HAT Tricks: Understanding Human Autonomy Teaming through Applications

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What is a "Hat Trick" ?

Achieving a positive feat three times in a game

Effective Human-Autonomy Teaming in three critical functions:

MONITOR → **ASSESS** → **DECIDE**

Safe and Efficient Crew-Autonomy Teaming/Technologies (SECAT) Sub-project

Goal:

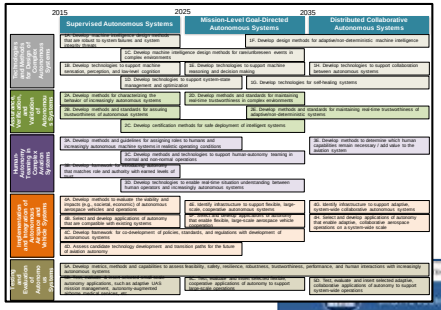
Develop and demonstrate the feasibility of using autonomous systems concepts, technologies, and procedures to improve aviation safety and efficiency during nominal and off-nominal operations.

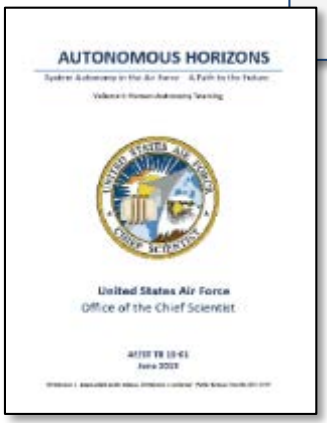
Benefits:

- Provide autonomy-based technologies that collaborate with the human crew to monitor and mitigate risk in flight.
- Develop crew-autonomy teaming strategies and techniques that will enhance trust in autonomy in the cockpit .

Addressing Autonomous Systems Research Needs

- SECAT addresses the research themes identified by the ***ARMD Strategic Thrust 6 Roadmap***, primarily:
  - Human-Autonomy Teaming in Complex Aviation Systems
  - Technologies and Methods for Design of Complex Autonomous Systems
- SECAT addresses the emerging White House AI policy
  - Identifying benefits and risks of Artificial Intelligence (AI)
- SECAT addresses USAF Autonomous Systems Research Needs
  - Goal: “the best benefits of autonomous software working synergistically with the innovation of empowered airmen”

