Achieving Supply Availability in the Face of Highly Uncertain Demand

A Case Study of Spare Parts for Military Aviation

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"It's tough to make predictions, especially about the future."

Yogi Berra

There Are Serious Challenges in Demand Forecasting for Military Aviation Spare Parts

- Very Long Production Lead-Times and Associated Forecast Horizons
- Uncertain Operating Environments
- Uncertain Operating Levels
- Uncertain Impacts of Political Process and Public Opinion
- Adequacy of Funding for Purchases

A Case Study

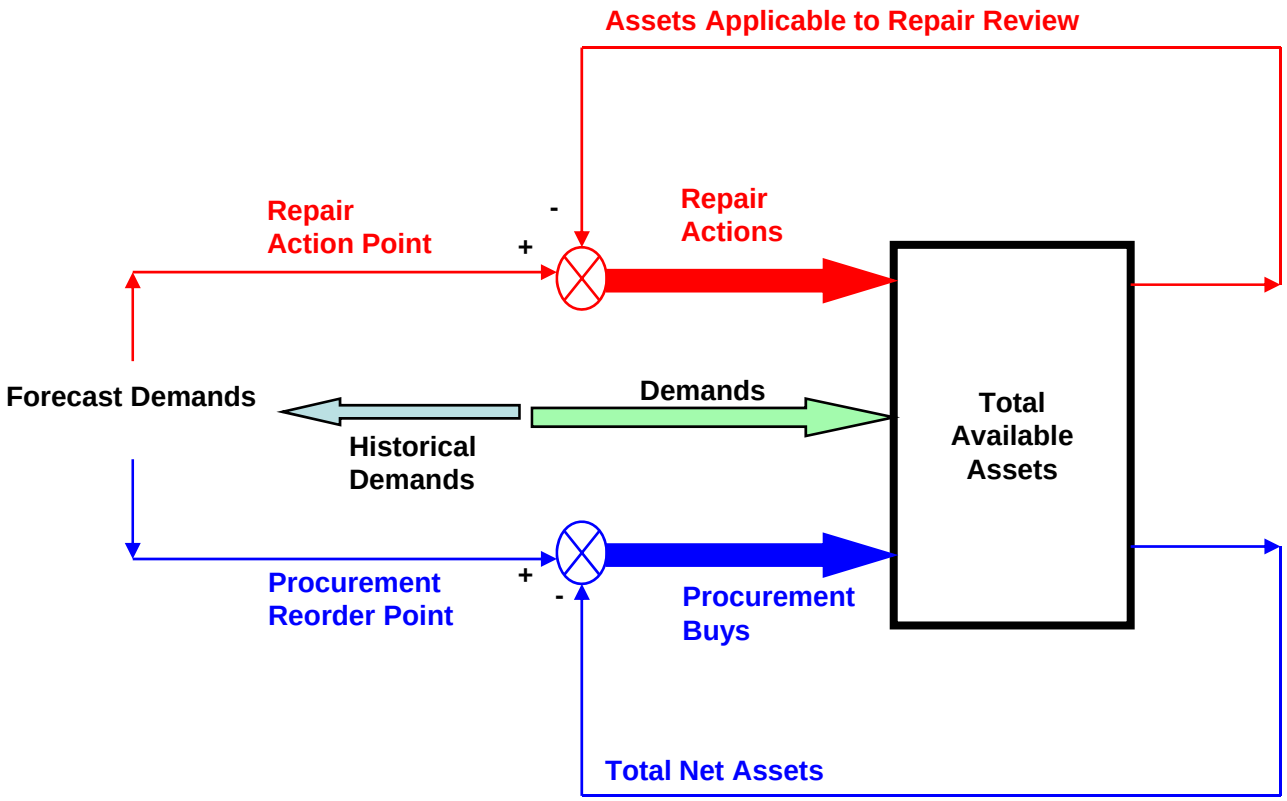
A Typical Challenge in Providing Spare Parts

- **A Helicopter Blade Costs Roughly $175,000;**
- **Recent Demand Has Been Running at Roughly 22/Month;**
- **Production Lead Time is Roughly Two Years;**
- **How Many Need to be Ordered Now to Meet Likely Demand in May of 2010? (*Don't Forget to Factor in the Forecast the Election Results of November 2008!)***
- **Is There Anything That Can Be Done to Develop Adaptability and Provide Risk Mitigation? *What might have been done in 2000?***

