Effectiveness of CAST, 5M and HFACS in Accident Investigation and Prevention

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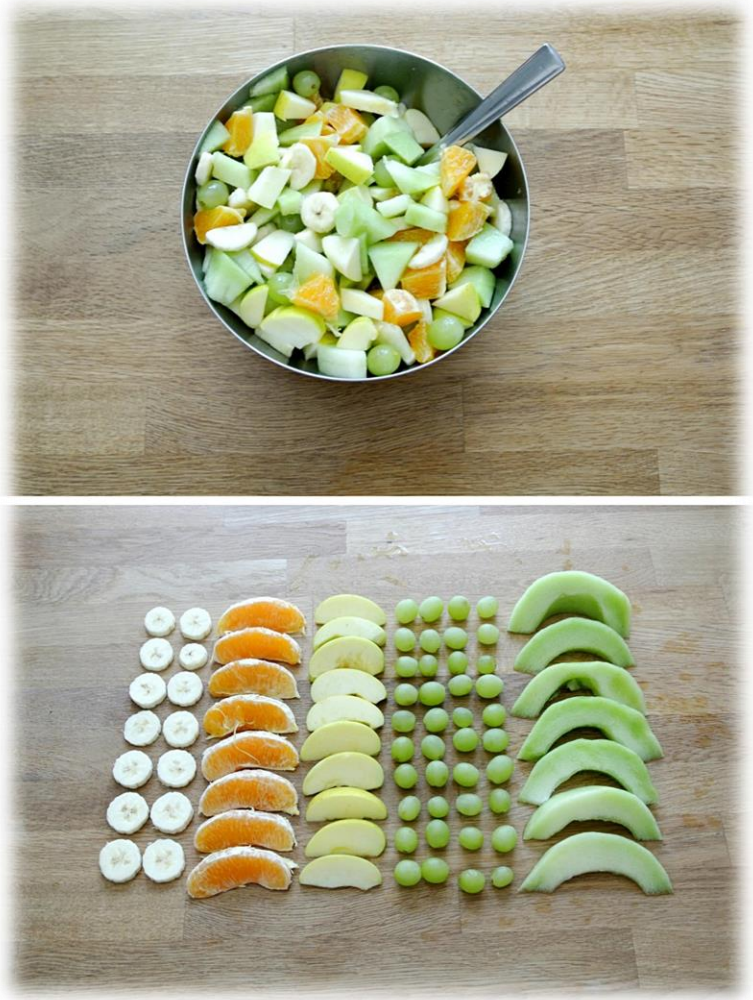
STAMP Workshop 2021

Agenda

- Introduction
- Case Study
- 5M
- HFACS
- STAMP/CAST
- Results and Outlook

Source: https://www.pinterest.at/pin/551409548120671421/



„It all depends on how we look at things, and not how they are in themselves.“

C.G. Jung

Source: https://i.pinimg.com/236x/06/50/b7/0650b704b1f940db719e0dc954aa168b--fruit-salads-fruit-bowls.jpg

Motivation: further development of Flight Safety System & test effectiveness of different tools for practical application

Research Question: determine differences between specific accident analysis models

Method: qualitative and quantitative, comparative analysis of different accident analysis methods.

Loss of Tail-Rotor Effectiveness (LTE)

