



The Human Element of STPA integrating user research into STPA for workplace safety analysis

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Boeing's Safety Guiding Principles

- We value human life and well-being above all else and take action accordingly.
- All incidents, injuries and workplace illnesses are preventable.
- We are personally accountable for our own and collectively responsible for each other's safety.
- By committing to safety first, we advance our goals for quality, cost, and schedule

<http://www.boeing.com/principles/employee-safety.page>

Outline

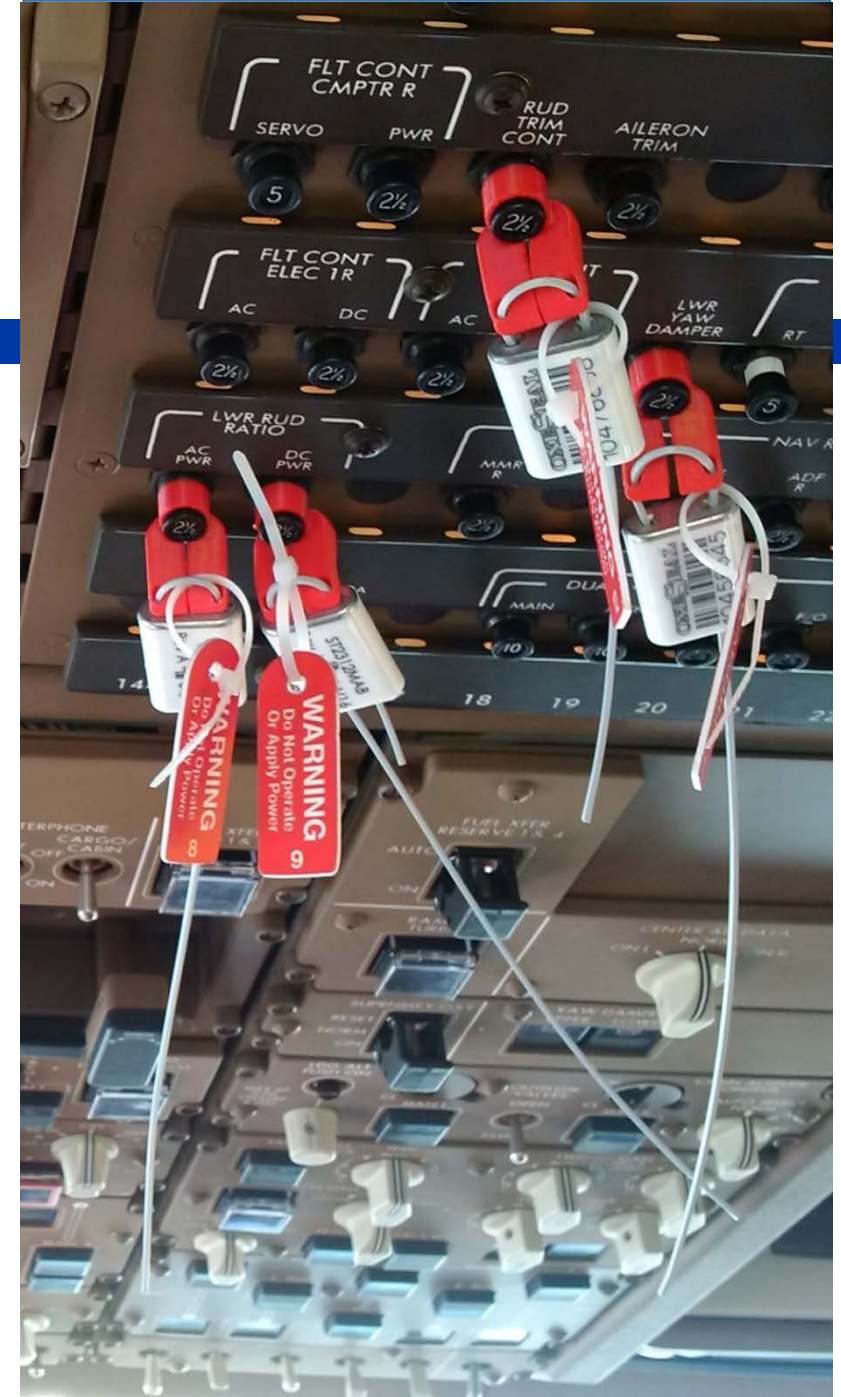
- Boeing STPA overview
- User research application
- User research tips
- Lessons Learned





