~~UAM~~ AAM Human Factors Issues

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Advanced Air Mobility (AAM) formerly known as Urban Air Mobility (UAM)

AAM Characteristics

- Low-altitude
- Vertical flight
- Very high-density operations
- New electric or hybrid vehicles
- Highly automated

Analogous to Helicopter Flights/taxi

- Vertical take-off and landing
- Low altitude
- VFR
  - No ATC separation
- Obstacles
- Terrain
- Weather

Helicopter accident rates

Year	Total accident rate per 100,000 flight hours	Fatal accident rate per 100,000 flight hours
2018	3.62	0.72
2017	3.7	0.6
2016	3.48	0.54
2015	3.67	0.52

Commercial airline suffer one fatal accident for every 3 million flights.

https://qz.com/1791791/helicopter-crashes-like-kobe-bryants-have-become-more-common/

https://www.cnbc.com/2019/01/02/fatalities-on-commercial-passenger-aircraft-rise-in-2018.html

Massive increase in number of flights

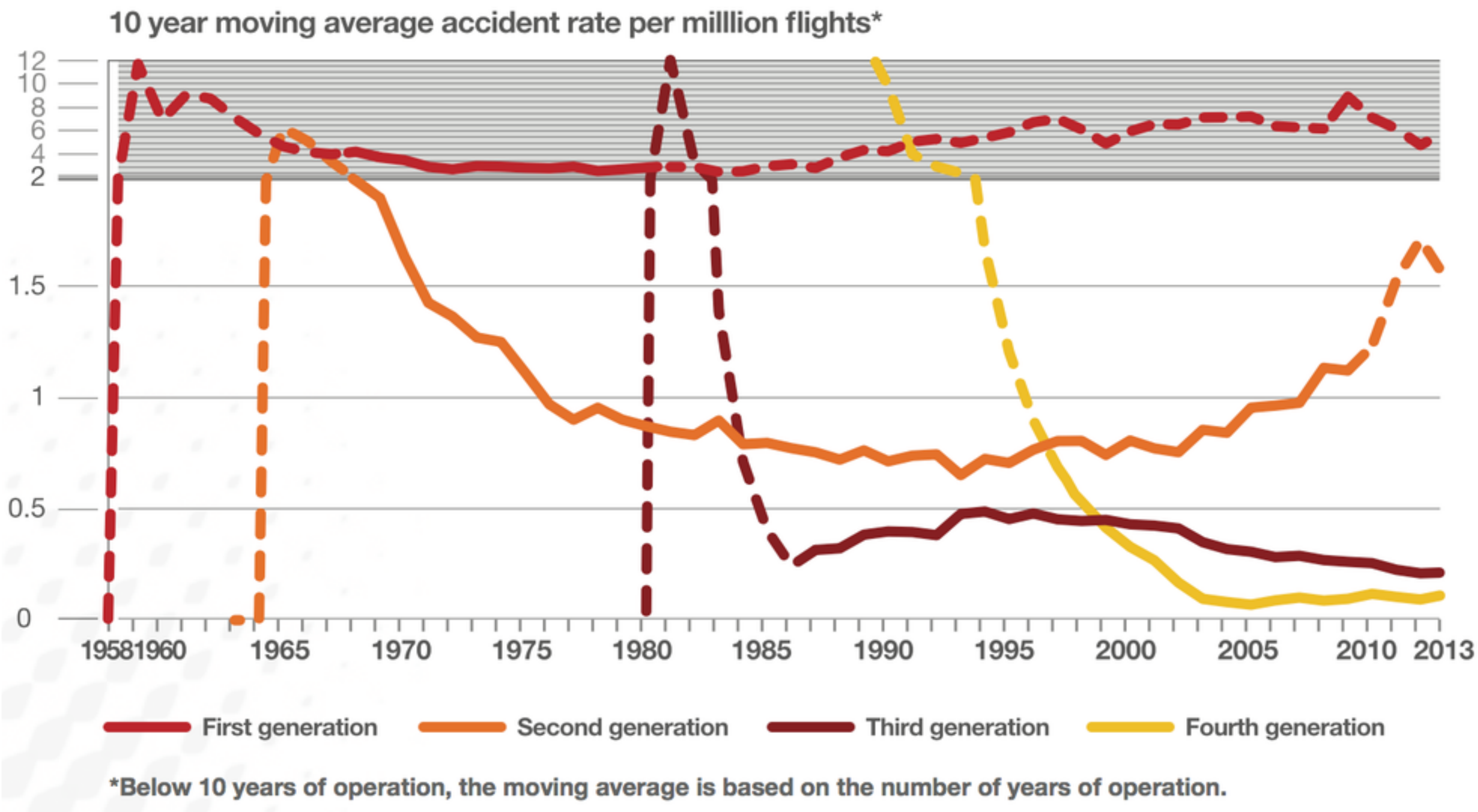
According to recent NASA-commissioned market studies, by 2030 as many as 500 million flights a year for package delivery services and 750 million flights a year for air metro services.

