Aalto University

Day 3: Human Error

ELEC-D7011 Human Factors Engineering
June 5, 2024

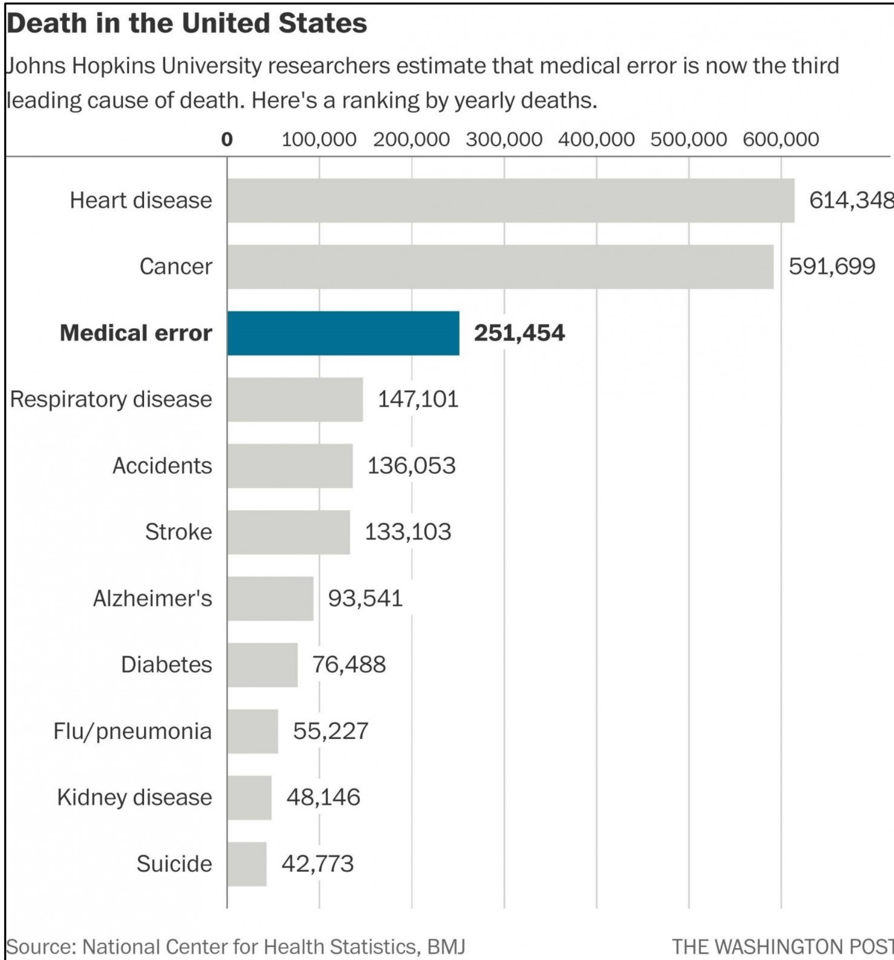
Antti Oulasvirta
Aalto University

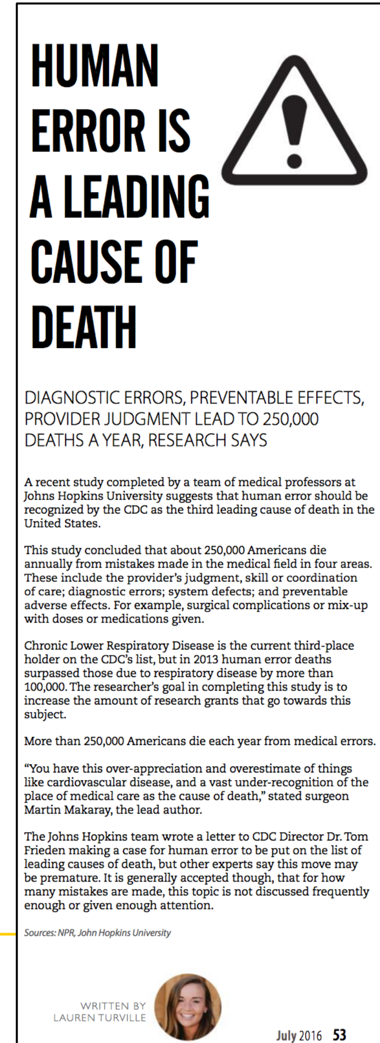
Aalto University

Harold Thimbleby

How will you die?

How will you die?





HUMAN ERROR IS A LEADING CAUSE OF DEATH

DIAGNOSTIC ERRORS, PREVENTABLE EFFECTS, PROVIDER JUDGMENT LEAD TO 250,000 DEATHS A YEAR, RESEARCH SAYS

A recent study completed by a team of medical professors at Johns Hopkins University suggests that human error should be recognized by the CDC as the third leading cause of death in the United States.

This study concluded that about 250,000 Americans die annually from mistakes made in the medical field in four areas. These include the provider's judgment, skill or coordination of care; diagnostic errors; system defects; and preventable adverse effects. For example, surgical complications or mix-up with doses or medications given.

Chronic Lower Respiratory Disease is the current third-place holder on the CDC's list, but in 2013 human error deaths surpassed those due to respiratory disease by more than 100,000. The researcher's goal in completing this study is to increase the amount of research grants that go towards this subject.

More than 250,000 Americans die each year from medical errors.

"You have this over-appreciation and overestimate of things like cardiovascular disease, and a vast under-recognition of the place of medical care as the cause of death," stated surgeon Martin Makaray, the lead author.

The Johns Hopkins team wrote a letter to CDC Director Dr. Tom Frieden making a case for human error to be put on the list of leading causes of death, but other experts say this move may be premature. It is generally accepted though, that for how many mistakes are made, this topic is not discussed frequently enough or given enough attention.

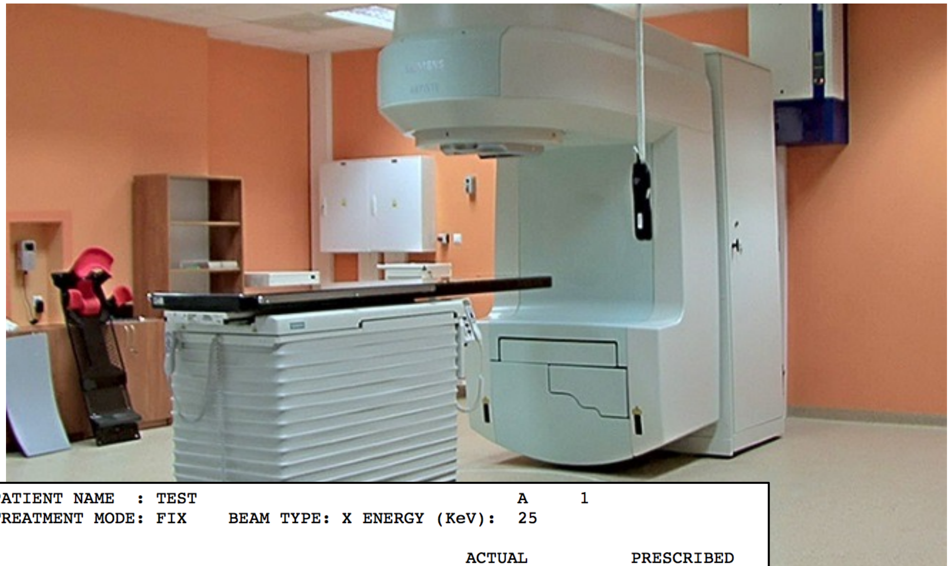
Sources: NPR, John Hopkins University

WRITTEN BY LAUREN TURVILLE

July 2016 53

Note: This claim – originally published in BMJ 2013 - has been contested on methodological grounds

Therac-25 Medical Accelerator - 1985-7



```
PATIENT NAME   : TEST                                A      1
TREATMENT MODE: FIX    BEAM TYPE: X ENERGY (KeV):   25

                                            ACTUAL          PRESCRIBED
          UNIT RATE/MINUTE                 0            200
          MONITOR UNITS               50   50         200
          TIME (MIN)                        0.27           1.00

GANTRY ROTATION (DEG)                0.0              0   VERIFIED
COLLIMATOR ROTATION (DEG)     359.2           359   VERIFIED
COLLIMATOR X (CM)                    14.2          14.3   VERIFIED
COLLIMATOR Y (CM)                    27.2          27.3   VERIFIED
WEDGE NUMBER                              1               1   VERIFIED
ACCESSORY NUMBER                          0              0   VERIFIED

DATE   : 84-OCT-26  SYSTEM: BEAM READY   OP.MODE: TREAT    AUTO
TIME   : 12:55. 8   TREAT : TREAT PAUSE           X-RAY     173777
OPR ID: T25V02-R03 REASON: OPERATOR      COMMAND:
```

Figure A. Operator interface screen layout.

"An operator involved in an overdose accident testified that she had become insensitive to machine malfunctions. Malfunction messages were commonplace, most did not involve patient safety. Service technicians would fix the problems or the hospital physicist would realign the machine and make it operable again."

http://courses.cs.vt.edu/professionalism/Therac_25/Therac_1.html

Three Mile Island accident - 1979

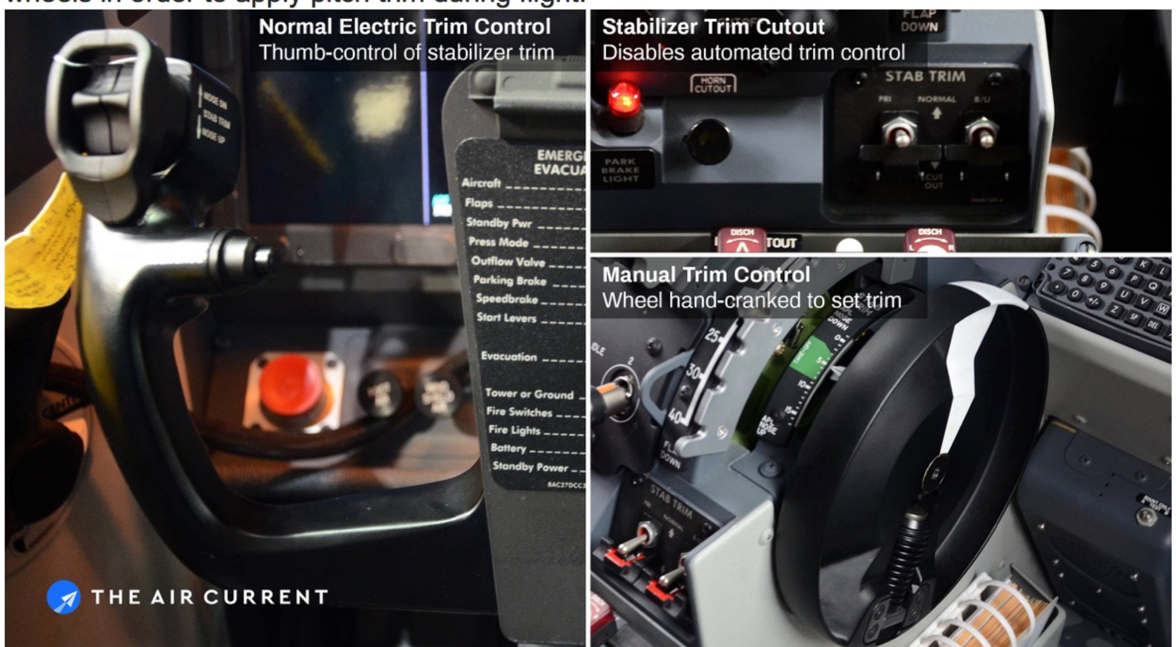
“Despite the valve being stuck open, a light on the control panel ostensibly indicated that the valve was *closed*. In fact the light did not indicate the position of the valve, only the status of the solenoid being powered or not, thus giving false evidence of a closed valve. As a result, the operators did not correctly diagnose the problem for several hours.”

Grounding of Royal Majesty - 1995

moment at high angles of attack that did not meet FAA longitudinal stability and stick force certification standards. The easiest fix was to automatically apply a little nose down trim at high angles of attack.

A few things that *should* disable it (with caveats)

1. **Lower the flaps**. It is intended to work only if the flaps are up.
2. **Turn the Stab Trim switches to OFF**. This disables the horizontal stabilizer's trim completely, and reverts to manual trim (there are two guarded stabilizer trim switches in the aisle stand, see Windshear's answer). This means that the pilots must move/rotate the trim wheels in order to apply pitch trim during flight.



The manual pitch trim appears to be what a few crews did prior to the LionAir crash in October 2018. It is unclear how many of the crews knew that it was MCAS, versus any other trim or pitch anomaly. The previous LionAir crews on the accident aircraft ended up flying to

Human error

- Intentions
- Norms

- An inappropriate or undesirable human decision or behavior that reduces or has the potential to reduce effectiveness, safety, or system performance
- A human action/decision that exceeds system tolerances
- ”An action is taken that was ‘not intended by the actor; not desired by a set of rules or an external observer; or that led the task or system outside its acceptable limits”

(Senders & Moray, 1991, p. 25 as cited in Proctor & van Zandt, 1994, p. 43).

Poor design is a preventable and therefore unacceptable cause of death

Investigation reports

Aviation

Railroad

Investigation reports by year

2022 Investigations

2021 Investigations

2020 Investigations

2019 Investigations

2018 Investigations

2017 Investigations

2016 Investigations

2015 Investigations

2014 Investigations

2013 Investigations

2012 Investigations

2011 Investigations

2010 Investigations

2009 Investigations

2008 Investigations

Entry page » Investigation reports » Railroad » Investigation reports by year » 2017 Investigations » R2017-03 Level crossing accident which led to four deaths at Raasepori on 26 October 2017

R2017-03 Level crossing accident which led to four deaths at Raasepori on 26 October 2017

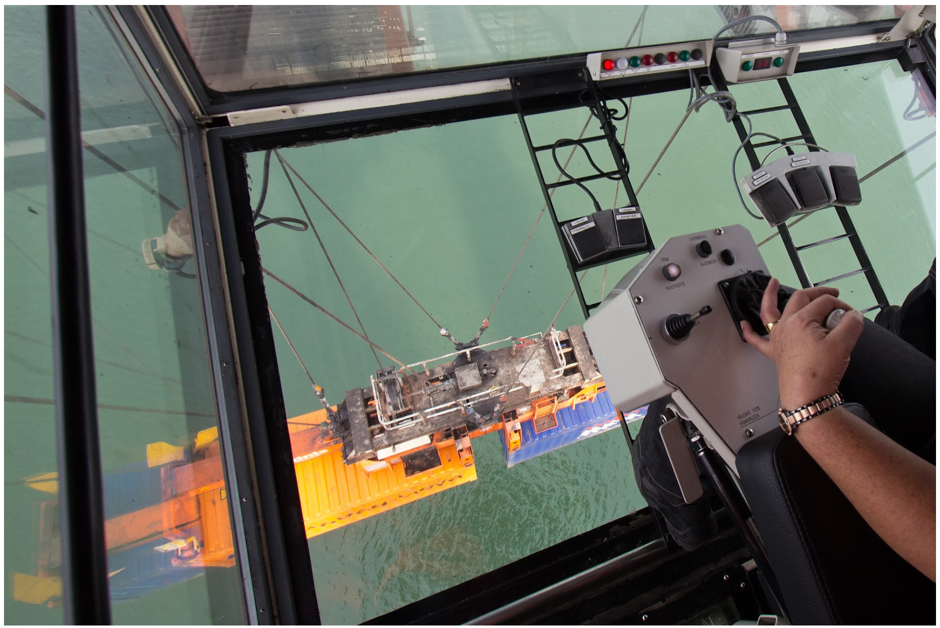
Investigation ID:	R2017-03
Type of accident:	Level crossing accidents
Date of publication:	7.6.2018

A rail bus travelling from Karjaa to Hanko collided with a Defence Forces high mobility terrain vehicle in Skogby, Raasepori, at an unprotected level crossing at 8am on Thursday 26 October 2017. A pioneer unit from the Uusimaa Brigade was engaged in an attack exercise, moving vehicles from Skogby to Syndalen in Hanko. There were eight conscripts in the high mobility terrain vehicle: three in the cabin and five on the platform. In addition to the driver, 15 passengers were travelling on the rail bus.

