

Subordinating Maintenance to The Goal

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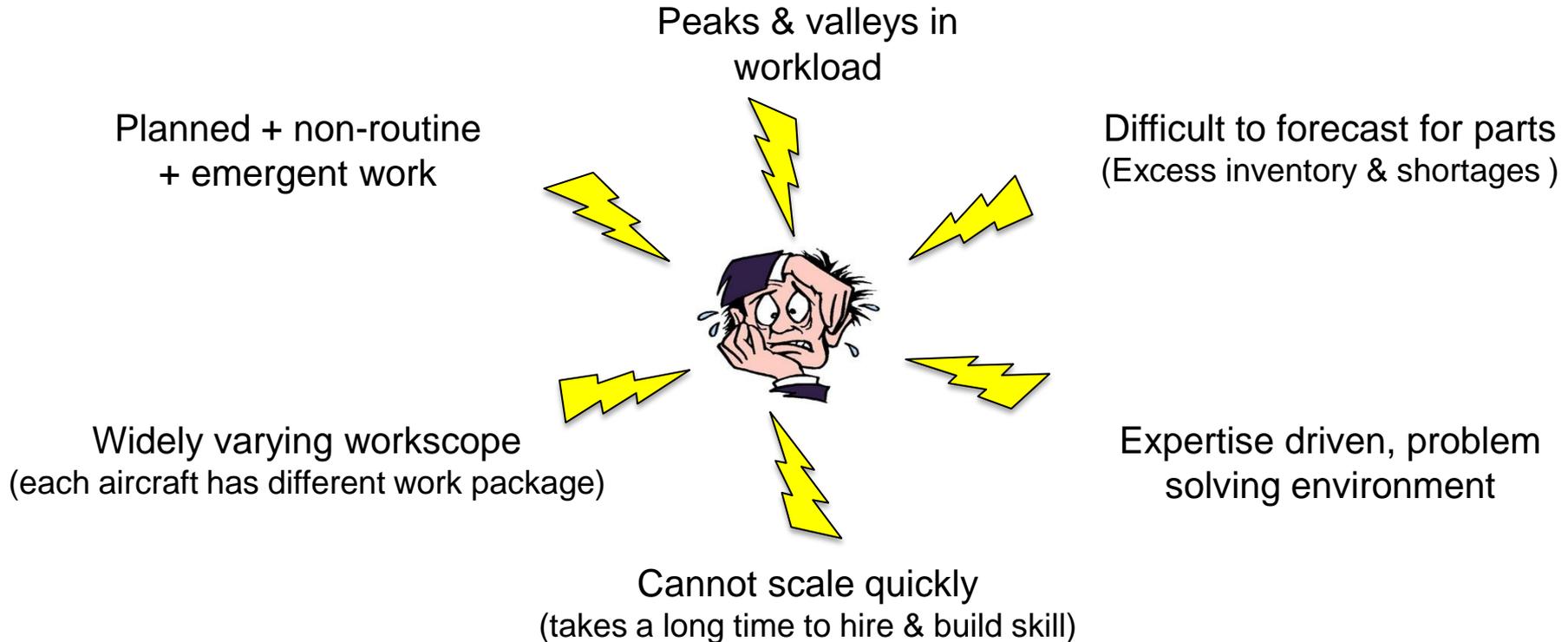
September 7-8, 2017



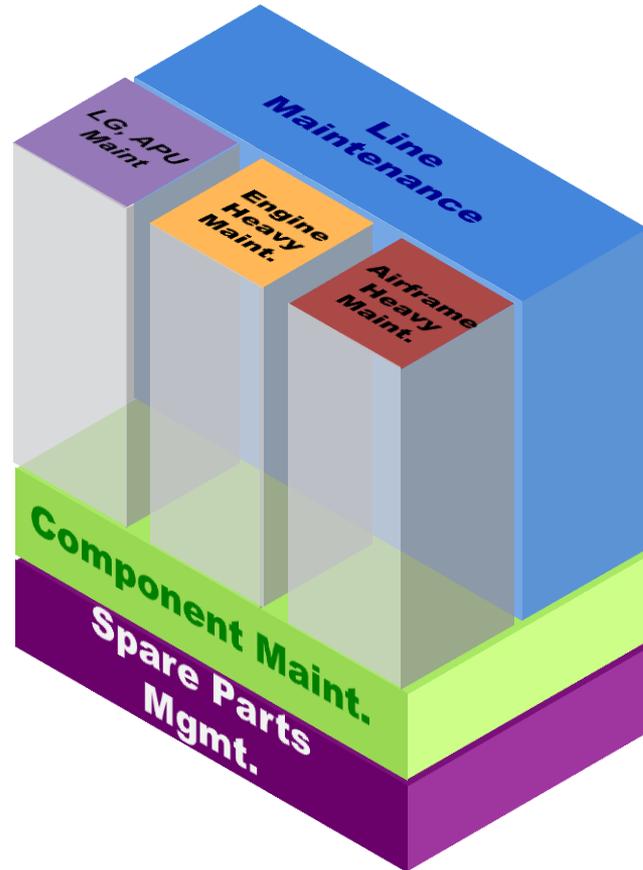
PRESENT: BUILDING ON SUCCESS 2017

**BREAKTHROUGH RESULTS FOR
GOVERNMENT AND BUSINESS**

Managing Maintenance is Difficult



MRO Overview



Economic / Business Drivers

Commercial

- High capital business (~\$40M to \$200M at discounted prices)
- Increasing utilization (↑ ASM) is crucial
 - One additional day of 737 can bring in ~\$100K of extra revenue*
- Increasing Margin (↓ CASM) is also vital
 - Airlines will make \$7.5 (avg.) / passenger (IATA '17 report)
 - Demand stimulus from lower oil price will taper off in 2017, slowing traffic growth. (IATA 2017 Report)
 - “The avg. return fare (before surcharges & tax) of \$429 in 2015 is forecasted to be more than **64% lower than 20 years earlier**, after adjusting for inflation,” (IATA)

