Finnish Institute of Occupational Health

Leveraging machine learning for analysing text-based data and assessing human factors identified in occupational incident reporting

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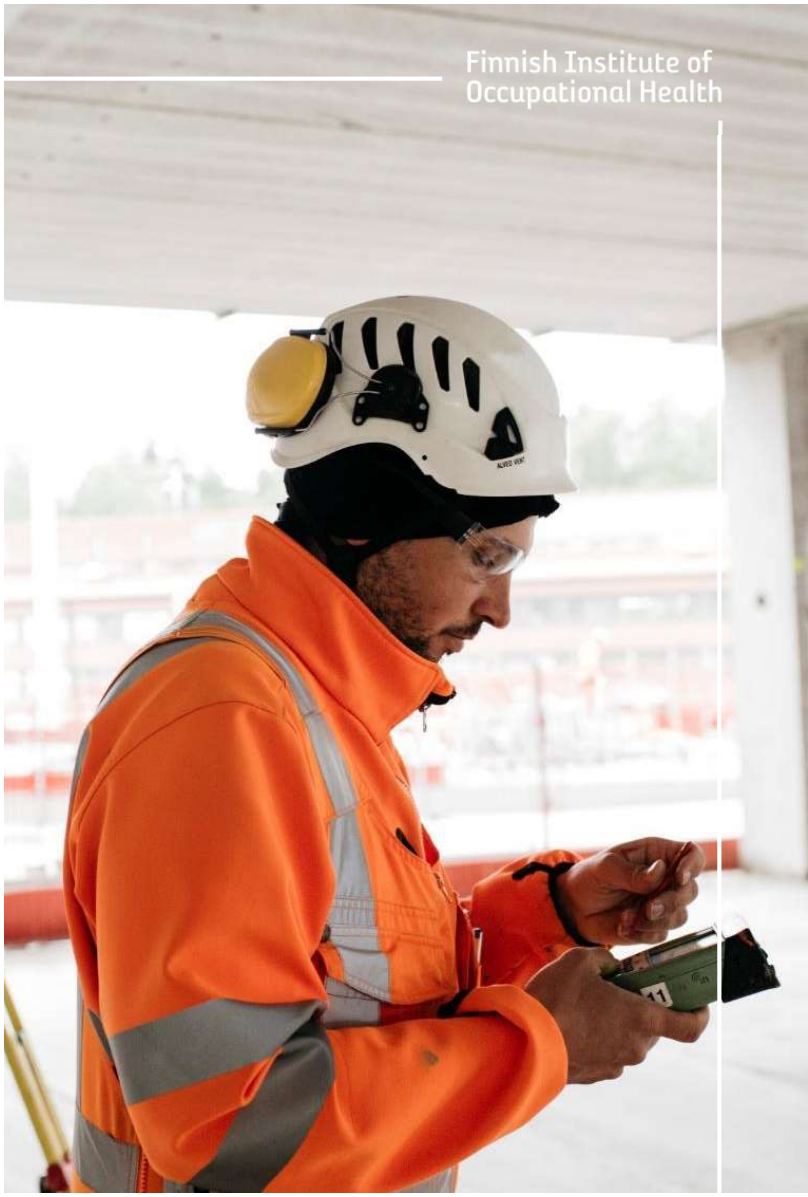
et al.

The main research questions were:

- Are the workplaces getting enough information on the causes of the accidents to prevent them happening again?
- Is it possible to train machine learning models to identify and classify the underlying causes mentioned in incident reports?



Three industrial datasets analysed with Human Factors Tool™

- 1587 accident and near-miss reports from four organisations
- 331 569 occupational accident descriptions from the Workers' Compensation Center
- 67 accident investigations from two organisations

A-M. Teperi 2012

Analysing safety incidents with large language model (LLM) using training data

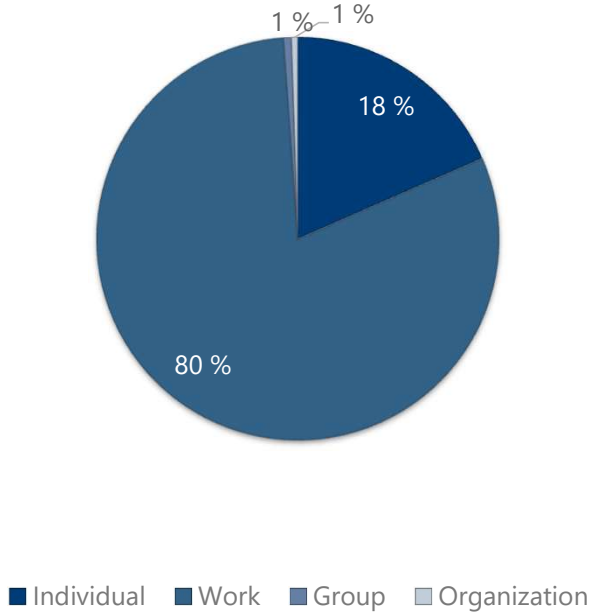
- The LLM was fine-tuned to classify safety incident texts according to HF Tool™ top levels
- Training data labelled manually according to HF Tool™ sub-items by sentence
  - Includes accidents, near-misses and safety observations recorded in organisations' systems
  - "Extended" with data from The Workers' Compensation Centre and investigations of accidents led to death
  - Approx. 1100 rows of training data

