

Design of a Single Cockpit Pilot for Airline Operations

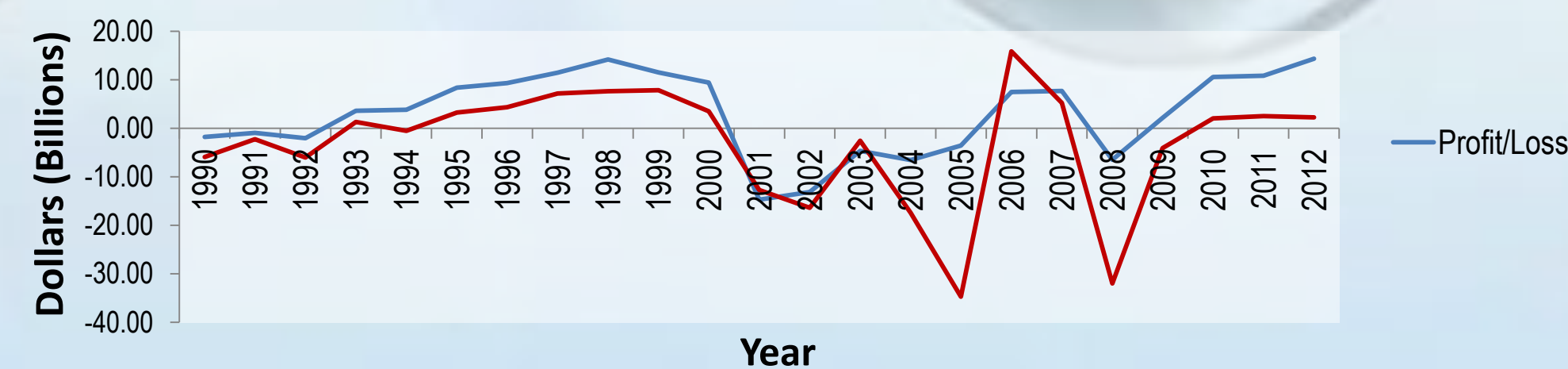
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Context

- Commercial air carriers have experienced poor financial performance over the past thirteen years
- Financial volatility is caused by rising operating expenses
- Rising variable costs such as fuel are driving operating expenses up

Profit/Loss for Major Air Carriers



- FAA has predicted a pilot shortage in the next 10 years
- Historically, the cockpit has decreased in size as a way to mitigate labor costs as technology became available to assume the roles of the replaced pilots. Could removing the co-pilot be the next step in this devolution?