Source: YouTube

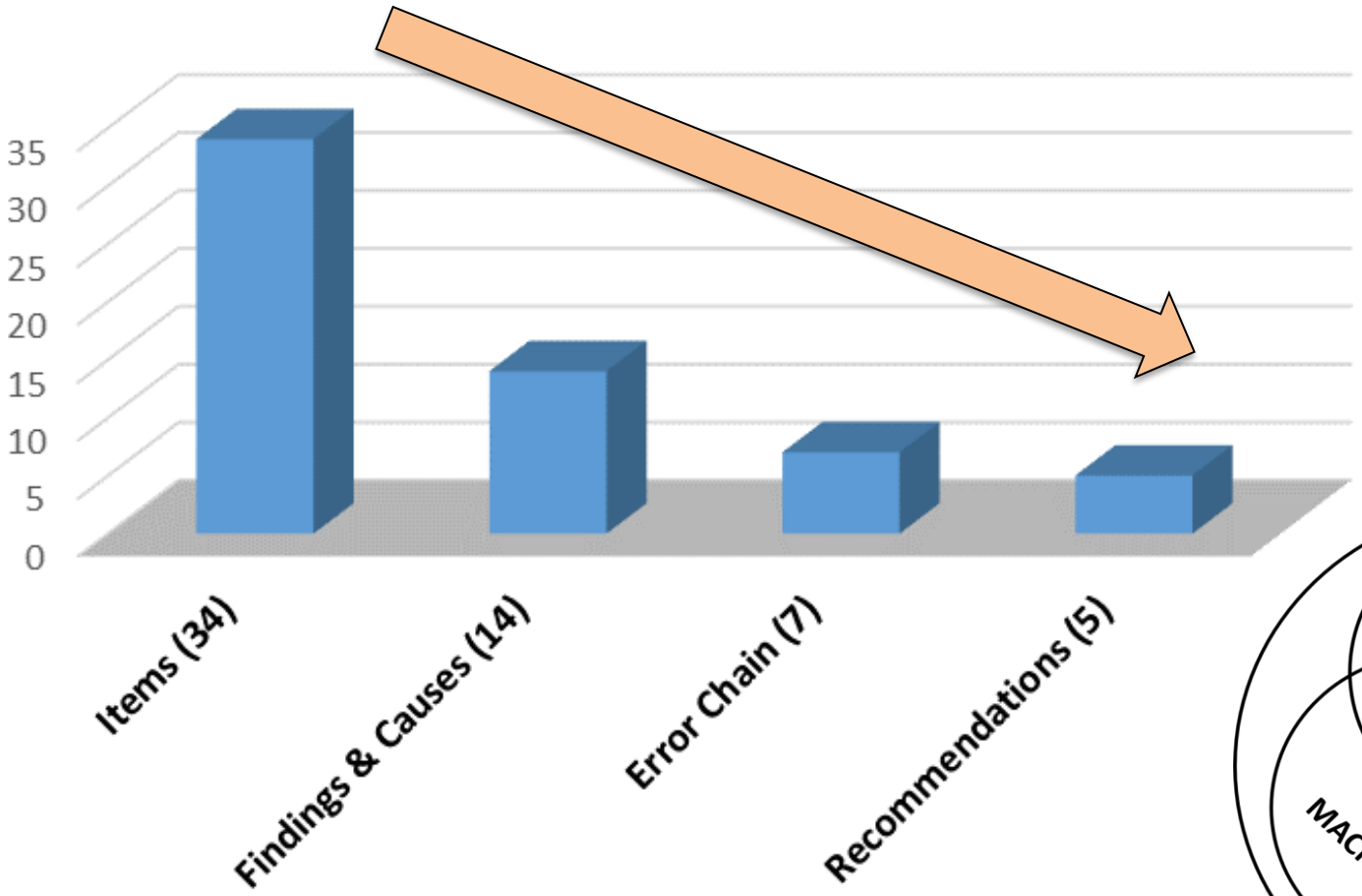
Case Study

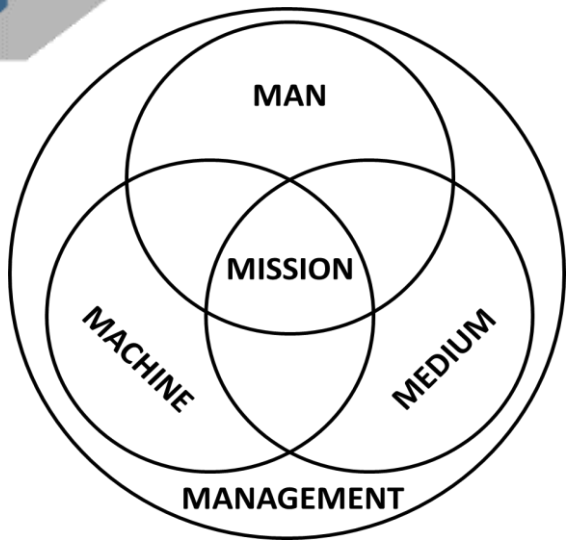
- Light helicopter
- Unplanned Outside Landing
- High Mountanious Terrain
- High TOW
- High Density Altitude
- Low Airspeed
- Tailwind

Source: BMLV, Gorup & Käfer

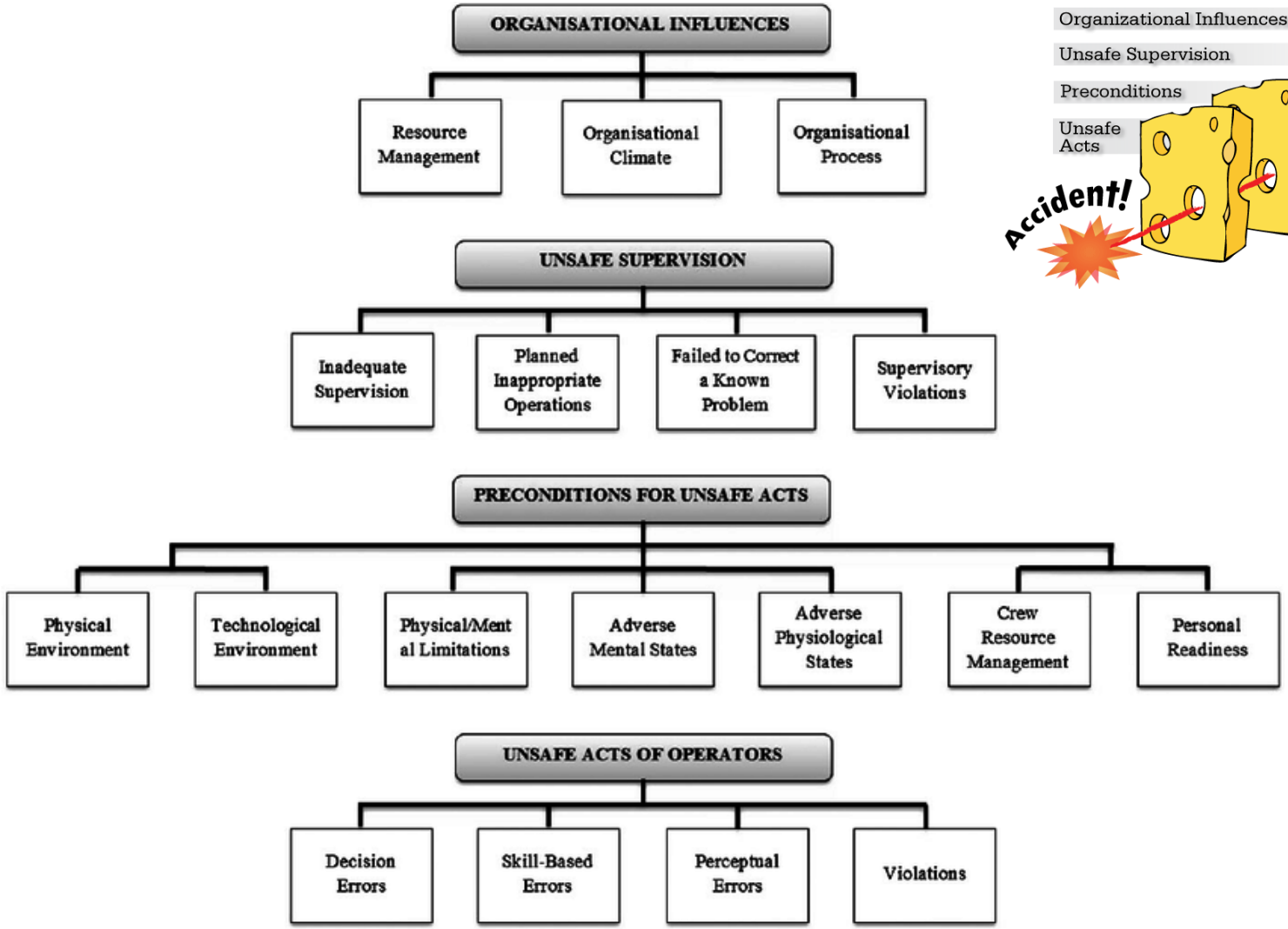
→ Loss of Tail-Rotor Effectiveness (LTE)