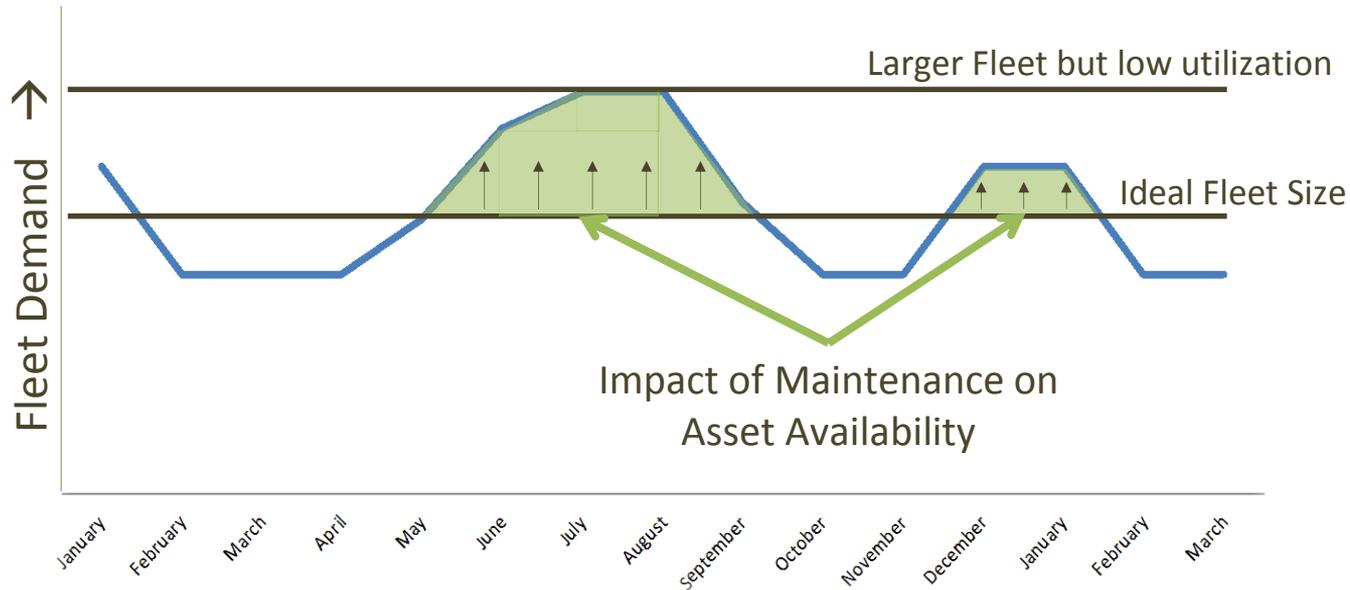
* 5 flts. / day X 170 seats *0.8 load factor *\$150 price per ticket

Military

- Extremely high replacement value
 - Substantial development cost spread over a small number of aircraft
 - Service life extended way beyond original plan
- Readiness (not utilization) is paramount
 - Cannot predict when we will need the assets → have to be ready all the time
- Bounded (& shrinking) Budgets
 - Growing federal debt
 - Increasing budget pressure on Military MRO and Inventory

Why not just add Capacity?

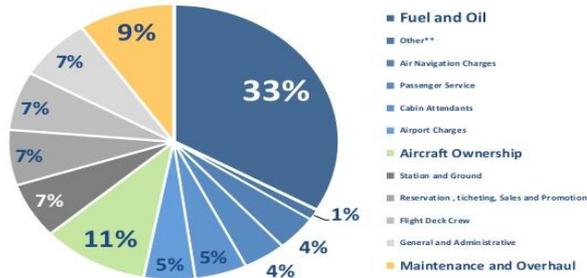
1. Passenger traffic is not uniform throughout the year
2. Airlines cannot just increase fleet size and accept poor utilization of an expensive asset



Maintenance can play a crucial role in exposing capacity of existing fleet

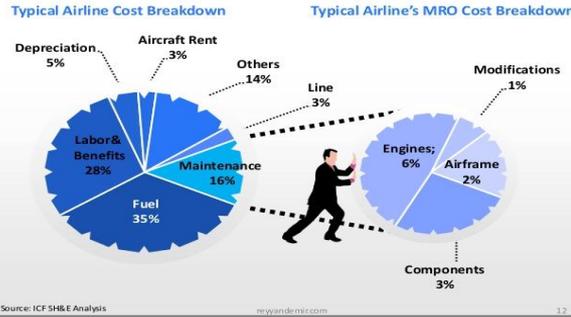
Cost Breakdown

Typical airline cost structure



IATA Airline Cost Management Group (ACMG) 2014

Airline Operating Cost Structure

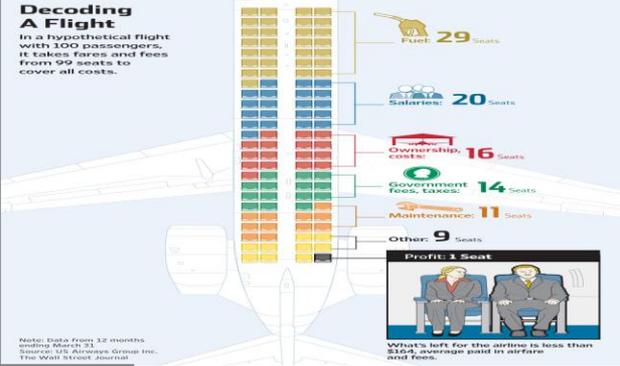


Source: ICF SH&E Analysis

www.dcmr.com

Decoding A Flight

In a hypothetical flight with 100 passengers, it takes fares and fees from 99 seats to cover all costs.



Note: Data from 12 months ending March 31, 2013. © 2013 Airline Cost Management Group. The Wall Street Journal

What's left for the airline is less than \$14 average paid in airfare and fees.

