


Delta Air Lines, Inc.



TOCICO 2008 Conference

 **Technical Operations**
Engine Maintenance Operations

Meeting Challenges in Engine Maintenance



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The Players....

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The Airline: Delta Air Lines, Inc.

- **Founded as Delta Air Service in 1928**
- **8 mainline fleet-types with ~4200 flights daily**
- **~50,000 Employees**
- **\$17B Top Line Revenues**



TechOps: Maintenance/Repair/Overhaul Facility

- **Grew as necessary to facilitate Delta maintenance**
- **Line, Airframe, Engine, and Component Maintenance**
- **6500 Employees worldwide**
- **63 Acres (58 Football Fields) of Facility in Atlanta**



Oops, change happens....

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The Airline: Delta Air Lines, Inc.

- **NWA merger 2008**
- **13 mainline fleet-types with ~6700 flights daily**
- **~75,000 Employees**
- **\$35B Top Line Revenues**



TechOps: Maintenance/Repair/Overhaul Facility

- **Grew as necessary to facilitate Delta maintenance**
- **Line, Airframe, Engine, and Component Maintenance**
- **6500 Employees worldwide**
- **63 Acres (58 Football Fields) of Facility in Atlanta**



Large, Complex Entities - Often Slow To Change...

RIP



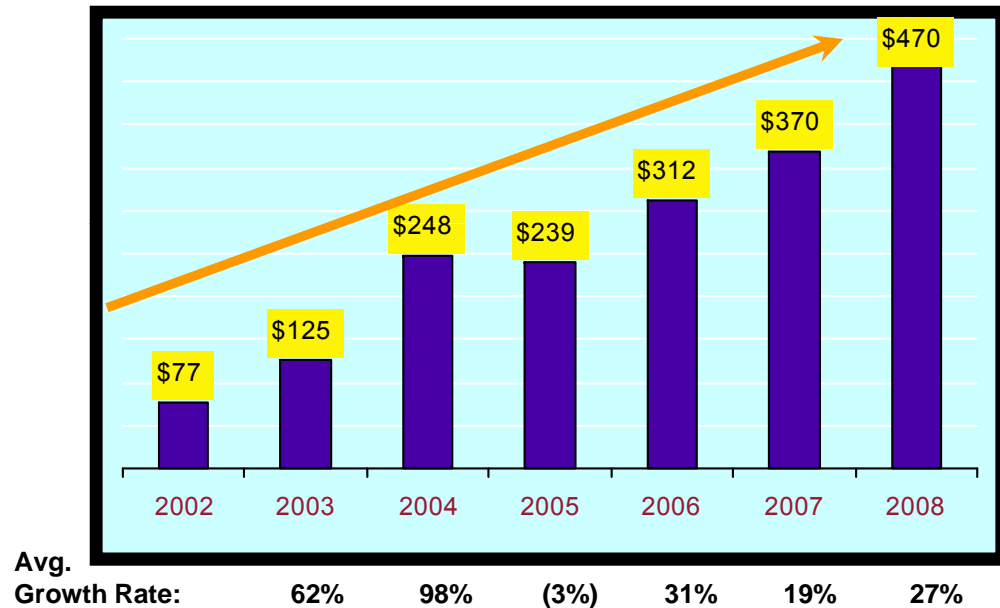
Grow the MRO Aggressively...

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Engine Maintenance Operations

- 6 Engine Lines
 - JT8D-219
 - PW2037
 - PW4060
 - CFM56
 - CF34
 - CF6
- Landing Gear, Auxiliary Power Units, Thrust Reverser Overhaul Facilities
- 4 Test Cells
- 20 Total Shared Shops – 1600 Employees
- 600+ Engine Shop Visits Per Year
- Great Capabilities – Great Worldwide Market
- Total Volume Continues Growing YOY

Customer Revenue Growth (in Millions)



Mix NOW represents 50+% of All Work

Complex Operations Can Be Simplified with TOC



Before TOC

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How Engines Flowed – Mid 2006:

