Mental load of the Westerschelde tunnel operator

TNO Human Factors

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Westerschelde motor-traffic tunnel: location

Westerschelde motor-traffic tunnel: details

- 6.6 km long
- 2 tubes, each tube 2 driving lanes
- Evacuation corridors every 250 m
- Cameras every 150 m
- 20 monitor displays
- Sensors (e.g. traffic speed, vehicle height, sight)
- Controllers (e.g. traffic lights, speed reduction signs)
- One operator to guard the tunnel

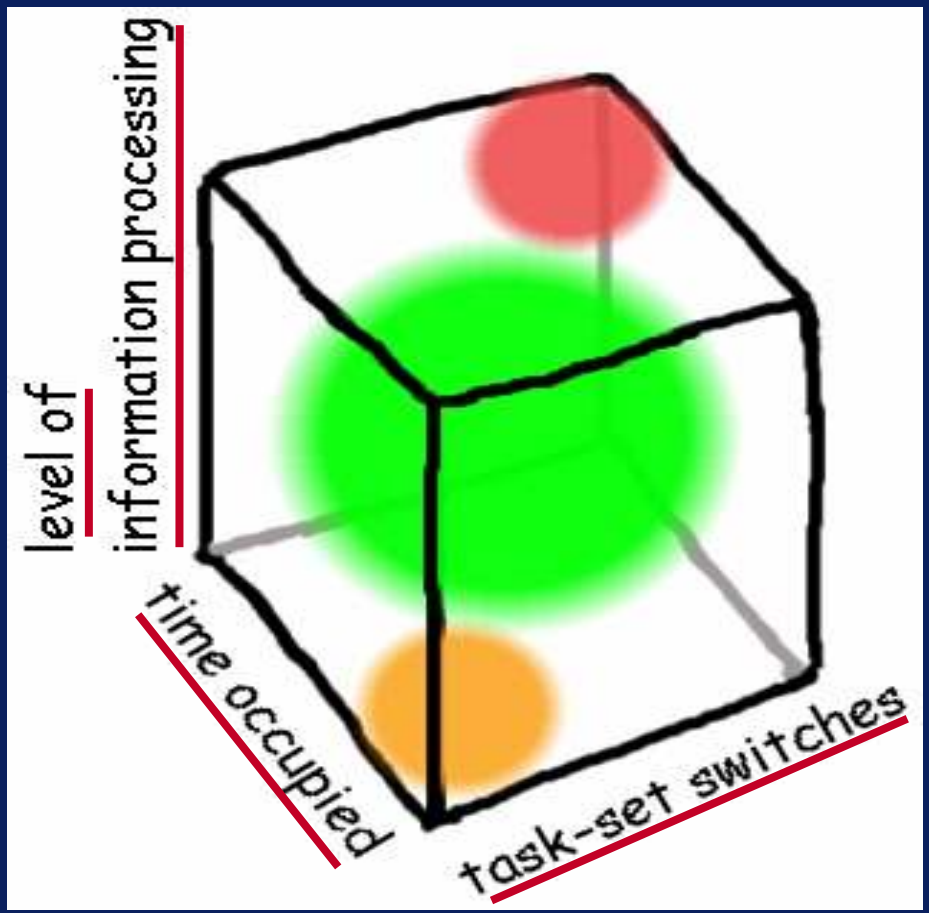
Question:

Can the tunnel be controlled safely by one tunnel operator?

Cognitive load analysis

- Is the operator capable to (cognitively) perform his or her tasks?