Need Statement & Alternative Con-Ops

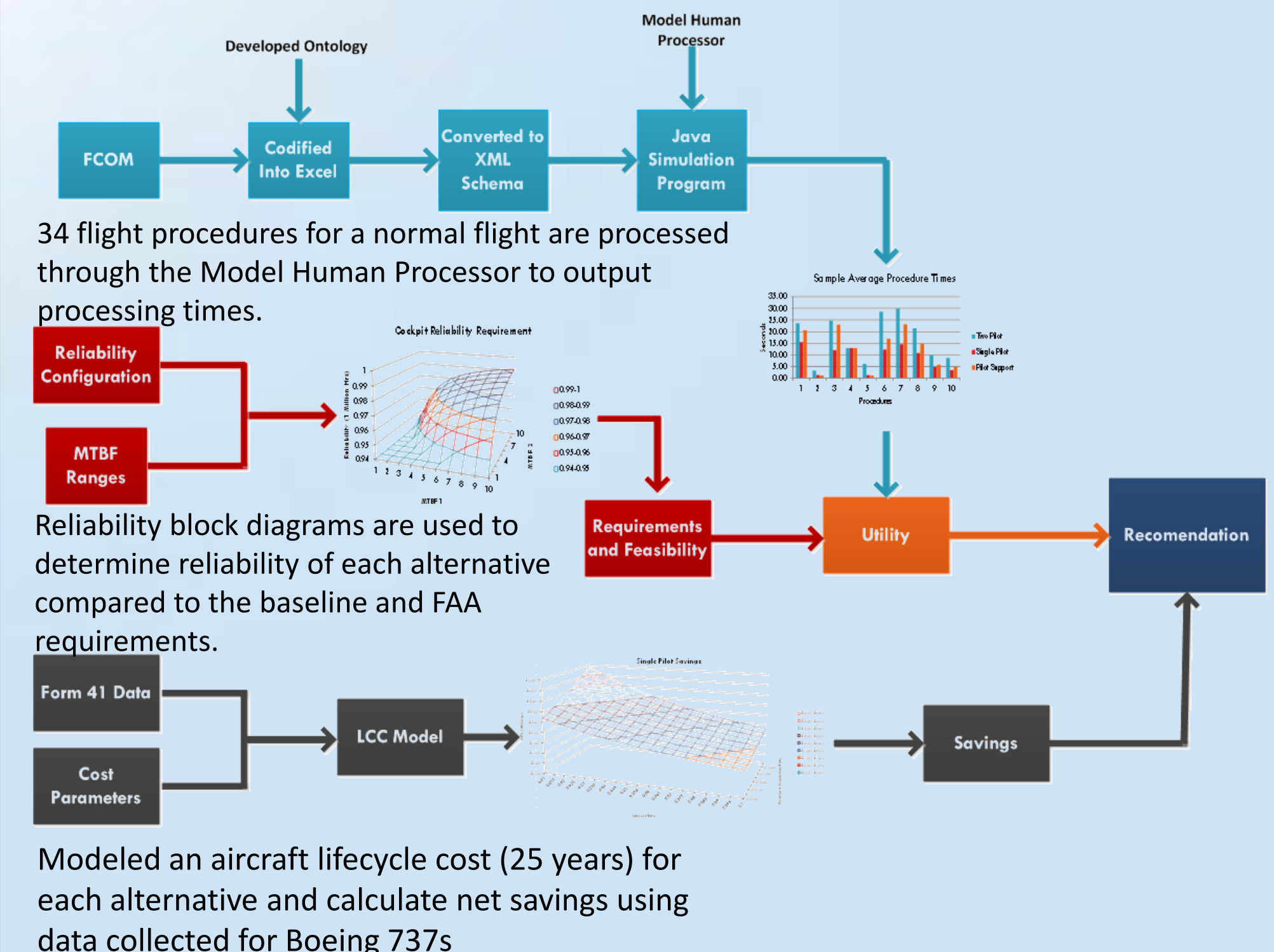
Need:

A single pilot cockpit is needed to decrease labor expenses and mitigate the effects of a pilot shortage

Alternatives:

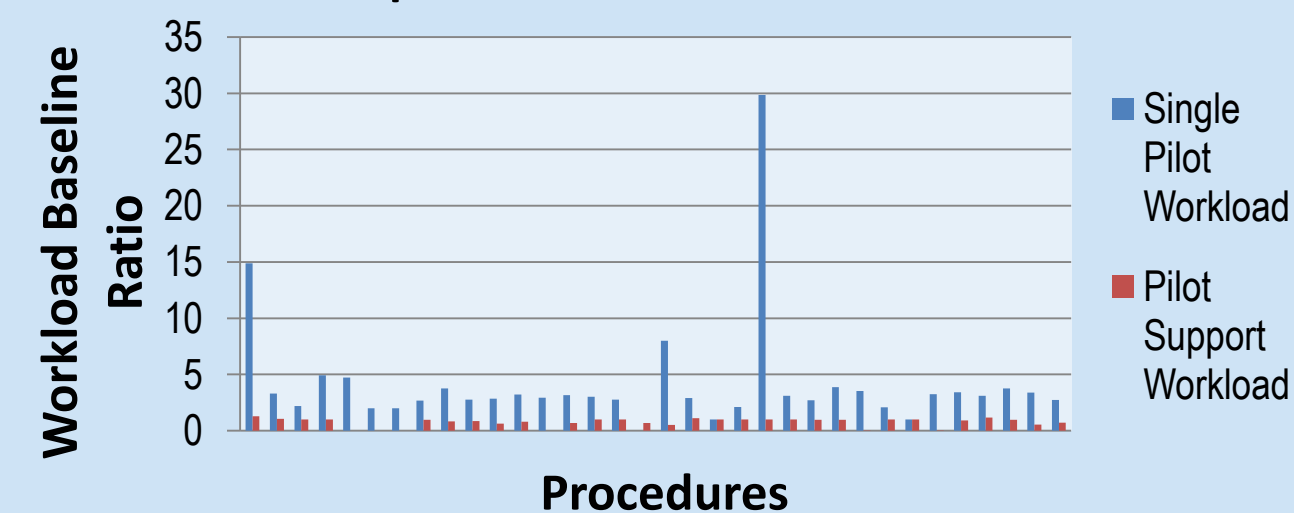
Two Pilot Cockpit (Baseline)	Single Pilot (No Additional Support)	Single Pilot (With Onboard Procedural Support System)
No change from system in place today	All tasks transferred to pilot	Co-pilot is replaced with hypothetical black box avionics system that is integrated into the cockpit.
Procedural breakdown does not change from FCOM	Callouts between pilot and co-pilot removed	System can give intelligent suggestions to pilot, but has no control over the plane.