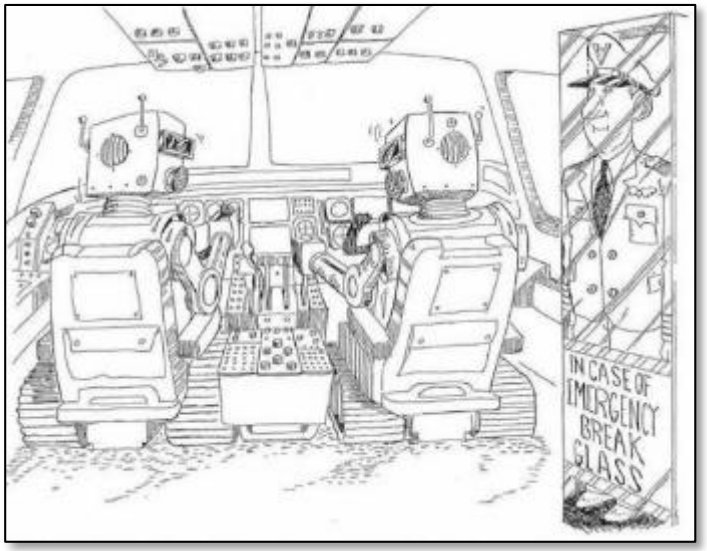




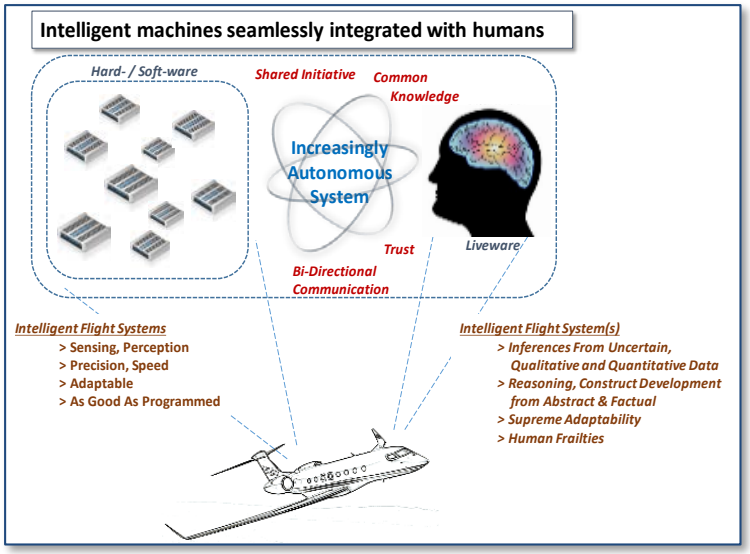
Technical Background - Increasingly Autonomous Systems

PRESENT → **FUTURE**

Increasingly Automated Systems

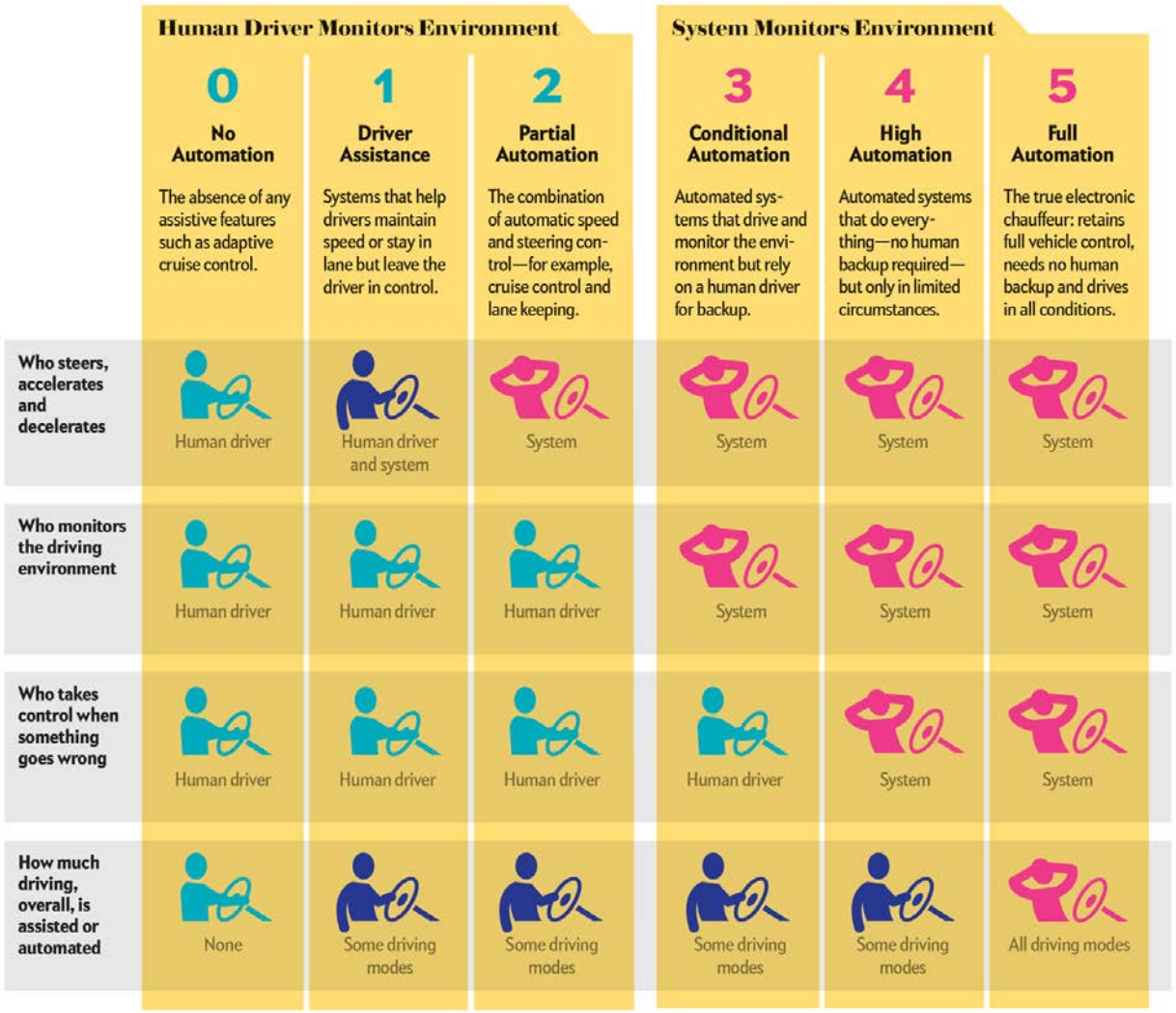


Increasingly Autonomous System



Performance and safety of combined system is greater than either component alone.