8 Product Lines– Independently Induct Products Based on Airline need



- Historical 4 year monthly average production = 38 engines/mth
- 20K open shop orders to support 60 engines in WIP

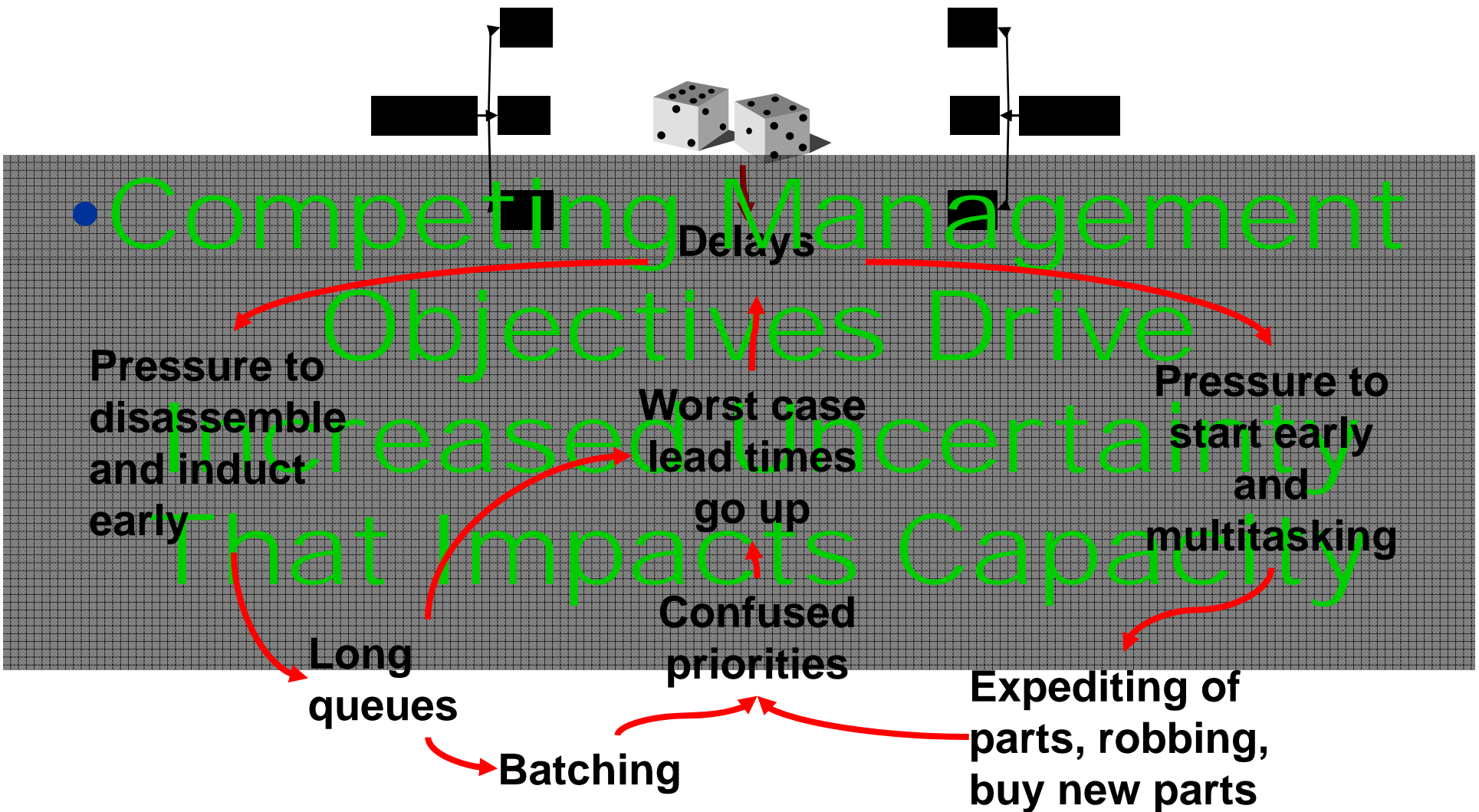
Key Challenges

- All parts are not available when needed (If I just had my **** parts)
- Fluctuations in engine demand causes variations in repair processes
- Eight product lines inducted independently based on perceived business need
- Changes to workscope causes delays
- Resources not available when needed
- Delta engines have different parts requirements than insourced engines
- Testing rejects can cause priority changes