The conscripts in the cabin of the high mobility terrain vehicle did not notice the approaching train and did not hear its warning sound. There was insufficient time to reduce the speed of the rail bus, despite emergency braking by the train driver. The collision was serious. The conscripts travelling on the high mobility terrain vehicle were thrown out of the vehicle. Three conscripts and one rail bus passenger were killed in the accident. Three conscripts were seriously injured and two were slightly injured. Some rail bus passengers suffered minor injuries. The Defence Forces high mobility terrain vehicle was completely wrecked in the accident and the nose section of the rail bus was damaged. The total costs caused by the accident were around €270,000.

Skogby's level crossing was particularly dangerous due to the angle of the track and road and the lack of warning devices. From the cabin in the high mobility terrain vehicle, it was difficult to see the train approaching at an angle from the rear. The section of line had a speed limit of 120km/h. A lower train speed would give train and vehicle drivers more time to react and take action as they approach a level crossing, and would reduce the damage in possible collisions.

Topics today



1. Complex systems
2. Human error
3. SRK
4. RCA

Aalto University

1. Complex systems

In this section

Complex systems in general

What makes them brittle: The human factor

Understanding failure

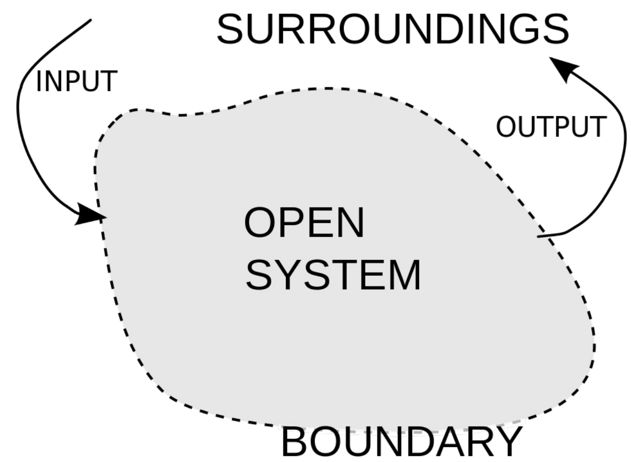
Q: Name a very complex (technological) system

Q: What is a complex system?

Q: Name a very complex system that does NOT involve a human operator/user

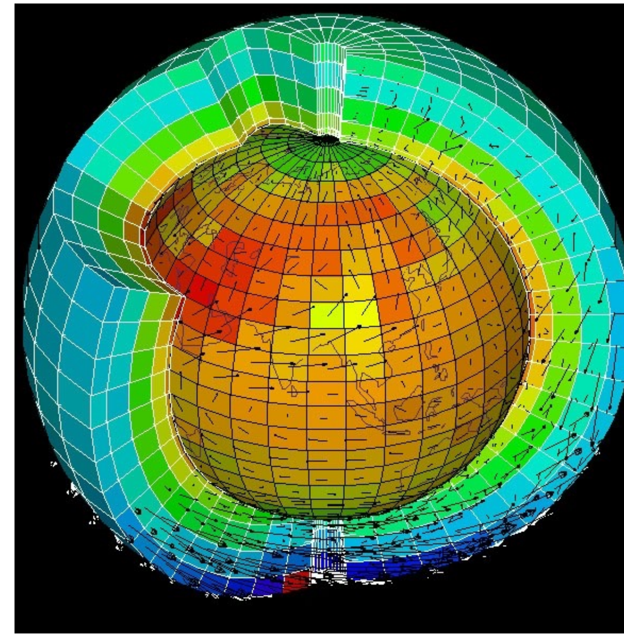
What is a system?

- A system is (1) a set of elements and (2) their interactions that form a whole
- It is defined by means of a boundary which determines entities that are not part of the system
- A system can exhibit system-level behaviors that do not reduce to its elements



Complex system

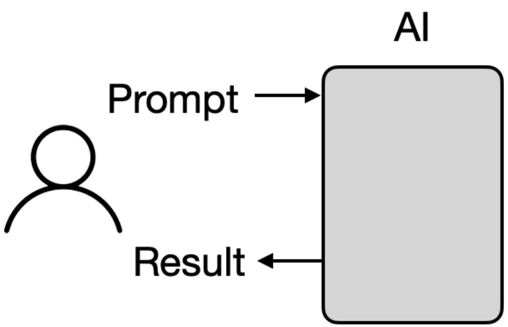
- **A system composed of many components**
- **Components interact with each other.**
- **Behavior is hard to predict**
- **Have emergent properties, such as nonlinearity, spontaneous order, adaptation, feedback loops, stability, attractors, ...**



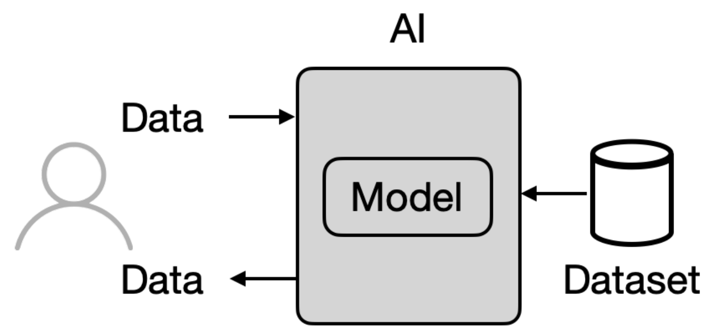
Example: A climate model

Example: What is “generative AI”?

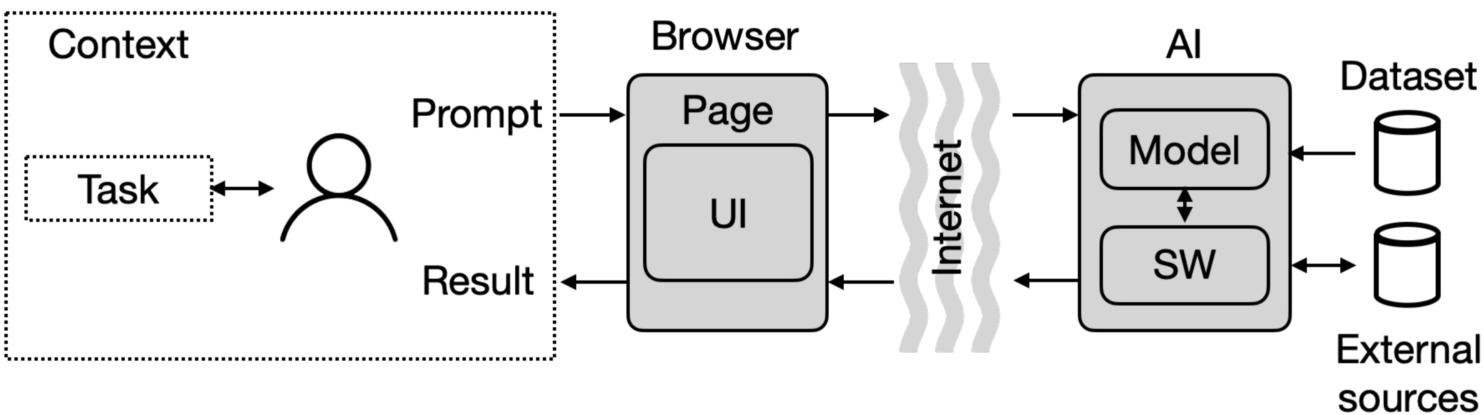
(a) User interaction



(b) ML algorithm



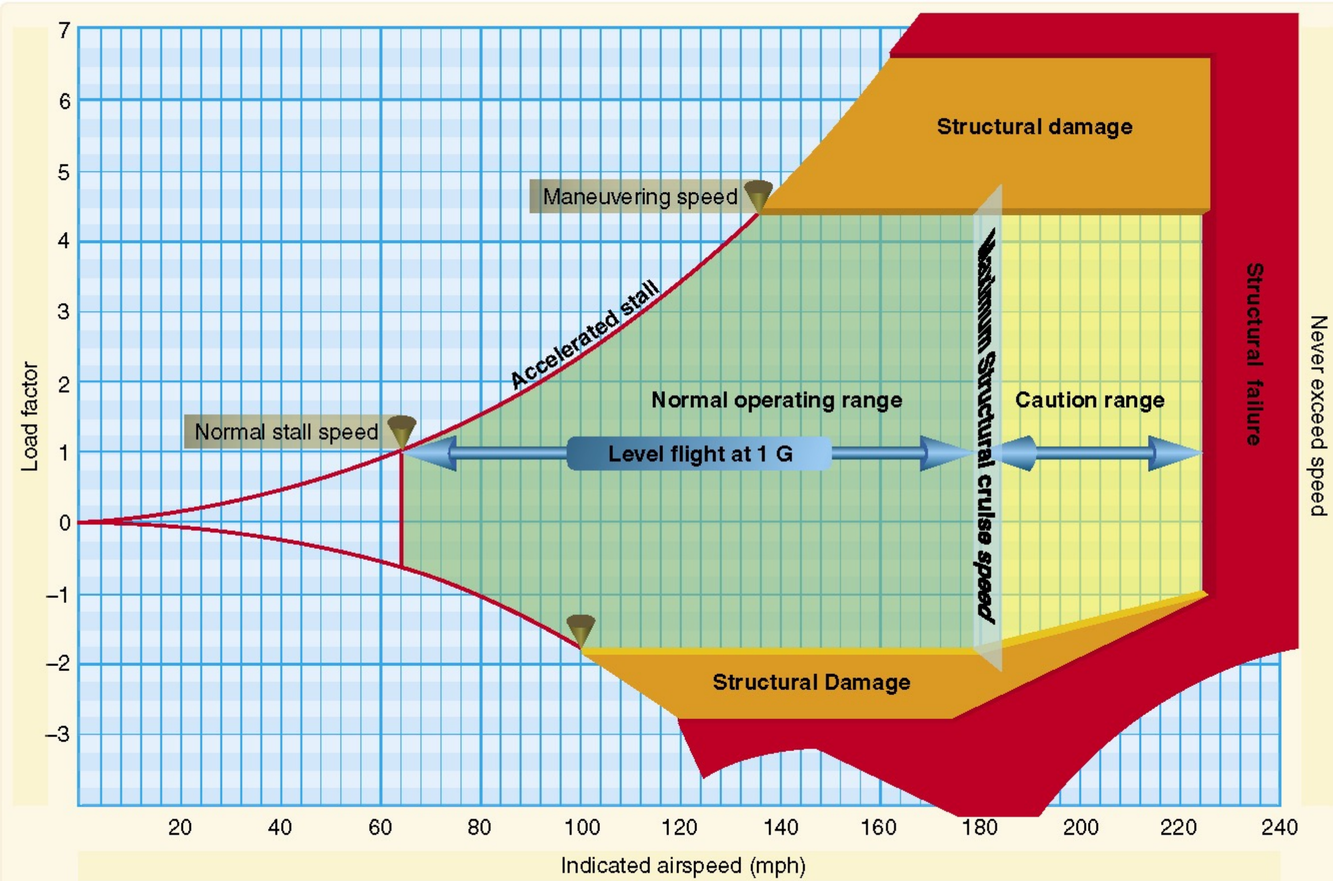
(c) Systems



Aalto University

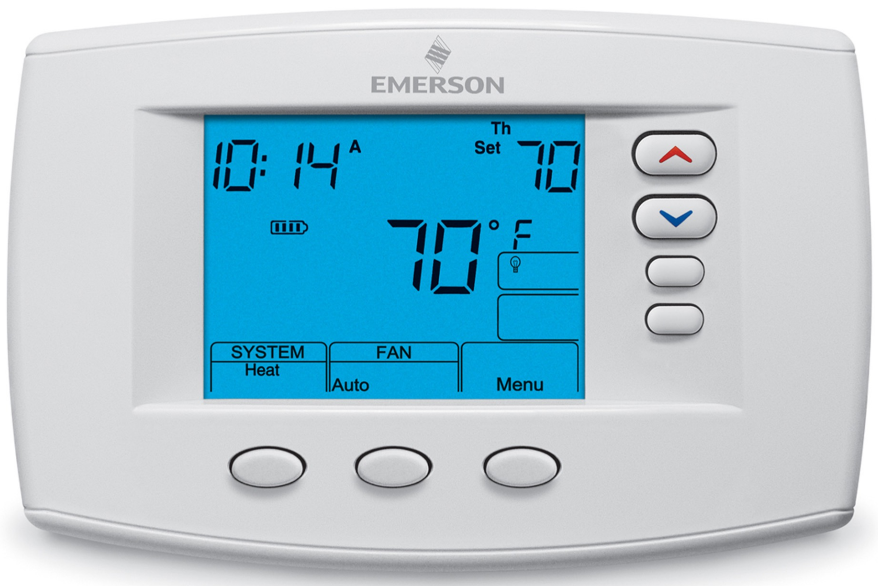
Humans and complex systems

1. Users face a multi-dimensional operating envelope

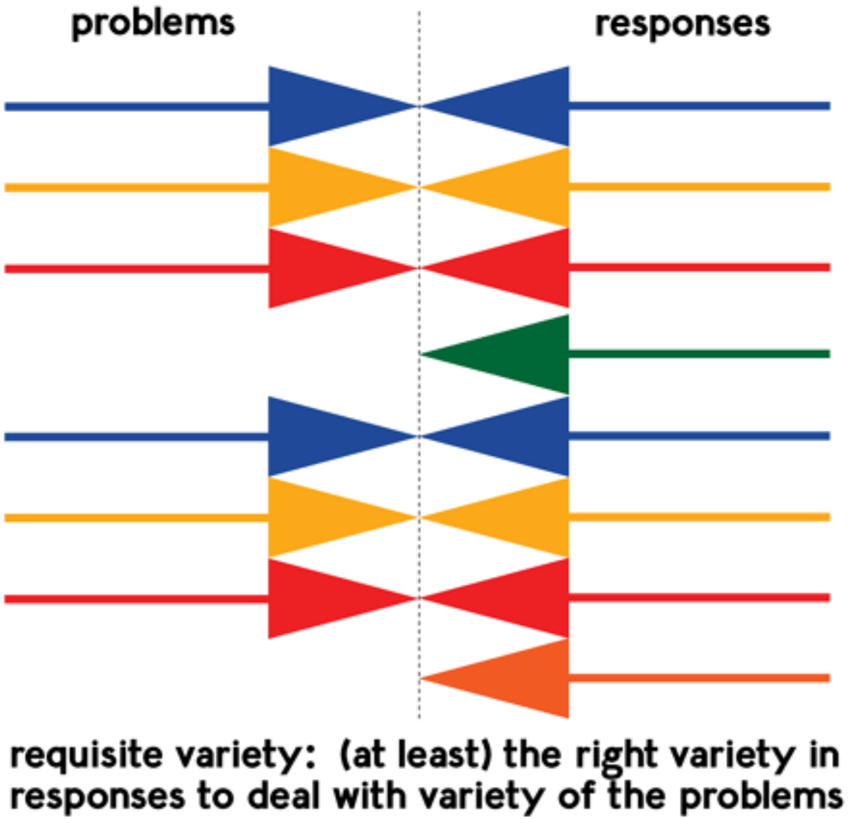


2. To control a complex system, a matching level of complexity in the controller (human) is needed

Example: Thermostat



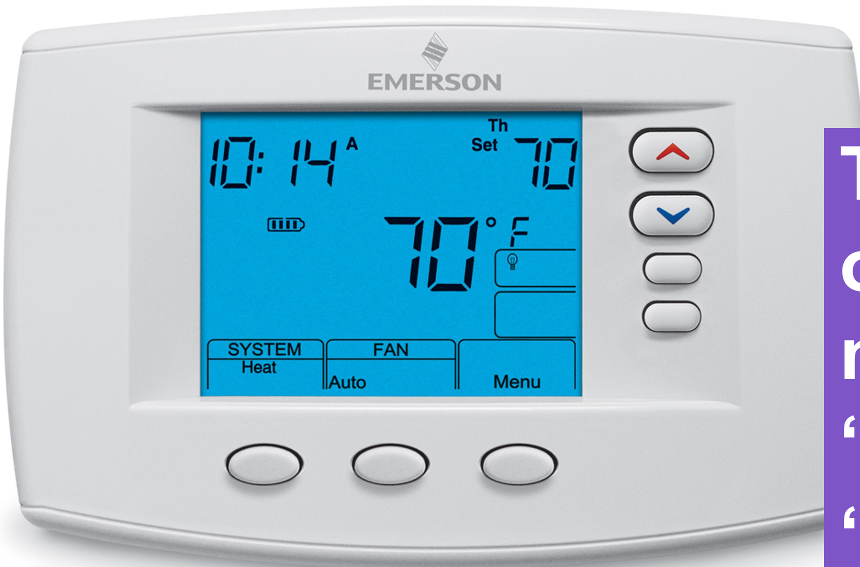
Law of Requisite Variety



A successful control system (e.g., user) must be capable of entering at least as many states as the system being controlled: "only variety can force down variety" (W. Ross Ashby 1956).