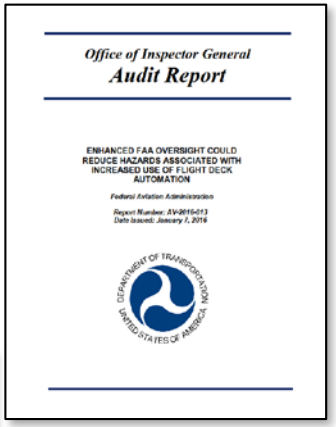
Levels of Automation



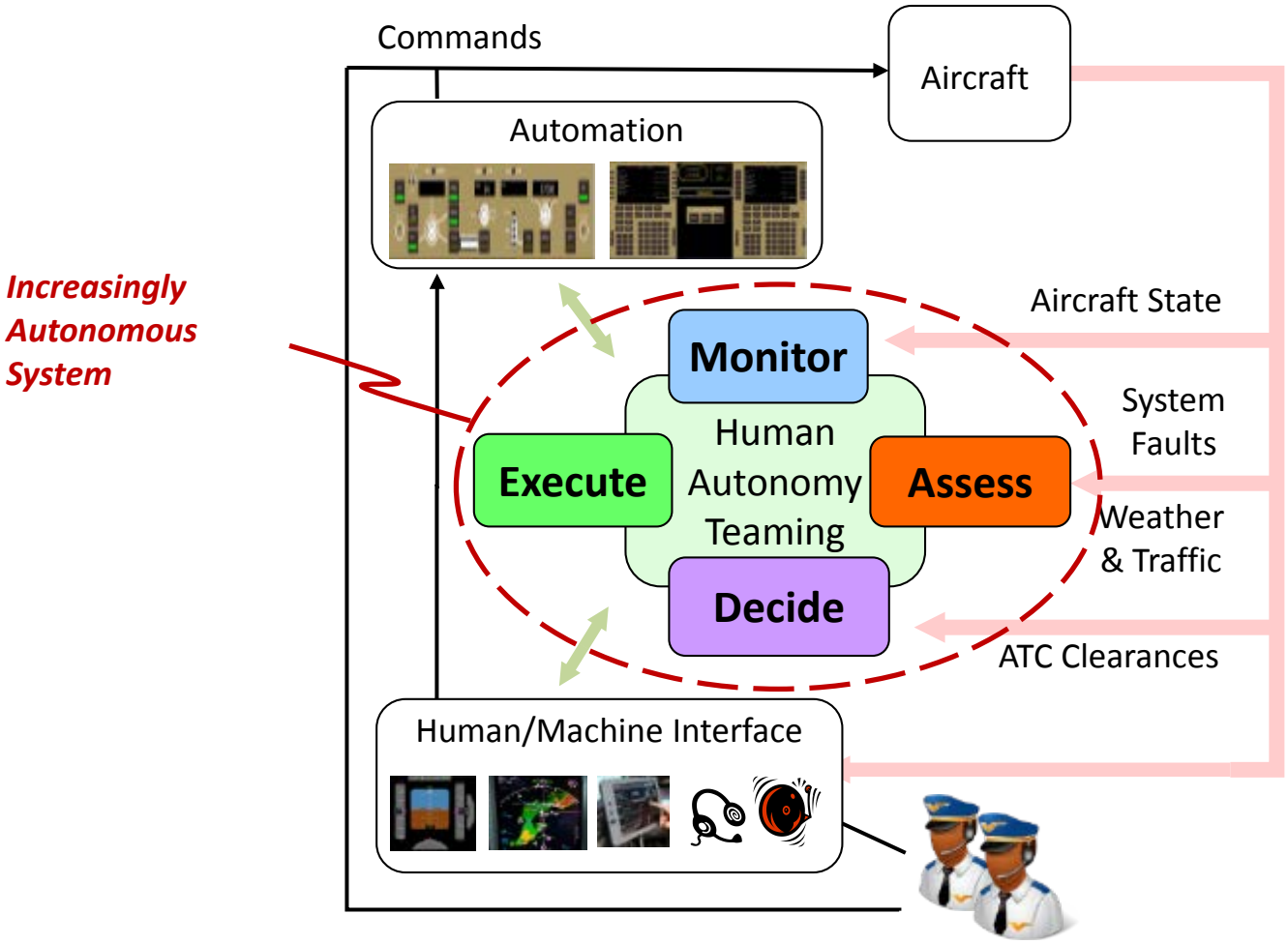
Credit: Scientific American, June 2016

Current Flight Safety Challenges with Automation

- *FAA PARC/CAST Flight Deck Automation Working Group Final Report, 2013*
  - Pilots frequently mitigate safety and operational risks – the aviation system is designed to rely on that mitigation
  - Insufficient depth of system knowledge or understanding of aircraft
    - may decrease pilots' ability to respond to failure situations
- *"Enhanced FAA Oversight Could Reduce Hazards Associated With Increased Use of Flight Deck Automation," DOT OIG Report, 2016:*
  - Relying too heavily on automation systems may hinder a pilot's ability to manually fly the aircraft during unexpected events
- From "Autonomy Research for Civil Aviation: Toward a New Era of Flight," *National Research Council*, 2014
  - *Stakeholder/Public/Flight Crew perception* - autonomy "trust" and "social issues"