Accident Investigation after 5M



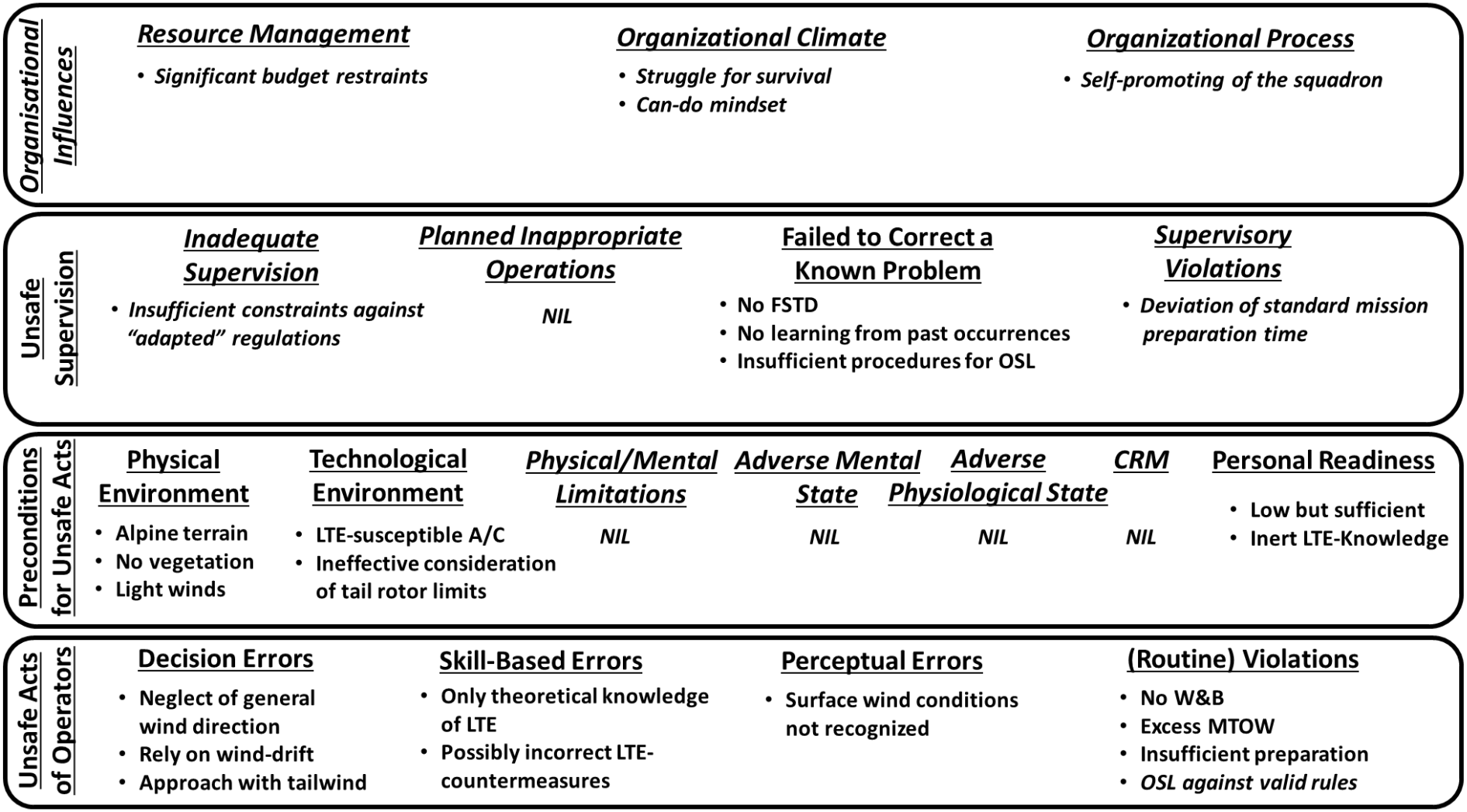


HFACS

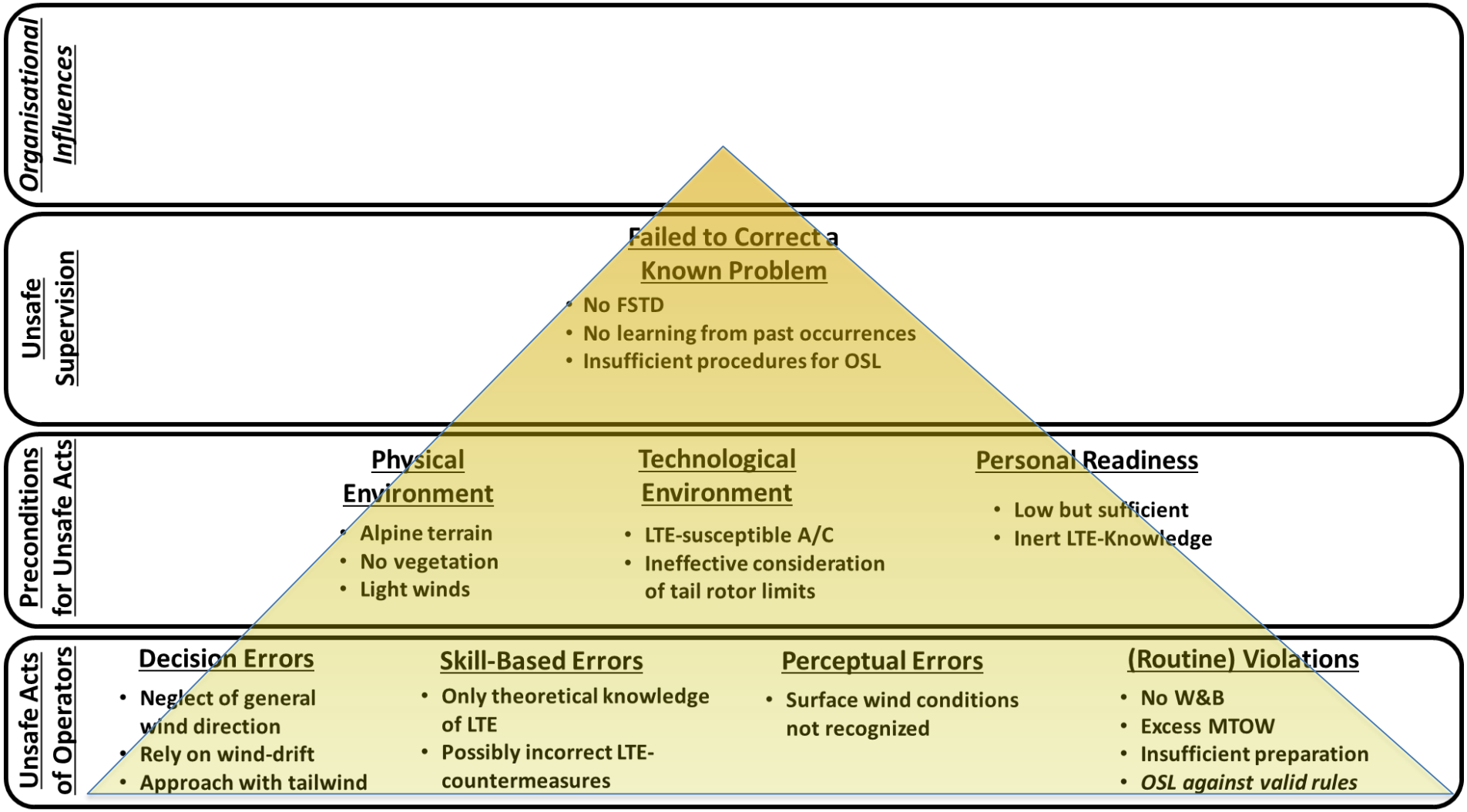


Source: https://www.researchgate.net/profile/Gizem_Serin/publication/326478796/figure/fig1/AS:650030385995776@1531990729001/Overview-of-Human-Factor-Analysis-and-Classification-System-HFACS-Adapted-from.png
Source: https://encrypted-tbn0.gstatic.com/images?q=tbn:ANd9GcRb6yiw2pfk7NqbsVsnsZO_71-0V4O4GCWjhR-4Dtx_N6aXc96S

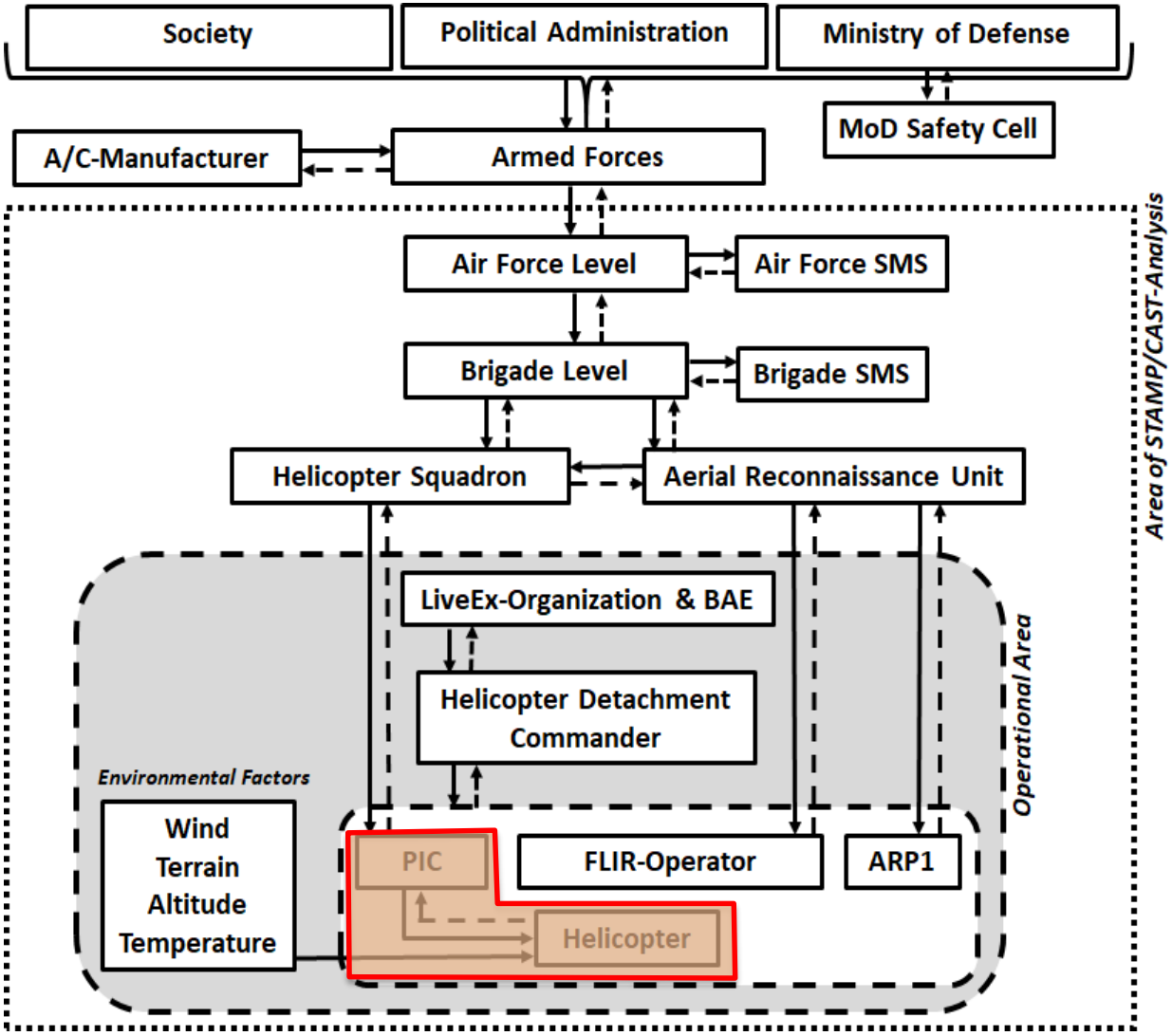
HFACS Overlay to 5M



HFACS Overlay to 5M



STAMP / CAST



Source: https://slideplayer.com/slide/6254966/21/images/4/System+Theoretic+Accident+Process+and+Modeling+%28STAMP%29.jpg

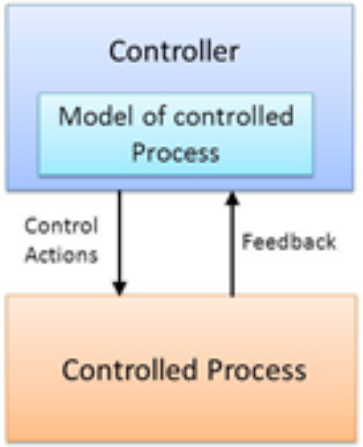
Pilot in Command

Safety Requirements and Constraints Violated:
- no preflight-planning including W&B
- no operational and tactical contingencies
- A/C-operation in accordance with publications
- no planning of safety margins
- no communicate restrictions, if necessary
- no use of purposeful means to ensure safe OSL
- no mission briefing

Mental/Process Model Flaws:
- unplanned and unbriefed high mountain OSL
- exceedance of MTOW not recognized
- LTE-enabling factors not consciously present
- wrong feeling of LTE-controllability and safety
- no desire to gain maximum safety buffer
- unplanned OSL generally accepted and tolerated
- rather "exercise" than operational mindset