Roger Conant: "Every good regulator of a system must be a model of that system"

Law of Requisite Variety in practice



To set a desirable level of temperature, the user needs to predict how "Set temperature", "Fan", and "System" affect the experienced temperature together with the room climate

Why do people fail to match requisite variety?

Lack of skill

Lack of knowledge

Lack of awareness

Poor judgment

Unsafe acts, errors, mistake

Overreliance on automation

Automation surprises

....

Aalto University

Understanding failure

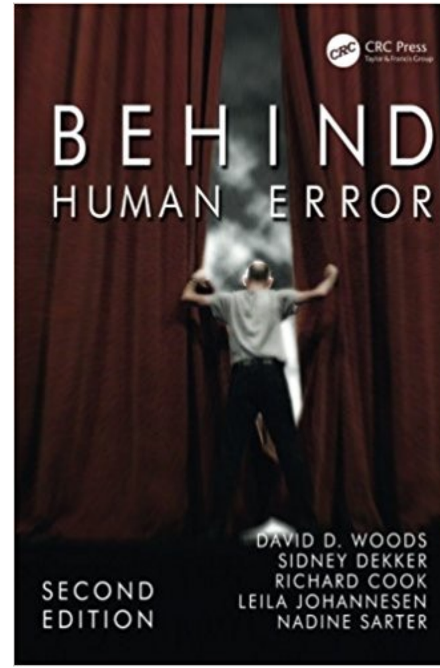
Good to Know

Richard I. Cook

How Complex Systems Fail (2002)

The Complexity of Human Error (1994)

Behind Human Error (2010)



1. Complex systems are intrinsically risky

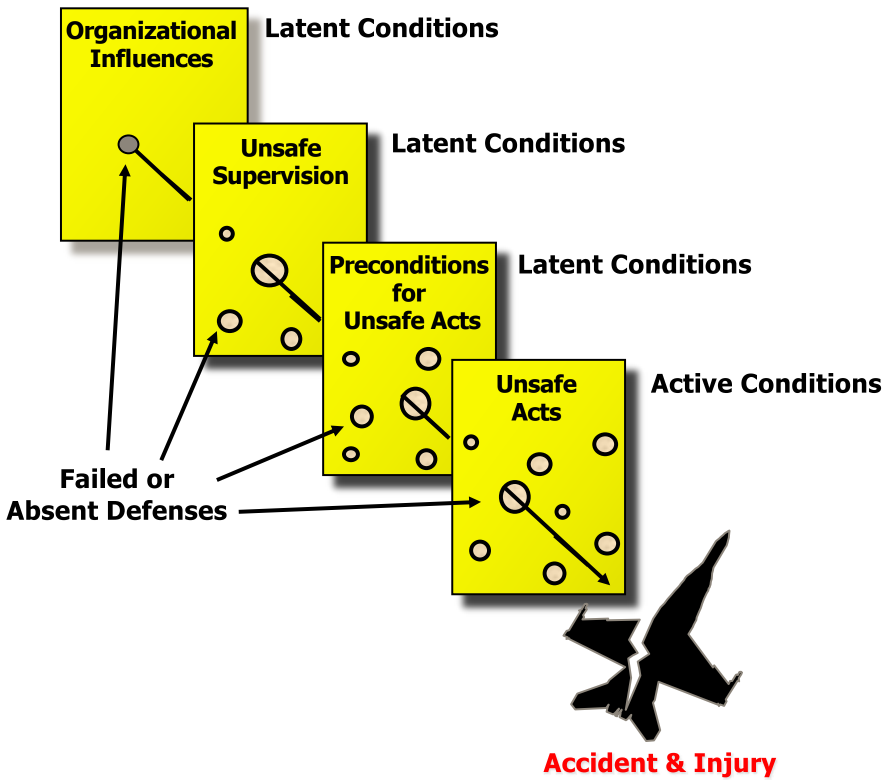
The presence of risk drives the creation of defenses against it.
Think: Healthcare, power plants, banking, aeroplanes, ...

2. Successful systems have *multiple* defenses against failure

Technical (testing, backup systems), human factors (UI design, training), and legal defenses

3. Catastrophes involve multiple failures

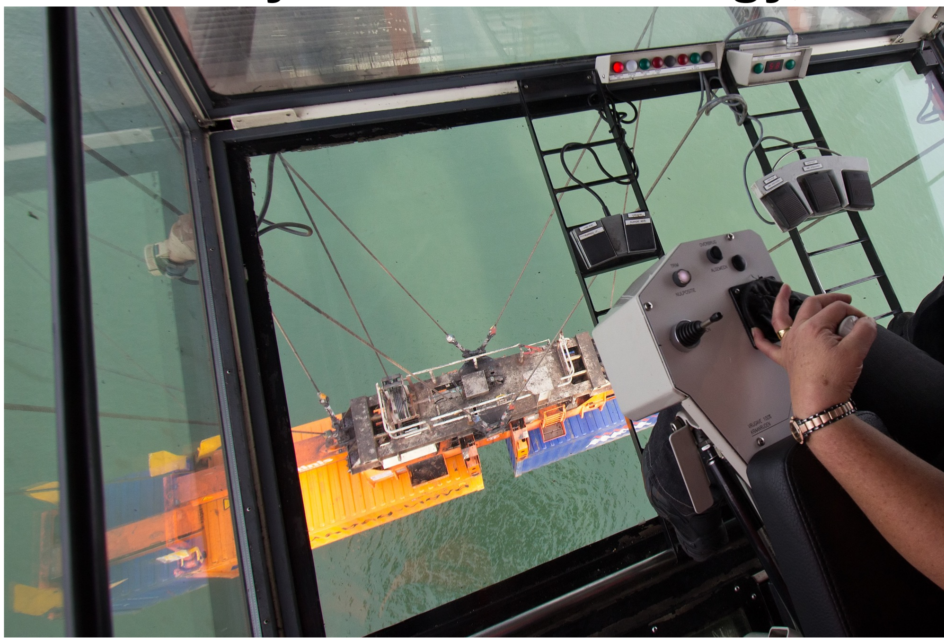
There are more failure opportunities than actual failures



"The Swiss cheese model"

4. Complex systems always involve multiple latent potentials for failure

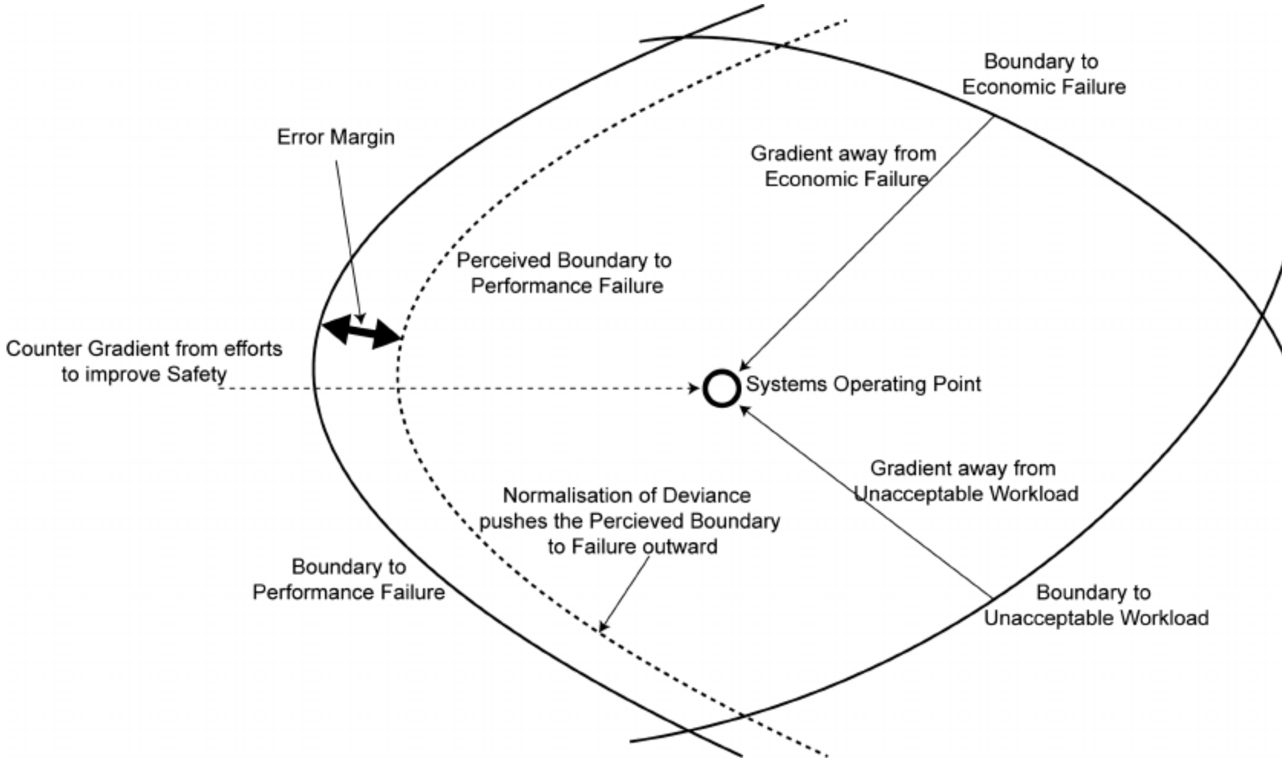
All failures impossible to remove. The failures change constantly due to technology, human practices, and R&D



Aalto University

5. Complex systems often operate close to failure point

Complex systems are often run as broken systems, which is possible due to multiple redundancies.



6. Post-accident attribution to a “root cause” is challenging and can be misleading

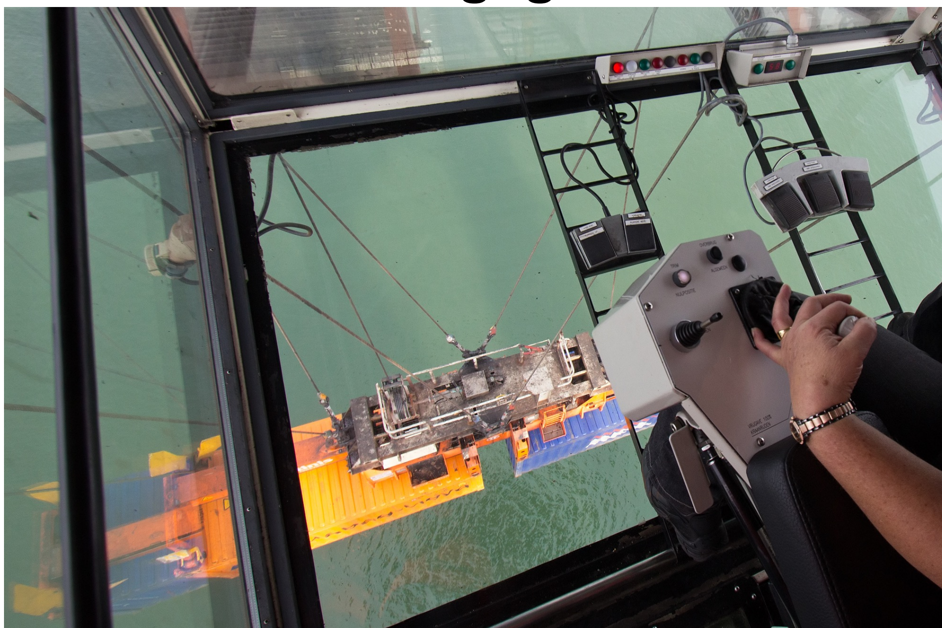
Isolated causes for accidents are often politically motivated attempts at “blaming”

7. Hindsight biases post-accident assessment

Knowledge of the outcome makes it seem that events leading to the outcome should have appeared more salient to practitioners at the time than was actually the case.

8. Human operators both produce and defend against failures

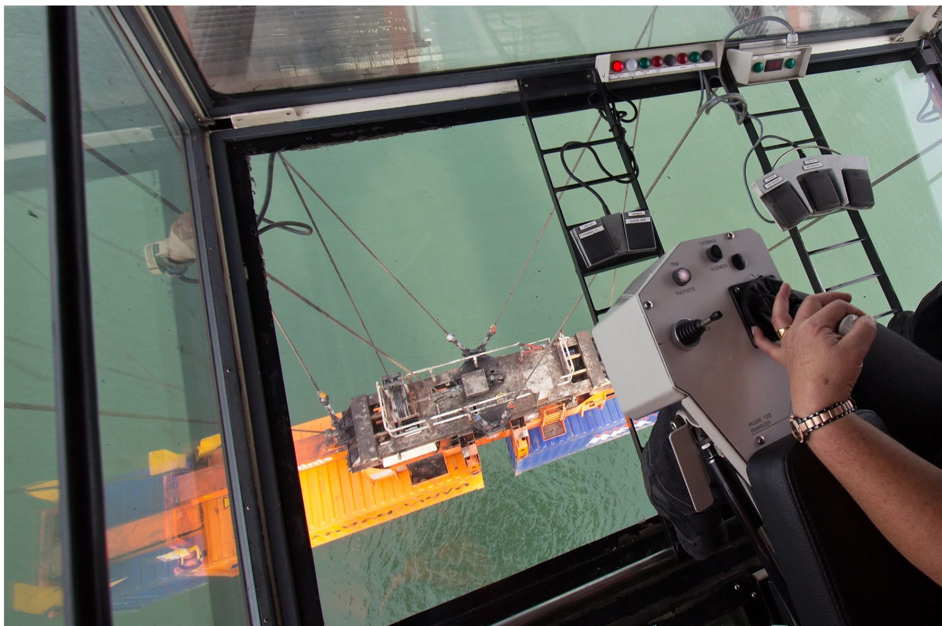
An outsider may misapprehend the operator's constant, simultaneous engagement with both roles.



Aalto University

9. Practitioner actions are *gambles*

Practitioner actions take place in the face of uncertain outcomes. The degree of uncertainty may change.