Technical Approach



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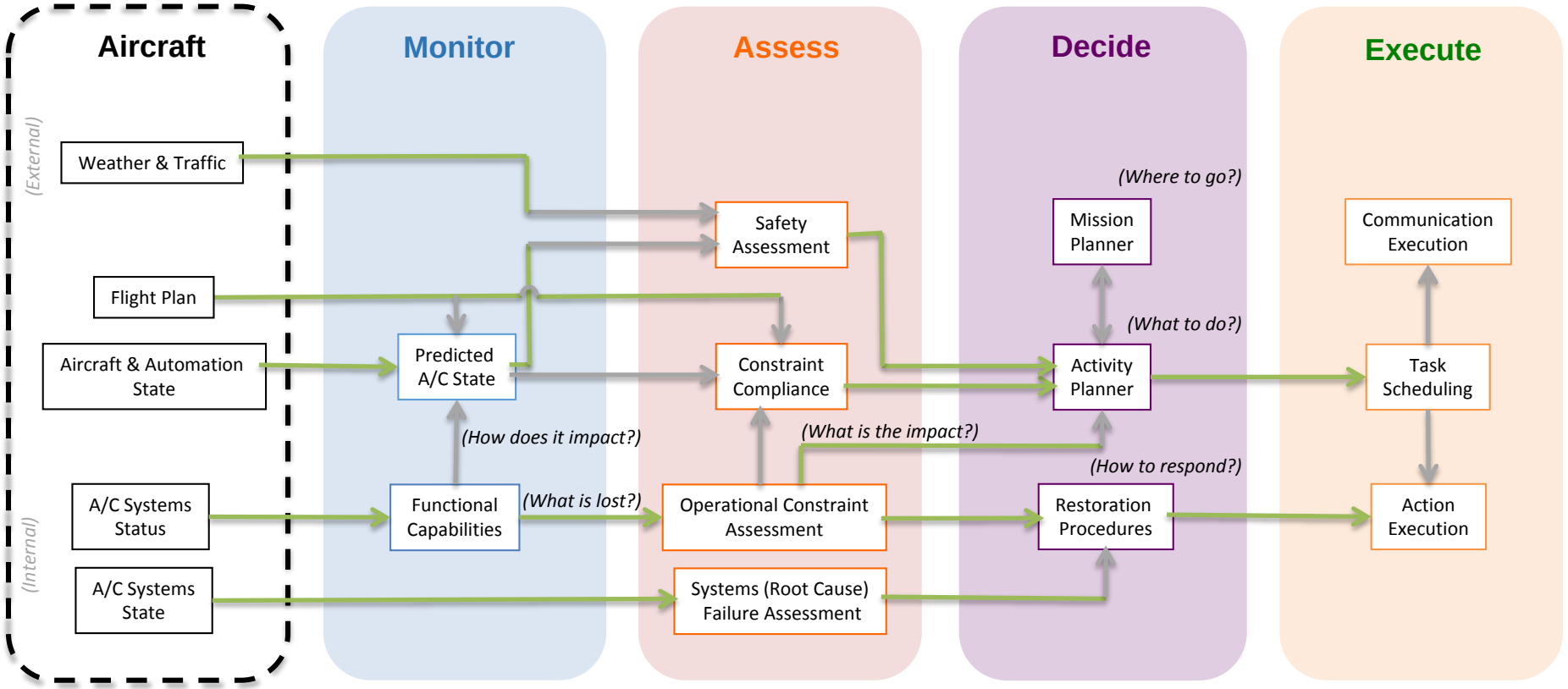