Context:
- last flight during a two-week live exercise
- "simple" mission
- supposed SA for mission orders at short-notice
- OSL inside reconnaissance area
- focus on engine torque limits, not tail-rotor limits
- over-reliance in regard to A/C-power
- no FSTD available for emergency training

Dysfunctional Interactions:
- did not question the landing site in terms of tactics
- ineffective CRM



Contributory Control Actions:
- no W&B
- A/C fueled to its maximum
- approach to OSL with tailwind
- possibly ineffective LTE-management

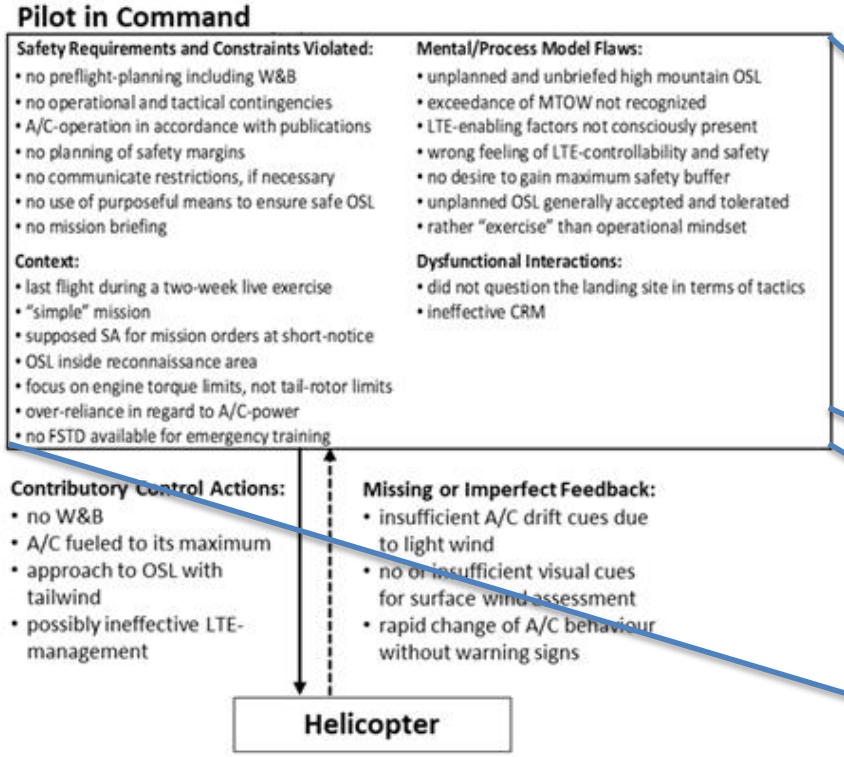
Missing or Imperfect Feedback:
- insufficient A/C drift cues due to light wind
- no or insufficient visual cues for surface wind assessment
- rapid change of A/C behaviour without warning signs

Helicopter

- **Possible Questions**
- **Safety Constraints**

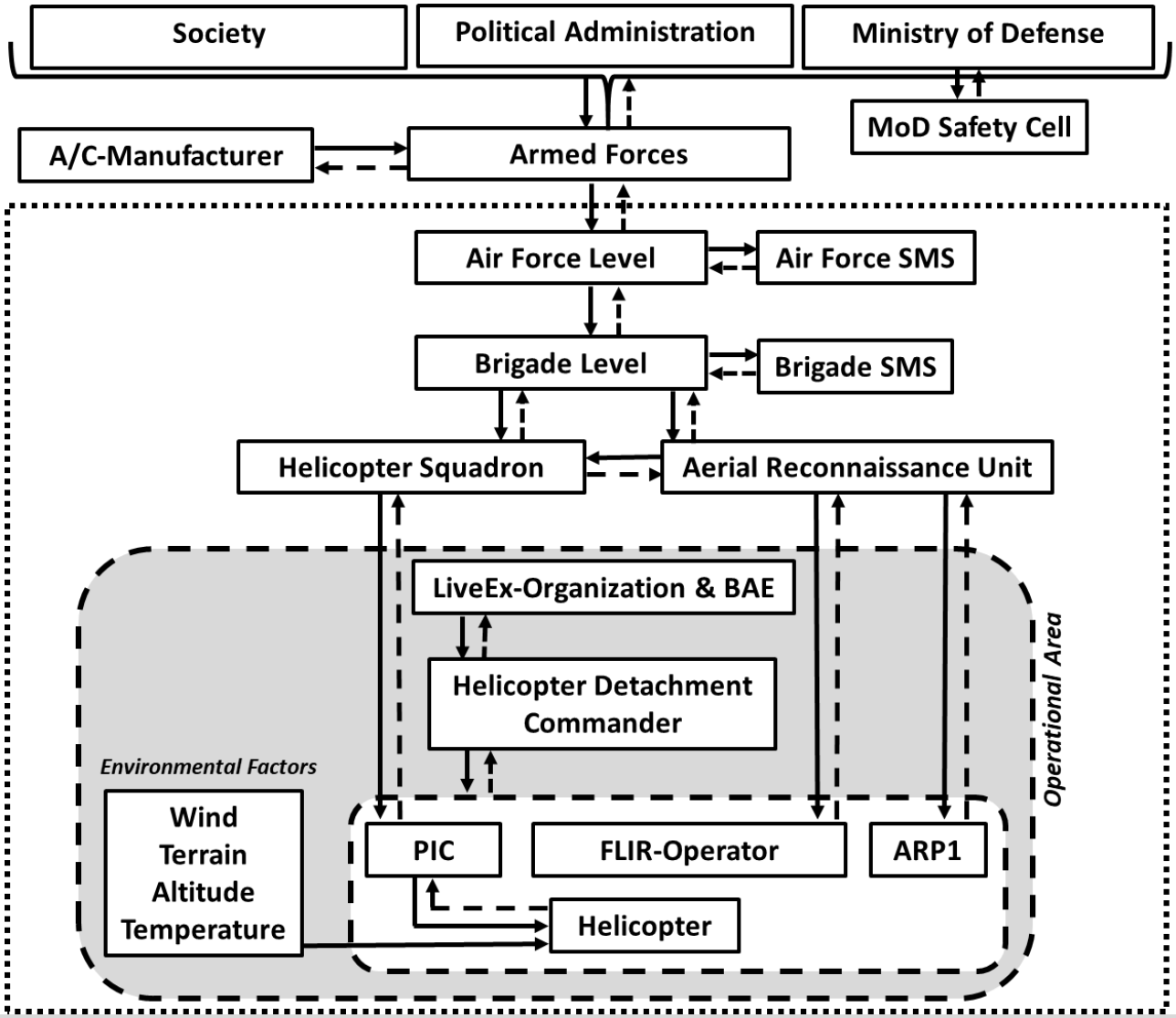
Source: https://slideplayer.com/slide/6254966/21/images/4/System+Theoretic+Accident+Process+and+Modeling+%28STAMP%29.jpg