Source: IATA

Table 4-6: 2013 Part 121 Passenger Air Carriers Filing Schedule P-5.2 Operating and Fixed Costs per Block Hour

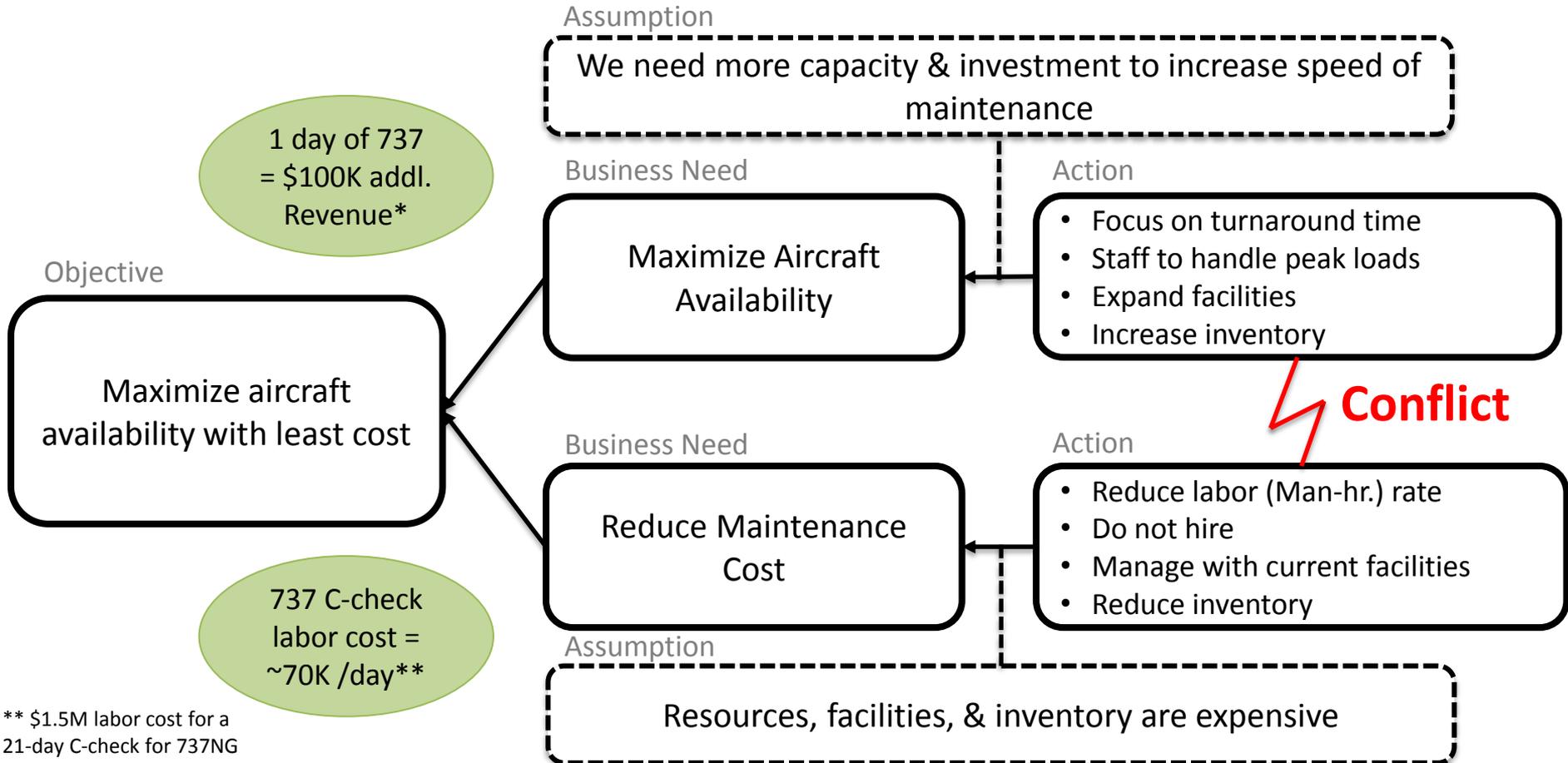
Source: FAA

Aircraft Category	Cost per Block Hour										Col. 11 Block Hours
	Col. 1 Fuel and Oil	Col. 2 Maintenance	Col. 3 Crew	Col. 4 Total Variable	Col. 5 Depreciation	Col. 6 Rentals	Col. 7 Insurance	Col. 8 Other	Col. 9 Total Fixed	Col. 10 Total	
Wide-body more than 300 seats	\$10,275	\$1,687	\$1,538	\$13,500	\$761	\$318	\$9	\$5	\$1,093	\$14,592	191,834
Wide-body 300 seats and below	\$5,719	\$1,343	\$1,174	\$8,236	\$522	\$328	\$10	\$6	\$867	\$9,103	2,006,089
Narrow-body more than 160 seats	\$3,102	\$964	\$777	\$4,843	\$352	\$199	\$6	\$1	\$558	\$5,400	2,260,009
Narrow-body 160 seats and below	\$2,394	\$715	\$724	\$3,833	\$221	\$325	\$9	\$3	\$558	\$4,390	8,959,309
RJ more than 60 seats	\$287	\$444	\$349	\$1,080	\$144	\$188	\$6	\$5	\$344	\$1,424	2,156,423
RJ 60 seats and below	\$145	\$468	\$379	\$993	\$59	\$179	\$6	\$3	\$248	\$1,240	2,596,269
Turboprop more than 60 seats	NR	\$654	\$323	\$1,020	\$264	\$155	\$3	\$2	\$423	\$1,443	210,338
Turboprop 20-60 seats	\$310	\$250	\$258	\$818	\$265	\$107	\$0	\$9	\$382	\$1,200	112,295
Turboprop under 20 seats (Part 23)	\$1,050	\$175	\$850	\$2,075	\$0	\$479	\$241	\$167	\$888	\$2,962	4,605
All Aircraft	\$2,322	\$754	\$688	\$3,764	\$244	\$270	\$8	\$4	\$526	\$4,289	18,497,171

- Maintenance Costs are 10 to 18% of Airline Costs (not trivial)
- Other costs are difficult to control