10. Humans are the most adaptable element of complex systems

These adaptations include:

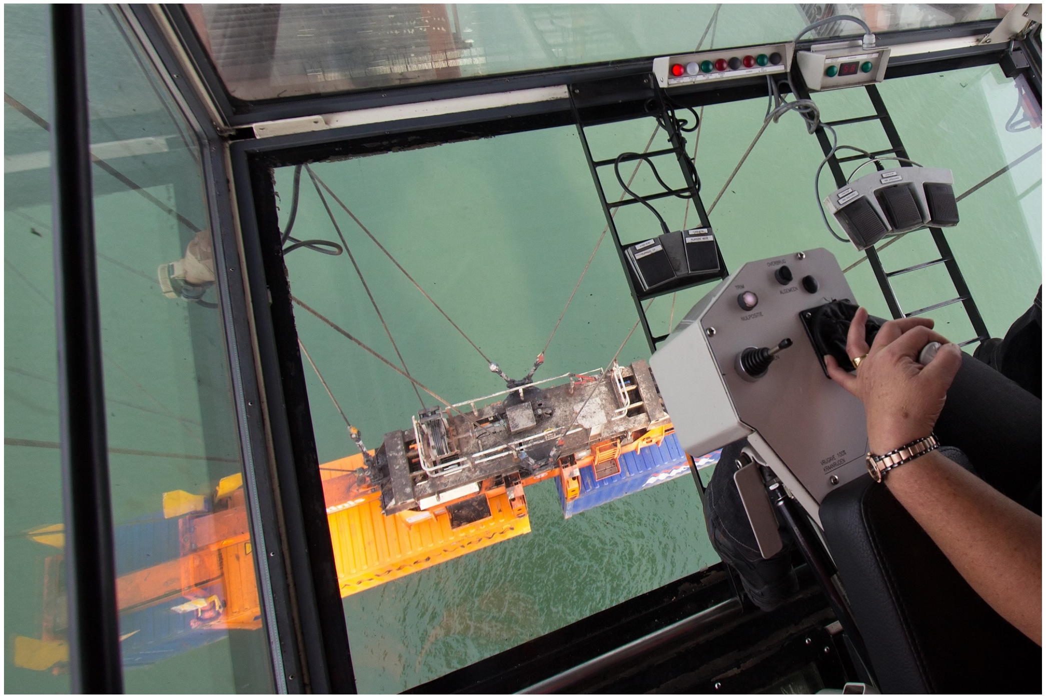
(1) Restructuring the system in order to reduce exposure of vulnerable parts to failure.

(2) Concentrating critical resources in areas of expected high demand.

(3) Providing pathways for retreat or recovery from expected and unexpected faults.

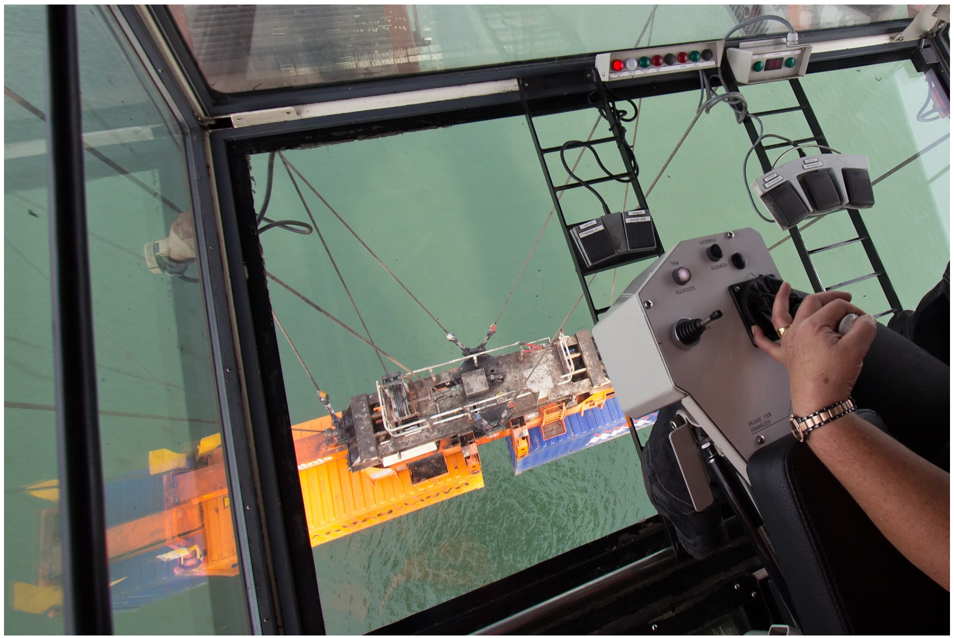
(4) Establishing means for early detection of changed system performance in order to allow graceful cutbacks in production or other means of increasing resiliency.

11. Changes introduce *new* causes for failure



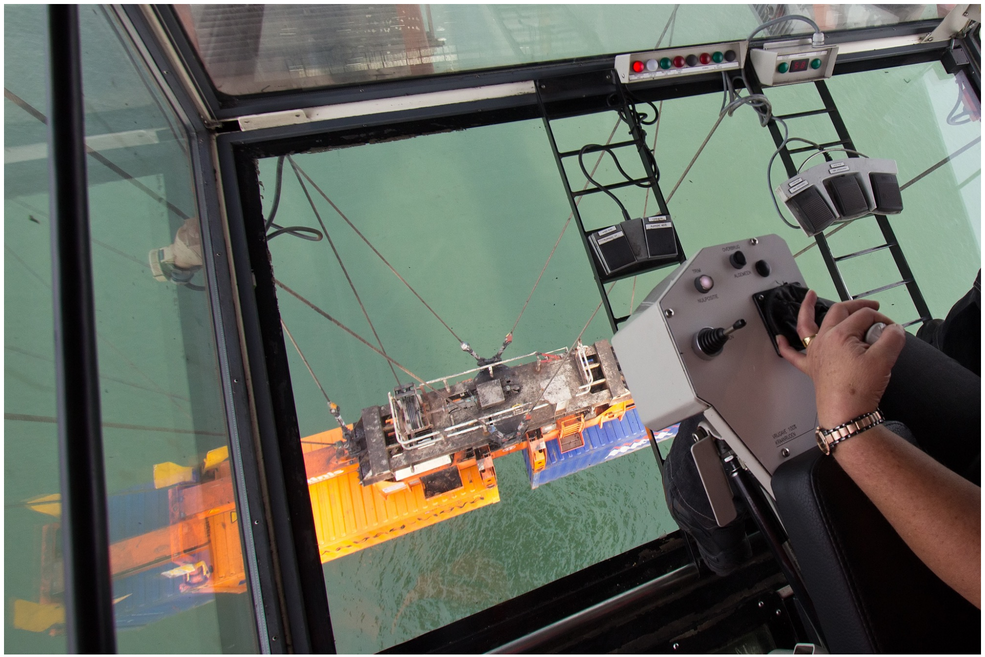
When new technologies are used to eliminate well understood system failures or to gain high precision performance they often introduce new pathways to large scale, catastrophic failures.

12. Failure-free operations require experience with failure



More robust system performance arises in systems where operators discern the "edge of the envelope". This is where system performance begins to deteriorate, becomes difficult to predict, or cannot be readily recovered.

13. “Safety” is characteristic of joint human-system performance



Safety is an emergent property of systems; it does not reside in a person, device or department of an organization or system

"Normal accidents"

System accidents are *normal and inevitable* in extremely complex systems.

Multiple failures interact with each other and errors will occur, despite efforts to avoid them.

Many failures are rooted in organization culture and have very small beginnings.

Accidents *will* happen. With good design, we can minimize their severity and probability, though.

Aalto University

2. Human Error

Definition: Human error

An error is a failure of achieving the intended outcome in a planned sequence of mental or physical activities (Reason, 1992)

Several decades of research

Taxonomy 1/3: Stages of human error

1. Activation/detection of system state signal
2. Observation and data collection
3. Identification of system state
4. Interpretation of situation
5. Definition of objectives
6. Evaluation of alternative strategies
7. Procedure selection
8. Procedure execution

Taxonomy 2/3: Action errors

- **Intrusion** – entering a dangerous area / location
- **Commission** – performing an act incorrectly
- **Omission** – failure to due something
- **Reversal** – trying to stop or undo a task already initiated
- **Misordering** – task or set of task performed in the wrong sequence
- **Mistiming** – person fails to perform the action within the time allotted

Taxonomy 3/3: Memory failures

Losing ones place

Forgetting intentions

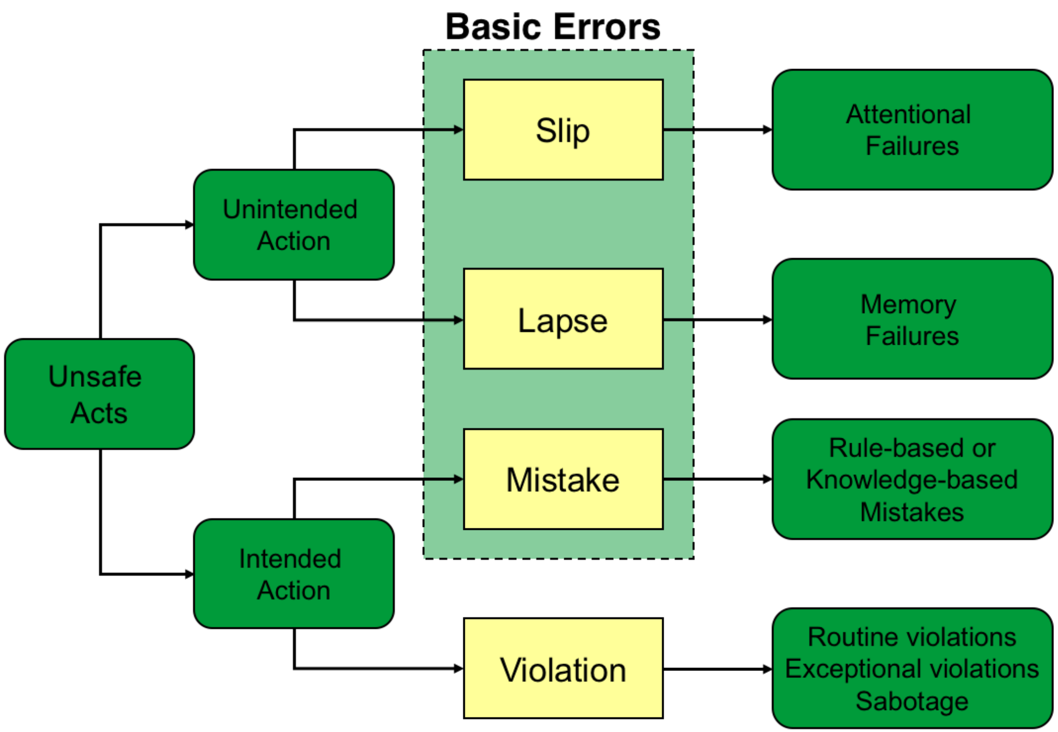
Application of a bad rule

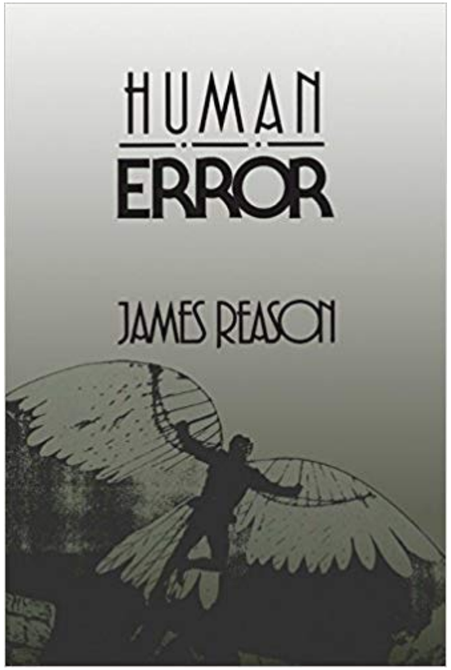
> "I' m in a public space in view of many people, therefore I won' t be robbed."

Misapplication of a good rule

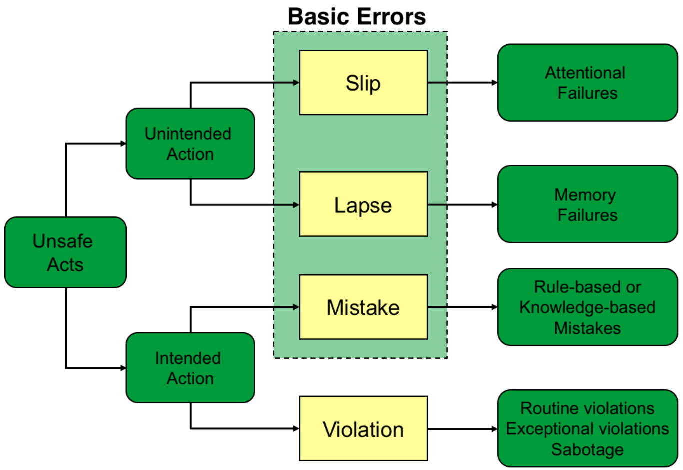
> "A patient on chronic medication became concerned about addiction and therefore deliberately stop taking the drug for a period each year even though the drug in question was not addictive."

James Reason’s taxonomy of error

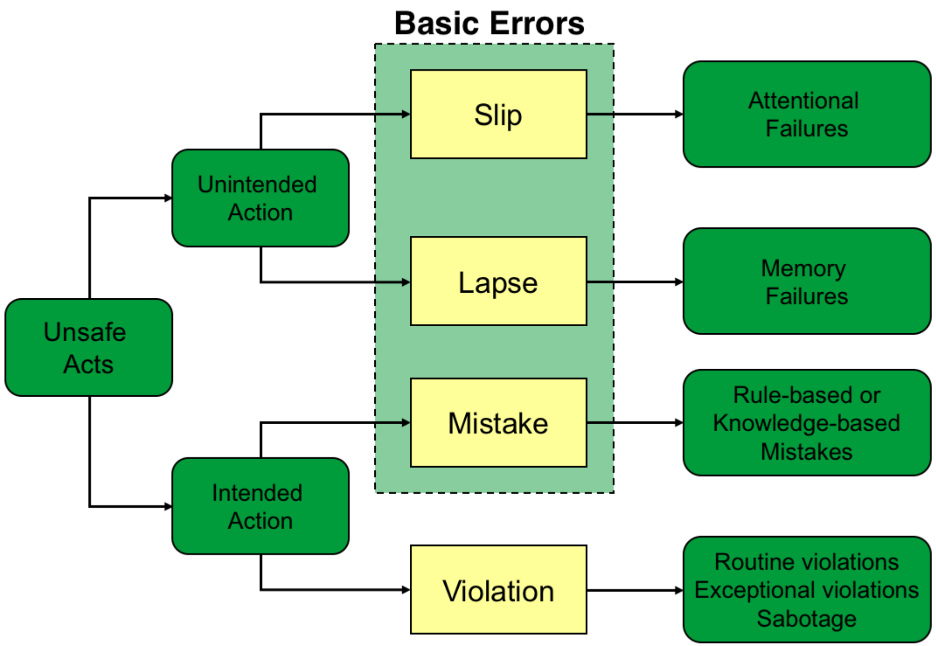




Example: Typing



E3.A. Pick an app and generate an example of every error type (10 mins)



Aalto University

Automation and Human Error

Q: What kinds of tasks should be given to a machine vs. human?

(replacement) trivializes the effects of automation!

Levels of automation

TABLE 2.1: A Scale of Degrees of Automation

1. The computer offers no assistance; the human must do it all.
2. The computer suggests alternative ways to do the task.
3. The computer selects one way to do the task and
4. executes that suggestion if the human approves, or
5. allows the human a restricted time to veto before automatic execution, or
6. executes the suggestion automatically, then necessarily informs the human, or
7. executes the suggestion automatically, then informs the human only if asked.
8. The computer selects the method, executes the task, and ignores the human.

Q: Automation levels: Setting the temperature of an industrial freezer?

