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When to STAMP? A case study in aircraft ground handling services

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Abstract

In this paper we show that safety analysis using the STAMP causation model is limited in the extent to which it appreciates complex dynamics of safety. When the STAMP is applied as management tool, controls may be introduced too soon in the analysis since it is necessary to understand emergent behaviour first. Emergent behaviour can be studied through organizational ethnography in parallel development with an agent-based model, as illustrated in a case study of airport ground handling services. Based on ethnographic research and theories from psychology and social sciences, we developed an agent model that showed why repeated attempts at managerial control to improve employees' safety compliance were not durable. The insights obtained through the case study attained to move management ideas about what control means towards creating smarter design and communication processes that involve the work force.

Keywords: STAMP; organizational ethnography; agent modelling; safety management; aviation.

1. Introduction

Leveson's STAMP (Systems Theoretic Accident Model and Process) promises to offer an alternative view on safety from traditional rule-based behavioural approaches [1]. It is framed as a 'New View' [2], a 'model 2' [3], or even a whole 'new paradigm' to safety [1]. STAMP explicates a model of the organization where safety is a control problem. Complex and emergent patterns in working processes are controlled by hierarchies of controlling units, e.g.

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management levels. These function by developing an adequate model of the process and algorithms to control the process. STAMP is 'new' or 'model 2' in the sense that it explains why safety should be a matter of continuous adjustment with thorough understanding of the complex interactions between various aspects of the work processes and technologies.

'Old' models such as the Swiss Cheese Model (SCM) simplify accidents as the outcome of chains of events that must be stopped by series of barriers [4]. The barriers are like slices of Swiss cheese, containing holes through which some unsafe actions may inadvertently pass through. Therefore, this theory implies that organizations should find out what kind of failure modes and accident paths exist and install multiple barriers in its way, such as physical redundancy or behavioural barriers (e.g., Standard Operating Procedures). Methods that use this way of thinking can be subsumed under the label reliability engineering.

A growing number of researchers believes that at higher levels of safety and in more technologically complex contexts, safety is better represented in terms of complex dynamics, rather than SCM's linear sequences of events [3, 5]. If accidents are complex emergent phenomena, then the rationale for designing safety nets in terms of preventing dangerous linear sequences of events is flawed. It is not possible to predict all failure modes and accident paths because safety nets may interact, fail to work as intended and produce new, unknown dangers [1].

Because linear reliability engineering models like the SCM have become part of the 'working theories' of safety management [6], also in contexts where this might not work, managers' and regulators' commitment to them may become 'bureaucratic' [7]. Working theories are internalized ideas and experiences that professionals, such as managers, use to understand problems and act in them. In this case, as the current literature suggests, managers may sometimes be wrongly advised to think about safety management as a chain of events issue. While they do, this may lead to conflict between managers and workers because the latter then come to view safety as a senseless burden [3]. The rules may not seem to be about safety but about covering responsibilities. The motives for introducing safety measures may be questioned and the designers of new and improved safety systems and procedures deeply distrusted.

The STAMP model embodies a fundamentally new approach to accidents and safety because it does acknowledge the complex interactions that contribute to accidents, and provides a way to analyse this complexity. STAMP could also have promising prospects as a working theory of safety management [8], as it may help deriving more sensible safety rules and procedures. Thus, STAMP may alleviate management-work floor conflicts about symbolic or bureaucratic safety rules.

In this paper, however, we argue that as a working theory for management, STAMP should not be seen as a whole new approach to safety. While STAMP is in many respects a significant improvement from older linear accident models, it has limitations as an organizational management theory. In some ways STAMP continues to encourage top-down thinking about management, because it is not intended to represent the behaviour of people. It simply places control on behaviour without understanding its driving forces, and does not count for the complexities that workers face and the contributions that they (could) make to safety. Therefore, STAMP to some extent fails to capture the 'new' view where safety is approached positively, in the sense that workers' input to safety are fully appreciated [9].

We substantiate this point of view with a case study in an airline ground safety department that was struggling with poor management-work floor relations as it attempted to implement safety procedures and systems. STAMP was used to identify the weak spots in management control and communication, with the aim to formulate actionable changes in management and improve the situation. We found that STAMP created some insights but did not help providing an actionable analysis of the situation, because it did not help to understand how the sour relations had arisen. In the same organization we also conducted research using organizational ethnography and agent modelling, both providing some promising insights and courses of action.

Therefore, in order to achieve a truly 'new' view, we recommend the use of complementary approaches to STAMP that attempt to capture the social dynamics and creativity that emerges bottom-up. We propose a process by which knowledge from relevant disciplines can be accessed and used in an empirical analysis of a particular organization. There is a large, untapped body of work from socio-technical systems modelling, social psychology, sociology, anthropology and organizational sciences that could refine working theories of safety managers, as well as the field of safety science. This could help analysts and managers understand the emergent behaviour of systems, before they introduce control. In this paper we show how those two methodologies can be applied in tandem to overcome the limitations of the STAMP approach.