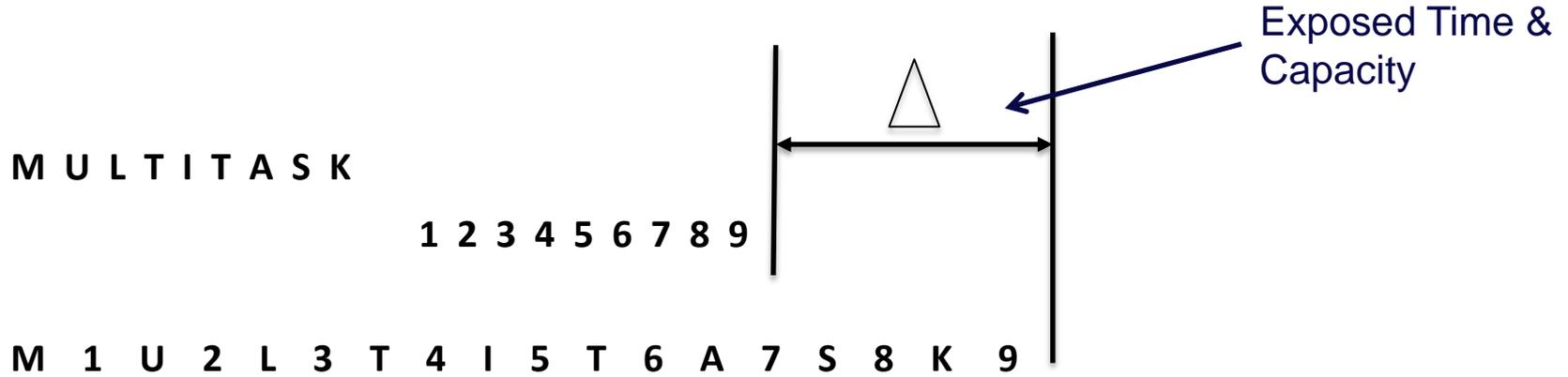
**Maximize Aircraft Availability with
Least Maintenance Cost**

Base Maintenance Conflict



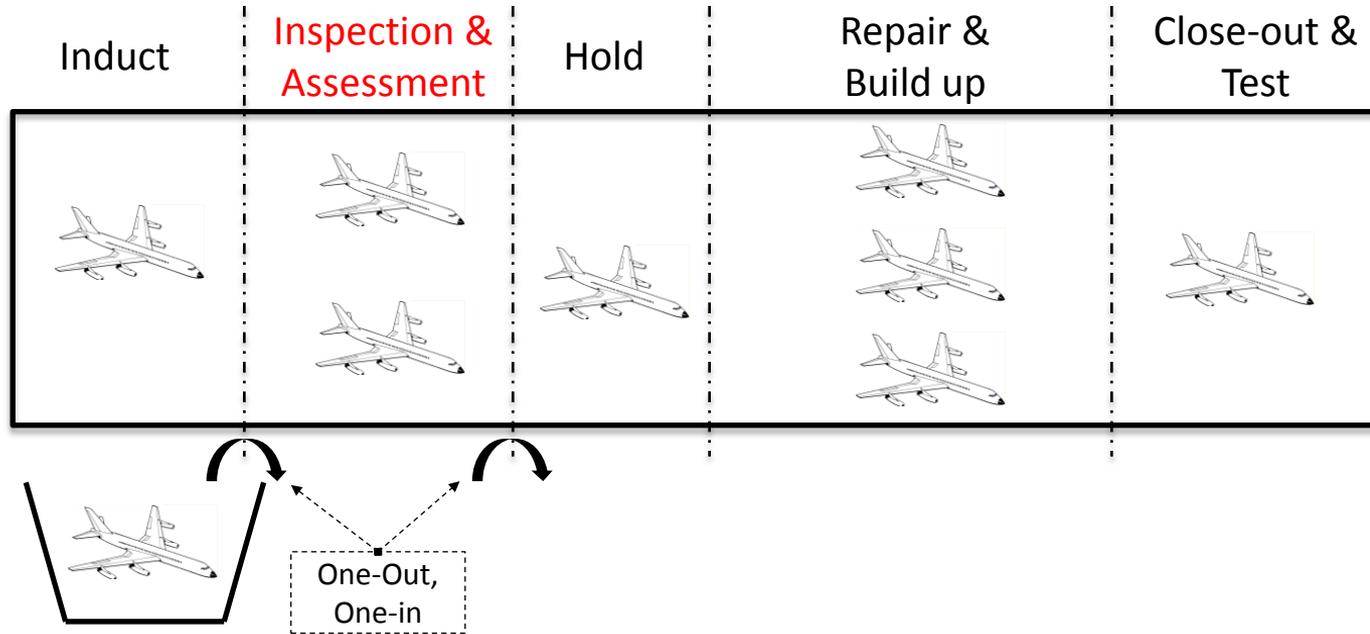
** \$1.5M labor cost for a 21-day C-check for 737NG

Exercise



***HIGH WIP significantly reduces
Speed, Productivity & Quality***

Resolving the Conflict – LOW WIP



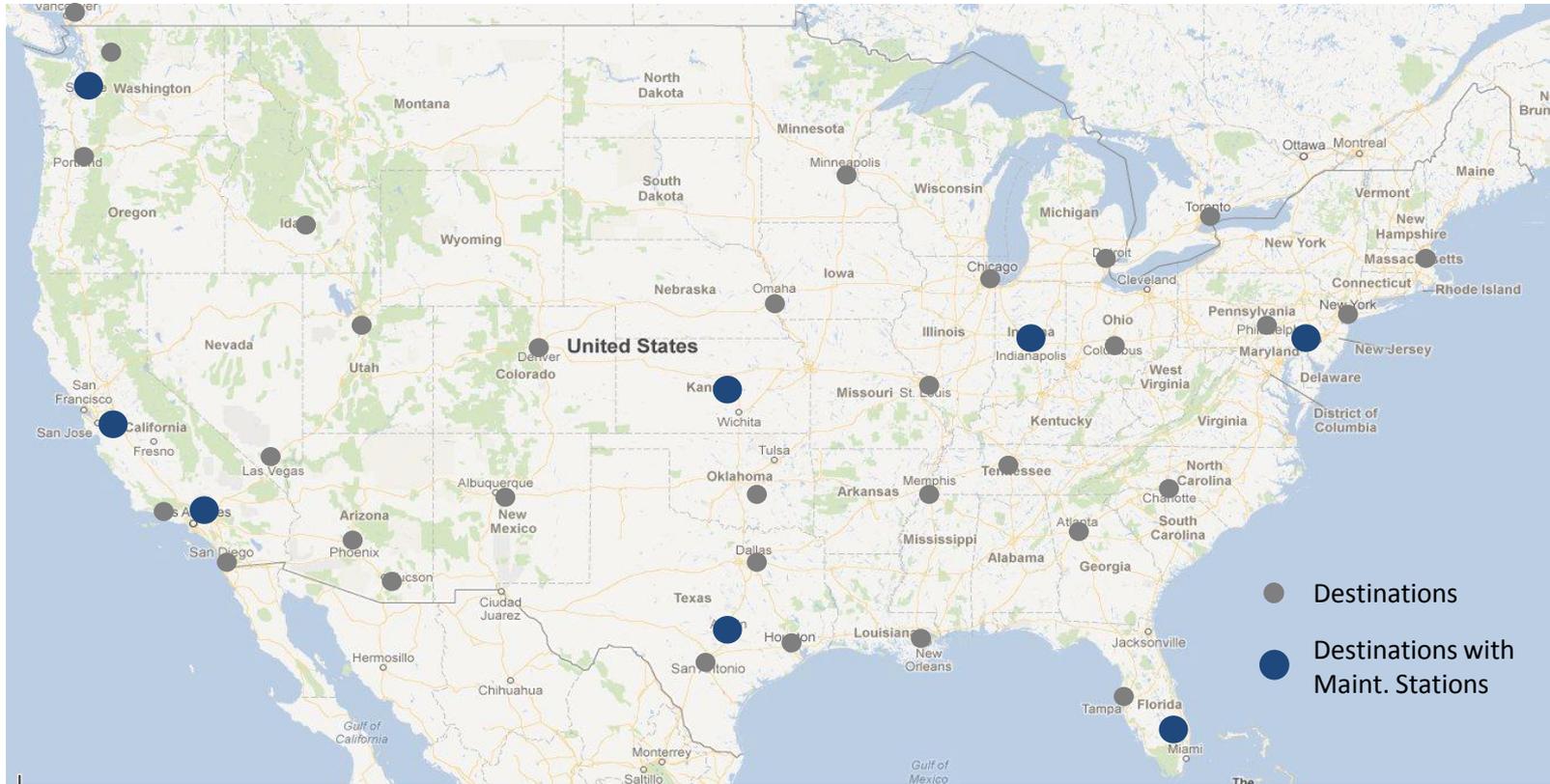
1. Identify **constraint** (pacing) phase
2. Set maximum work-in-process (WIP) limit & follow 1-out, 1-in rule
3. Concentrate Resources on fewer aircraft
4. **Full Kit** before releasing work

