Intelligent Load Planning for Unmanned Cargo Aircraft

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Company

- Founded: 2009, The Netherlands
- Team: Rob Hagmeijer (development)
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- Launching customer (2009):

Experts in Computational Load Control
Role of Load Control

Load, and ...
- Airplane Flyability
- Airplane Structural Integrity
- Regulations (DGR, Airline rules, IATA, ...)

- Operational Efficiency (loading/off-loading)
- Fuel Efficiency (center of gravity)
Load Control & **UCA**

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Full aircraft, and ... 

... route flexibility
Load Control & UCA

Global services, ...

... or a local application.
Load Control: History

1904 ... Paper

1990 ... Spreadsheet

2000 ... Graphical User Interface
- Let a computer \textit{compute} the load plan (autoload):
  . Airplane Flyability
  . Airplane Structural Integrity
  . Regulations
  . \textbf{Bonus}: Very Short Problem Turn-around Times (secs)

- Let a computer \textit{optimize} the load plan:
  . Operational Efficiency
  . Fuel Efficiency
Example: 747-400ERF

Load plan generated in seconds
Fuel Efficiency
Aerodynamically stable configuration:

Put center of gravity as aft as possible:

=> minimum balance force
=> minimum drag
=> highest fuel efficiency
Structural Integrity

Error(s): Unsymmetrical Linear Load Limits
- Unsymmetric linear-load limit exceeded
  - Limit: 48.9 kg/in
  - Actual: 53.44 kg/in
- ULD: PMC10043KC @ RL/M (53.44 kg/in)
- Reference: Boeing WB manual, D043U542-Rev.8, 1-60-001 p4/5 (All)
Regulations

Error(s): Dangerous Goods Segregation
| IMPS conflict (adjacent): ROX-RFL
| ULD: PMC19340KC @ GR/M ()
| ULD: PMC17292KC @ GL/M ()
| Reference: Segregation Table 5.12, p1 ...

Error(s): Climate Restriction
| Incompatible climate ranges (ULD-ULD combination)
| ULD: PMC17052KC @ 41P/M ()
| ULD: PMC11335KC @ 42P/M ()
| Reference: Fundamental Constraint

oxidizer
flamable liquid
Operational Efficiency

Key issue for success of UCA:
Route flexibility: efficient unloading
Load Factor

Key issue for success of UCA:
Full airplanes: ULD-shapes accommodation

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Conclusions

- Load Control is essential:
  - Airplane Flyability
  - Airplane Structural Integrity
  - Regulations (DGR, Airline rules, IATA, ...)
  - Operational Efficiency (loading/off-loading)
  - Fuel Efficiency (center of gravity)

- Key to the success of UCA:
  - Full airplanes & Route flexibility
  - High level of automation and optimization

Thank you