguard operators, introduced additional risks due to its failure
Safety technicians assigned to test and visually inspect the systems (not supervising maintenance)
Rescue team unfamiliar with the plant
Lack of communication from the issuer to the executors in the planning meetings
Teams failure in maintenance caused leakage from generators

#### Web interface

Key References

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Universität Hannover		other ~	The basis for the tool is described in the research article : Identification of Morais,C., Yung, K., Johnson, K. Moura, I., Bert, M., Patelli, E. The implement Please note that the human factors outputs are just an indication to suppr	human errors and influending factors: a machine learning approach , by tation in jowa has been done by MS Kaneosha Maneharan. art the user, and that they potentially present a similar accuracy, precision.
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#### Additional information and software available at:

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