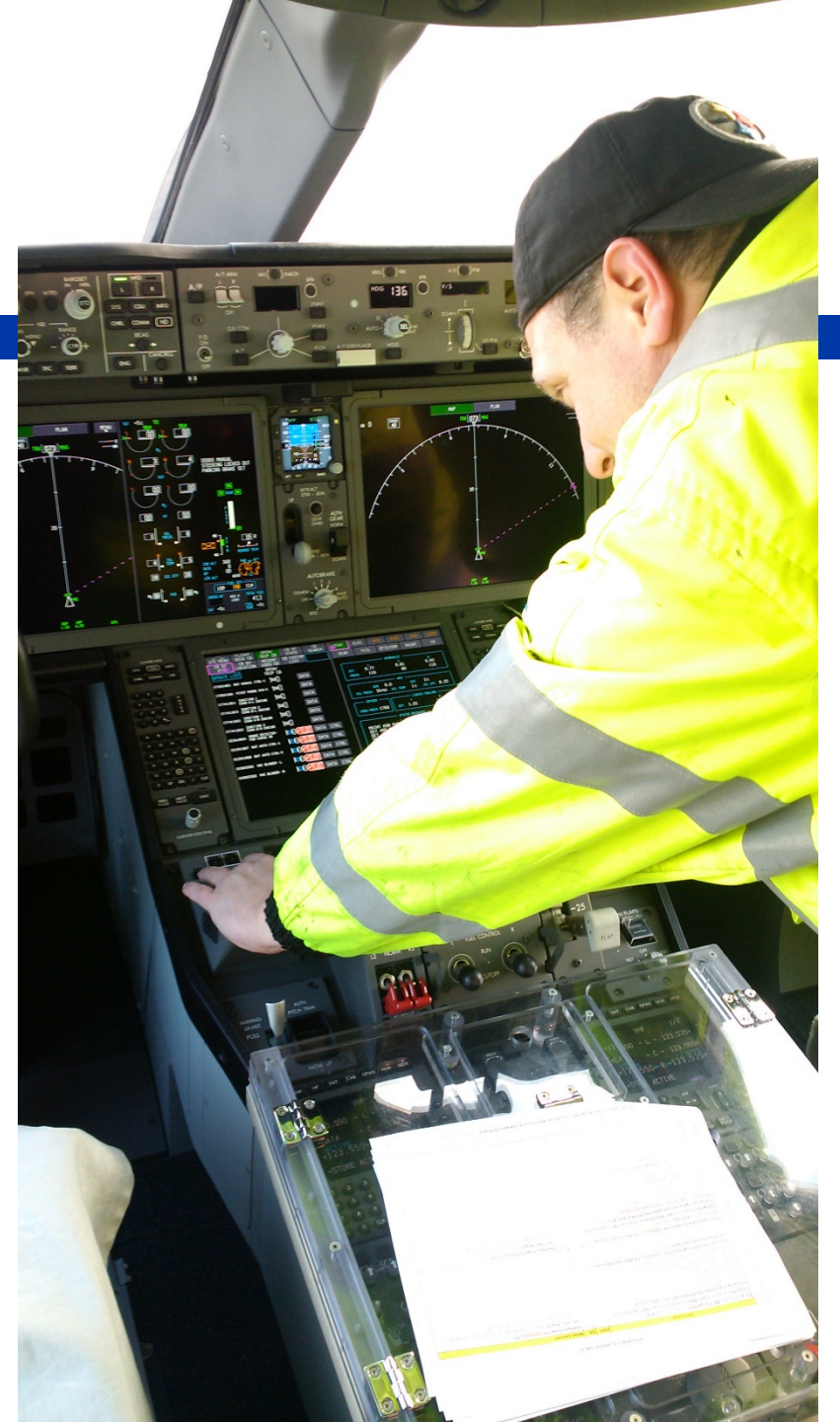
Project Background

- Boeing using STPA for workplace safety
- Lock out, Tagout, Try out (LOTO) process
 - Most complex
 - High hazard area of work
- Ensure a user-centered approach to solution development