Method of Analysis



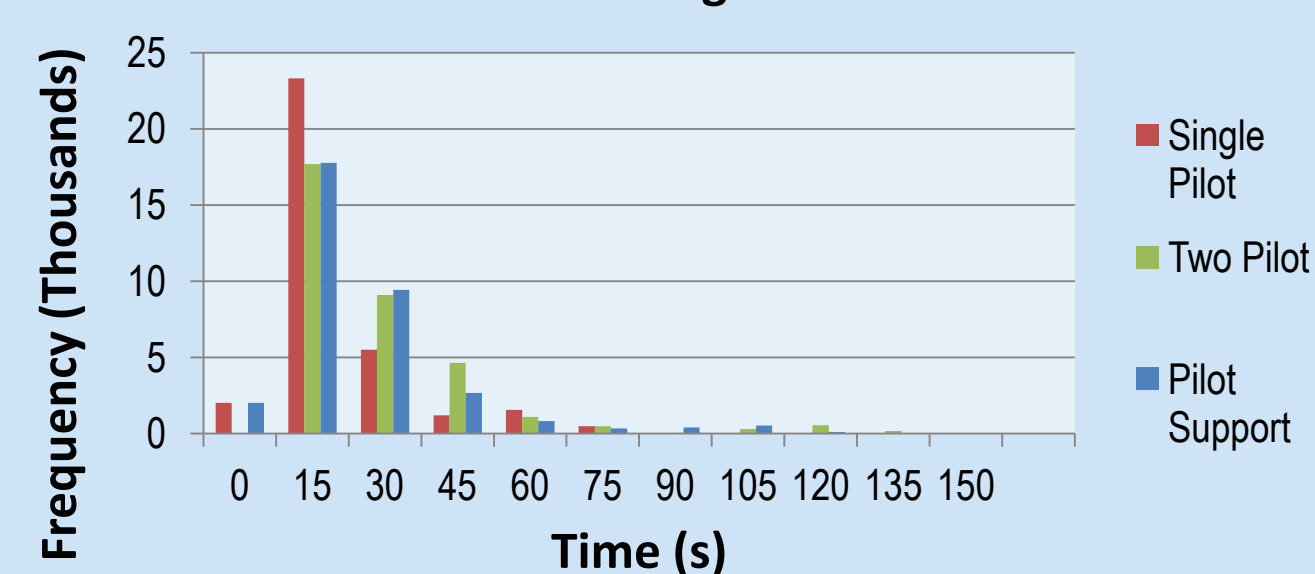
Procedure Model Results

Relative Single Pilot Cockpit Workload Compared to Baseline Workload



- Unsupported single pilot had smallest processing time
- The unsupported single pilot showed a **fourfold increase** in workload over the baseline
- The onboard-supported single pilot, however, saw a **25% decrease** in workload from the baseline