Line Maintenance

1. High Dispatch Reliability (*avoid Maintenance issues*)
 - Minimize Delays & Cancellations
 - Minimize First Flight delays
2. Fast Turnaround (*If there is an issue, fix it quickly*)
 - Minimize long (3+hr delays)
3. Maximize Flexibility (*minimize “Maint. Capture Rate”*)

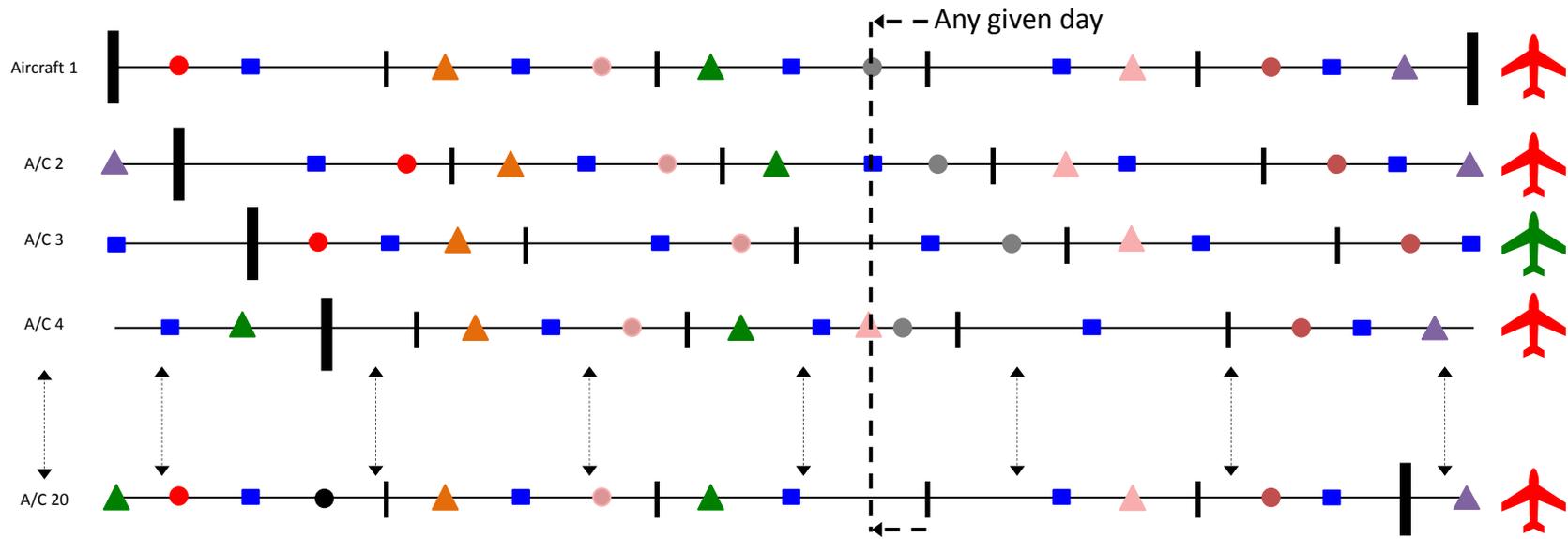
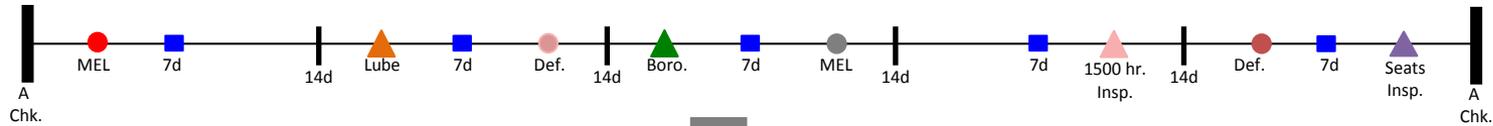
Safety & Quality is Given