TABLE 2.1: A Scale of Degrees of Automation

1. The computer offers no assistance; the human must do it all.
2. The computer suggests alternative ways to do the task.
3. The computer selects one way to do the task and
4. executes that suggestion if the human approves, or
5. allows the human a restricted time to veto before automatic execution, or
6. executes the suggestion automatically, then necessarily informs the human, or
7. executes the suggestion automatically, then informs the human only if asked.
8. The computer selects the method, executes the task, and ignores the human.

SAE **J3016™** LEVELS OF DRIVING AUTOMATION™

Learn more here: sae.org/standards/content/j3016_202104

	SAE LEVEL 0™	**SAE LEVEL 1™**	**SAE LEVEL 2™**	**SAE LEVEL 3™**	**SAE LEVEL 4™**	**SAE LEVEL 5™**
What does the human in the driver's seat have to do?	**You <u>are</u> driving** whenever these driver support features are engaged – even if your feet are off the pedals and you are not steering			**You <u>are not</u> driving** when these automated driving features are engaged – even if you are seated in "the driver's seat"		
	You must constantly supervise these support features; you must steer, brake or accelerate as needed to maintain safety			When the feature requests, you must drive	These automated driving features will not require you to take over driving	
	These are driver support features			**These are automated driving features**		
What do these features do?	These features are limited to providing warnings and momentary assistance	These features provide steering **OR** brake/acceleration support to the driver	These features provide steering **AND** brake/acceleration support to the driver	These features can drive the vehicle under limited conditions and will not operate unless all required conditions are met		This feature can drive the vehicle under all conditions
Example Features	• automatic emergency braking • blind spot warning • lane departure warning	• lane centering **OR** • adaptive cruise control	• lane centering **AND** • adaptive cruise control at the same time	• traffic jam chauffeur	• local driverless taxi • pedals/steering wheel may or may not be installed	• same as level 4, but feature can drive everywhere in all conditions

Studies of autopilot

Boeing 727

Ironies of automation

”Even highly automated systems, such as electric power networks, need human beings… one can draw the paradoxical conclusion that automated systems still are man-machine systems, for which both technical and human factors are important”

Lisa Bainbridge 1984

Known consequences of bad automation

Bainbridge's ”Ironies of automation”

1. misunderstanding or missing feedback
2. misunderstanding operating logic
3. overreliance
4. lack of trust
5. mixed-initiative conflict
6. alienation
7. deskilling
8. denying responsibility

Immediate causes of human-automation failures

Brittle automation: Only responds to a narrow set of situations

Combination with information outside the system

Unavailable warning about reaching the limits of automation

Insufficient feedback about the state of the automation

Inadequate interpretation of device state by operator

Mode confusion: Inability to keep track of and predict device state

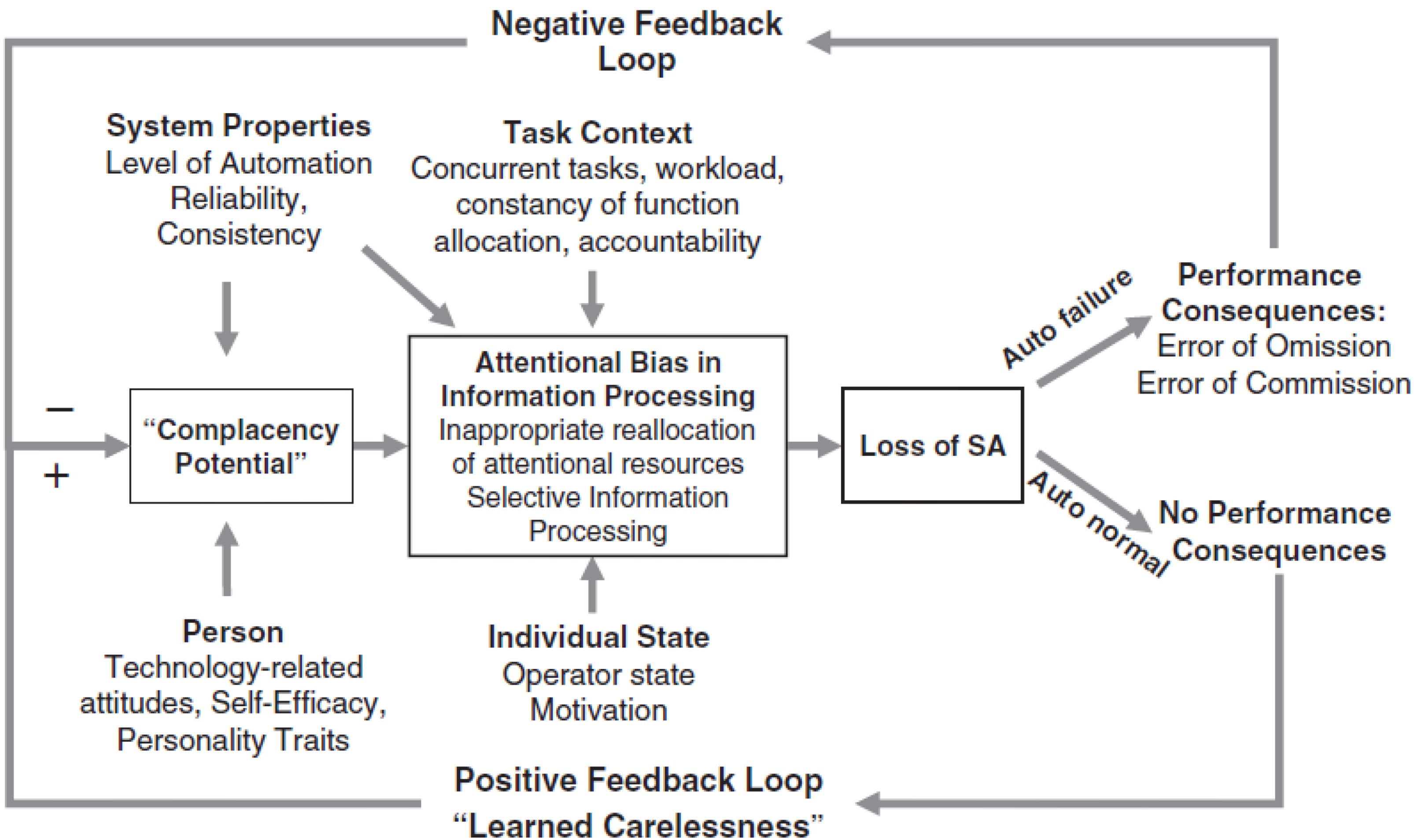
Overreliance on automation, habit-formation

Deskilling

Loss of vigilance

Learned carelessness

SA = situation awareness



Asiana Flight 2013

Overreliance on automation caused fatigue

Air France Flight 447 2009

“The official cause of the accident was the freezing of the pitot tubes which caused the autopilot to disconnect. The aircraft switched from normal law to alternate law with no stall protection on control inputs. The misdiagnosis of the situation led to the pilot demanding full nose up.”

Checklists and SOPs

Checklist for Anaesthetic Equipment 2012

AAGBI Safety Guideline

Checks at the start of every operating session
Do not use this equipment unless you have been trained

Check self-inflating bag available

Perform manufacturer's (automatic) machine check

Power supply	• Plugged in • Switched on • Back-up battery charged
Gas supplies and suction	• Gas and vacuum pipelines – 'tug test' • Cylinders filled and turned off • Flowmeters working (if applicable) • Hypoxic guard working • Oxygen flush working • Suction clean and working
Breathing system	• Whole system patent and leak free using 'two-bag' test • Vaporisers – fitted correctly, filled, leak free, plugged in (if necessary) • Soda lime - colour checked • Alternative systems (Bain, T-piece) – checked • Correct gas outlet selected
Ventilator	• Working and configured correctly
Scavenging	• Working and configured correctly
Monitors	• Working and configured correctly • Alarms limits and volumes set
Airway equipment	• Full range required, working, with spares

RECORD THIS CHECK IN THE PATIENT RECORD

Don't Forget!	• Self-inflating bag • Common gas outlet • Difficult airway equipment • Resuscitation equipment • TIVA and/or other infusion equipment

This guideline is not a standard of medical care. The ultimate judgement with regard to a particular clinical procedure or treatment plan must be made by the clinician in the light of the clinical data presented and the diagnostic and treatment options available.

Tesla autopilot fails (no warnings)

Aalto University

https://www.youtube.com/watch?v=VVJSjeHDvfY

TABLE 2.2: Some Criteria of Human-Centered Automation (and Reasons to Question Them)

1. Allocate to the human the tasks best suited to the human, and allocate to the automation the tasks best suited to it. (Unfortunately, there is no consensus on how to do this; nor is the allocation policy necessarily fixed, but may depend on context.)
2. Keep the human operator in the decision-and-control loop. (This is good only for intermediate-bandwidth tasks. The human is too slow for high bandwidth and may fall asleep if bandwidth is too low.)
3. Maintain the human operator as the final authority over the automation. (Humans are poor monitors, and in some decisions it is better not to trust them; they are also poor decision makers when under time pressure and in complex situations.)
4. Make the human operator's job easier, more enjoyable, or more satisfying through friendly automation. (Operator ease, enjoyment, and satisfaction may be less important than system performance.)

5. Empower or enhance the human operator to the greatest extent possible through automation. (Power corrupts.)
6. Support trust by the human operator. (The human may come to overtrust the system.)
7. Give the operator computer-based advice about everything he or she should want to know. (The amount and complexity of information is likely to overwhelm the operator at exactly the worst time.)
8. Engineer the automation to reduce human error and minimize response variability. (A built-in margin for human error and experimentation helps the human learn and not become a robot; see Rasmussen, Pedersen, & Goodstein, 1995.)
9. Make the operator a supervisor of subordinate automatic control systems. (Sometimes straight manual control is better than supervisory control.)
10. Achieve the best combination of human and automatic control, where best is defined by explicit system objectives. (Rarely does a mathematical objective function exist.)

Expertise and adaptability as the rule

Assign roles based on information processing requirements

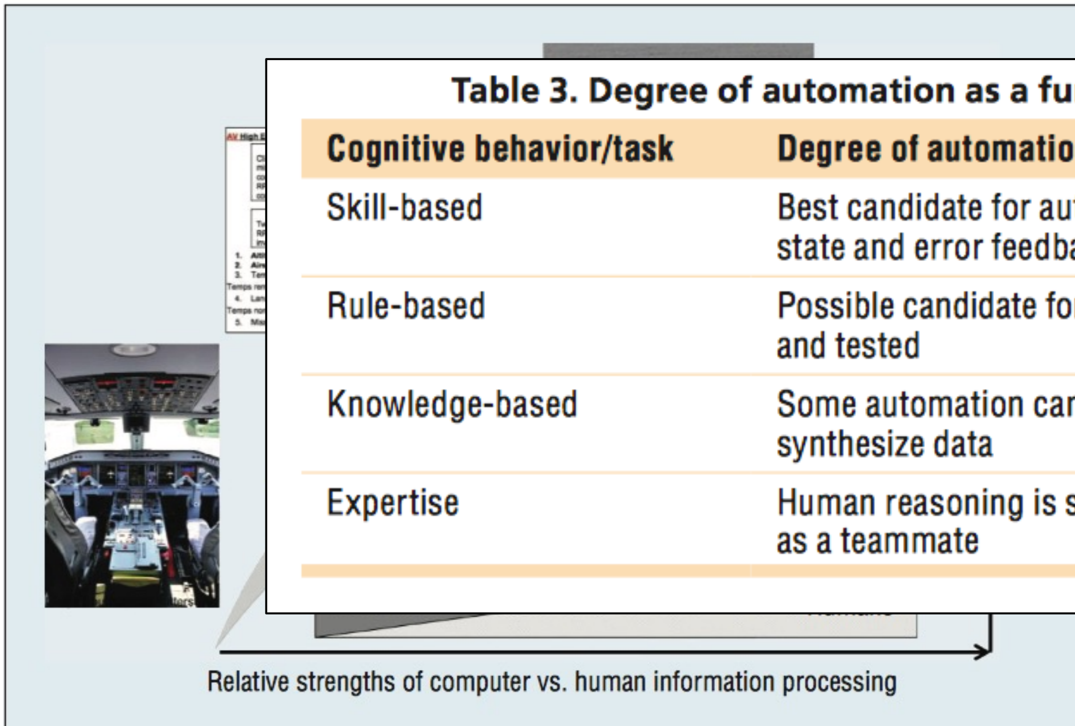
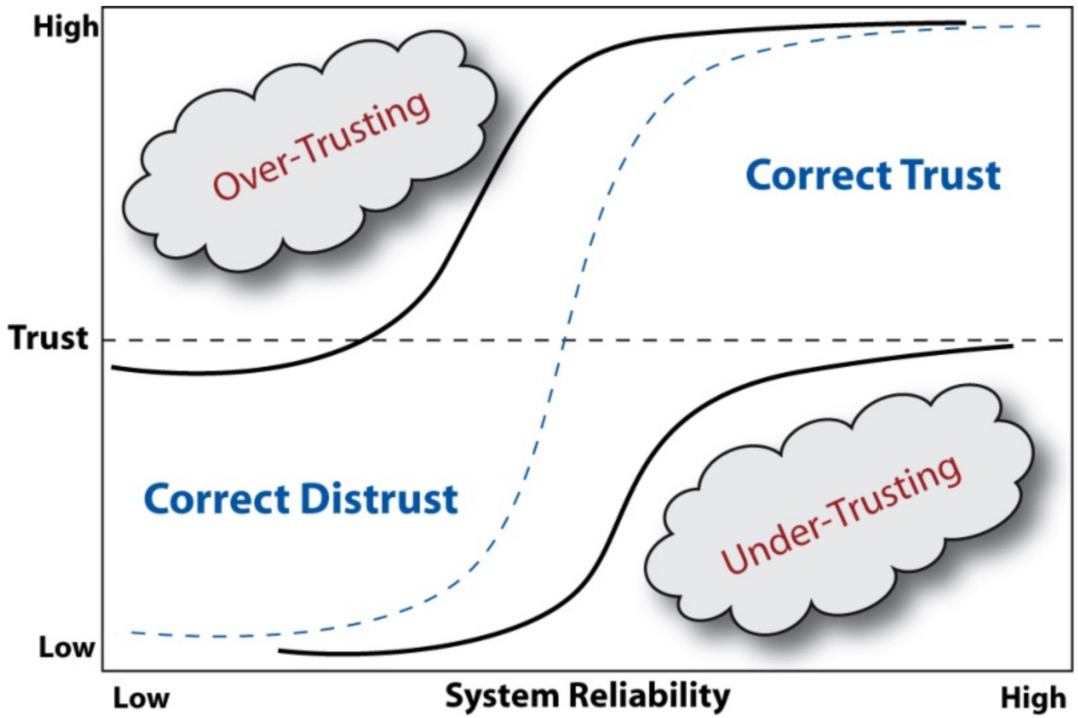


Table 3. Degree of automation as a function of a desired behavior.

Cognitive behavior/task	Degree of automation
Skill-based	Best candidate for automation, assuming reliable sensors for state and error feedback
Rule-based	Possible candidate for automation, if rule set is well-established and tested
Knowledge-based	Some automation can be used to help organize, filter, and synthesize data
Expertise	Human reasoning is superior, but can be aided by automation as a teammate

Figure 2. Role allocation for information processing behaviors (skill, rule, knowledge, and expertise) and the relationship to uncertainty.