- **Safety Requirements & Constraints**
- **Context**
- **Mental/Process Model Flaws**
- **Dysfunctional Interactions**

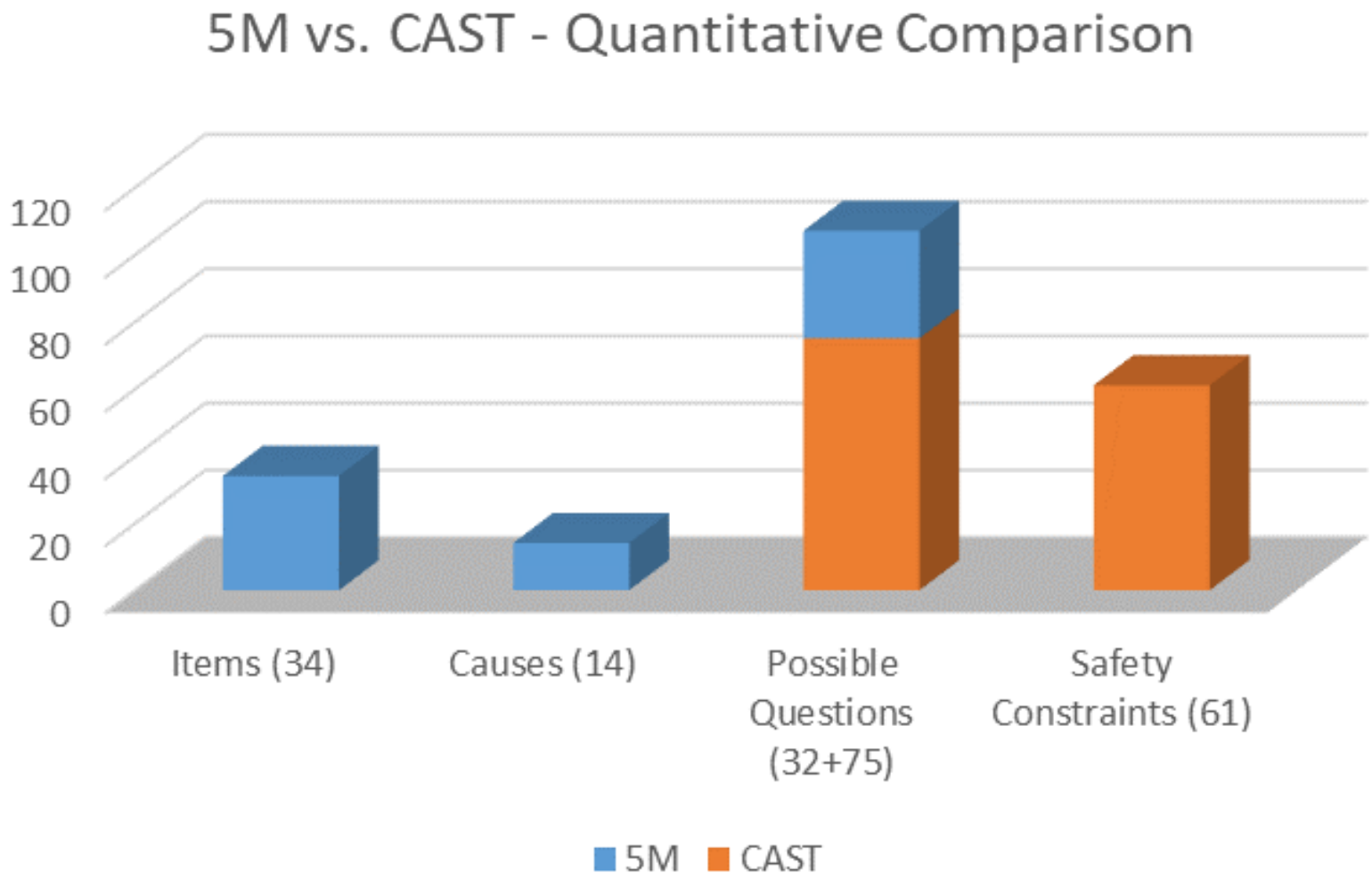


Source: Käfer

STAMP / CAST Analysis

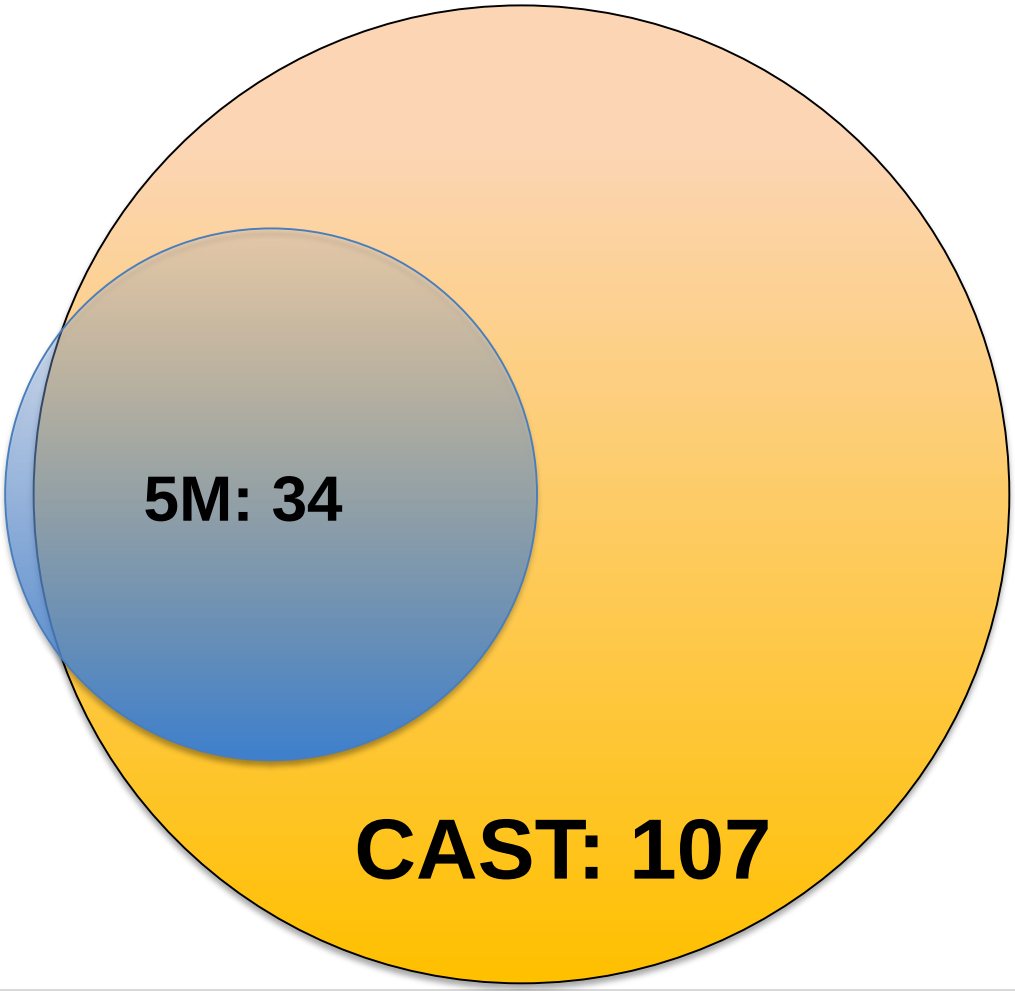


	QR	SC
	4	23
	8	10
	28	9
	4	5
	5	6
	58	8
	107	61

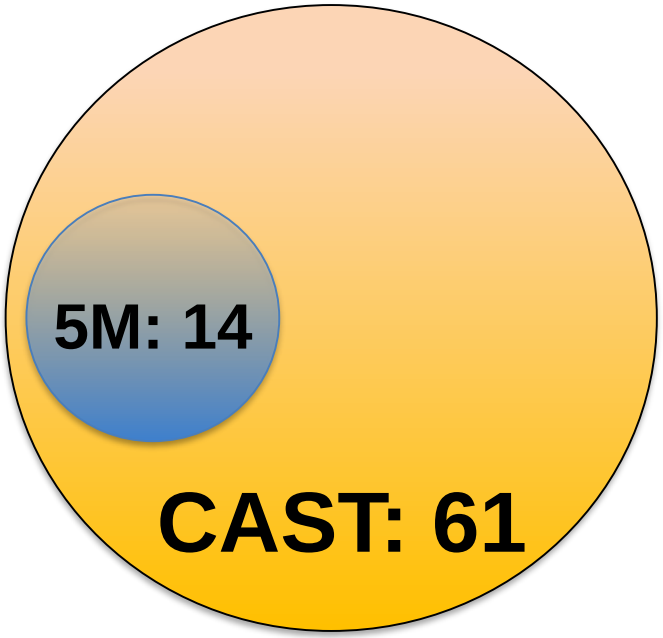

5M vs. CAST - Quantitative Comparison
120
100
80
60
40
20
0
Items (34)
Causes (14)
Possible Questions (32+75)
Safety Constraints (61)
5M
CAST

