The Use of STAMP in Aircraft Evaluation, Test and Research

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Briefing Focus

- Very high level discussion of STPA / STAMP within Boeing Test and Research
Boeing Test and Evaluation

- 6500 employees
- 23 States and 60 Sites
- Flight Operations
- Lab Operations
System complexity is growing exponentially!
Existing Methodologies

- FMEA, FMECA and HAZOP are similar
  - A committee (workshop environment) applies past history in conjunction with mental models to identify “what if?” Scenarios
  - FMEA/FMECA
    - Most commonly used in pragmatic risk analysis
    - Can be overly focused on root cause’s
  - HAZOP
    - Existing or planned operations or processes
    - Tends to be better for well understood complex systems
- Event and fault trees
  - More complex and costly due to focusing on the details
  - Post mortem
    - Event and fault trees used to gain further insight into failure process
STPA / STAMP Journey for Test

- STPA / STAMP workshop 2012
- MIT Intern 2013 (James Clark)
  - Created internal education package
  - Extensive internal socialization
- Prototyping STPA / STAMP Implementation
  - Start small to learn and gain success
Areas of interest

- **Ramp safety**
  - Complex movement of people, equipment, vehicles and aircraft

Port-au-Prince’s International Airport, crowded ramp operations in the aftermath of Haiti’s earthquake in January 2010. *(Federal Aviation Administration photo courtesy of Kenneth Langert)*

Boeing 787 static test being moved around Everett Washington ramp. *(Photo Boeing)*

http://asrs.arc.nasa.gov/publications/directline/dl8_ramp_title.jpg
Lab Safety

Could STPA be applied to identify potential incidents?

Full scale testing of 747 wing generates over 1 million pounds of force!

Full scale wing testing. *Photo Boeing*

Helicopter crash testing. *Photo United States Navy*
STAMP Analysis of NextGen

The US National Airspace System is Complex

Source FAA
STAMP-Related Analysis for NextGen Safety (1/2)

- Boeing Research & Technology (BR&T) Airspace & Operational Efficiency (AOE) group
  - Analyzed the overall NextGen (Next Generation Air Transportation System) hazard situation
  - Performed a high-level analysis of the hazards in a selected NextGen Operational Improvement (OI) (i.e., OI-0349 Automation Support for Separation Management)
  - Performed a high-level analysis of how hazards can result from the highly dynamic complexity involved in a scenario of that OI

JPDO (2010, p. 5)
The BR&T AOE group also analyzed whether a selected but representative set of the existing safety methods, tools, processes, and regulations are sufficient to assess safety of OI-0349 and ensure that safety will not be compromised.

- Adopted a control-theoretical view of the relationship among the methods, tools, processes, and regulations
- Used STAMP control structure as the framework for the analysis

**Diagram**

- **Safety Certification & Approval Processes** (e.g., Aircraft Certification, Operator Certification, & Air Traffic Approval)
- **Safety Risk Management (SRM) Process**
  - Hazard Identification
  - Risk Analysis
  - Risk Assessment
  - Risk Treatment

**Relationship among Safety Methods, Tools, Processes, & Regulations** (Xu et al., 2013, Figure 9, p. 23)
References

  [http://jpe.jpdo.gov/ee/docs/conops/NextGen_ConOps_v3_2.pdf](http://jpe.jpdo.gov/ee/docs/conops/NextGen_ConOps_v3_2.pdf)


  [http://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/20130010405.pdf](http://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/20130010405.pdf)