# Forging Links between Safety Critical Task Analysis and Incident Investigation

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#### **SUMMARY**

Safety Critical Task Analysis (SCTA) is an established methodology in high-hazard industries for identifying and managing the human contribution to the risk of major accidents. It seeks to identify which tasks could contribute to the initiation or escalation of a major accident, and then identifies the steps within those tasks where additional controls may be required to mitigate against the effects of human failure. An incident investigation that incorporates examination of human and organisational factors would also be expected to examine where and how failures occurred, the efficacy of control measures in place and where remedial actions are required.

This paper describes how the incident investigation process and investigation findings and the SCTA process can support each other and sets out a case for connection and improved alignment between them. This is a connection that has been underexplored to date, yet which has benefits for both risk management and human factors integration.

#### **KEYWORDS**

SCTA, Task Analysis, Investigation, Risk Management

#### Introduction

Investigations provide valuable insights that guide improvements in risk management and control, albeit after the incident and its associated damage have occurred. This has supported risk management methodologies that can look ahead and proactively identify where and how failures may occur. Within design and engineering, Hazard Identification (HAZID) and Hazard and Operability (HAZOP) studies provide a structured way to achieve this and are established elements of major accident risk management. Safety Critical Task Analysis (SCTA) provides a multi-phase, structured approach to analysing and assessing non-technical aspects. SCTA shares features of HAZID/HAZOP such as the involvement of experienced people to provide input to the assessment, use of guidewords to support discussion and a qualitative approach. SCTA focuses on human activities and seeks to identify where and how human failure could occur within tasks that could contribute to the initiation or escalation of a major accident.

Investigation and SCTA share common elements. Both rely on the construction of a sequence of actions and events within which failures can be identified. Both seek to understand how failures occur, the control measures in place to prevent the failure or mitigate the effects, and any resulting gaps. Both seek to identify improvement actions. This provides potential for alignment between the two processes, and a potential information input and feedback mechanism to support them both. Examples are shown in Figure 1.



Figure 1: Potential alignment and feedback link between SCTA and investigation processes.

# Evidence from Inspections, SCTA projects and Investigations

Evidence from focused Human Factors inspection of UK offshore duty holders in 2021-2022 and from investigation and SCTA work for UK onshore duty holders in 2018-2022 revealed no links between investigation and SCTA processes of the type illustrated in Figure 1. For the duty holders and organisations involved, the processes were functionally distinct. Specifically:

- No investigation procedures that were reviewed as part of the inspections identified SCTA data as a potential evidence source or included the SCTA process as part of post-investigation, follow-on activities.
- No investigation procedures that were reviewed specified that the task(s) that were involved in the incident should be identified.
- No SCTA procedures that were reviewed included using investigation information to inform or verify the analyses of identified tasks.

A review of existing SCTA guidance found that investigation findings were briefly included as a potential source of information for constructing an inventory of tasks for safety criticality screening. The Energy Institute guidance (2020) describes how SCTA is a proactive way to manage risk, unlike investigations which are reactive. It also states that SCTA is used by some high-hazard companies as the established approach to managing the human component of MAH risk. No links or acknowledgment of a potential operational relationship between SCTA and the investigation processes is included. A review of existing Human Factors in Investigation guidance (CIEHF 2020, HSE 2005, Energy Institute 2008) found no link between investigation and critical task analysis.

## Discussion

The duty holders who were inspected were generally at an early stage of the SCTA process and had not reached a level of maturity with the process by which they could begin to explore operational interactions with other processes. Similarly, some (though not all) of the duty holders were at a relatively early stage of Human Factors integration with their investigation process and were focused on developing HF competence and adopting a structured HF analysis methodology. Existing guidance on SCTA (HSE 1999, Energy Institute 2020) generally focuses on the methodology and the activities required for the various phases of the process. The existing guidance does not explore how the process might link to other areas of risk or operational safety management. Taken together, there is no clear pointer in the existing guidance that might prompt a duty holder or organisation to link the processes, other than through their own initiative.

## **Forging Operational Links**

This paper does not present a new, distinct methodology. Rather, it sets out a case for improved alignment between SCTA and investigation processes to support operational risk management. The following examples build on the information provided in Figure 1. They do not provide an exhaustive list but help to illustrate how operational links between investigations and SCTA might work in practice by describing activities in the present tense in a hypothetical organisation that has established SCTA and investigation processes.

