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A systemic-interactional perspective to the analysis of and design for safe practice

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Introduction

Most approaches to safety engineering are based on two assumptions, which will be stated in slightly extreme terms, to make the point more effectively. Human cognition is subject to biases, oversight, forgetting, complacency and other limitations that make it vulnerable and thus unreliable when it comes to manage operations under safety-critical, high tempo, high workload conditions; hence human cognition needs support like decision support systems, visualisation displays, and safety barriers. The latter are the special concern of the present study. The second assumption is that complex systems can effectively be handled by decomposing them into "modular" subcomponents, each of which is dealt with independently from others. We argue that both assumptions, when it comes to design for safe practice, might lead to less than optimal design solutions. An alternative view, based on the Russian developments of Theory of Activity, is to conceptualise individual cognition as emerging from societal activity and to seek relevant interactions among apparently distinct components of the Activity system.

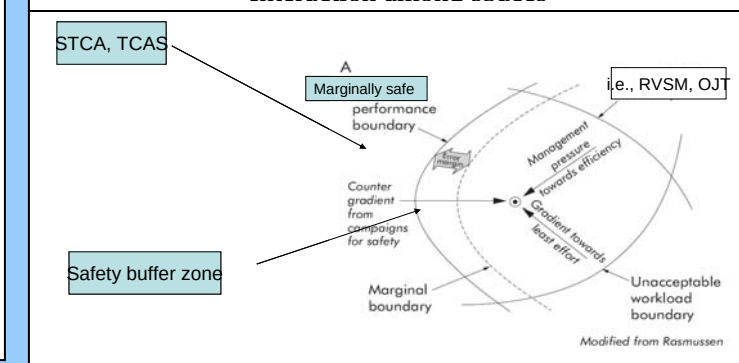
The "modular" approach rests on the assumption that complex cognitive systems can be decomposed into simpler cluster of "elements" each of which can be addressed by a specific safety barrier. But elements never function in isolation: the interaction among them is "discovered" once the "barrier" is put into operation. "Finishing the design", "violation", "appropriation" can all be regarded as strategies to cope with modularity.
Two main views on Human Error are contrasted: Ecological approach states that errors are useful health checks. But they still point to a malfunction of the individual/team cognition
Systemic view: Errors become a reflection of an organisational/institutional order over which individuals have no direct control but to which they respond by forming acts that contribute to the production of the Object of the activity.

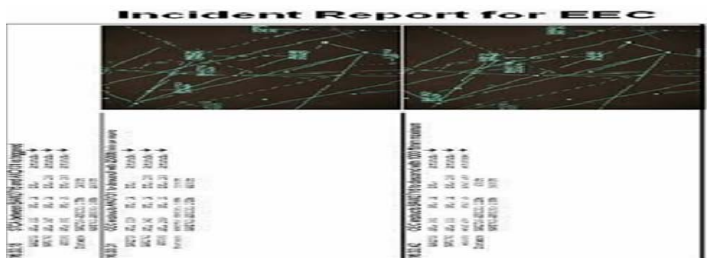
- About 30 Incidents Reports from Eurocontrol databases have been analyzed to seek evidence for unexpected interactions due to the modular assumption and for "the emergence of individual activity on the basis of societal activity".

- Safety barriers embody simultaneously different visions of how safety can be maintained:

Conflicts among these visions can create opportunities for "errors".
Initial Results from Incident Reports:
-"Errors" found to be the outcome of unexpected interactions among competing "spaces".

Interaction among spaces





Results

Human Factors	Interactions and functional adaptations
Call sign confusion; Lack of inter sector co-ordination; Colour coding; "Wrong" flight level assignment; "Ambiguous" clearance (330, degree of FL?) "Hear back" omitted; FL occupancy misjudgement;	Close interactions among STCA, TCAS, ATC, Pilots. TCAS and STCA were very close in time (a few seconds difference). Cases where ATC and TCAS provided different solutions. Few cases of "negative automation surprises".

We argue that not only errors cannot simply be viewed as individual (more or less justified) variations, but rather they have a functional role with respect to the objectives of the Organisation. We call this the systemic view of error: Individual errors become a reflection of an organisational/institutional order
When errors are shown to be functional, they reveal how the sharp end learns to cope with limitations of resources, clumsy interactions among barriers, competing goals.

Conclusion

In the new view errors are seen as functional to the accomplishment of those goals that are valued as good practice at the community, organizational, or institutional level

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