Controller = End User

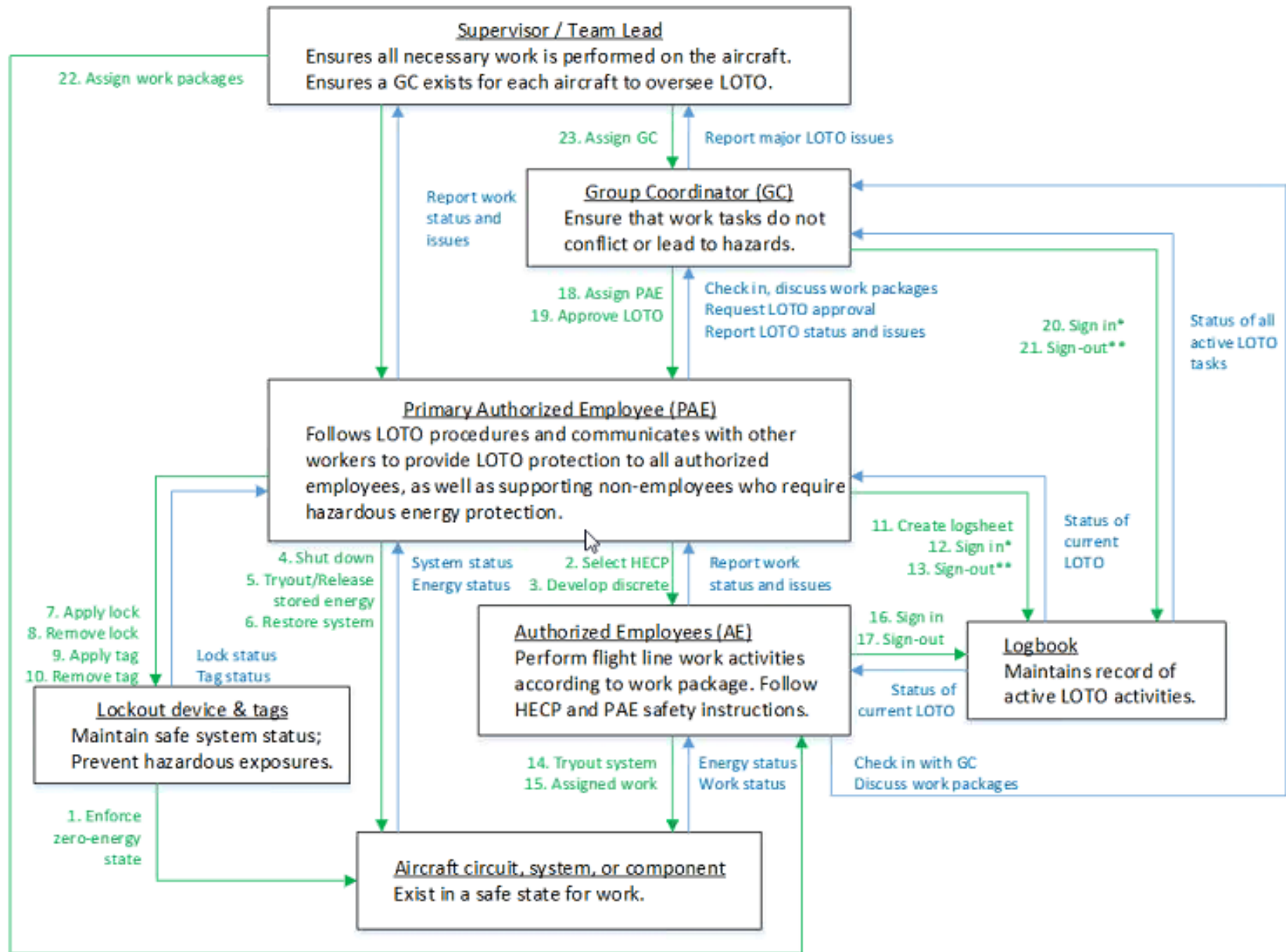
- **GCs:** Group Coordinators
- **PAEs:** Primary Authorized Employees
- **AEs:** Authorized Employees



Control Action = Process Step

- Check in
- Work Coordination & “Deconfliction”
- Perform LOTO
- Do Work
- Remove LOTO





Causal Scenarios = Problems

- **Controller:** Authorized Employee (AE)
- **Control Action:** AE signs into LOTO Log Sheet
- **Unsafe Control Action:** (Perform LOTO) AE does not sign into the Log Sheet because...
- **Causal Scenarios:**
 - ... AE can't find the sheet
 - ... AE forgot
 - ... AE didn't know it was required

BOEING AIRCRAFT HAZARDOUS ENERGY CONTROL LOG (LOTO)

Date	02/08/2017	Work Package (WP)		
Model	777	[REDACTED]		
Line #	1478	[REDACTED]		
Reason for Lockout / Tagout				
HECP Title		HECP Revision or Discrete HECP Date		
INSTALLATION AND HOOKUP OF ENGINE THRUST REVERSERS		02/08/2017		
Group Coordinator (GC)				STATUS
BEMSID	Name	Shift	Date / Time In	Date / Time Out
[REDACTED]	[REDACTED]	2	02/08 1500	2/8 2330
Primary Authorized Employee				STATUS
BEMSID	Name	Date / Time In	Date / Time Out	Transfer / Complete
[REDACTED]	[REDACTED]	02/08 1500	2/8 2330	complete
Authorized Employee				STATUS
BEMSID	Name	Date / Time In	Date / Time Out	
[REDACTED]	[REDACTED]	2-8 1620	2-8 2207	
[REDACTED]	[REDACTED]	2-8 1620	2-8 2207	
[REDACTED]	[REDACTED]	2-8 1620	2-8 2207	
[REDACTED]	[REDACTED]	2-8 1620	2-8 2207	

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AE does not sign into log sheet when beginning a shift and LOTO is active because...

WITHOUT Users:

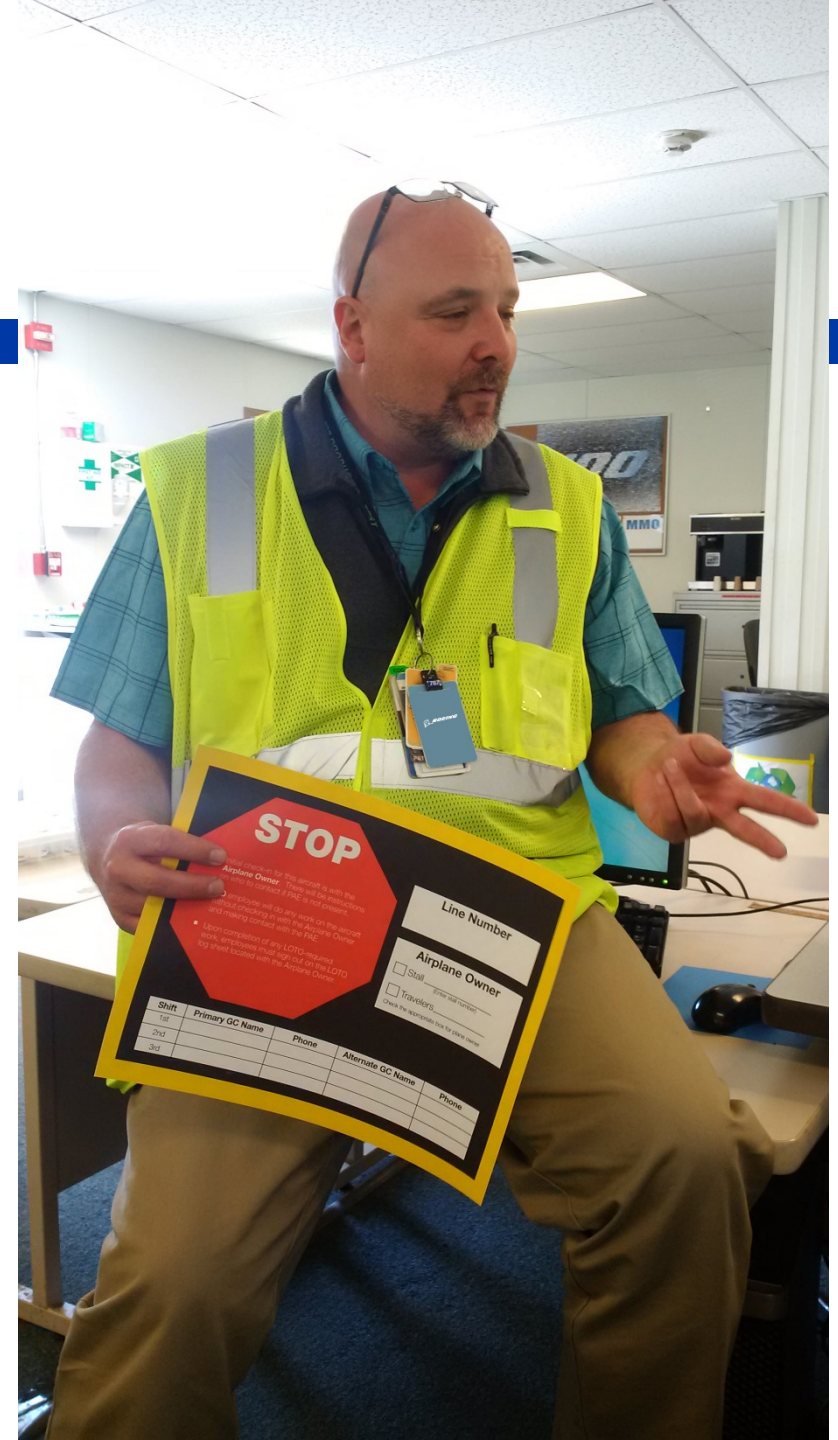
1. AE believes that the required info has already been adequately conveyed to staff
2. AE can't find the sheet
3. AE forgot
4. AE didn't know it was required

WITH Users:

1. AE is not performing LOTO work.
2. AE is not working that open job that has LOTO on it.
3. AE believes that they are not working any LOTO work, when in fact they are. (Didn't know they needed LOTO).
4. AE are unaware of the LOTO risks in a hazardous energy work area (main example: Passenger cabin)
5. AE are on a tight schedule / don't have time
6. The check in process is not enforced.
7. AE don't know who the GC is
8. AE does not see the value of checking in
9. AE had their team lead/team member do it for them (the whole team).
10. AE signs in for themselves thinking it covers the whole team.
- ...
17. AE don't know AE need to check in (forgot what AE learned in the training