Calibration of trust

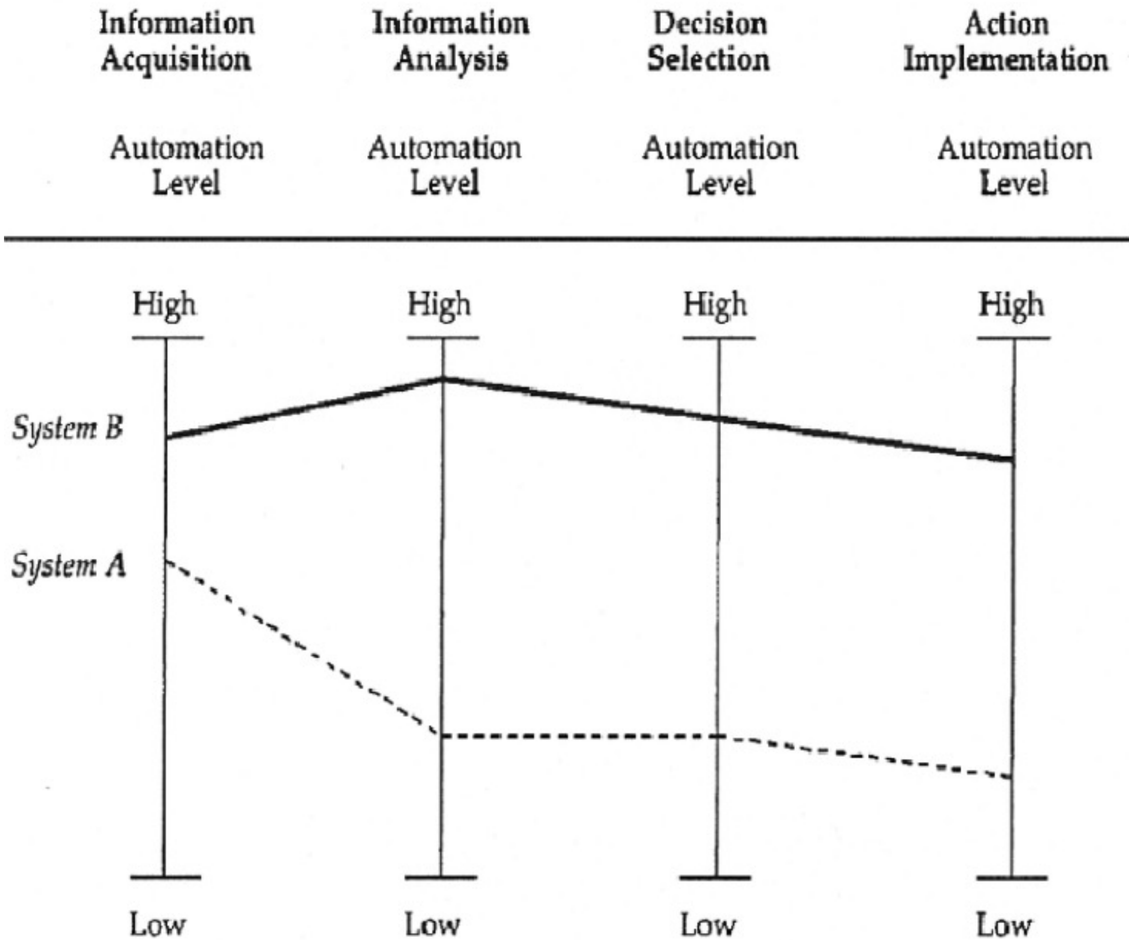


Levels of automation theory: Revisited

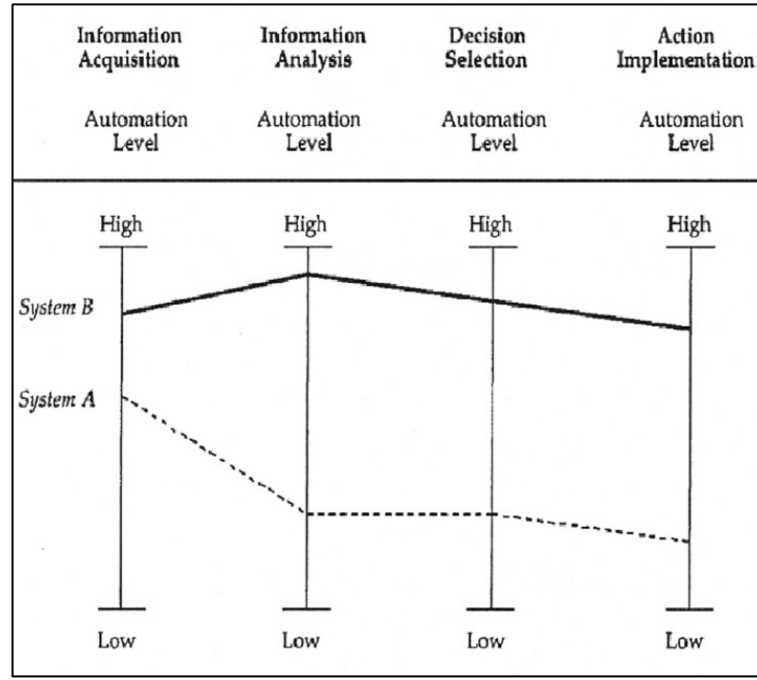
TABLE 2.1: A Scale of Degrees of Automation

1. The computer offers no assistance; the human must do it all.
2. The computer suggests alternative ways to do the task.
3. The computer selects one way to do the task and
4. executes that suggestion if the human approves, or
5. allows the human a restricted time to veto before automatic execution, or
6. executes the suggestion automatically, then necessarily informs the human, or
7. executes the suggestion automatically, then informs the human only if asked.
8. The computer selects the method, executes the task, and ignores the human.

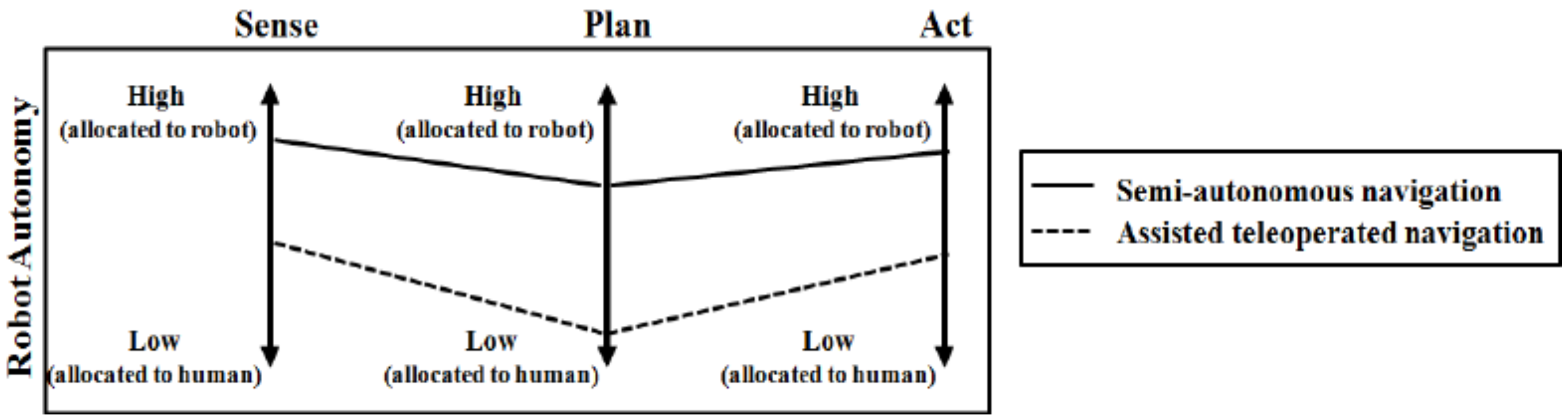
A temporal breakdown of LoA



Q: Roomba: Which level at which stage?



Automation allocation in human-robot interaction



Aalto University

3. SRK

Skills, Rules, Knowledge

Rasmussen's SRK: Skills, Rules, Knowledge

Example from power plant operation

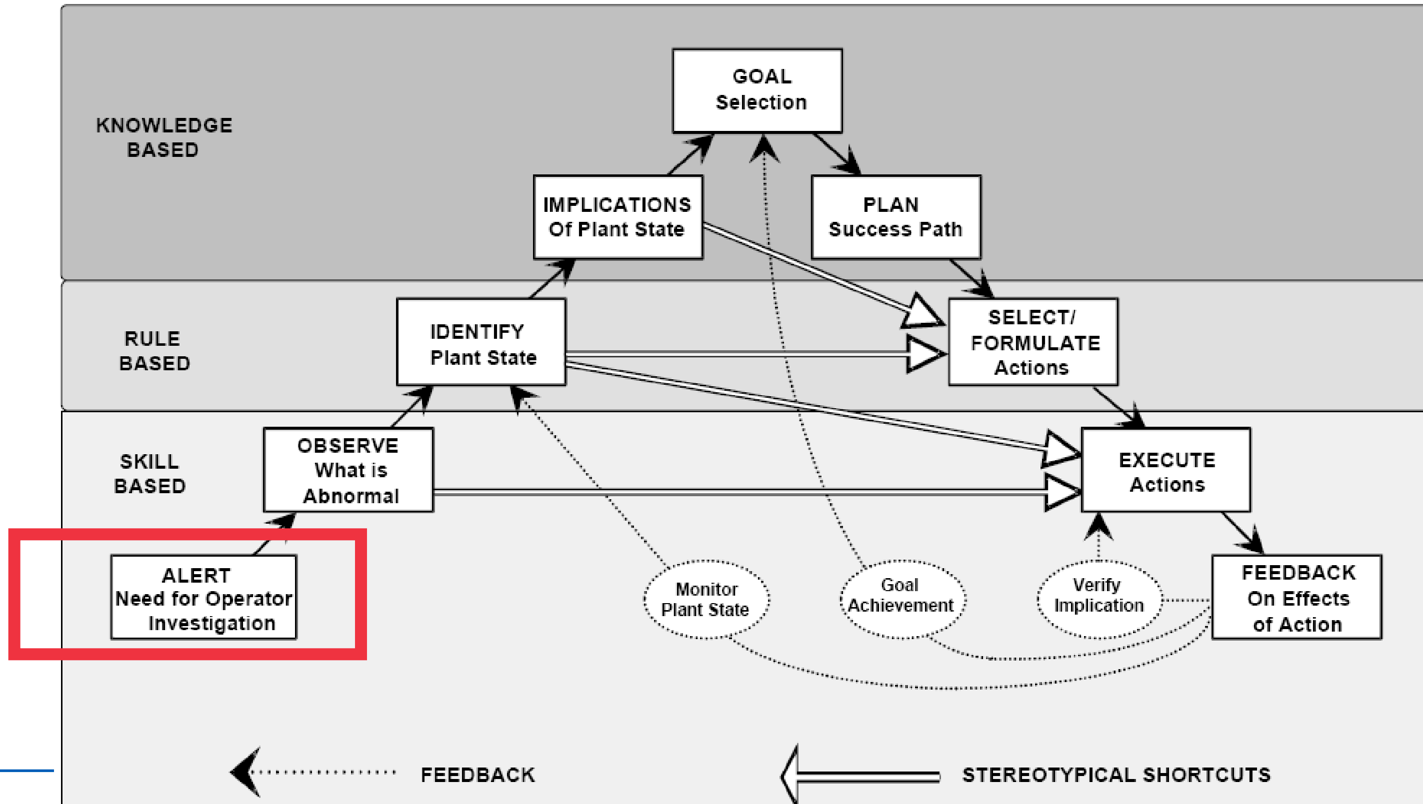


Figure 5: Decision-Making Model (adapted from Rasmussen) including Feedback

E3.B (10 min)