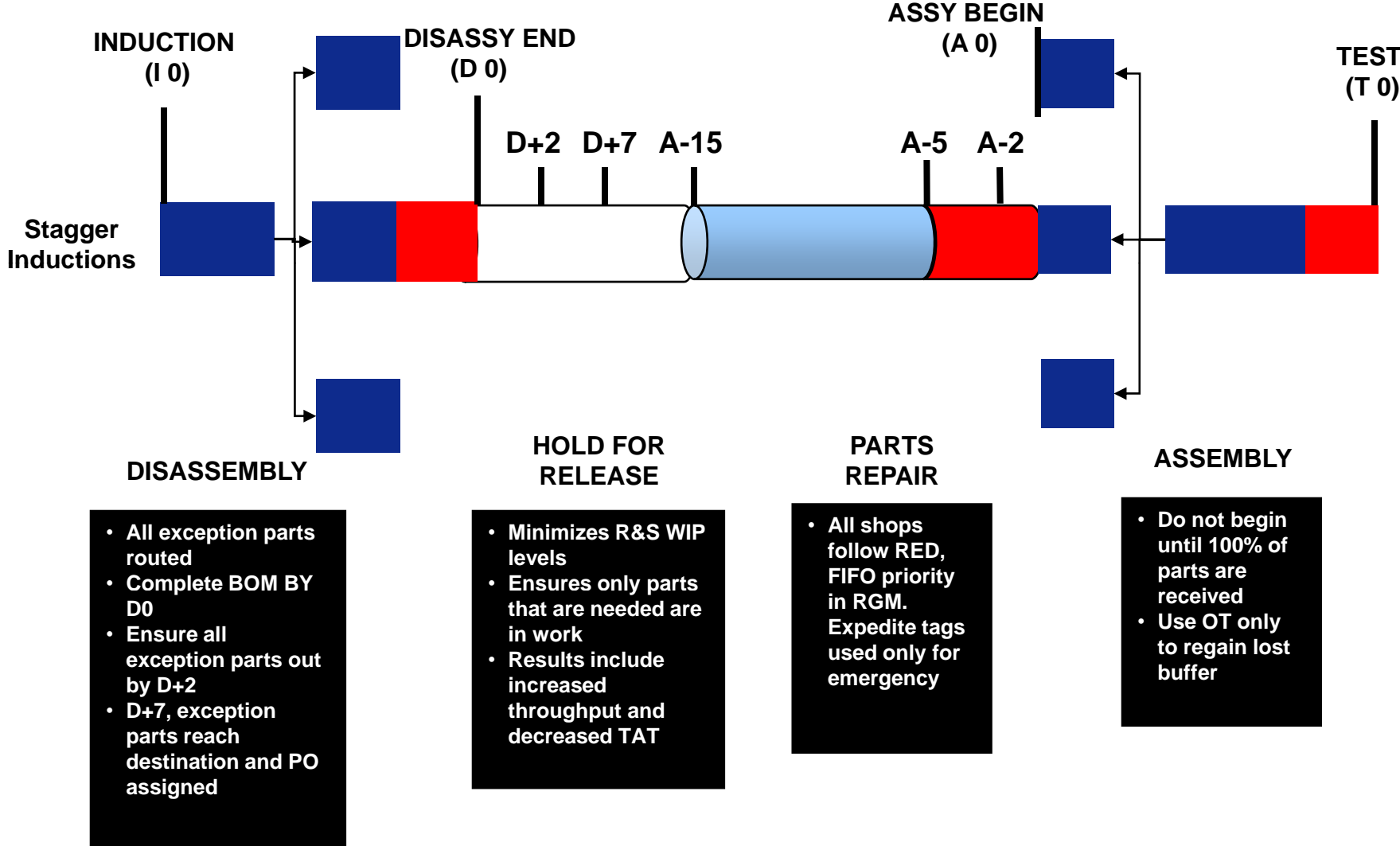


Diagnosing the Root Cause

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Current Execution Process



- DISASSEMBLY**
- All exception parts routed
 - Complete BOM BY D0
 - Ensure all exception parts out by D+2
 - D+7, exception parts reach destination and PO assigned

- HOLD FOR RELEASE**
- Minimizes R&S WIP levels
 - Ensures only parts that are needed are in work
 - Results include increased throughput and decreased TAT

- PARTS REPAIR**
- All shops follow RED, FIFO priority in RGM. Expedite tags used only for emergency

- ASSEMBLY**
- Do not begin until 100% of parts are received
 - Use OT only to regain lost buffer



Summary of Changes

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1. Create Plans with Buffers

- Developed aggressive project plans with buffers for engine lines
- Setup aggressive piece part TAT using FIFO/red/expedite DBR system

2. Control WIP

- Control the release of engines and parts into work based on WIP levels
- Hold non-exception parts until A-15
- Do not start assembly before A0

3. Manage Using the Buffers

- Turn parts red 5 days before the start of assembly
- Assign work based on buffer priorities
- Allocate resources to red parts and/or red tasks

4. Exception Management

- Review OSR parts at D+2 and D+7 to ensure on-time delivery
- Review all parts starting A-2 and make decisions if A0 will not be met



Lessons Learned

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1. Process Lessons:

- Driven change faster
- Be more aggressive with goals
- Sync Frontline CI/TOC training to better coincide with rollout
- Rolled out Concerto (CC) earlier in the implementation
- Driven a central release area much sooner
- Establish a process to review exception parts list sooner

2. Management Lessons:

- Set up a series of management “offsites” from the beginning
- Ensure metrics were in place faster
- Better anticipated budget pressures to hold back production (cost centered behavior)