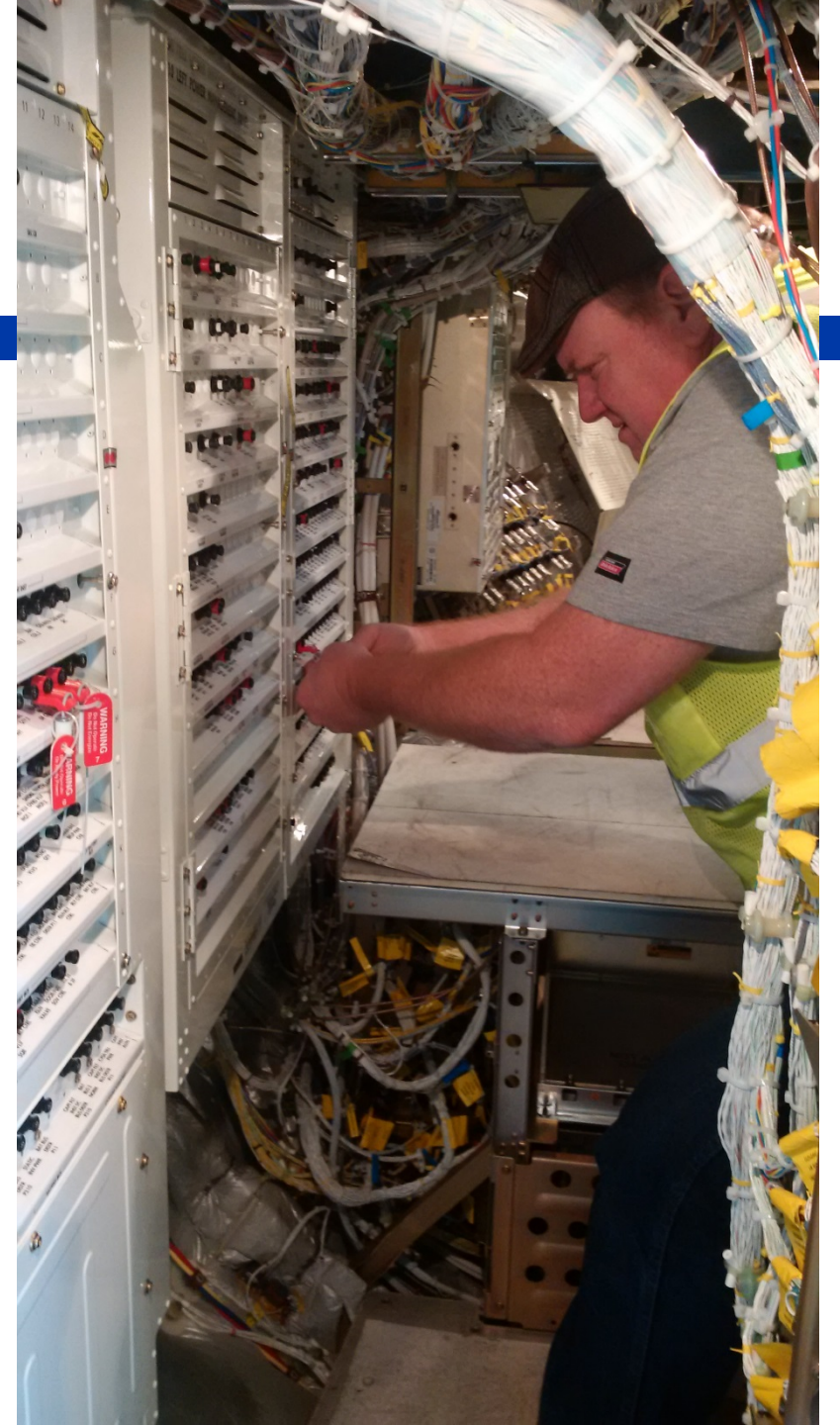
Mitigations = Prototypes

- Consider incorporating Design Thinking in solution generation
- 3 workshops to come up with solutions “mitigations” for certain aspects of LOTO



