

# Adding Intelligence to HAZOP

## Background

Hazard and Operability studies have been conducted for the last 40 years across a variety of industries to systematically analyse a given system and process qualitatively.

Arguably this process has meant that many industrial processes and systems are much safer than they would have been otherwise.

However there are still a couple of common draw backs to this approach:

- This is a very time intensive process to go through, and hence an expensive exercise to complete properly
- The quality of any given HAZOP study is linked directly experience of the team members involved

## Objectives

Using these common issues as a starting point and adapting the HAZOP approach to consider smaller mobile systems which also consider autonomy, a series of case studies were performed and the quality and quantity of output was analysed.

The case study highlighted two main points:

- The larger the HAZOP team, the more time was lost in “meeting overheads”, although the scope of analysis was much wider.
- All of knowledge comes from the personal experience of the team members, but the key factor was the ability for the team member to make analogies between past observations and current designs.

From these observations, the objectives were derived:

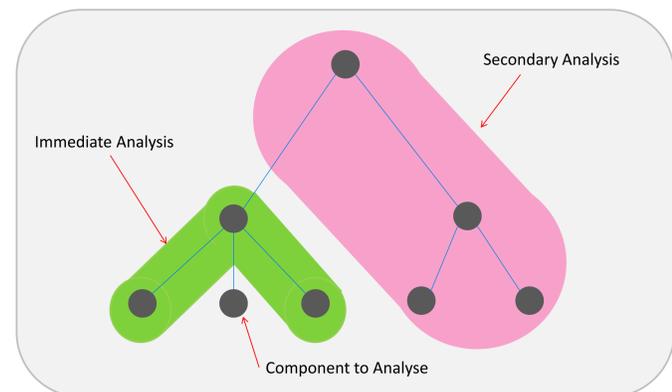
- Develop a fully functioning HAZOP tool that would facilitate a HAZOP review.
- Develop a reasoning system that would be able to compare components within a system for similarity and to draw analogies.
- Extend the HAZOP tool so that suggestions could be made by the system based on the analogies.

A series of HAZOP reviews would then be completed to test an intelligent approach against a standard approach for:

- Scope of the results from the HAZOP review
- The time taken to derive the HAZOP review
- User feedback on thee different approaches

## Drawing Analogies

Within a hierarchical system, the first step is to consider parents, siblings and the overall distance within the hierarchy.



The second step is to consider more components that wouldn't appear within a “is-a” or “part-of” hierarchy and this is when an Ontology would be useful.

Using an ontology it would be possible to consider certain aspects of a component individually and hence draw analogies between completely unrelated components. For example:

*“Electric motors are very different to engines, however within an electric vehicle they provide the same function”*

Within the automotive industry, there is a lot more knowledge about traditional engine based vehicles as opposed to electric vehicles and hence being able to use this knowledge to inform a future electric vehicle HAZOP would be useful

## System Design

The proposed system has several core components:

- HAZOP Tool
- Storage of past reviews with reasoning
- Ontology & Ontology Learning