- Taken a TOC approach to capital/inventory investment
- Management involvement critical to exception management



Results (Since Mid 2006)

- **WIP:**
 - Was 20,000 Piece Part WIP → Now ~5,000 Piece Part WIP
 - Was 60 Engines in WIP → Now: 75-80 Engines in WIP
- **TP:**
 - 25% increase in piece part repair
 - 97+% parts back at A0
 - 23% increase in engine production in one year (from 476 to 586) now 600+
 - 50+ engines per month produced consistently with less resources
- **Turn Time:**
 - 50% Reduction in Piece Part TAT
 - Engine total TAT reduction – 20% AVG across all product lines
 - Engine assembly and disassembly times reduced by 18 to 38%
 - Landing Gear TAT reduced 50%
- **Financials:**
 - Revenue: 2006: \$312M → 2008: 470M
 - Cost: 2006 → 2008 → 12.7% reduction



CI – Methods Integration

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- **TOC + Lean + Six Sigma**
- **Six Sigma initiated by TechOps 1999 to drive local cost reductions and quality improvements**
- **Lean initiated 2000 to establish flow of engine disassemble/assemble, point of use, Kanbans, and cell creation. Focused on eliminating waste, understanding flow, and developing a visual workplace**
- **TOC concepts implemented 2006 to drive focus on constraint(s) and improve overall engine maintenance performance, using CI as a growth strategy**

TOC concepts has given clear understanding where to apply Six Sigma and Lean methods to achieve true bottom line results



Next Steps...Never ever give up!!!

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TOC implementation has continued to drive the flywheel faster YOY

Next steps:

1. Focus on outside repair vendors and new material supply processes
2. Attention around exception management
3. Continue to drive inventory reduction
4. Improve sales/production synchronization



THANK YOU FOR....

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Today**

Questions?