Pressure on Line Maintenance

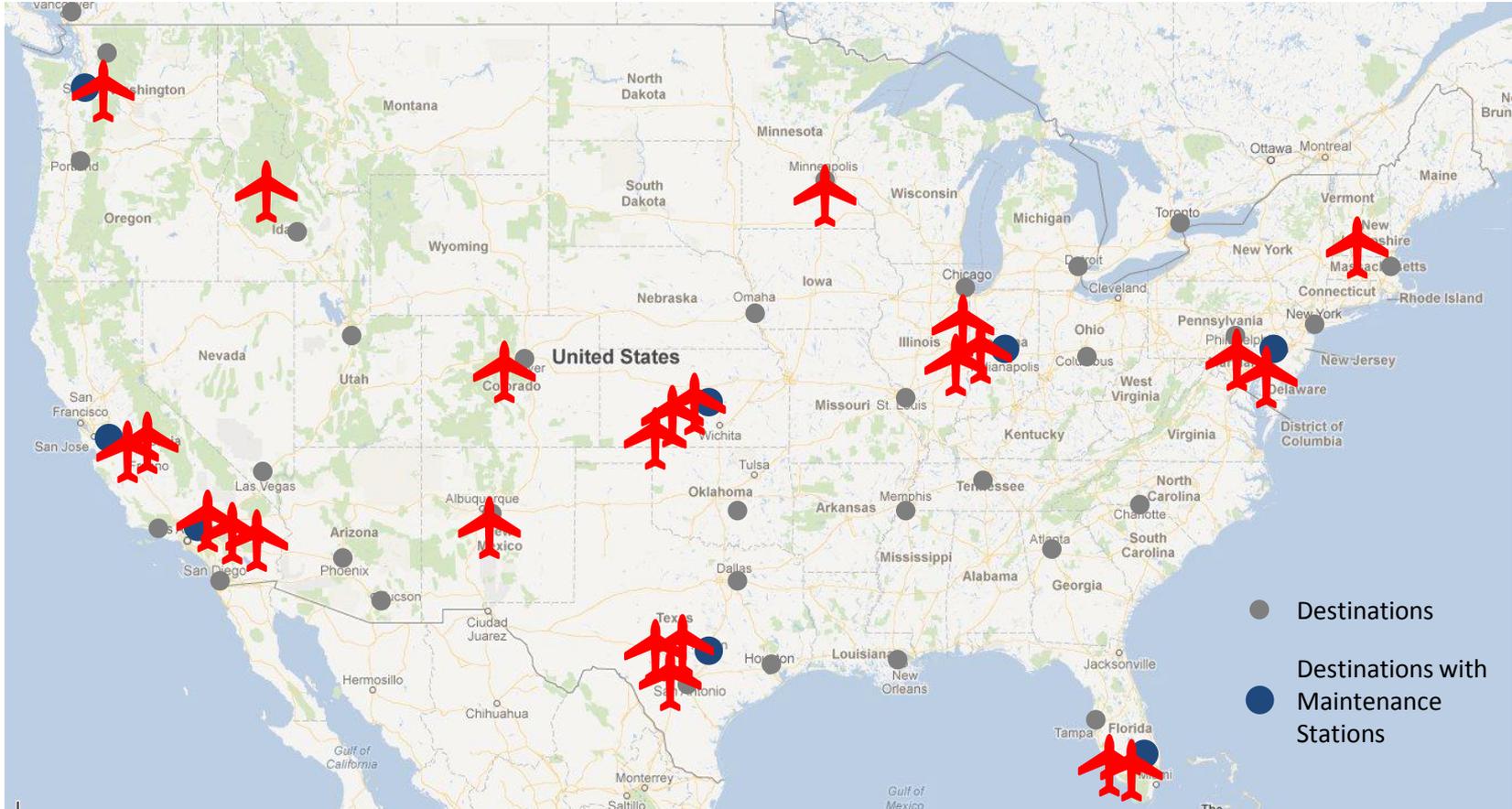


Revenue pressures → Expand Network & Flexibility → Expand Maint. Footprint

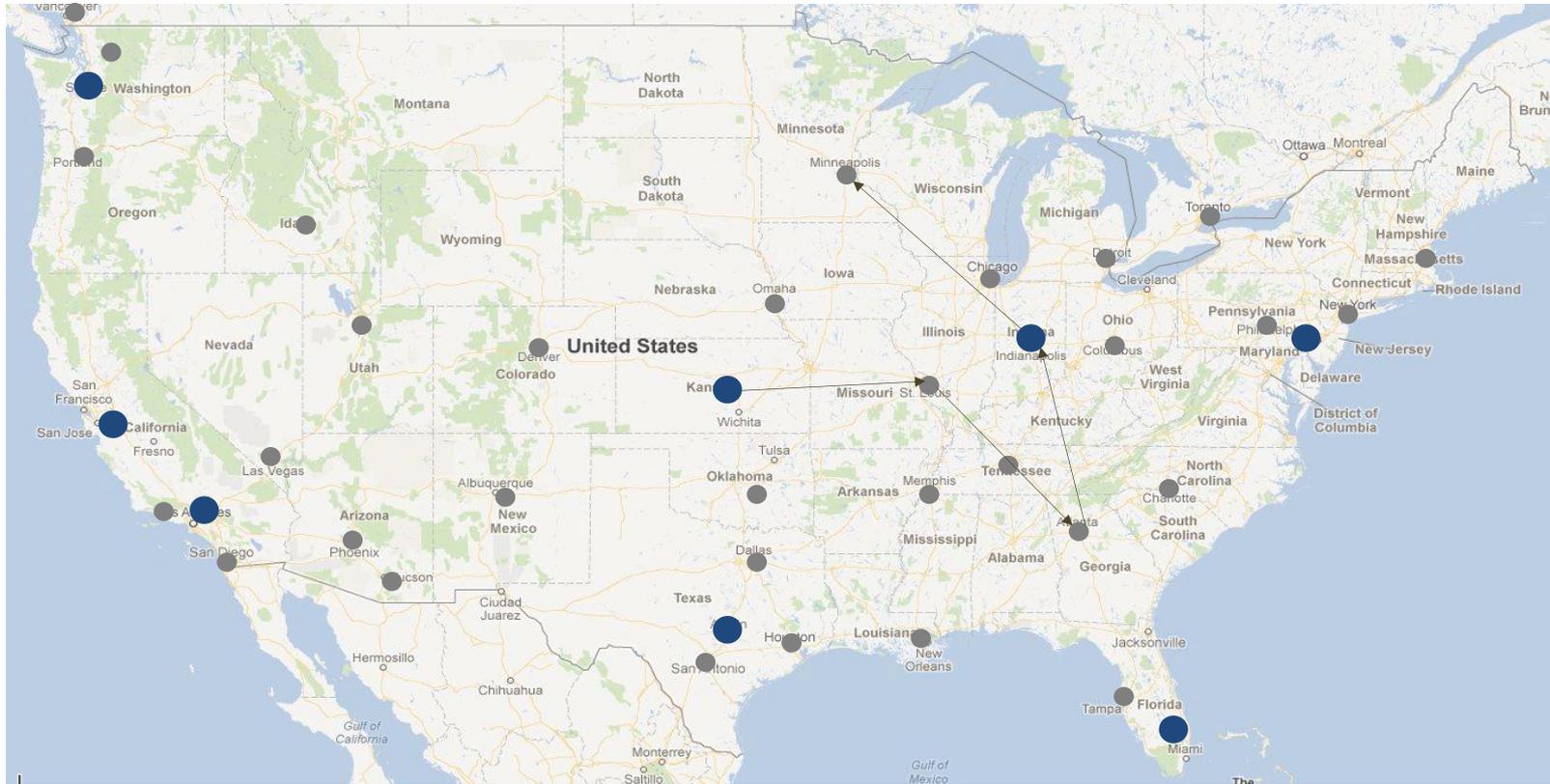
Line Maintenance Example



Line Maintenance Example Contd.