Modified example of the training data

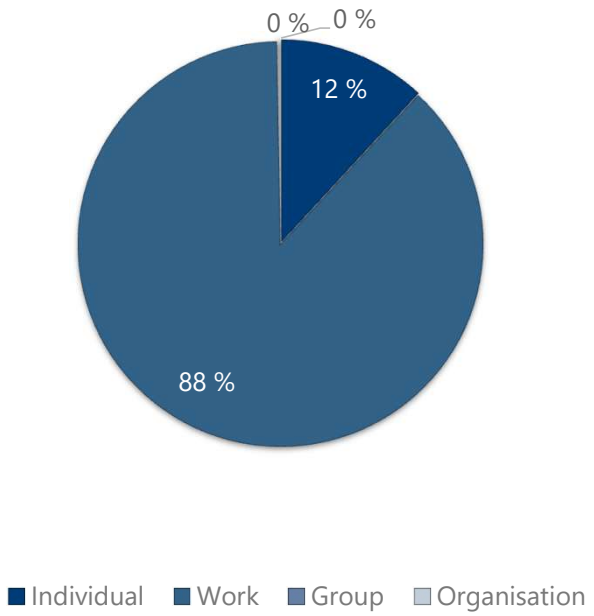
Description/sentence	Related HF™ Tool item
The team went to the rescue.	33
Misinterpreted.	33
The day had been busy and I was tired.	7
The route was designed for truck traffic, but after changes made in the workplace, it also began to be used by pedestrians.	45
The working pair was tired due to not taking breaks.	7
My colleague and I noticed that the pipe was incorrectly installed.	32

The results

Accident and near-miss reports from organisations



Accident descriptions from the Workers' Compensation Center



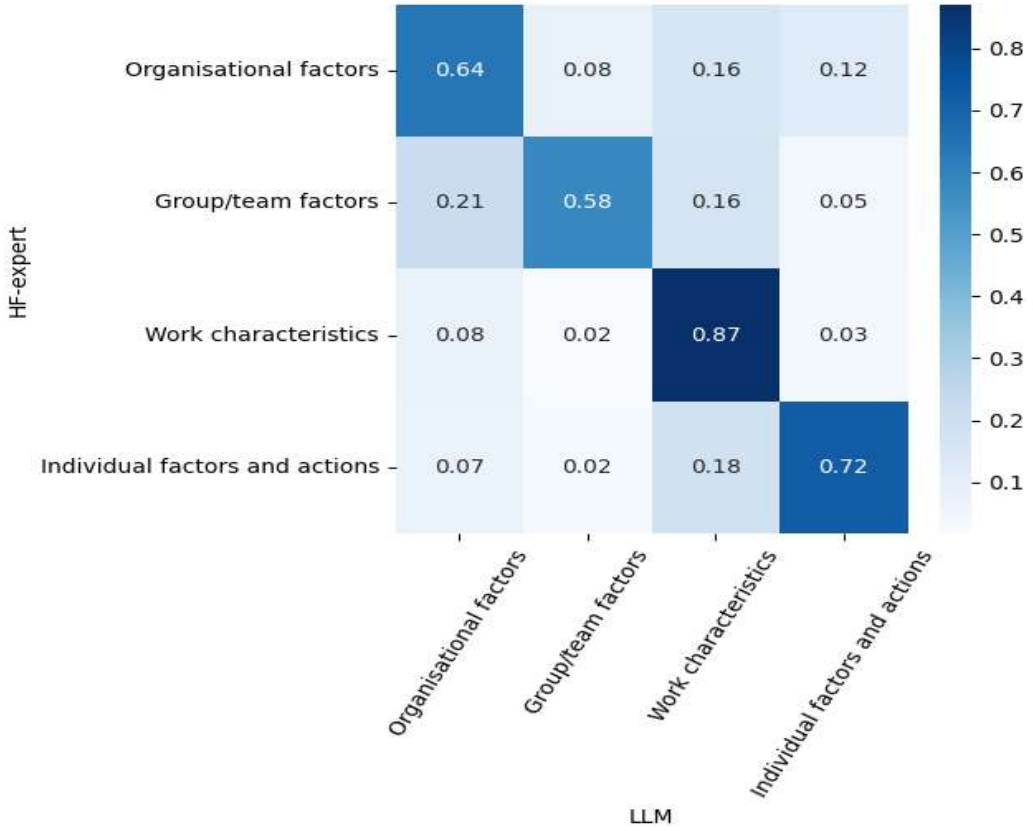
E.g:
Individual:
"The forklift collided with the guardrail, no sightings of the driver."

