Safety-Critical Systems: Day Four Lab Session

Human Factors of the Kegworth Accident

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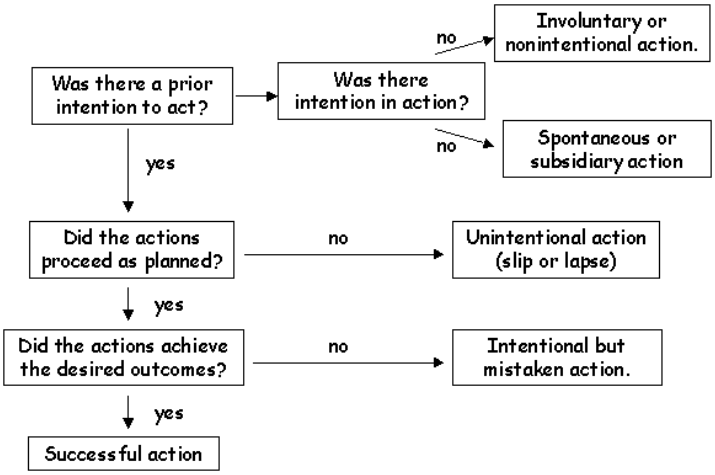
Introduction:
The study of 'human factors' is an area of research in its own right. It is increasingly important in the development and analysis of safety-critical systems. The last exercise described how we cannot easily use existing risk assessment techniques to identify the likelihood and consequences of human error. In this exercise, you will apply a taxonomy of human error to the UK Air Accident Investigation Branch report into the Kegworth aviation accident. This accident has been chosen because it illustrates the complexity of crew behaviours during complex incidents. It is also difficult to distinguish between what can be classed as 'errors' and 'normal behaviour' that should be anticipated by engineers and designers.

Overview of the Kegworth Accident: The official report into the Kegworth accident can be found on the AAIB web site:

http://www.aaib.gov.uk/publications/formal_reports/4_1990_g_obme.cfm

The Kegworth accident occurred when a Boeing 737–400, crashed onto the embankment of the M1 motorway. 47 people died and 74 were injured. Shortly after taking off a fan blade detached from the port engine. The pilots heard a pounding noise and experienced severe vibrations. Smoke entered the cabin through the ventilation system. Passengers saw smoke and sparks coming from the left engine. The flight was diverted to nearby East Midlands Airport and the Captain disengaged the autopilot. He asked the First Officer which engine was malfunctioning, he First Officer replied: 'It's the left one. No, the right one'. The smoke in the led the crew to shut down the working right engine instead of the malfunctioning left engine. They had no way of looking at the engines from the cockpit to check where the problem was coming from. The problem seemed to go away, with less smoke and vibrations but this was a coincidence. The decision to take off the autothrottle, reduced the fuel flow to the left engine and this reduced the fuel which had been igniting in the jet exhaust. The vibration reduced but the crew did not look at their airborne vibration monitors that continued to show a problem; because these instruments were notoriously unreliable.



A Taxonomy of Human Error: James Reason was introduced in the first lab exercise as one of the people who popularized the 'Swiss cheese' model of accidents. He also wrote one of the most influential books on human aspects of safety; James Reason, Human Error, Cambridge University Press, 1990 (ISBN-0-521-31419-4). In that book, he uses the diagram on the right to illustrate different forms of error. You follow the various

arrows to determine whether an individual made an involuntary or spontaneous act, whether they committed a slip or a lapse or they made a mistake. A slip occurs when an additional action is inserted into a task. A lapse occurs when a necessary act is omitted during interaction. A key strength of this approach is that it provides a vocabulary for talking about different forms of error during interaction with complex software systems, such as the airborne vibration monitors during the Kegworth accident.

Your Task: Your task is to analyze the interactions between the crew and their on-board systems, as well as the actions of Air Traffic Control staff.

Task one: You should identify when key decisions were made and use the Reason taxonomy, illustrated in the previous picture to state whether they were spontaneous acts, slips, lapses, mistakes etc.

Task two: there is a growing movement in Europe and North America to create a 'no blame culture'. This argues that humans tend to make mistakes and that designers must consider this in systems development. In particular, we should not blame the crew for any problems but instead look at issues such as the reliability and design of the vibration monitors or smoke monitoring systems that put the crew in a situation where they were likely to make mistakes. Personally, I think we should follow a proportionate blame approach that examines each act to determine appropriate levels of responsibility. You should writ**e** a paragraph about this in your report.

Task three: You should write a further paragraph about the new theories of human performance in what has been called 'resilience engineering' by writers such as Hollnagel, Woods and Leveson. This focuses less on errors and more on the role that humans play in protecting safety in a dynamic and flexible way. Illustrate your answer with reference to events in the Kegworth accident.

Submission: Please show your solution to one of the tutors during the afternoon session for the safety-critical systems course. This will form one of the four pieces of coursework that will be assessed in Safety-Critical Systems.