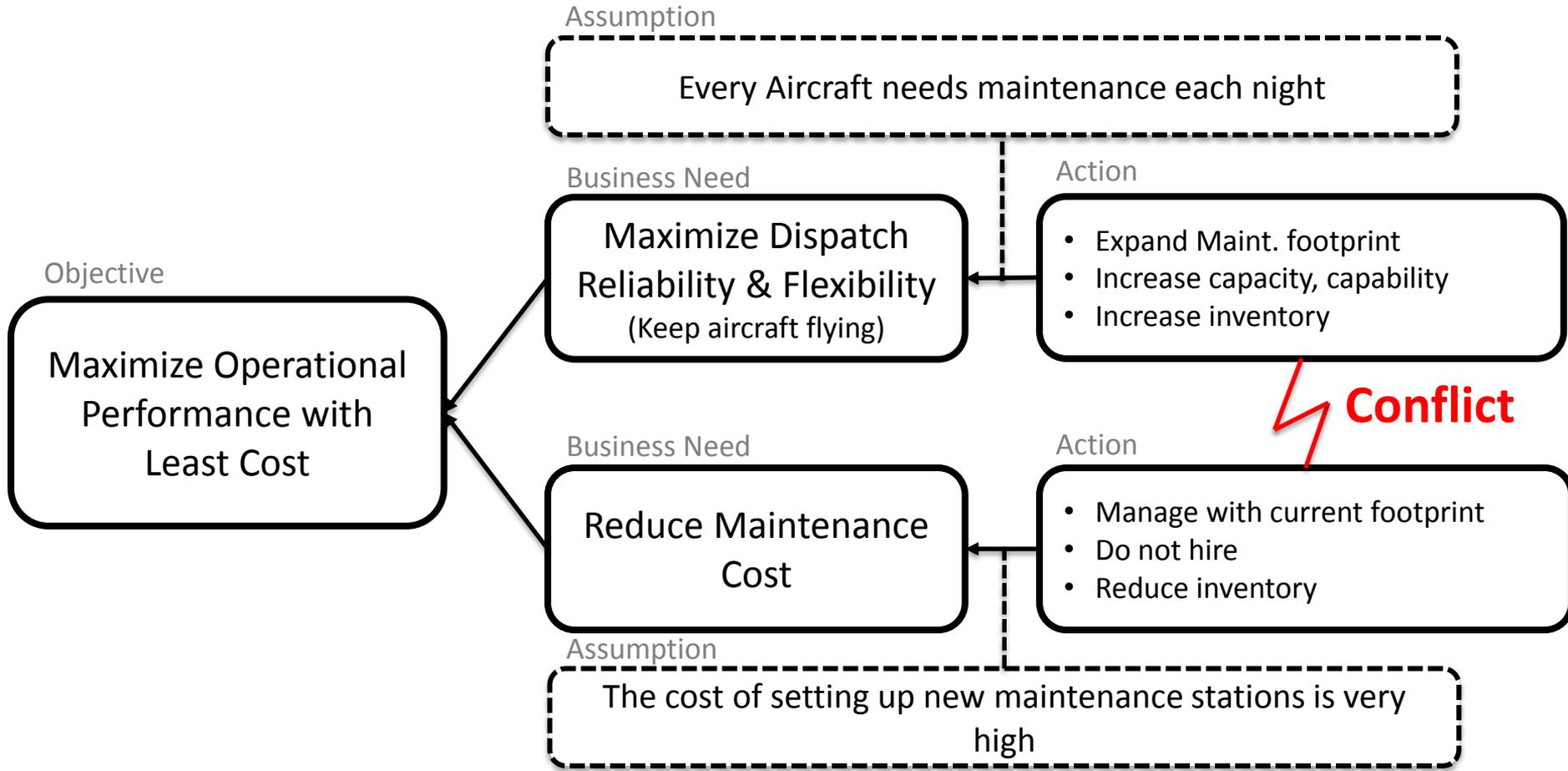


Line Maintenance Challenge

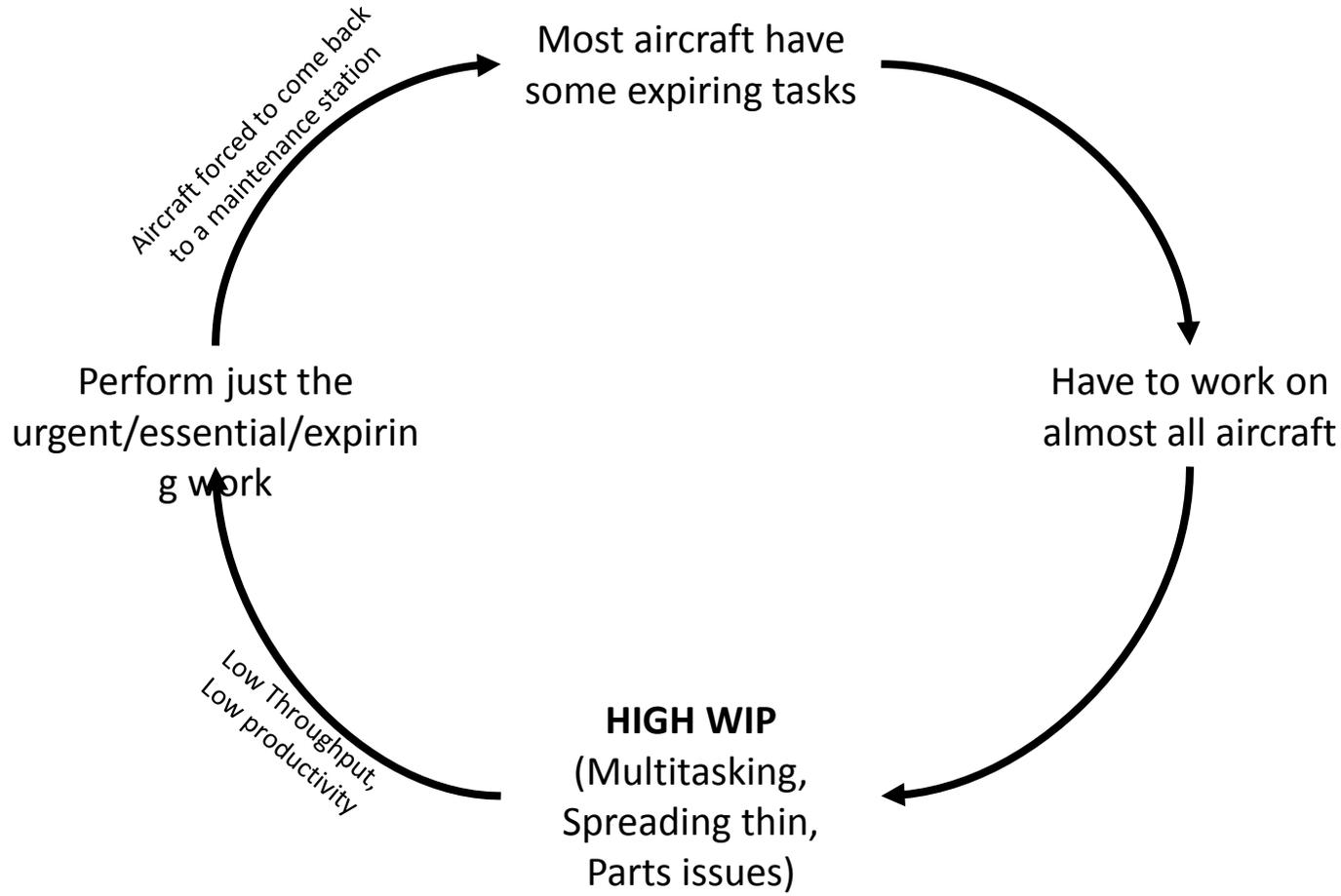


How to perform all maintenance without constraining airline operations?

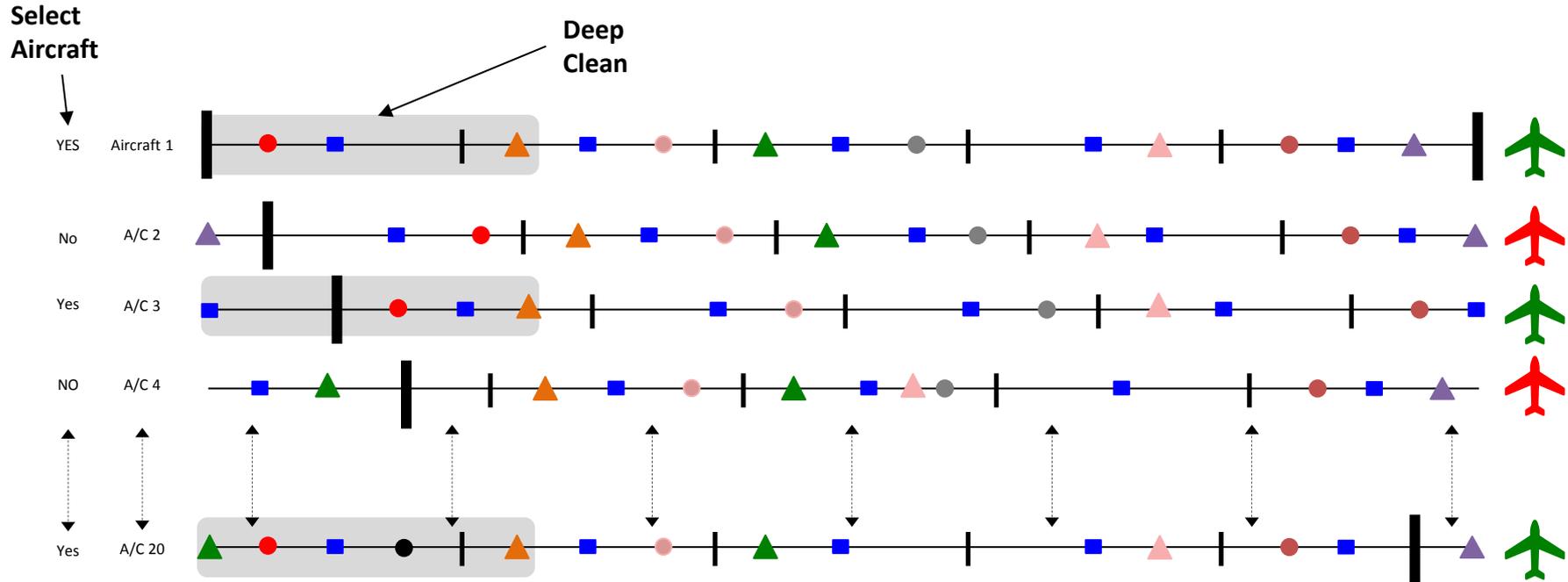
Line Maintenance Conflict



Cause & Effect



Resolving the Conflict – Deep Cleaning



Deep Cleaning reduces Maintenance WIP, & Increases Flexibility for Airline

Summary

1. Managing Maintenance operations is inherently difficult
2. Maintenance has conflicting goals (*maximize asset availability with least cost*) that compounds the difficulty
3. **Reducing WIP** breaks the conflict for Base Maintenance
4. **Deep cleaning** (& as a result reducing WIP) breaks the conflict for Line Maintenance

Conclusion:

***LOW WIP helps Maintenance Increase Asset Availability,
Reduce Costs AND greatly Simplify Management***

Thank you