Work:
"The dressing room floor is splashing with water, risk of slipping."

Classification of accident investigations – HF-expert vs. LLM

The LLM correctly classified 73 % of the texts that were categorized by HF-experts

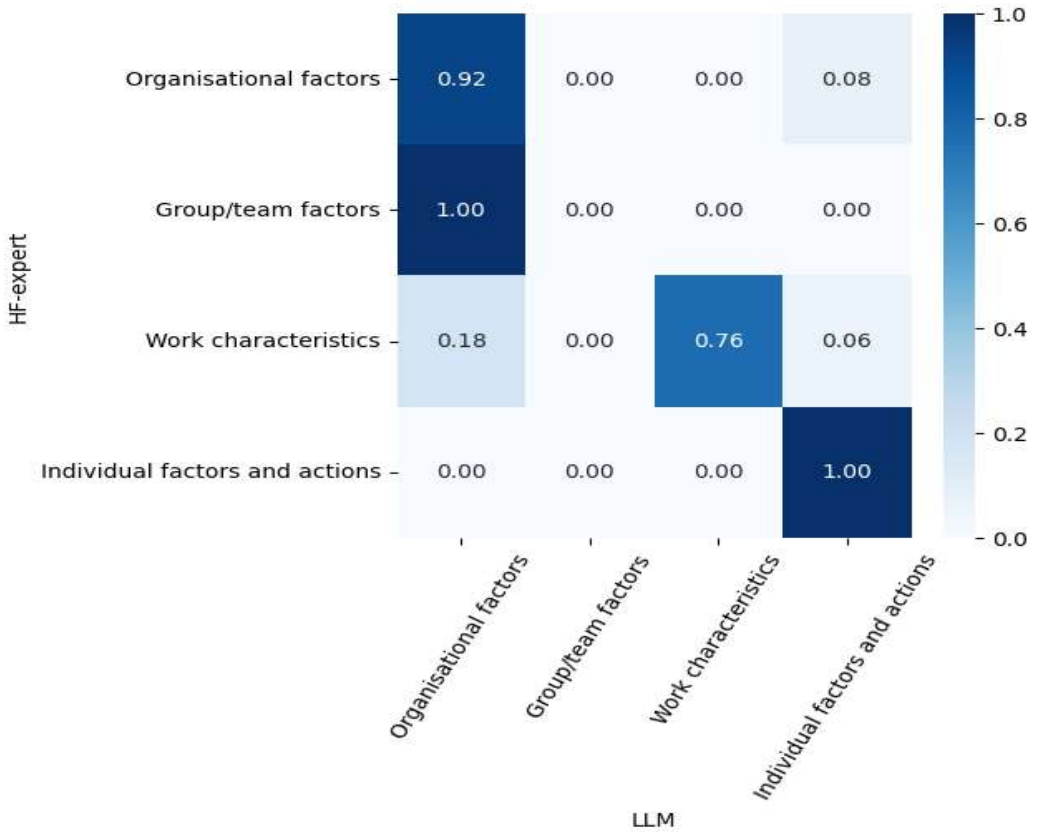
- Individual factors and actions: 77 extracts
- Work characteristics: 137 extracts
- Group factors: 36 extracts
- Organisational factors: 81 extracts



Classification of the Safety and Chemicals Agency investigation – HF-expert vs. LLM