# Investigation input to SCTA

- The organisation's procedure or governing document for SCTA specifies that the incident recording database is interrogated when developing an inventory of tasks to screen for safety criticality. The focus is principally on high potential incidents. The personnel responsible for carrying out the SCTA work review the results and note the work activities that were involved in the incidents, and any indications of human failure or Performance Influencing Factors (PIFs) that were included in the investigation reports. Recommendations from the investigation(s), particularly recommendations that have not been completed are also noted.
- The work activities identified from the investigation information are compared with the list of tasks compiled from lists of procedures or work instructions, input from operators and the other sources of information used for defining the various types of tasks performed at the site / installation / functional area. Where there is an existing procedure, work instruction or similar the investigation information is included as notes. Where no such documentation exists, the investigation information is used to describe distinct tasks that are included in the inventory and taken forward for screening.
- During screening, where a task has been associated with an incident, or if the incident still has recommended actions outstanding, the screening output is considered alongside this information. If the screening indicates a low level of safety criticality the option is provided to revise the priority of the task for further analysis, based on the investigation information.
- Where a task has been prioritised for further analysis and has been associated with an investigated incident, the notes about human error, PIFs and recommendations made from the incident recording database are fed into the task analysis and the Human Error Analysis (HEA) work phases. This information informs the discussion that the analyst(s) have with operators when tasks are observed, talked-through and analysed in detail.
- Recommendations for additional control measures arising from the Human Error Analysis are checked against the recommendations noted from the investigation information. An investigation recommendation that is closed-out but which reappears from the HEA work prompts re-examination of the issue. An investigation recommendation that has not been closed-out and which results from the HEA work is flagged and given a higher priority rating.

These activities acknowledge a risk of cognitive bias, particularly where the analyst(s) and workshop participants' thinking may be overly influenced by investigation information and does not consider alternative failure modes, consequences or requirements for additional control measures. This can be mitigated against through awareness raising in the education process for SCTA facilitators, and by specifying in the SCTA procedure that investigation information shall not dictate the course of the HEA work.

## SCTA input to investigations

- The investigation procedure specifies that the task(s) involved with the incident shall be identified as part of the investigation terms of reference for describing the incident and sequence of events (the "what happened" part that is common to investigations).
- The investigation team checks the inventory of tasks for the site/installation or functional area that was created to provide input to safety critical task screening. The team records a) any matches and b) any potential omissions. This is done once the investigation team have sufficient knowledge of the incident to determine what tasks might have been involved, for example when the main fieldwork phase concludes and the data analysis phase commences.
- Where a task from the inventory has been identified as safety critical and a HEA has been carried out, the information is used in the investigation analysis process. The HEA provides information about PIFs, potential human failure modes, existing risk controls that were cited at the time of the analysis and where additional risk control requirements were identified. These elements are all of relevance to the investigation and might be corroborated through the investigation work or highlight areas where risk control was inadequate.
- Where a previously unidentified task is revealed through the investigation, it is added to the task inventory and screened for safety criticality. The actual and potential severity of the incident is considered during screening and prioritisation for subsequent analysis as described in the previous subsection. The investigation information is used to inform the analysis, also as described in the previous subsection.
- Where a known task has been involved in the incident, an action arising from the investigation is to review the SCTA work associated with that task. This may include re-screening the task for safety criticality and adjusting the previous results, reviewing the task analysis and reviewing the HEA as required.
- Recommendations arising from the investigation are compared with any additional risk controls identified from the HEA process for involved tasks and are reviewed or re-prioritised in the same way as described in the previous subsection.

It is important that this aspect of the investigation-SCTA link is not misinterpreted as "correcting the homework" of the SCTA analyst(s), rather that the link helps to validate the proactive work and provides opportunities to potentially improve the quality of both the proactive and reactive work.

The examples provided above demonstrate that, where an organisation has an investigation process and a SCTA process in place, no major changes to either process are required. Instead, the operational links can be achieved through formal acknowledgement of the respective processes in the relevant procedures or governing documentation and through specifying actions within them. This provides the formal mandate for the actions and helps to ensure that they will be carried out and followed-up. By modifying existing processes rather than introducing a new process, the workload and resource requirements are not anticipated to be burdensome, and this would be expected to become more efficient as the organisation's experience with working with SCTA and human factors in investigations matures.

# Conclusion

Forging links between investigation and SCTA means that retrospective findings from investigations can support proactive findings from SCTA work and vice versa. This supports the quality of both processes. It is particularly useful for helping to identify more complicated failure

modes or Performance Influencing Factors (PIFs) at key task steps, which can be challenging even for experienced workshop participants. It also helps to identify safety critical tasks that are but might not have been previously identified. Forging links between SCTA and investigation reinforces the concept of SCTA as a dynamic process that reacts to changes and new information, like any other risk assessment. Linking investigated incidents from an organisation's incident recording database to tasks in the SCT register can help an organisation to identify 'hot spots' in particular task types or functional areas, which in turns supports prioritisation of resources for risk management. Using investigation information in the HEA phase of SCTA (rather than just as input when constructing a task inventory) helps to support learning from incidents, specifically through capturing relevant information in a proactive risk management process and reviewing actions required for improved risk control.

The findings described in this paper indicate that guidance in both areas could be developed further, particularly as human factors in investigations and SCTA become more established operational applications of Human Factors in high-hazard industries and operational links become more apparent. Some duty holders in the petroleum industry have linked SCTA to Management of Change (MoC) processes and have used SCTA to support focused risk management projects. This indicates that beyond the SCTA / Investigation link presented in this paper, SCTA has further unrealised potential for connection with risk management processes and as a supporting framework for human factors integration.

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