



Humans in Complex Systems

Sixten Nolén, Swedish Transport Agency



Introduction

- It's human to make errors and mistakes even in road traffic
- Human errors and mistakes will happen sooner or later
- Design of the transport system has to take that in to account
- It will not stop errors and mistakes from happen
 - but it will reduce the risk (probability and consequence)





Human factors and accidents

- Errors in road traffic could be intentional (violations)
- But many errors are unintentional
- It's not acceptable that it could lead to deaths or serious injuries



"Analyses in a number of industrial sectors have indicated that up to 80% of accident causes can be attributed to human factors

(Helmreich, 2000, Reason, 1990, Wagenaar and Goenweg, 1987)



Human performance and limitations

Cognitive limitations

-Distraction, mental overload, fatigue, stress

- We interpret incomplete and often unreliable information
 - Risk for confirmation bias
- Easier to perceive benefits than "cost" from behaviour

- Bad perception of probabilities (underestimate risks)

- Hard to assess consequences of small changes in speed
- We make "workarounds" or risk compensate
- Tendency to overestimate our performance
- Influenced by social norms (group pressure)

It is not surprising that we make mistakes!



Do humans have the right preconditions?

- Are traffic rules easy to understand and follow?
- Are speed regulations relevant and "self-explanatory"
- Are infrastructure and technology complicated?
 - Distraction or mental overload?
- Are traffic signs easy to interpret?
- Is it easy to risk compensate or make "workarounds"?
- Is it social acceptable to take risks?
- How are working conditions for professional drivers?
 - Fatigue or stress?
 - Safety culture?

It should be easy to behave safely!



Many factors influence road user behaviour















Interaction between Man – Technology - Organisation















Human errors from a system perspective

"Latent conditions"

Organisation

- Laws, regulations
- Enforcement
- Information/education
- Work conditions
- Safety culture, SMS

Technology

- Vehicle safety
- Communication systems
- Technical support systems
- Road design, infrastructure
- Protection systems

"Active failures"

Man

- Distraction
- Inexperience
- Over confidence
- Fatigue, stress
- Group pressure





Road user need support from organisation and technology



Based on Reason's Swiss Cheese Model

Road traffic is a complex system

- In a complex system it is difficult to predict all risks
- A safe system also needs to handle unpredictable risks
- Technology and organisation are important barriers
 - Human adaptability may also play an important role in a resilient system





The role of humans in a complex system?



Conclusions

- Important to have a MTO-perspective
 - Preconditions to behave safely
- Technology and organisation need to support human performance
- Humans also have strengths that are useful in a resilient system

- Potential in human performance from a Safety II-perspective?











Thank you for your attention

Sixten.nolen@transportstyrelsen.se