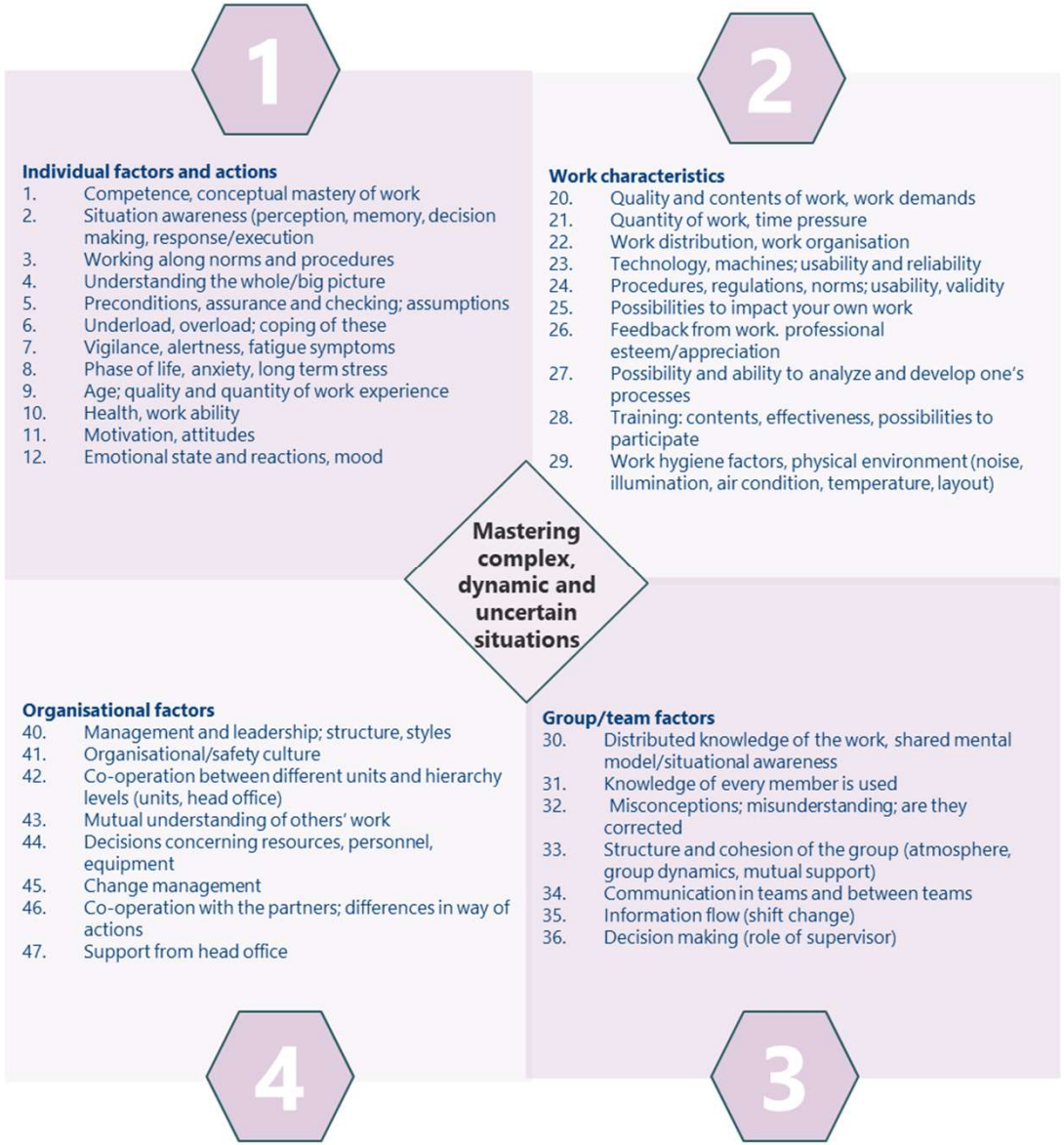
The LLM correctly classified 82 % of the texts that were categorized by HF-experts

- Organisational factors: 17 extracts
- Group factors: 0 extracts
- Work characteristics: 13 extracts
- Individual factors and actions: 8 extracts



HF-expert analysis of accident investigations

- Text data on accident investigations (67 in total)
- Theory-oriented classification of the causes identified in the reports -> which HF Tool™ sub-items can be seen



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The results

- **46%** of the identified factors were related to **work characteristics**
  - The most identified were working methods and instructions (HF24), functionality and availability of equipment systems and technology (HF23), and physical working environment and working conditions (HF29)
- **36%** were related to **individual factors and actions**
  - The most common were situational awareness (HF2), anticipating situations (assumptions and verification) (HF5) and following instructions and agreed procedures (HF3)
- **11%** were related to **organisational factors**
  - Most commonly related to overall management and mutual understanding of each other's work (HF43), decisions made at the organisational level (HF44) and cooperation with partners (HF46)
- **7%** were related to **group factors**

Conclusions

- The fine-tuned model works better than the data would allow us to expect
  - Due to the pre-training, which has 'encapsulated' information about Finnish language and high-level concepts such as those of HF
  - GPT-4 trials underway
- We can utilize the LLM in analysing the HF scope of any Finnish text
  - Gives interesting insight to the safety culture of an organisation: Is the training and reporting focused simply on an individual, or perhaps on other HF levels too
- The analysis reflects inadequate reporting -> Most texts do not have enough features that could be identified reliably with the HF Tool™
- Data quality and collection can be improved significantly (e.g. reducing noise)
  -> *for more information, please contact me later!*

Based on the work done in and after "AI Safety project"

- 9/2020 – 9/2023
- Four large industrial companies participated
- Funded by the Finnish work environment fund, Finnish Institute of Occupational Health (FIOH) and participating organisations
- More info: www.ttl.fi/en/aisafety

Työsuojelurahasto
Arbetarskyddsfonden
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Thank You!

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