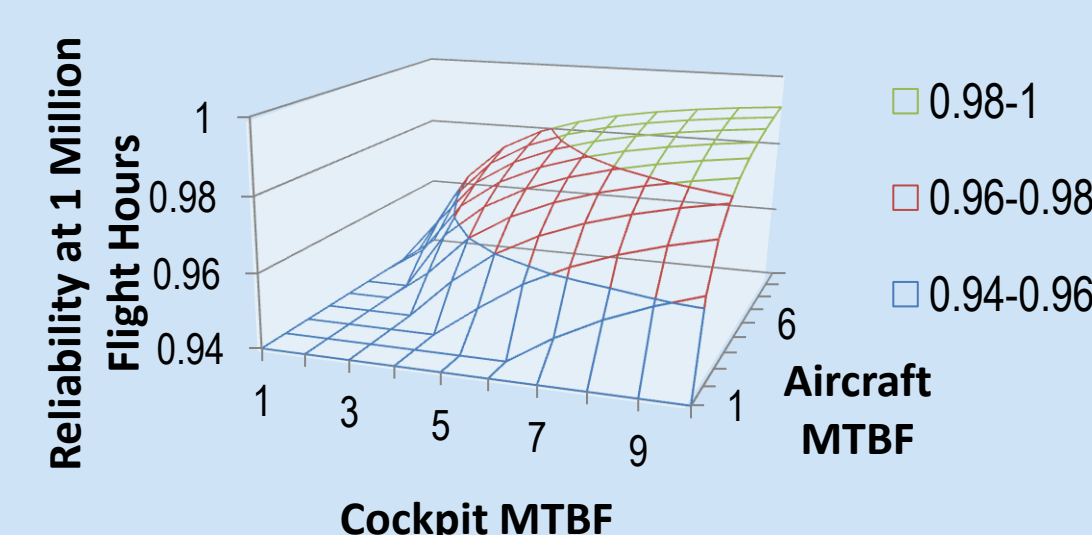
Procedure Processing Time Distributions



- Predicted reduced processing times due to reduction in task count
- Both single pilot cockpit designs have average procedure times significantly smaller than the two pilot cockpit, as expected

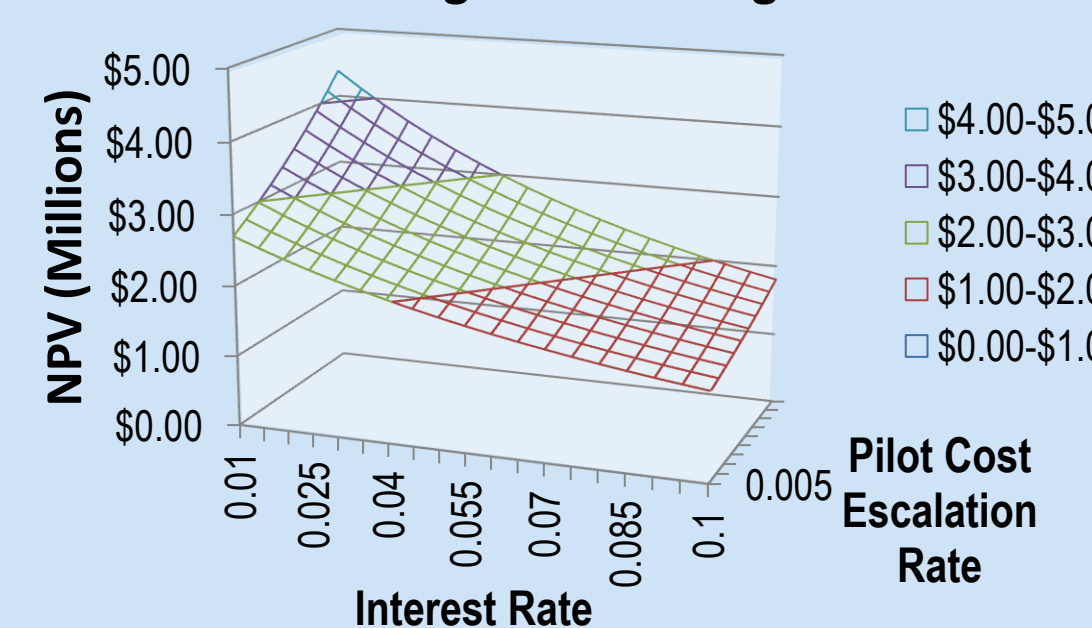
Reliability and Business Model Results

Cockpit Reliability Requirement



- Required system reliability at 1 million flight hours is 0.94
- An unsupported single pilot would require aircraft reliability to be at an unachievable level, making it an infeasible option
- Single pilot with onboard support would be feasible as long as an emergency auto-landing feature could be implemented
 - Avionics would have to be certified above 1 in 1 million flight hour failure

