~~Negotiation~~
Bi-directional Communication
A Critical Component of HAT

- Either Human or Agents can initiate com
- Agent response can be mediated by context
  – high time pressure
  – high consequences

Problems

- Lack of Mode Awareness
  - Real world: Autopilot mode confusion
  - RCO: Who is responsible? Where am I in solving the problem?
- Brittle automation
  - Real world: Automation kicks off when faced with corner cases (e.g., Air France 447)
  - RCO: Divert tool under-weights proximity
- Miscalibrated trust
  - Real world: Tesla accident, driver watching a video while care, on autopilot, runs into a truck
  - RCO: Subjects rate automation as less reliable when they don't understand it

Dialog/Bi-Directional Communication

Both the automation and human operators may have information or know of constraints the other is unaware of. Sharing this information is important to making plans that are acceptable and implementable

- Transparency
  - In order to evaluate a recommendation, it is necessary to understand how that recommendation was arrived at
- Shared Language
  - Human and computer reasoning systems often take very different forms (e.g., humans categorize and satisfice; computers are more quantitative). Dialog and Transparency require an interface that bridges such differences
- Human Directed
  - Ultimate responsibility needs to fall somewhere. We believe that is going to be the human. It follows that the human should be giving explicit direction to the automation.

Lack of Mode Awareness

- It should be **transparent** what the operator and automation are doing
- Because the **human** must **direct** any plan, the operator should be aware of that plan's content
- When the automation cannot meet a goal, it should enter a **dialog** with the operator
- RCO Example: Plays, operator calls plays to set system goals. Responsibilities outlined in play details.

Anti-skid Fail	Anti-ice fail	Windshield Overheat	Wheel Well Fire	Wx Radar Fail
No Auto-Land	Cabin Pressure Fail	Medical Emergency	Auto-Brake Fail	Cabin Fire
Cargo Door Open	Divert	Weather		

"This one was definitely awesome. Sometimes [without HAT] I even took my own decisions and forgot to look at the QRH because I was very busy, but that didn't happen when I had the HAT."

NASA35 - Medical Emergency

- ☐ SWITCH STATUS TO MEDICAL
- ☐ SUGGEST DIVERT OPTIONS FOR NEAREST SUITABLE
- ☐ MAKE RECOMMENDATION TO PILOT
- ☐ UPLINK AGREED UPON FLIGHT PLAN
- ☐ ADD DETAILS OF ILLNESS TO OPERATOR NOTES
- ☐ CONTACT EMS
- ☐ CONTACT MAINTENANCE
- ☐ CONTACT CUSTOMER SERVICE
- ☐ CONTACT SLOT CONTROL
- ☐ CONTACT CARGO CONTROL
- ☐ ASK IF PILOT NEEDS ADDITIONAL ASSISTANCE

Brittle Automation

- Dialog allows the operator to input information or alter the reasoning of automation in situations the automation was not programmed for, without having the automation punt entirely
- RCO Example: Sliders, the operator can adjust the weighting of various factors going into a divert decision.
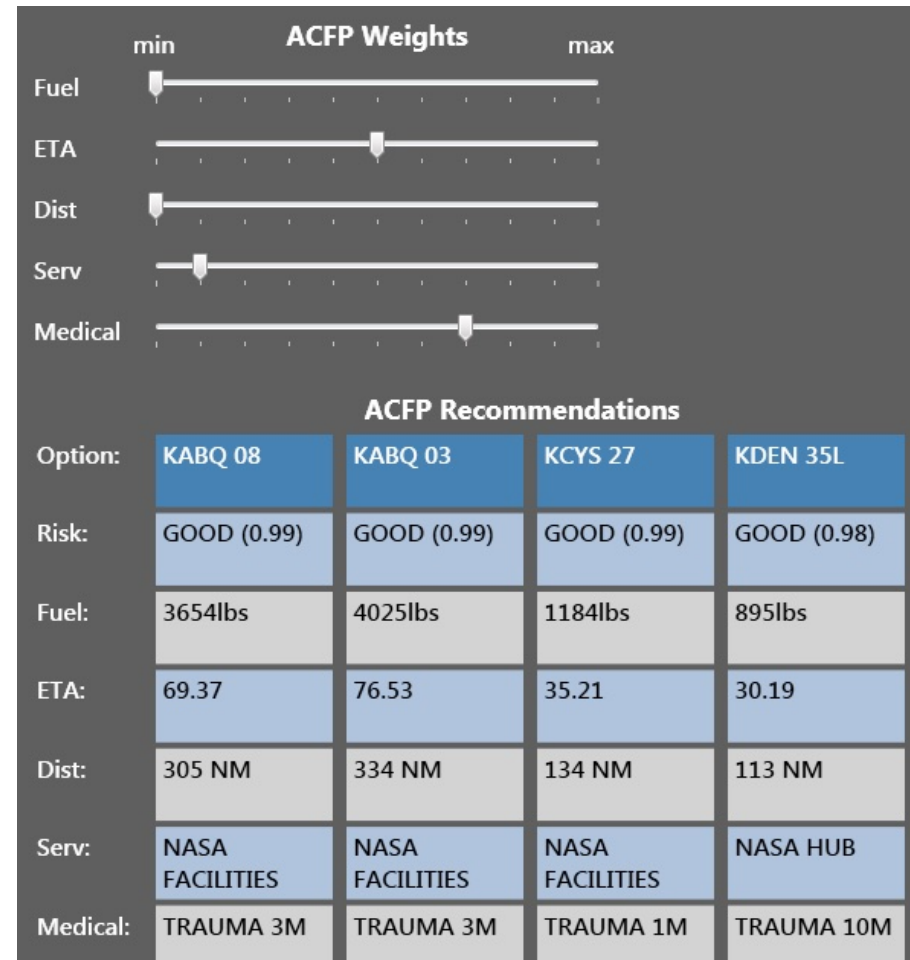
The sliders was [sic] awesome, especially because you can customize the route.... I am able to see what the difference was between my decision and [the computer's decision].