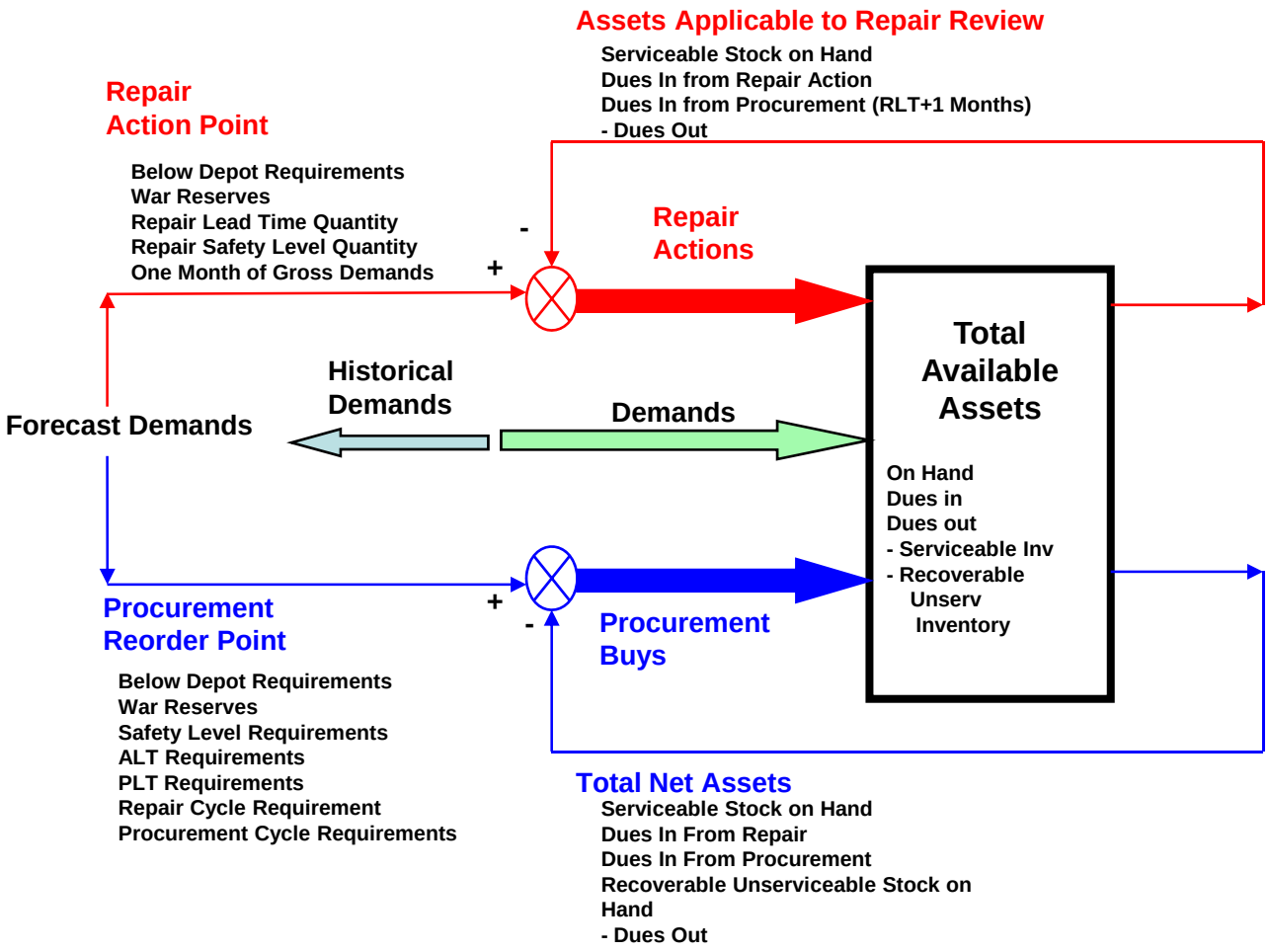
Steps in the Analysis

- Identify Current Role of Demand Forecast in Supply Planning; Are There Problems in the Process?
- Understand Structure and Details of the Supply Chain;
- Develop Strategy for Risk Mitigation and Minimizing Impacts of Forecast Error;
- Assess Impacts, Costs and Benefits