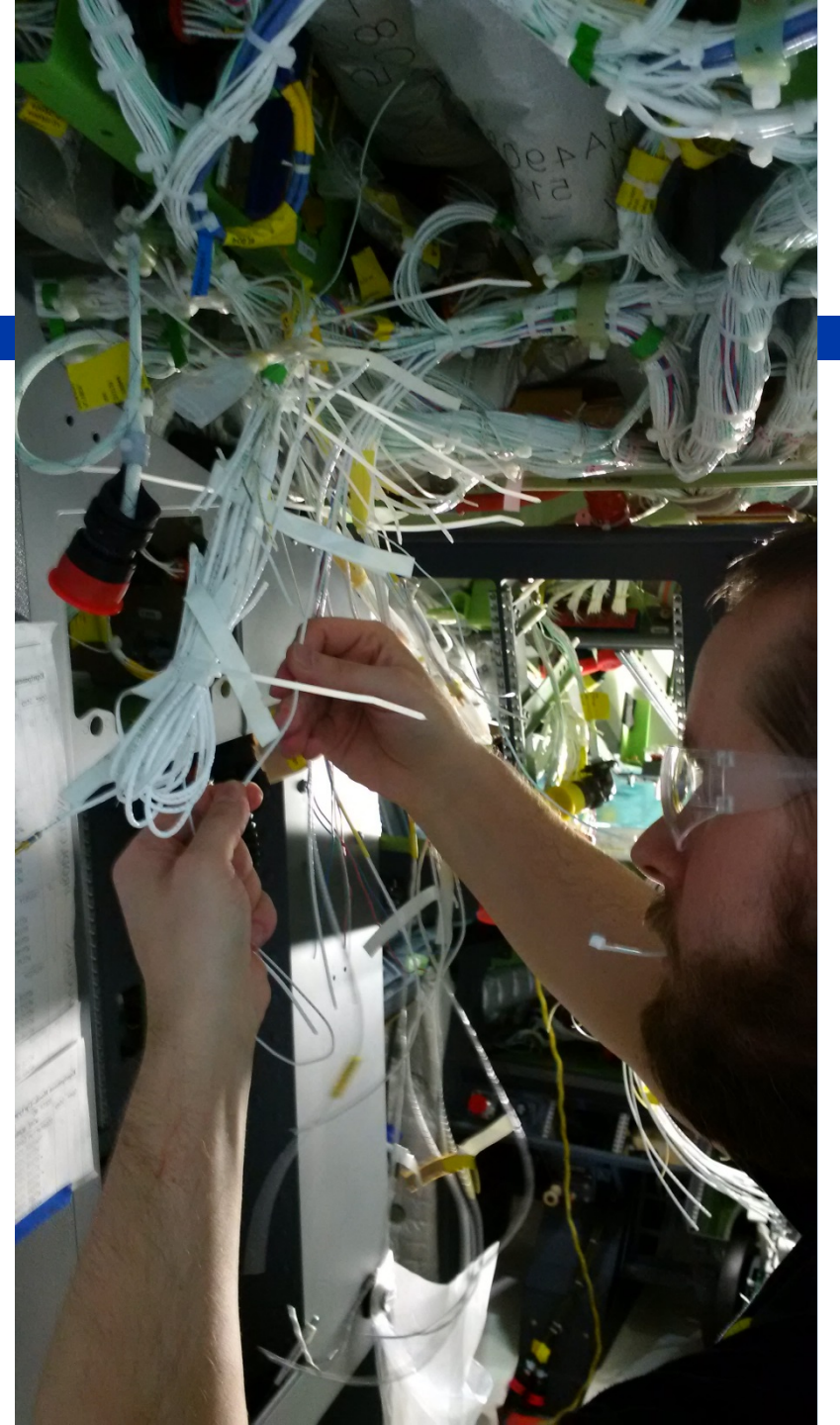
#1: Watch your users work

- Observe quietly
 - Gemba Walk – “Go, Look, See”
 - Contextual Inquiry
- Read up on business processes and instructions before you go
 - What should they do?
- Document their ultimate process
 - What do they do?
- Look for gaps
 - How are they trying to improve their job?