Comparison of Results - Quantitative

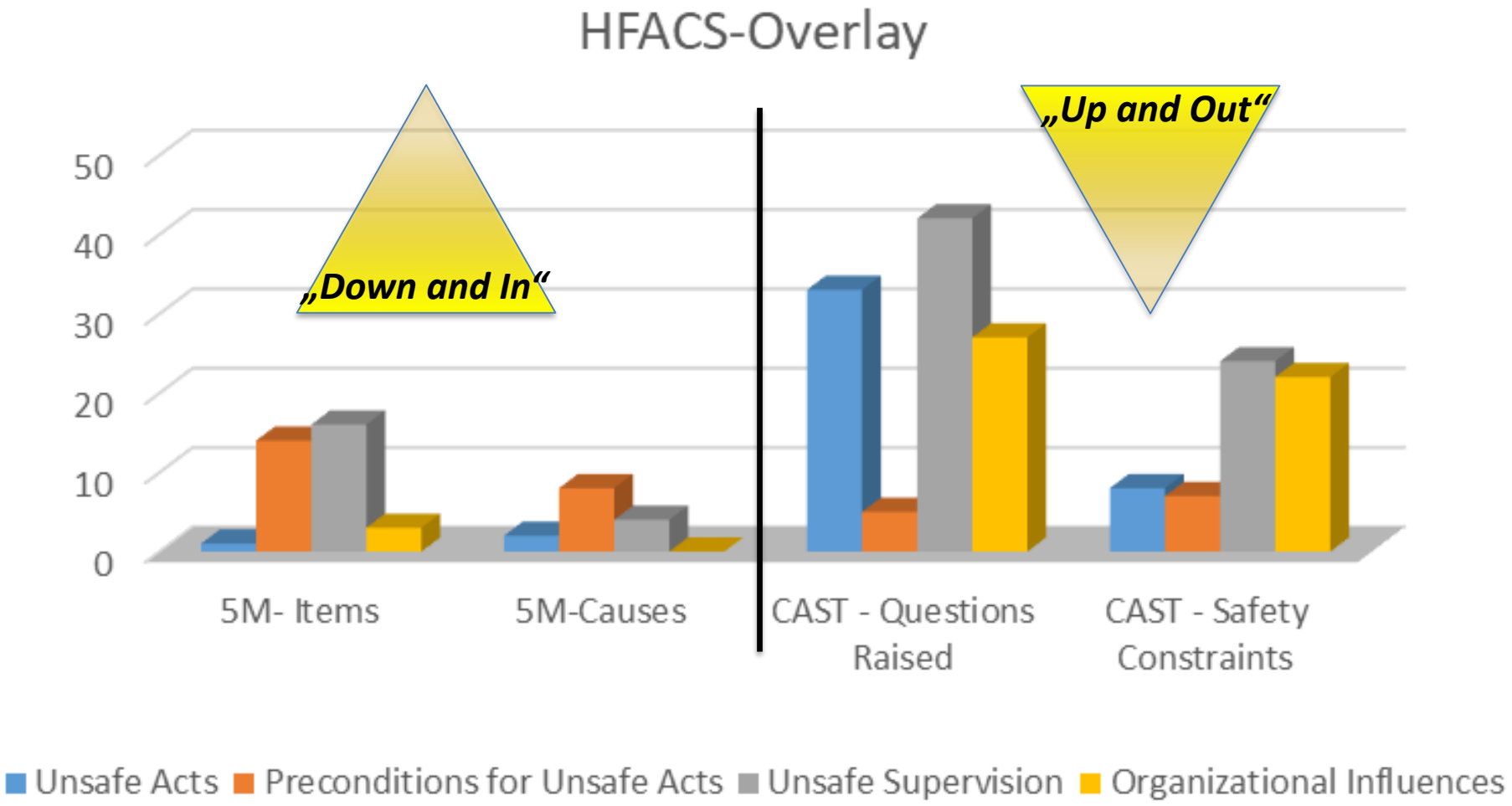
5M-Items
vs
CAST Questions Raised



5M-Causes
vs
CAST Safety Constraints

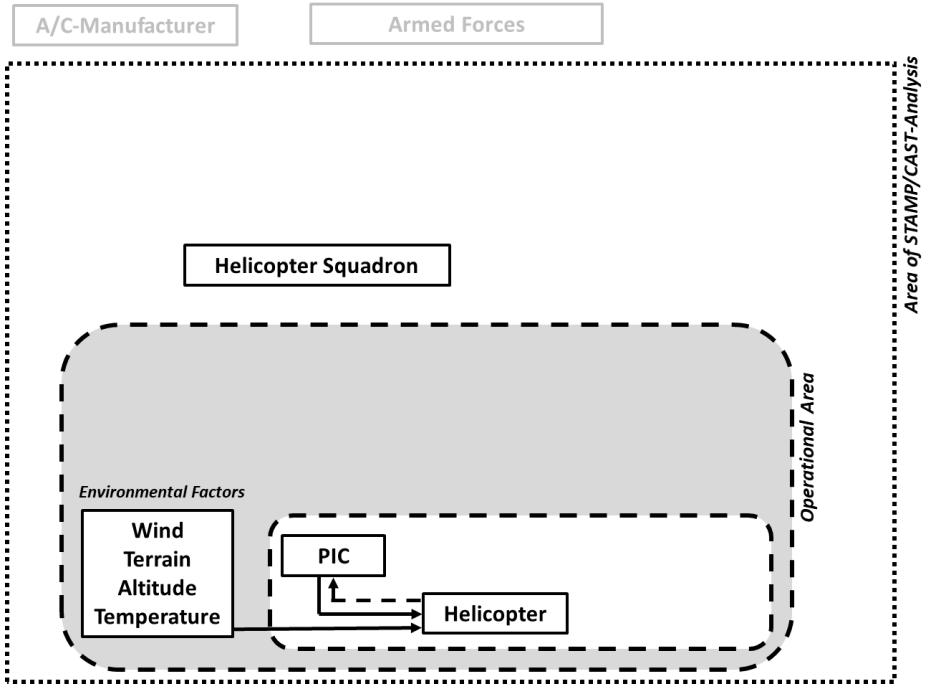


Comparison of Results - Quantitative

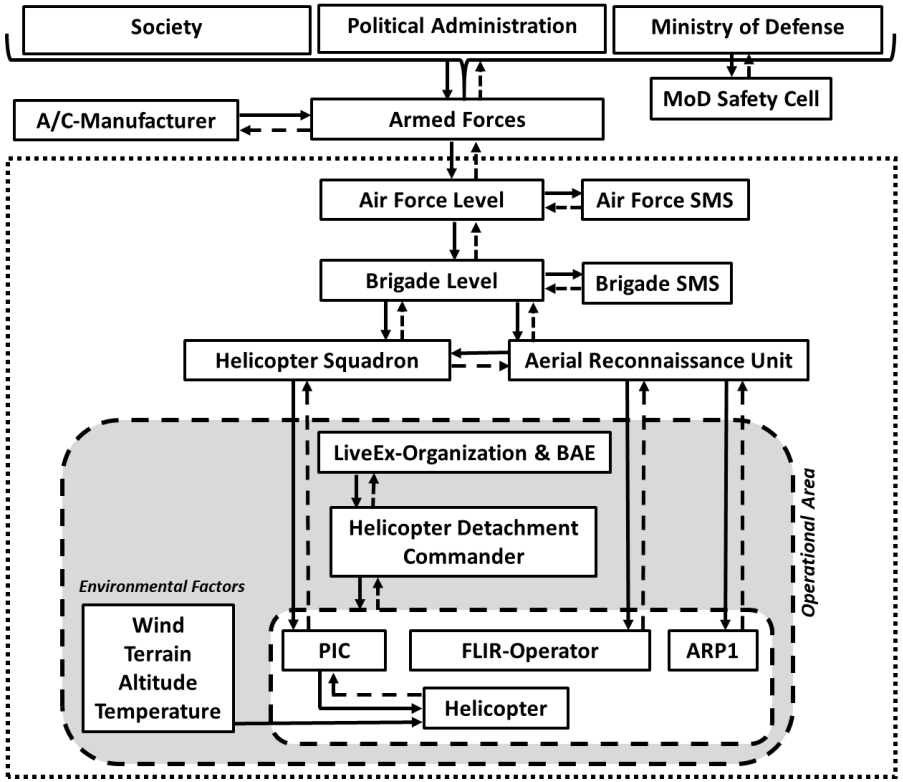


Comparison of Results - Qualitative

5M Analysis



STAMP/CAST Analysis



Considered Levels: 3

Considered Levels: 7

5M-Model:

+ simple model
+ suitable for quick risk assessment
+ retrospective and prospective use possible

- lack of instructions how to use
- no interactions and processes analysed
- no systemic approach
- focus on operational level
- no graphical illustration
- reduced number of findings and recommendations

HFACS:

+ based on Swiss-Cheese-Model
+ broad focus up to organizational level
+ clear aviation-related taxonomy
+ easy to understand, simple method

- classification (not a model)
- little power in determining the causality
- no interactions and processes analysed
- only retrospective use possible
- simplistic view of human factors
- lack of systemic or procedural factors

STAMP/CAST:

+ comprehensive and up-to-date model
+ focus on systemic interactions and developments
+ suited for big-scale analyses
+ enables to raise the right questions (context, why?
+ raises many questions, by that best answers
+ helps to determine effective preventive actions
+ steep learning curve

- great amount of data and domain knowledge
- complex and extensive model
- not a simple application at operational level

Future work with STAMP/ CAST

- Tailored models specific for the organisation and its processes
- Templates that are easy applicable to foster acceptance in the organization
- Using STPA to improve the Safety Management System simplifies the application of CAST

Thank you for your attention!

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https://medan.tribunnews.com/2020/07/23/jet-tempur-incaran-prabowo-subianto-inilah-4-spesifikasi-canggih-eurofighter-typhoon