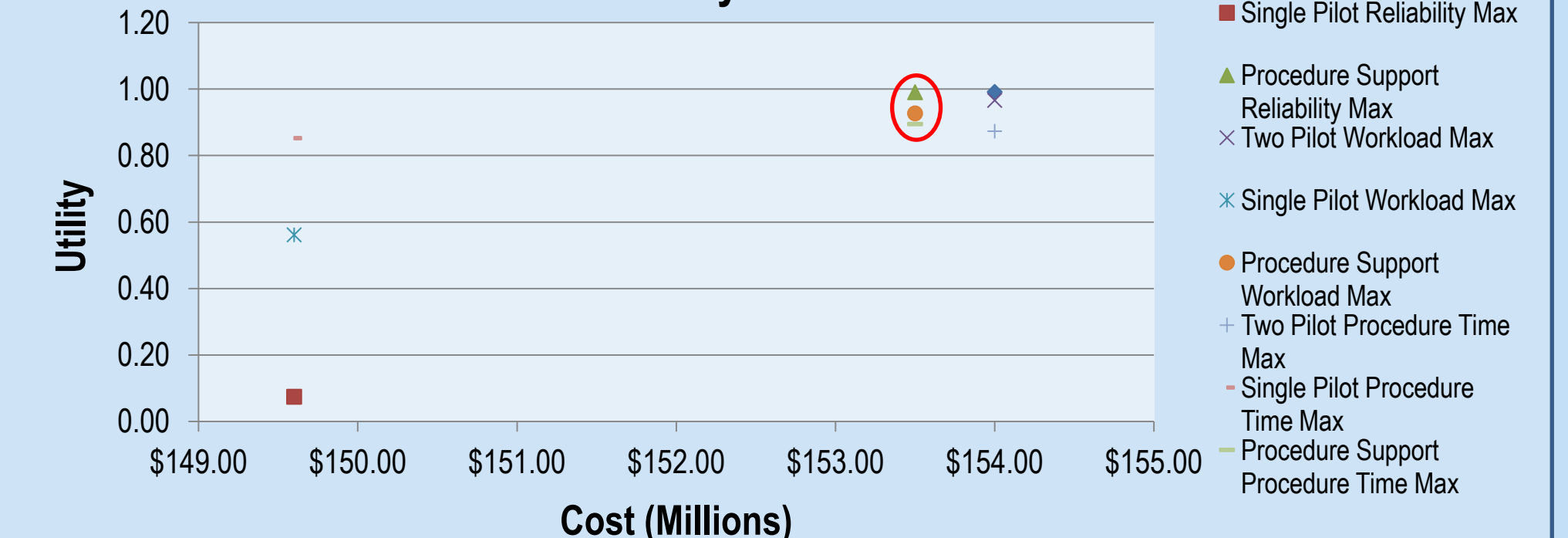
Single Pilot Savings



- Single pilot would support up to a **\$4.38M per-aircraft savings over the 25-year life cycle**
- Savings could be allocated to procedure support system acquisition or other operating costs
- Single pilot cockpit decreases aircraft operating costs

Conclusions & Future Work

Utility vs. Cost



- Single pilot with onboard support alternative gave best utility to cost ratio
- Recommend keeping two pilot cockpit with the procedure support system to be phased in and evaluated for the eventual change to the single pilot cockpit pending further future analysis
- Extend procedure simulation to a live pilot simulator to validate and/or recalibrate models
 - Tie in ATC procedures to test their workloads
 - Incorporate dynamics feedback loop
- Conduct focus groups with stakeholders to establish win-win scenario
- Begin development of Single Pilot with Onboard Support requirements baseline