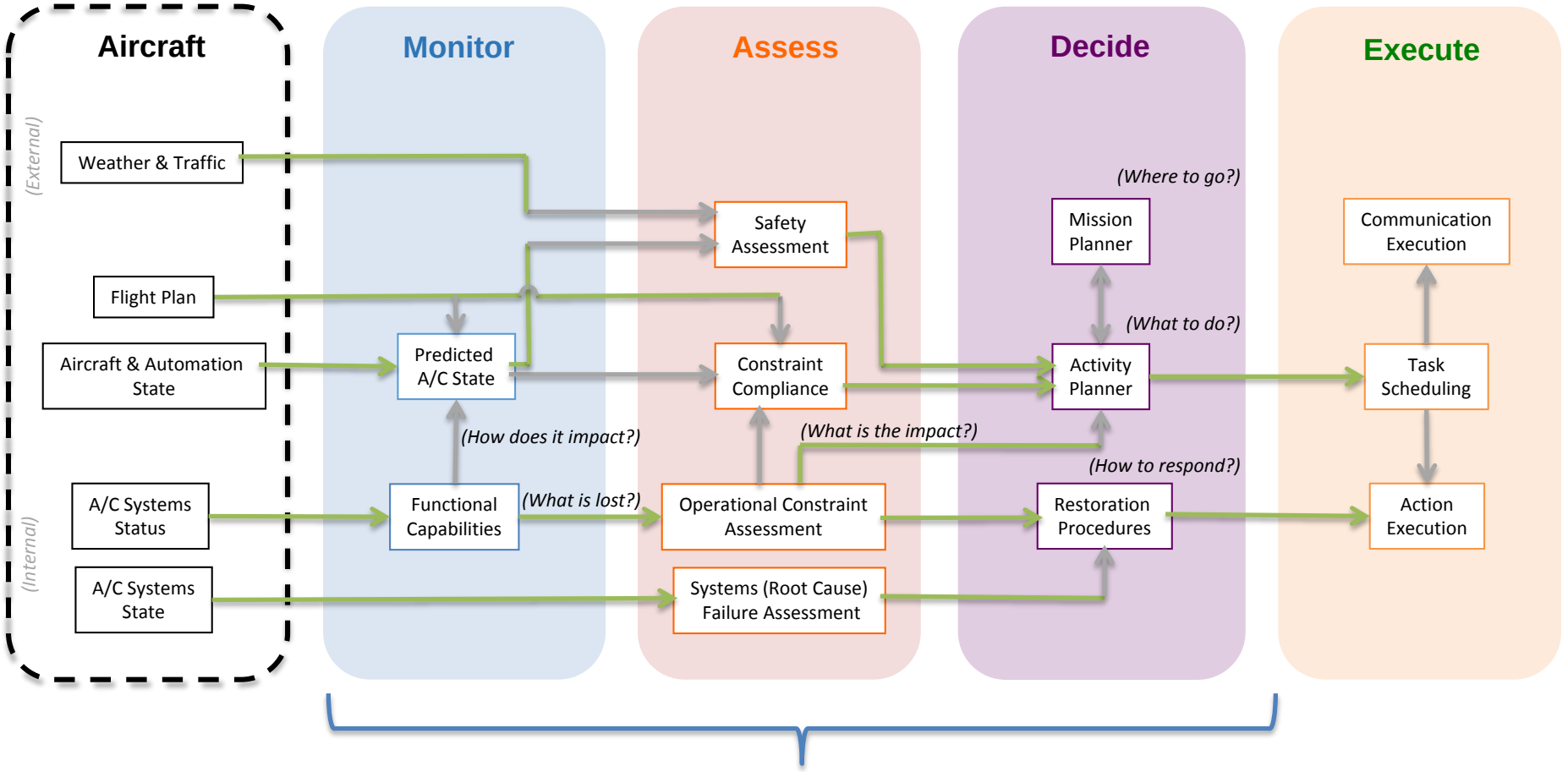
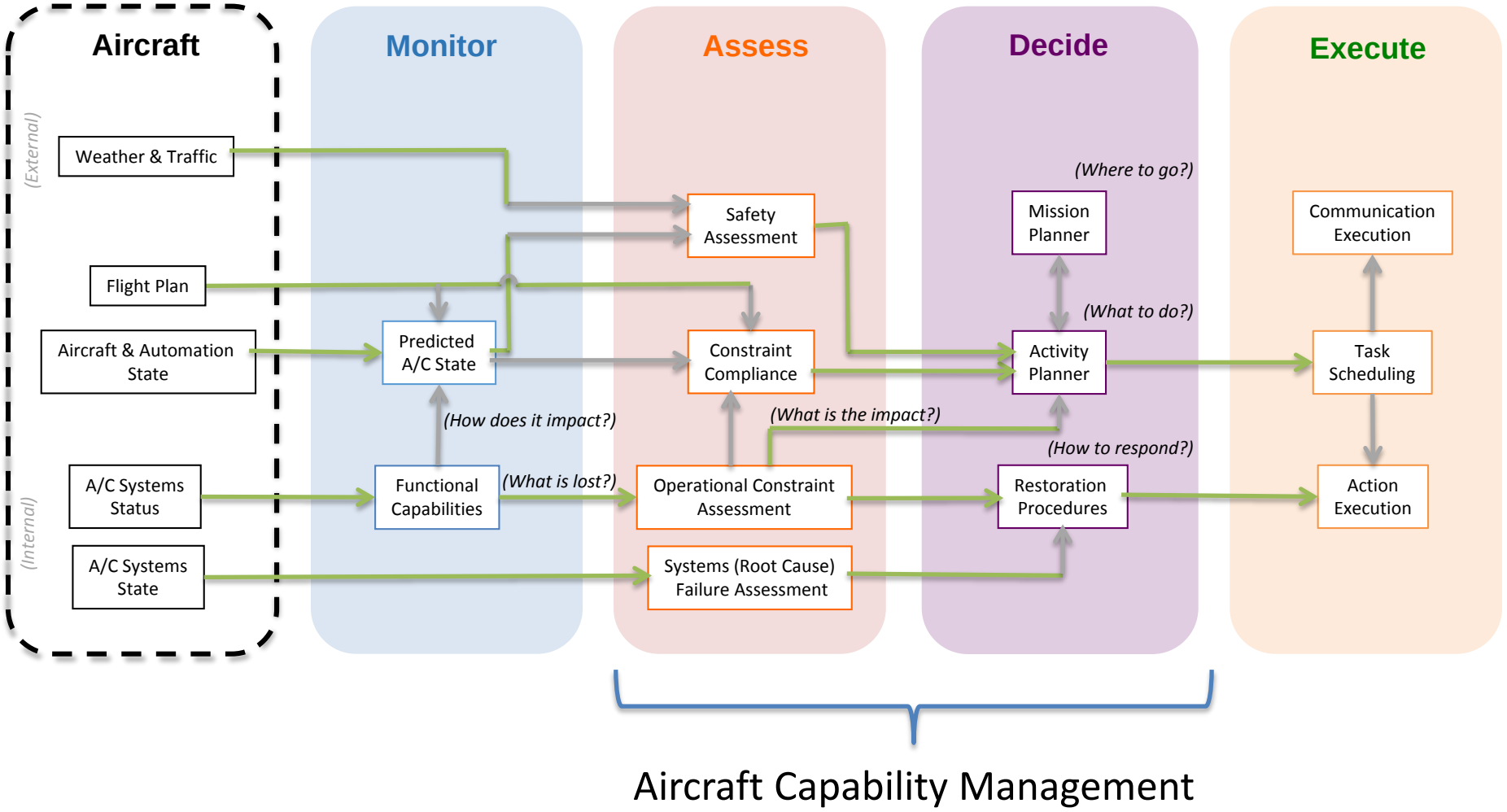