ACFP Weights

min   max

Fuel

ETA

Dist

Serv

Medical
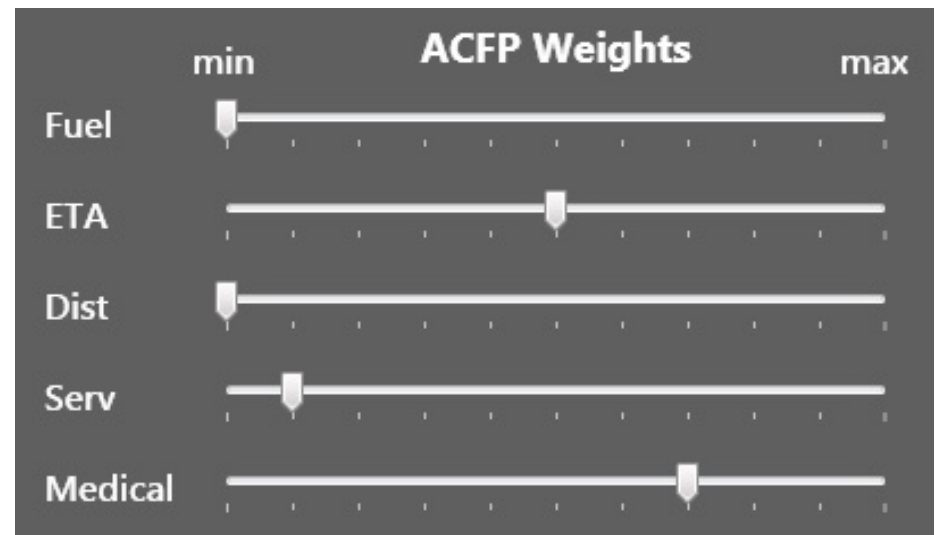
Miscalibrated Trust

- Transparency creates better understanding of the automated process which allows the operator to know when to trust it

- RCO Example: Table and Sliders, make it clear how divert options are rated

"This [the table] is wonderful…. You would not find a dispatcher who would just be comfortable with making a decision without knowing why."

ACFP Weights

min | max

| | Fuel | ETA | Dist | Serv | Medical |

ACFP Recommendations

Option:	KABQ 08	KABQ 03	KCYS 27	KDEN 35L
Risk:	GOOD (0.99)	GOOD (0.99)	GOOD (0.99)	GOOD (0.98)
Fuel:	3654lbs	4025lbs	1184lbs	895lbs
ETA:	69.37	76.53	35.21	30.19
Dist:	305 NM	334 NM	134 NM	113 NM
Serv:	NASA FACILITIES	NASA FACILITIES	NASA FACILITIES	NASA HUB
Medical:	TRAUMA 3M	TRAUMA 3M	TRAUMA 1M	TRAUMA 10M

Human queries to Agent

- Confidence
- Reasoning
- Add/modify constraints

Auto to Human

- Goals
- Time (deadlines)
- Evaluation of plays/ alternatives
  - Overwatch play can't be executed with current assets, but can suspend a lower priority play…
  - Changing environment changes abilityt to execute play
- Assets

Issues

Authority – does final authority ALWAYS stay with human ?

- Maybe not – human perf outside of defined parameters (Rogue pilot)

Should agent auto employ etiquette ?

- How ?
- Mediated by context (time pressure)