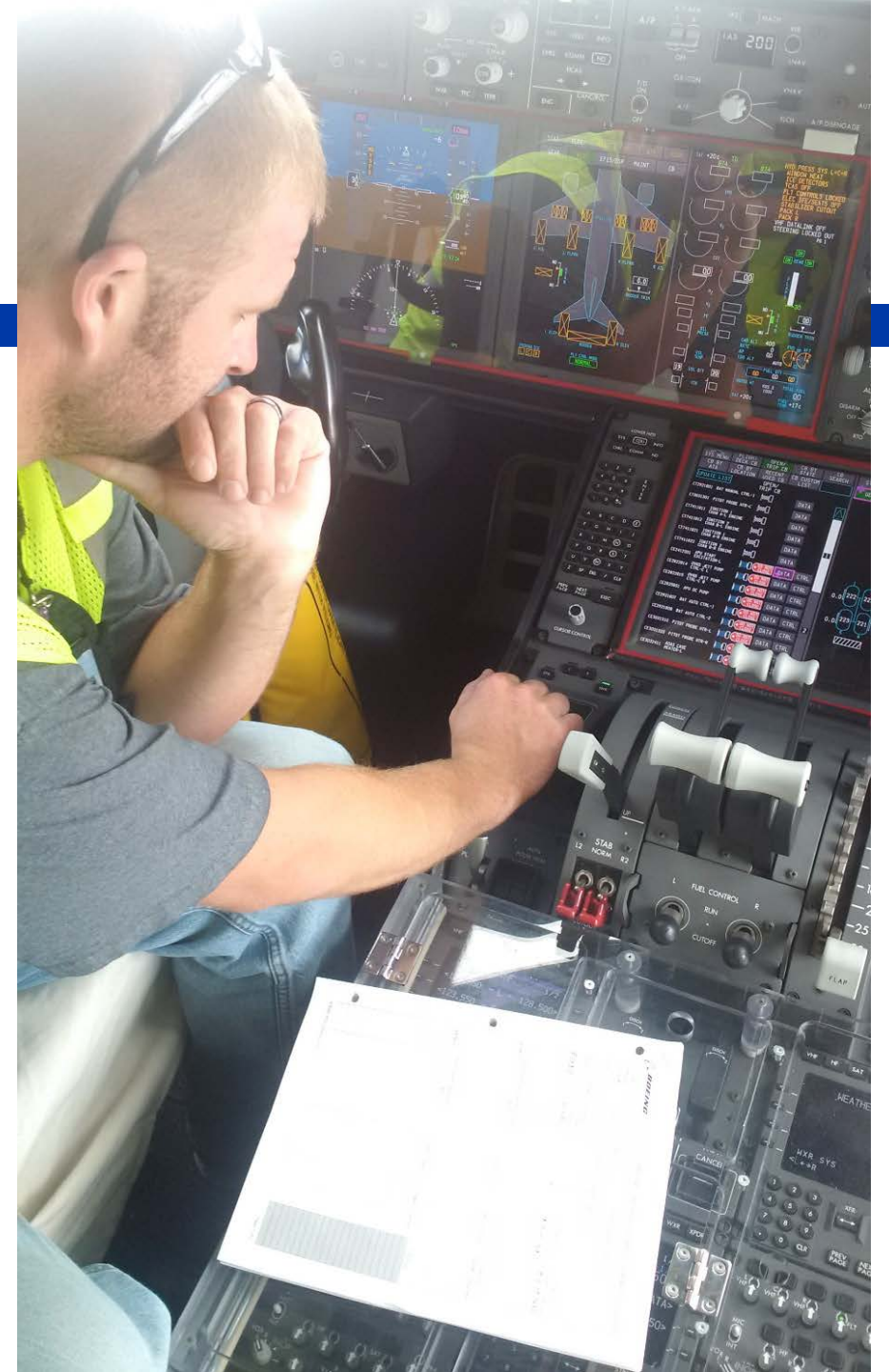
#2: Ask the right questions

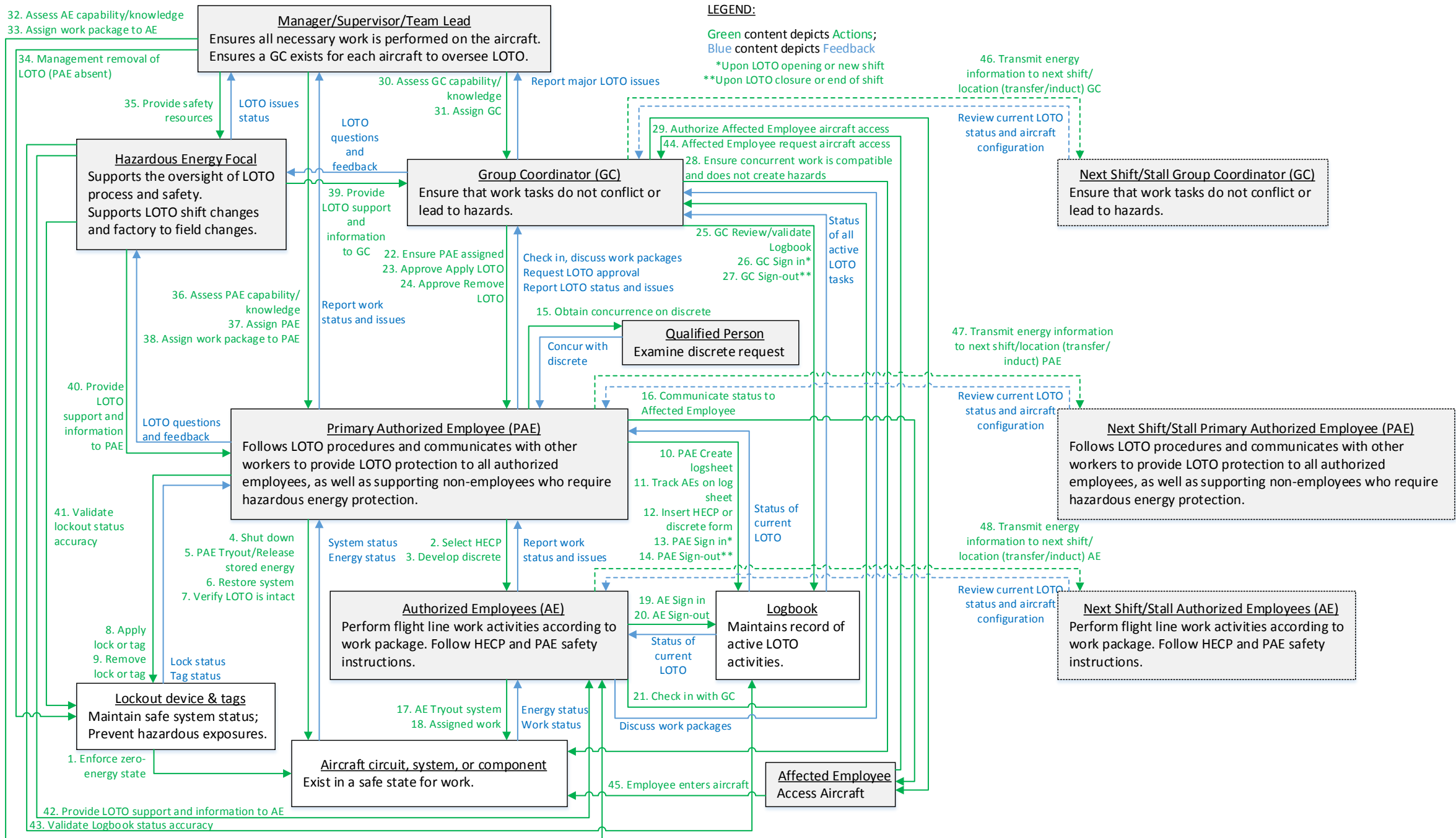
- Remember that they're doing an actual job
- Don't interrupt
- Clarify process steps during a mental break
- Never directly ask them to predict their future behavior