SECAT Technical Objectives



General Framework for Human Autonomy Teaming

SECAT Technical Objectives



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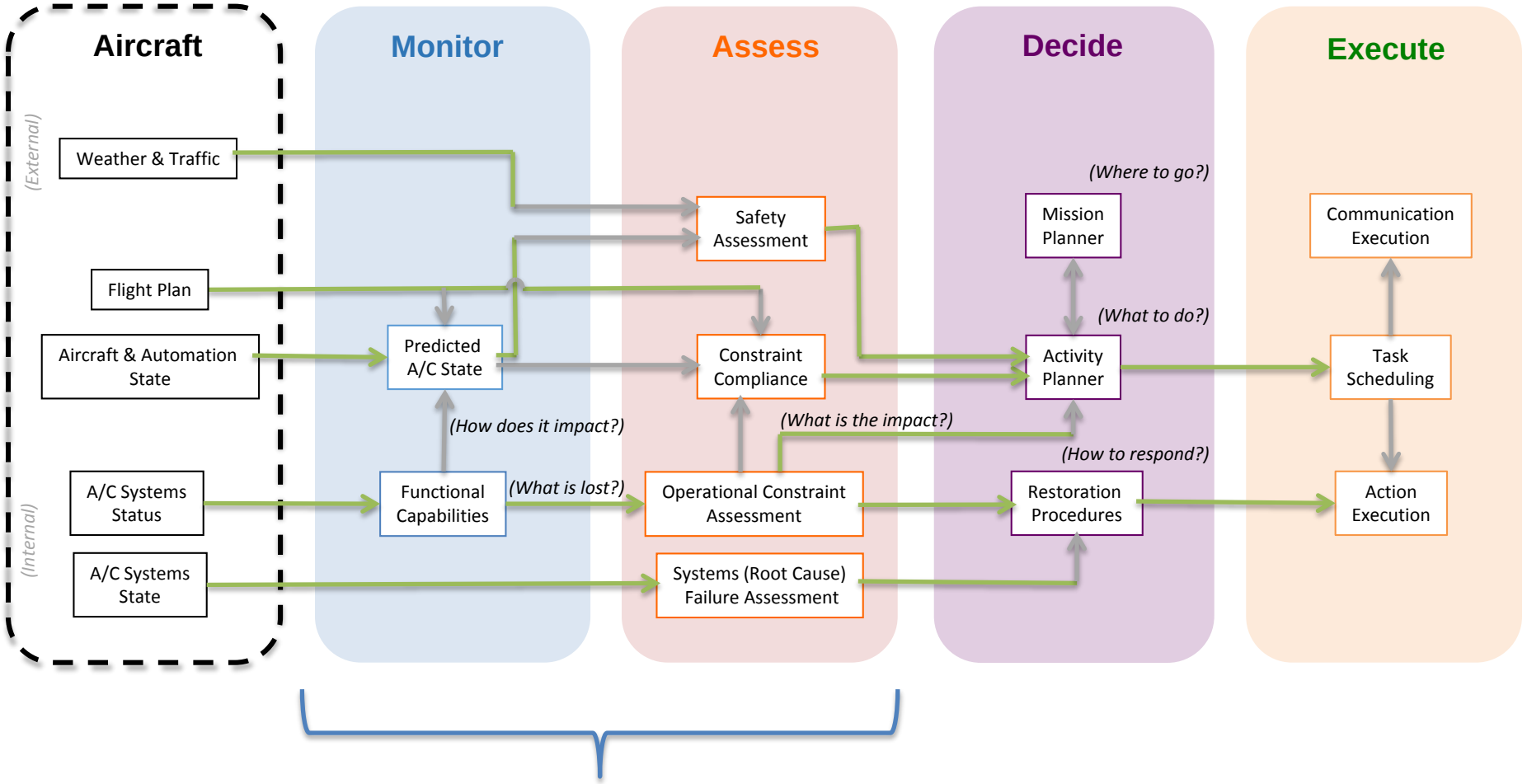

Cockpit Hierarchical Activity Planning and Execution