2018 Helo accident rates @ 500 Million flights –
3,600 Fatal Accidents per year

Roughly TEN PER DAY !!!

New Vehicles

- vTOL
- Electric
- Hybrid
- Multi-rotor



10 year moving average accident rate per milllion flights*
12
10
8
6
4
2
1.5
1
0.5
0
1958
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2013
First generation
Second generation
Third generation
Fourth generation
*Below 10 years of operation, the moving average is based on the number of years of operation.

Feary, 2018

“Potential” Issues ?

- Take high risk environment with a demonstrated poor safety record.
- Increase the rate of flights dramatically.
- Fly with all new vehicles.

What could go wrong?

How to address?

Automation !!

1. Remove pilot – Automate completely

2. Remote pilot – RPAS

3. Pilot on board – simplified vehicle operations

Problems with Automation

- Automation for automation's sake
  - Lack of underlieing methodology/process
- Brittleness
- Mode Awareness
- Trust (over/under)
- Automation paradox

Automation Paradox

- The *Paradox of Automation* says that the more efficient the automated system, the more crucial the human contribution of the operators. Humans are less involved, but their involvement becomes more critical.

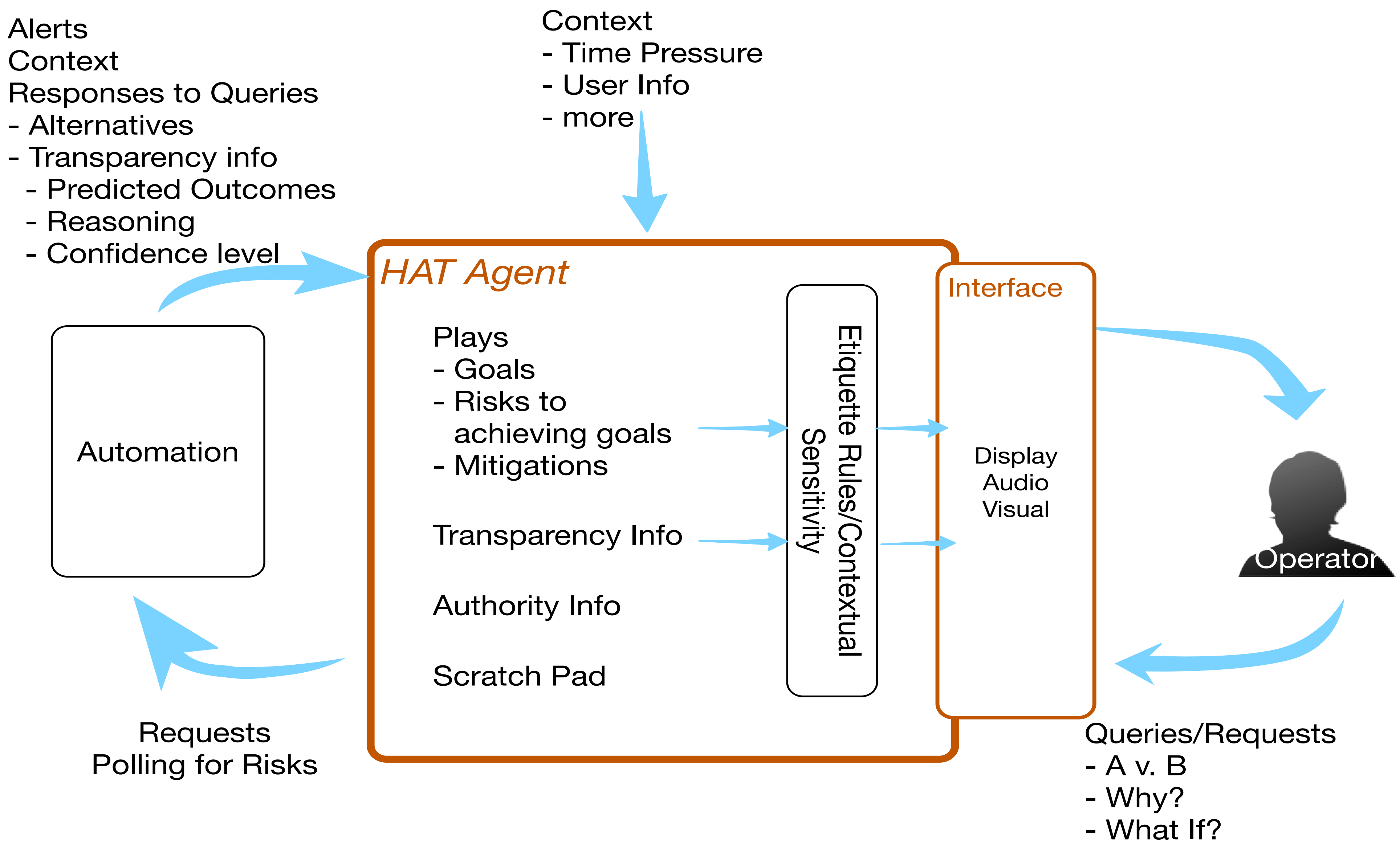
- If an automated system has an error, it will multiply that error until it's fixed or shut down. This is where human operators come in.

- Efficient Automation makes humans more important, not less.