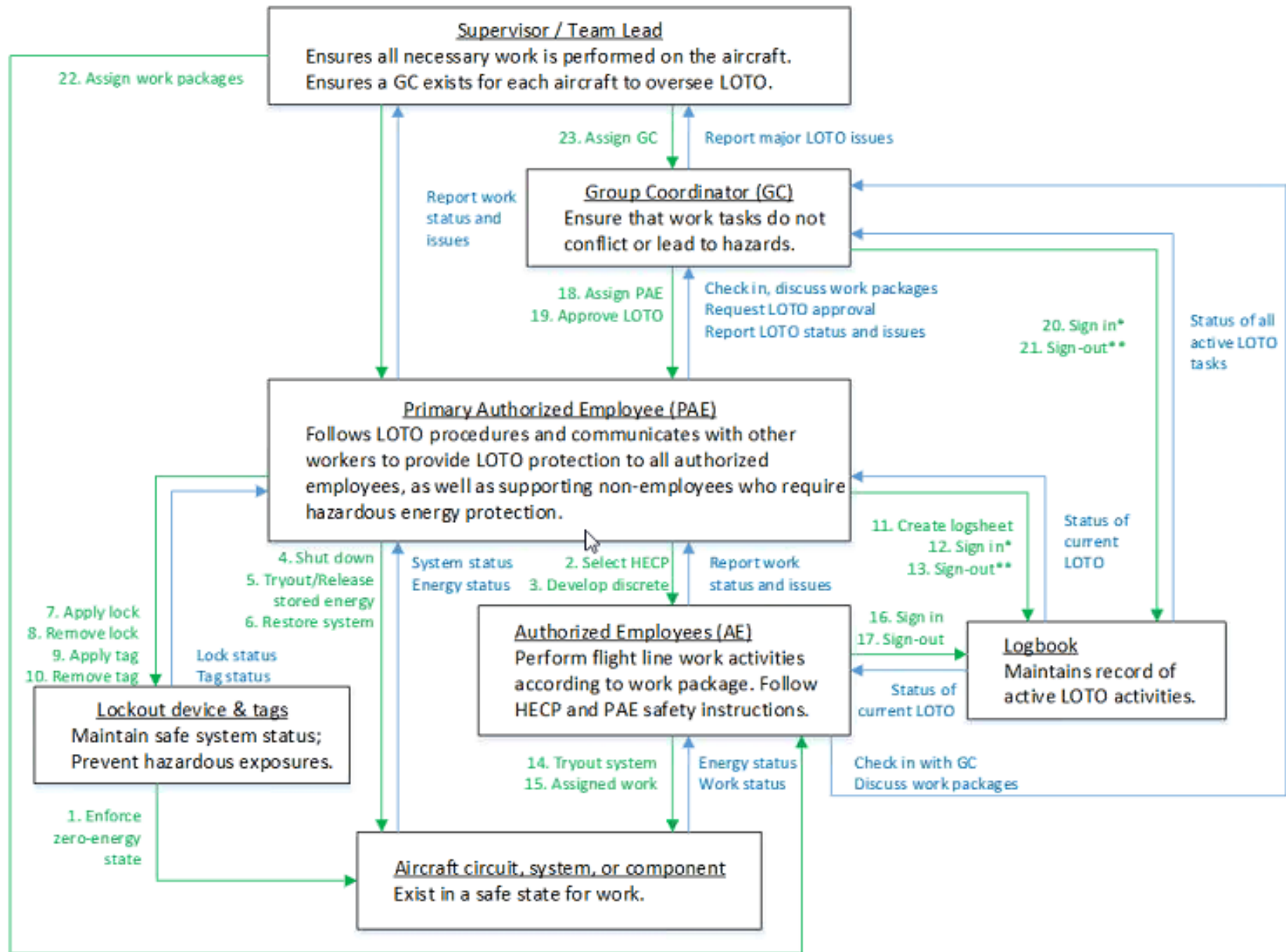


#3 Show, don't tell

- Visual communication is key
- Talk to a sketch, objects, some visual
- Craft clarity
- Shared understanding and shared vision of mitigations







Benefits of User Research with STPA

- Helps capture all of the possible causal scenarios and insights as they are emerging
- Helps speed up the generation of causal scenarios
- Helps develop a solid business case for these mitigations
- Ensures mitigations will work and a solution that is real
- Builds relationships: End-users are engaged and willing to adopt the mitigations

Lessons Learned and Parting Thoughts

- Complementary analyses
- STPA forced us to ask, “is this ever possible in the future?”
- Need to get everyone involved in the analysis engaged with the business.
 - Observation: understand their behaviors, needs and pain points.
 - Process Analysis: Read between the lines to understand their motivations and goals.
 - Ask the right questions to understand the What, How and Why.
 - Show don't tell: Have visual conversations to understand how work can be done more efficiently with end-users (controllers).
- Next Steps – Test phase
 - Where are we automating process steps?
 - Are the mitigations really helping?



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Abstract

For STAMP applications to workplace safety, including real system users in the STPA is a crucial step to success. Boeing's Environment, Health and Safety (EHS) is partnering with the mechanics on the Everett Flight Line to analyze the numerous and complex safety hazards that the mechanics face daily in the workplace. Boeing EHS incorporated interviews and observation of mechanics to help speed up the generation of unsafe control actions and produce additional causal scenarios. This talk will illustrate how user research complements STPA. In particular, the mitigations and solutions identified in the STPA will have a better chance of improving safety in the workplace because of end-user inclusion throughout the analysis.