Draw an SRK diagram getting a Roomba to go to the kitchen

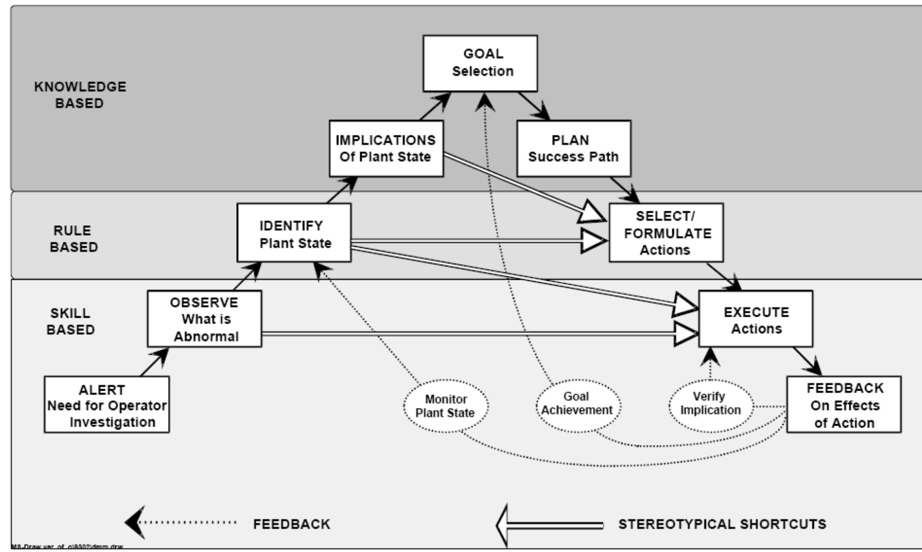


Figure 5: Decision-Making Model (adapted from Rasmussen) including Feedback

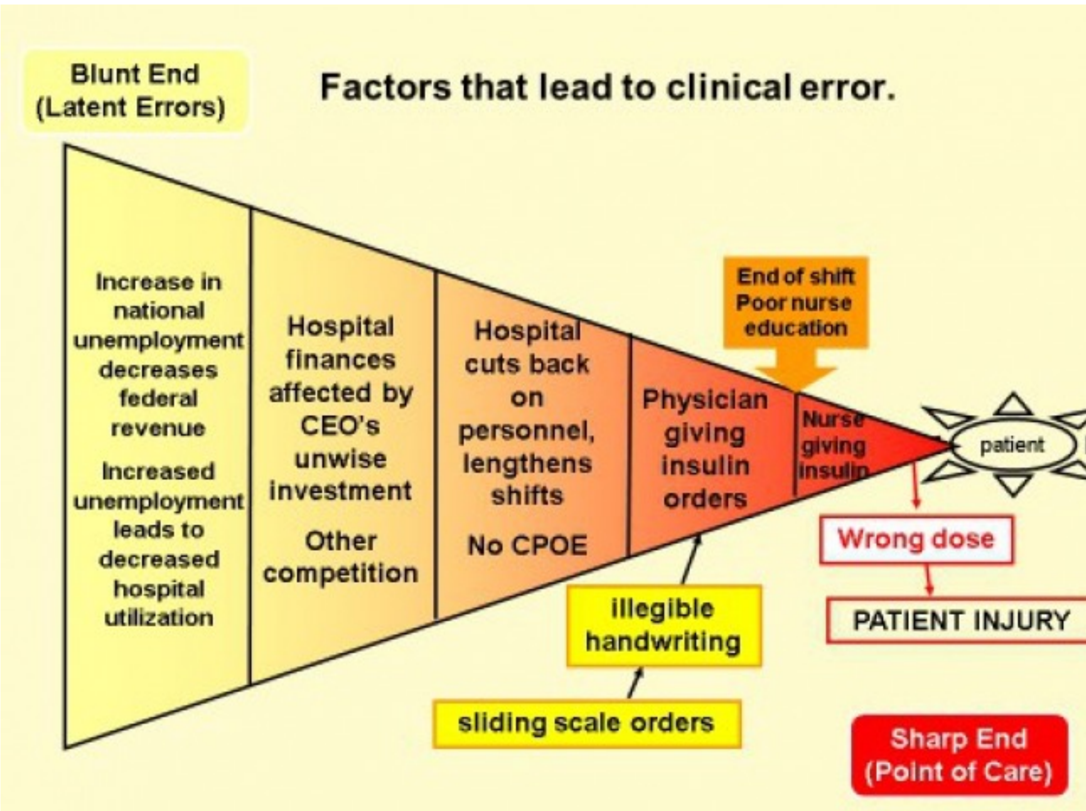
Aalto University

4. Root cause analysis

Risk vs. accident analysis
Pre vs. post risk analysis

Sharp end vs. blunt end

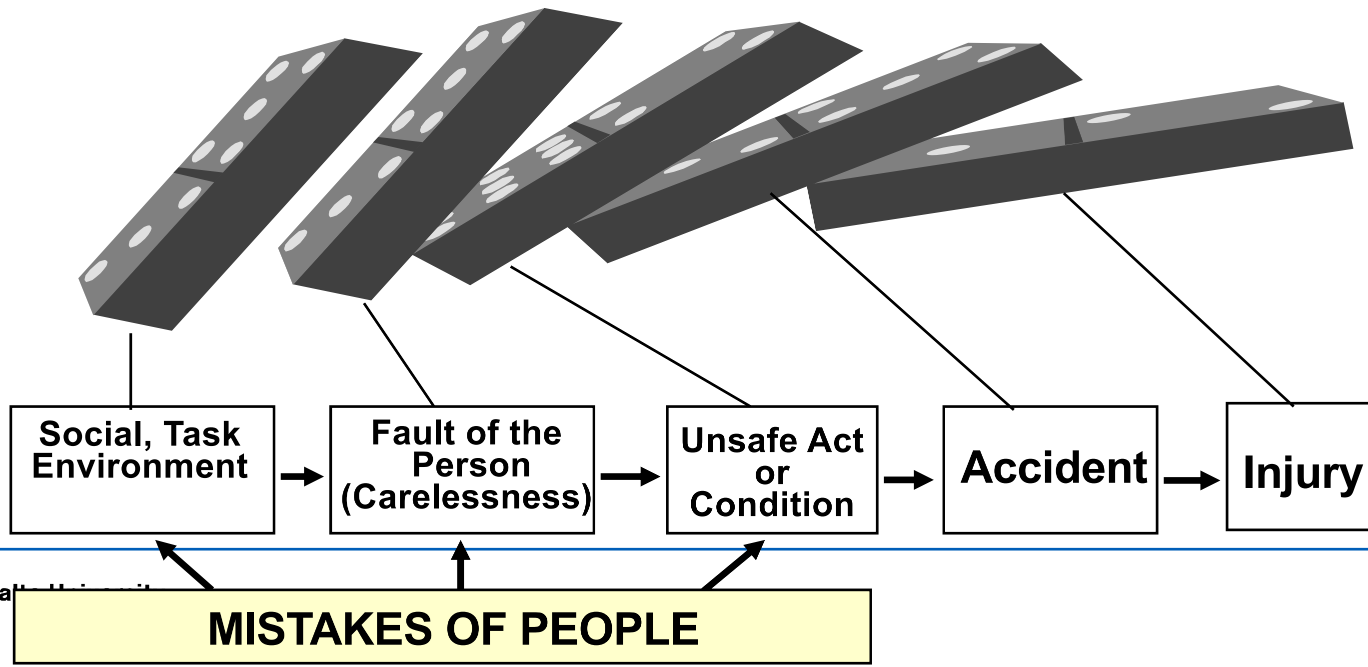
Visible errors only part of the causal chain. The goal of analysis is to identify the LATENT factors



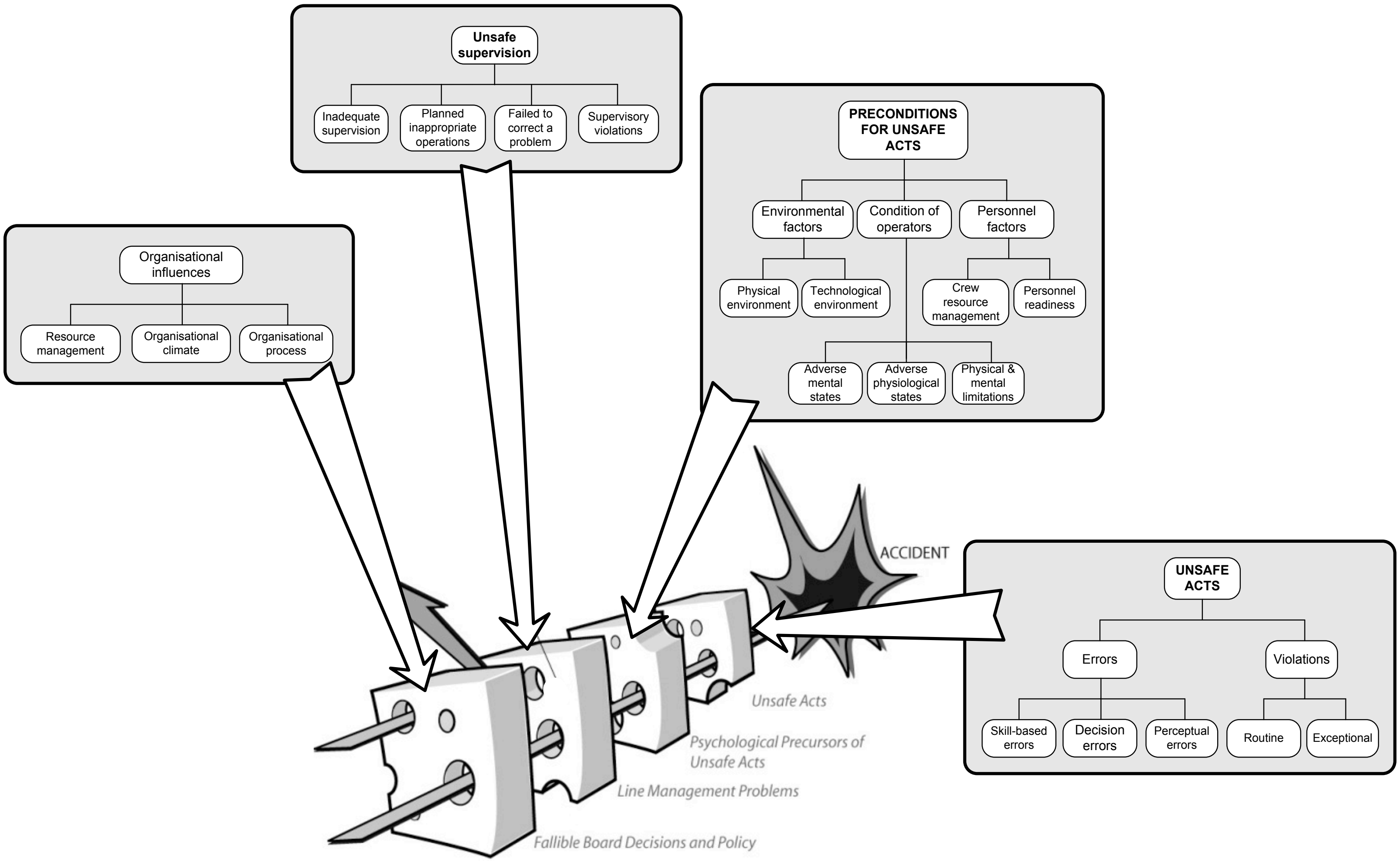
Domino theory

1932 First Scientific Approach to Accident/Prevention - H.W. Heinrich

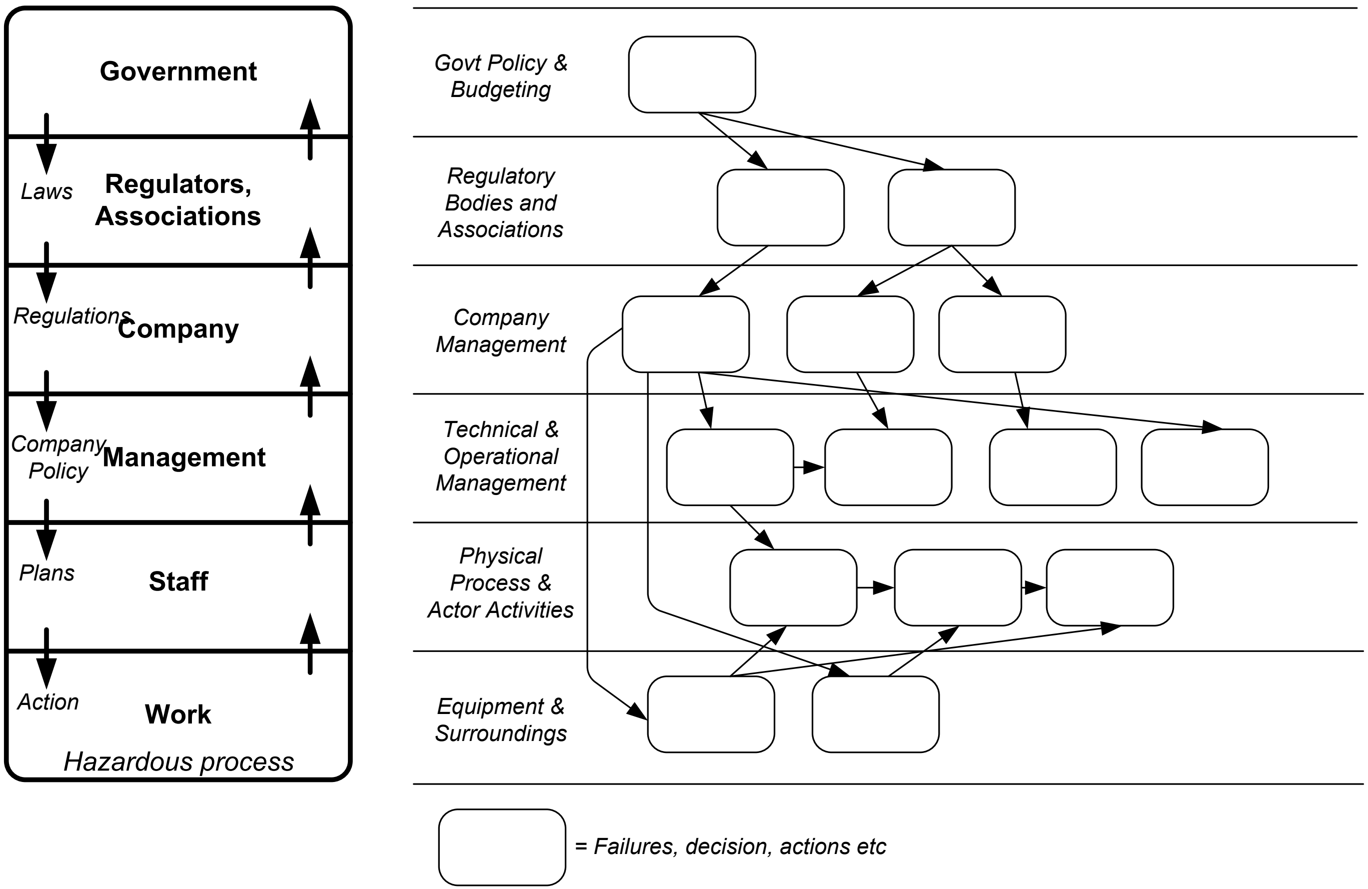
“Industrial Accident Prevention”



“The Swiss Cheese model”



Accimap method for risk management and accident analysis (Rasmussen)



Root Cause Analysis (RCA)

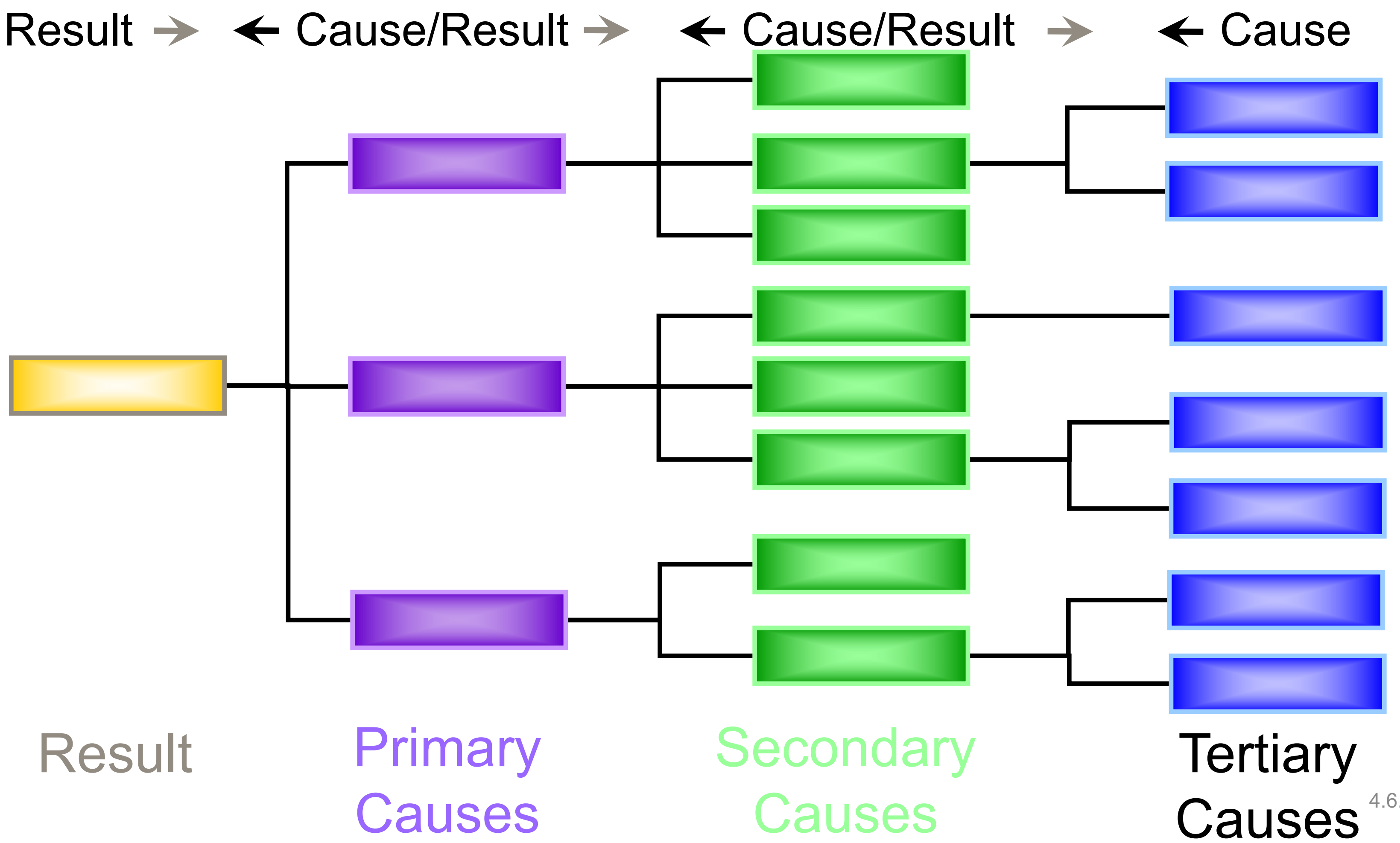
A tool

1. to prevention, not punishment, of adverse events
2. for building a “culture of safety”

A process

1. for identifying basic or contributing causes
2. for identifying what can be done to prevent recurrence
3. for measuring and tracking outcomes

RCA: Tree diagram



How the Boeing 737 Max Disaster Looks to a Software Developer

Design shortcuts meant to make a new plane seem like an old, familiar one are to blame