https://personalmba.com/paradox-of-automation/#:~:text=The%20Paradox%20of%20Automation%20says,it's%20fixed%20or%20shut%20down.

Human Autonomy Teaming

- Analysis of future issues/gaps/barriers not current for general aviation or helicopters
- Intelligently determine what *should* be automated to help the human (not what *can* be automated to help throughput)
- Implement automation smartly - HAT
- SVO *with experienced highly-trained pilots*


Alerts
Context
Responses to Queries
- Alternatives
- Transparency info
- Predicted Outcomes
- Reasoning
- Confidence level
Context
- Time Pressure
- User Info
- more
HAT Agent
Plays
- Goals
- Risks to achieving goals
- Mitigations
Transparency Info
Authority Info
Scratch Pad
Etiquette Rules/Contextual Sensitivity
Interface
Display
Audio
Visual
Automation
Operator
Requests
Polling for Risks
Queries/Requests
- A v. B
- Why?
- What If?

Automation Design “Checklist”

- Stakeholders
- Tech readiness
  - Automation failure rates
- Why
  - Workload
  - Scalability
  - Training
- Transparency
- Two-way communication
- Clear operating modes
- Reversion modes (for the inevitable automation failure)
- Operational envelope
- Enunciation

Automation Operation “Checklist”

- Inherit all of design questions:

- Do users know what it does, when and why?
- Does the user (and other stakeholders) trust the automation appropriately?
- Failure rates match design?
- Unintended uses/issues?
- Does it address design goal?

AAM

- Can revolutionize aviation ! (or not)
- Must be implemented intelligently
- Human Autonomy Teaming is critical