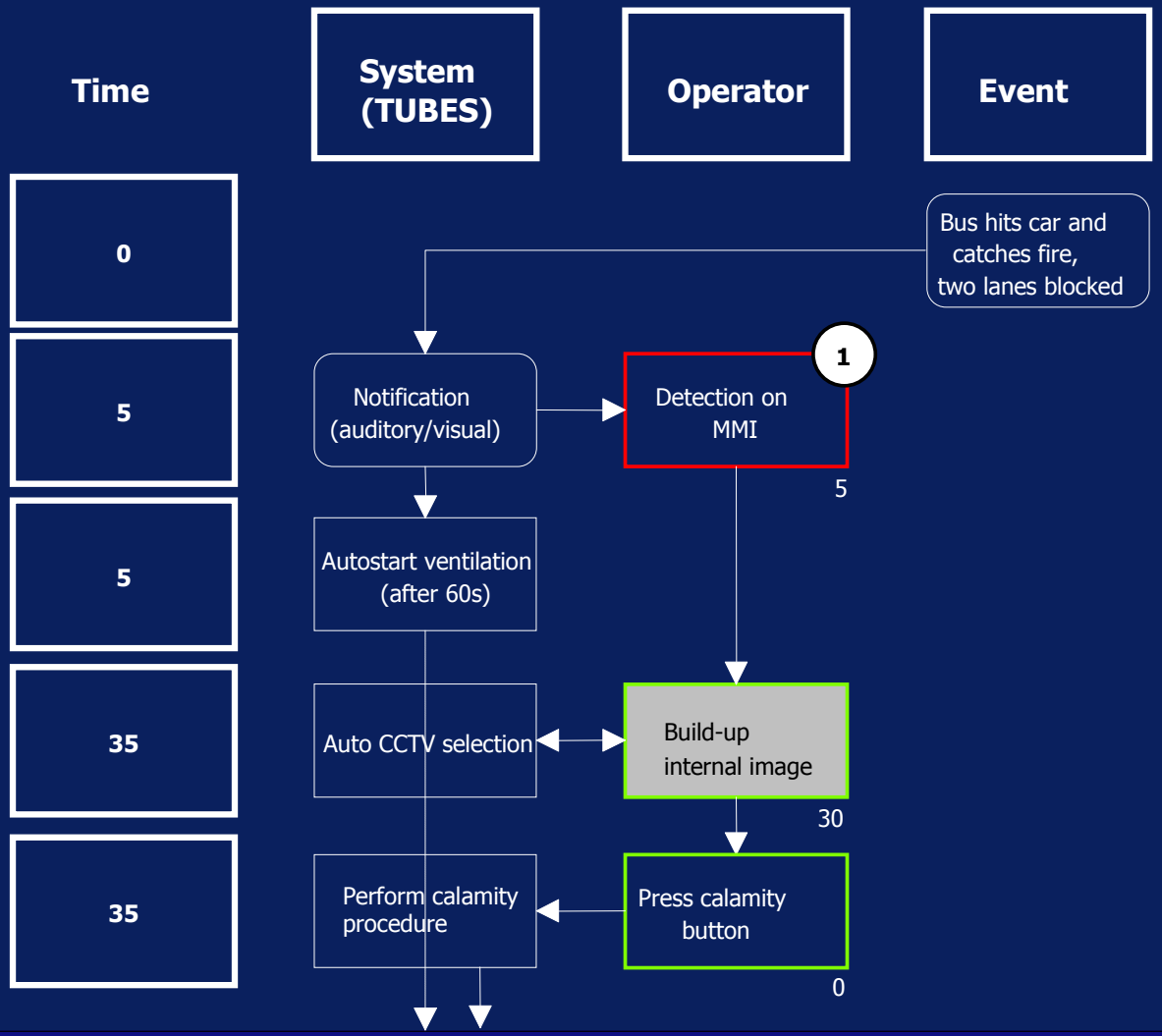
3D cognitive load model



Scenarios

- Five scenarios were analysed
- Some severe (for example, accident with bus that catches fire)
- Some more common (for example, car without fuel standing still in tunnel)

Scenarios: method analysis



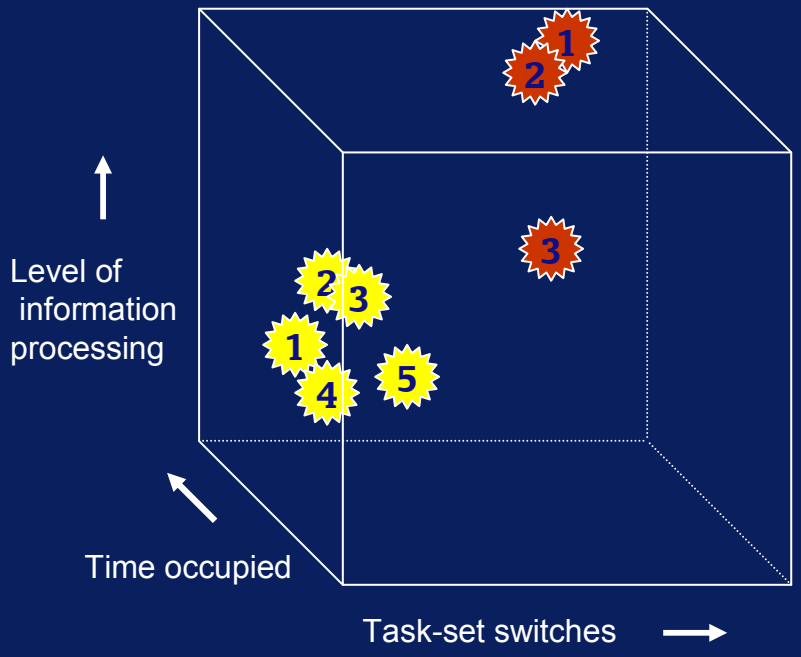
Results

- Time occupied always high (vigilance)
- Overall, average cognitive load acceptable, but
- Cognitive load is extremely high for three scenarios during period just after incident

Scenario	1	2	3
Time (in sec)	0 - 675	0 - 1105	0 - 920
Time occupied (in %)	100	100	100
Complexity (in %)	52	54	23
Task-set switches (number)	13	12	10
Task-set switches (average time between switches)	52	92	92

Critcal period

Results (2)


Level of
information
processing
Time occupied
Task-set switches
1
2
3
2
3
1
4
5

Conclusions

Cognitive load too high at the start of incidents, because:

- Too many tasks in short time (especially with evacuation)
- Tasks too complex because lack of (clear) procedures
- Sometimes number of task-set switches too high as a result of intertwined task-sets

And:

- Sudden change from monotonous vigilance task to highly demanding crisis situation
- Responsibility until emergency services arrive

Recommendations

- Develop / improve procedures related to categories of incidents.
- Develop evacuation procedures. Pay attention to communication and guidance.
- Improve procedures for communication with third parties. Restrict communication tasks during crisis situations.
- Cluster the operator tasks in sets.
- Provide a second person for assistance during crisis situations.

Recommendations training

- Train “on the job” for normal situations.
- Use a simulator to train for critical situations.
- Repeat training frequently (3-6 monthly).
- Organize interdisciplinary training with emergency services.

Thank you for your attention

For more information contact:

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