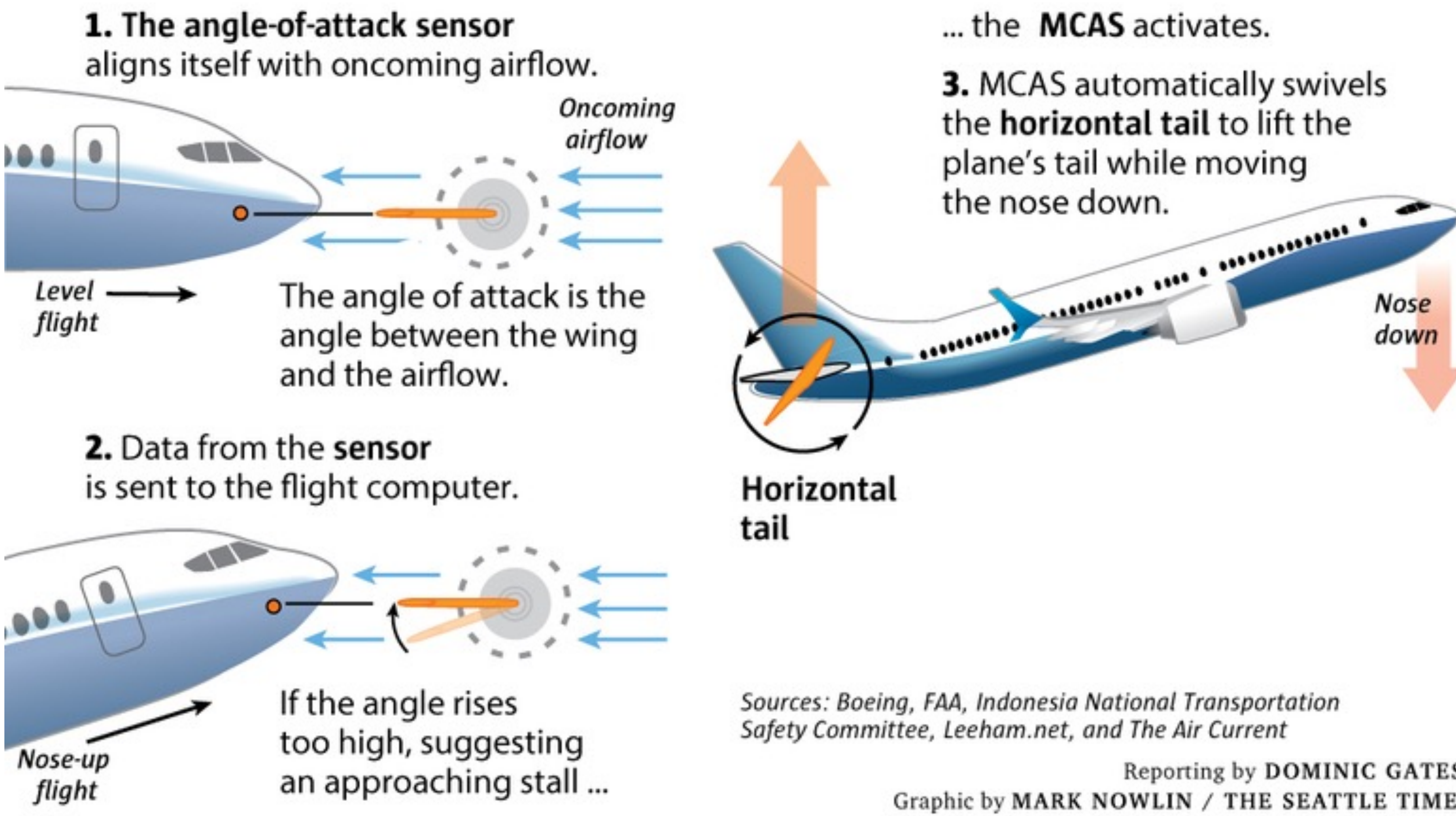
By **Gregory Travis**

The views expressed here are solely those of the author and do not represent positions of IEEE Spectrum *or the IEEE.*

Photo: Jemal Countess/Getty Images

This is part of the wreckage of Ethiopian Airlines Flight ET302, a Boeing 737 Max airliner that crashed on 11 March in Bishoftu, Ethiopia, killing all 157 passengers and crew.

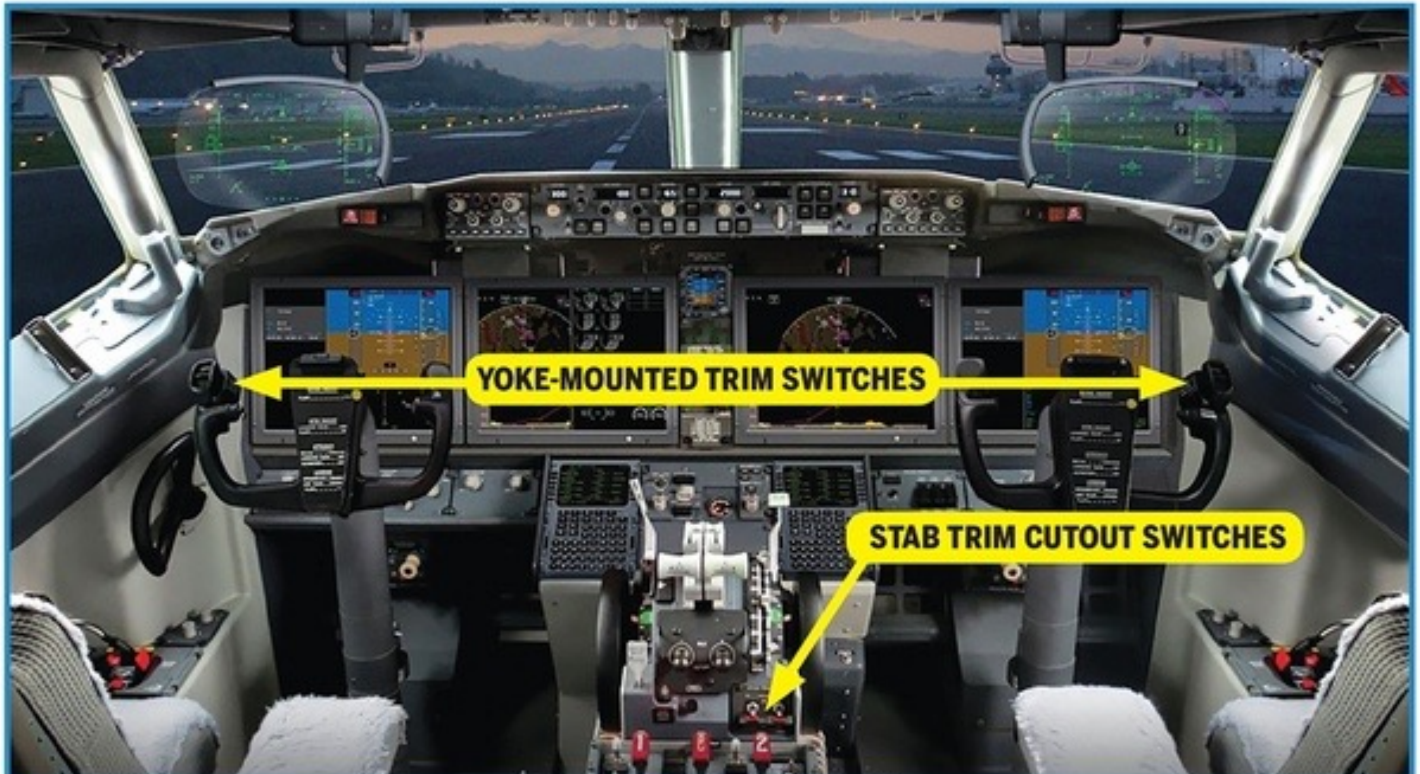
How the MCAS (Maneuvering Characteristics Augmentation System) works on the 737 MAX



Sources: Boeing, FAA, Indonesia National Transportation Safety Committee, Leeham.net, and The Air Current

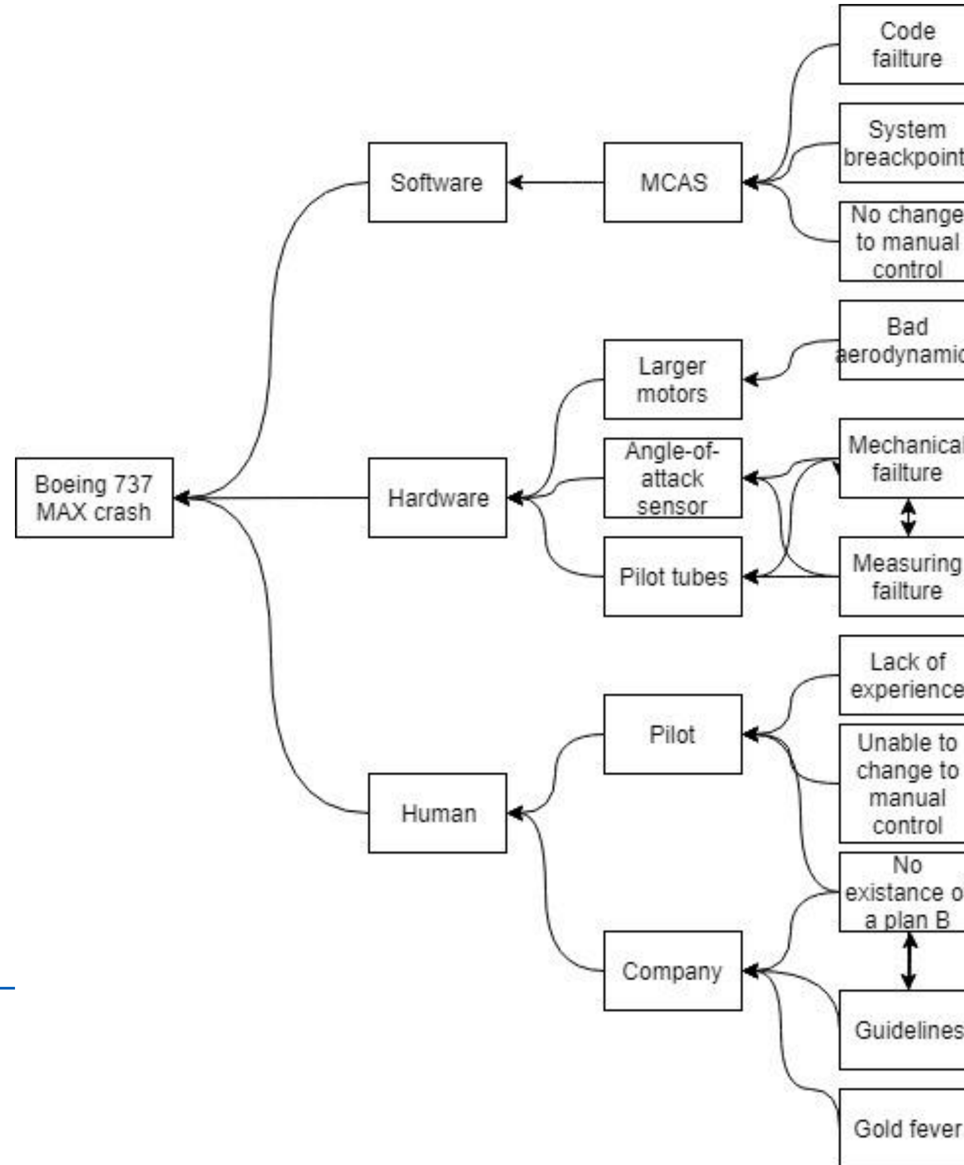
Reporting by DOMINIC GATES,
Graphic by MARK NOWLIN / THE SEATTLE TIMES

The MCAS user interface



Root cause analysis

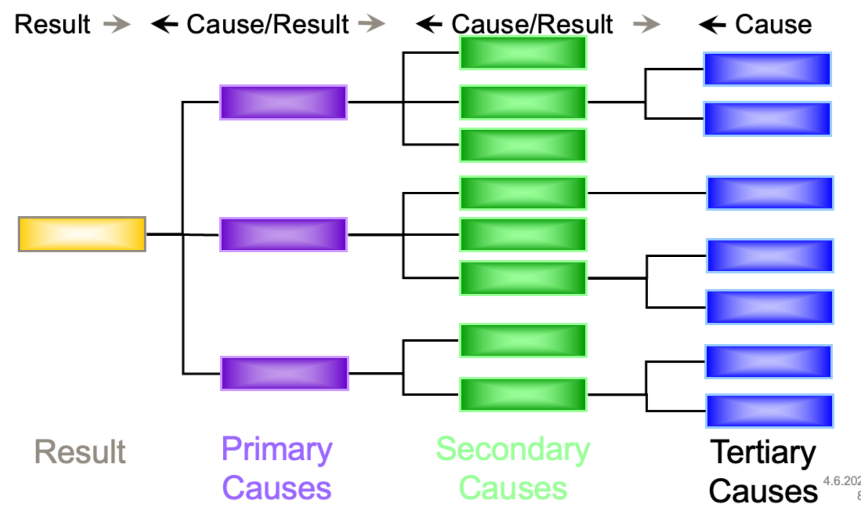
(student work from 2021)



E3.C (10 min)

Root cause analysis of why you missed a lecture

(Fundamental attribution error)



https://shorturl.at/ObmBR

Pairwork topics

Accident reports

https://shorturl.at/ObmBR

Safety Investigation Authority, Finland

Contact | In English

Entry page | Current issues | SIAF | Investigation reports | Recommendatio

R2017-03 Level crossing accident which led to four deaths at Raasepori on 26 October 2017

Investigation ID:	R2017-03
Type of accident:	Level crossing accidents
Date of publication:	7.6.2018

A rail bus travelling from Karjaa to Hanko collided with a Defence Forces high mobility terrain vehicle in Skogby, Raasepori, at an unprotected level crossing at 8am on Thursday 26 October 2017. A pioneer unit from the Uusimaa Brigade was engaged in an attack exercise, moving vehicles from Skogby to Syndalen in Hanko. There were eight conscripts in the high mobility terrain vehicle: three in the cabin and five on the platform. In addition to the driver, 15 passengers were travelling on the rail bus.

The conscripts in the cabin of the high mobility terrain vehicle did not notice the approaching train and did not hear its warning sound. There was insufficient time to reduce the speed of the rail bus, despite emergency braking by the train driver. The collision was serious. The conscripts travelling on the high mobility terrain vehicle were thrown out of the vehicle. Three conscripts and one rail bus passenger were killed in the accident. Three conscripts were seriously injured and two were slightly injured. Some rail bus passengers suffered minor injuries. The Defence Forces high mobility terrain vehicle was completely wrecked in the accident and the nose section of the rail bus was damaged. The total costs caused by the accident were around €270,000.

Skogby's level crossing was particularly dangerous due to the angle of the track and road and the lack of warning devices. From the cabin in the high mobility terrain vehicle, it was difficult to see the train approaching at an angle from the rear. The section of line had a speed limit of 120km/h. A lower train speed would give train and vehicle drivers more time to react and take action as they approach a level crossing, and would reduce the damage in possible collisions.

Patient safety

National patient safety incident reports

National patient safety incident reports: 29 September 2021

National patient safety incident reports: 13 October 2022

National patient safety incident reports: 23 September 2020

Improving safety critical spoken communication

Patient safety culture

Martha's Rule

Home > Patient safety > National patient safety incident reports

National patient safety incident reports

Data workbooks on all patient safety incidents reported in England to the National Reporting and Learning System (NRLS).

September 2023 update: We have paused the annual publishing of this data while we consider future publications in line with the current introduction of the Learn from Patient Safety Events (LFPSE) service to replace the NRLS.

Contents

Warning! A different type of reasoning is involved

Abductive reasoning (also called **abduction**, **abductive inference**, or **retroduction**) is a form of logical inference that seeks the simplest and most likely conclusion from a set of observations. -Wikipedia

Topics and deliverable

Safety Investigation Authority
Accident reports
https://shorturl.at/ObmBR

Task

1. Pick an incident report that involves possible human error and technology (ideal: AI, automation)
2. Read the report and associated news articles
3. Analyze the error using SRK and RCA/AcciMap
4. Provide an expanded account of the error

Presentation slides

1. Incident overview
   - Photo
   - Annotations
2. Overview of explanation
3. SRK + interpretation
4. RCA/AcciMap
5. How cases like this *might* be prevented in the future (realistically)