The Role of Forecast Demand in the Supply Process for Aviation Spares



Data Elements Used in the Supply Process

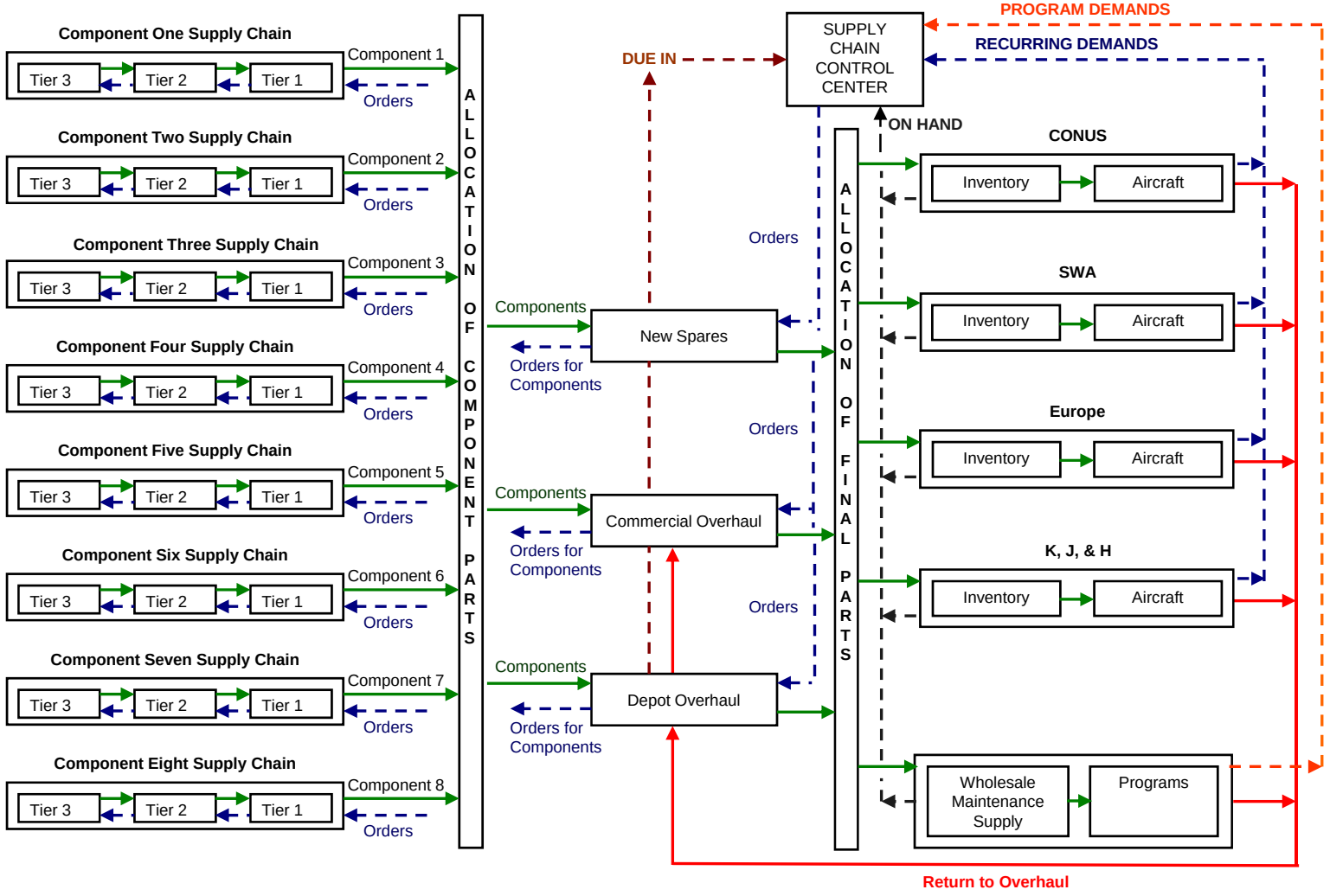


Observations

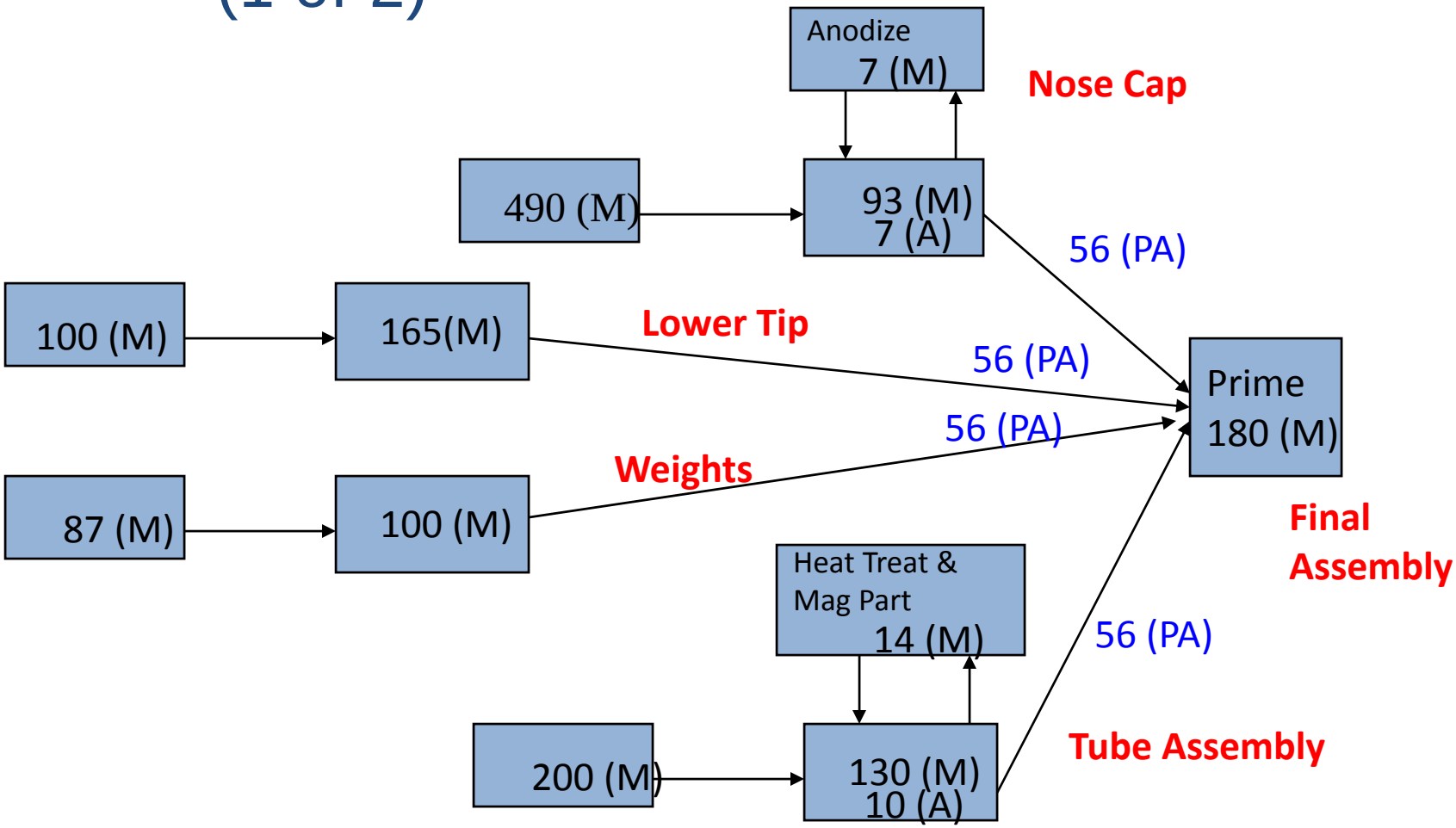
How Do You Spell Trouble?

- **The ordering process is driven by forecast demand, typically calculated as a rolling twenty four month average;**
- **Recommended buys and overhaul efforts are each calculated as the difference of two large numbers;**
- **The ordering process is extremely sensitive to forecast error and common data errors such as the production lead-time;**
- **Shortages and backorders, and in some cases, excess inventories, are not uncommon.**

Structure of Supply Chain for Aviation Spare Parts



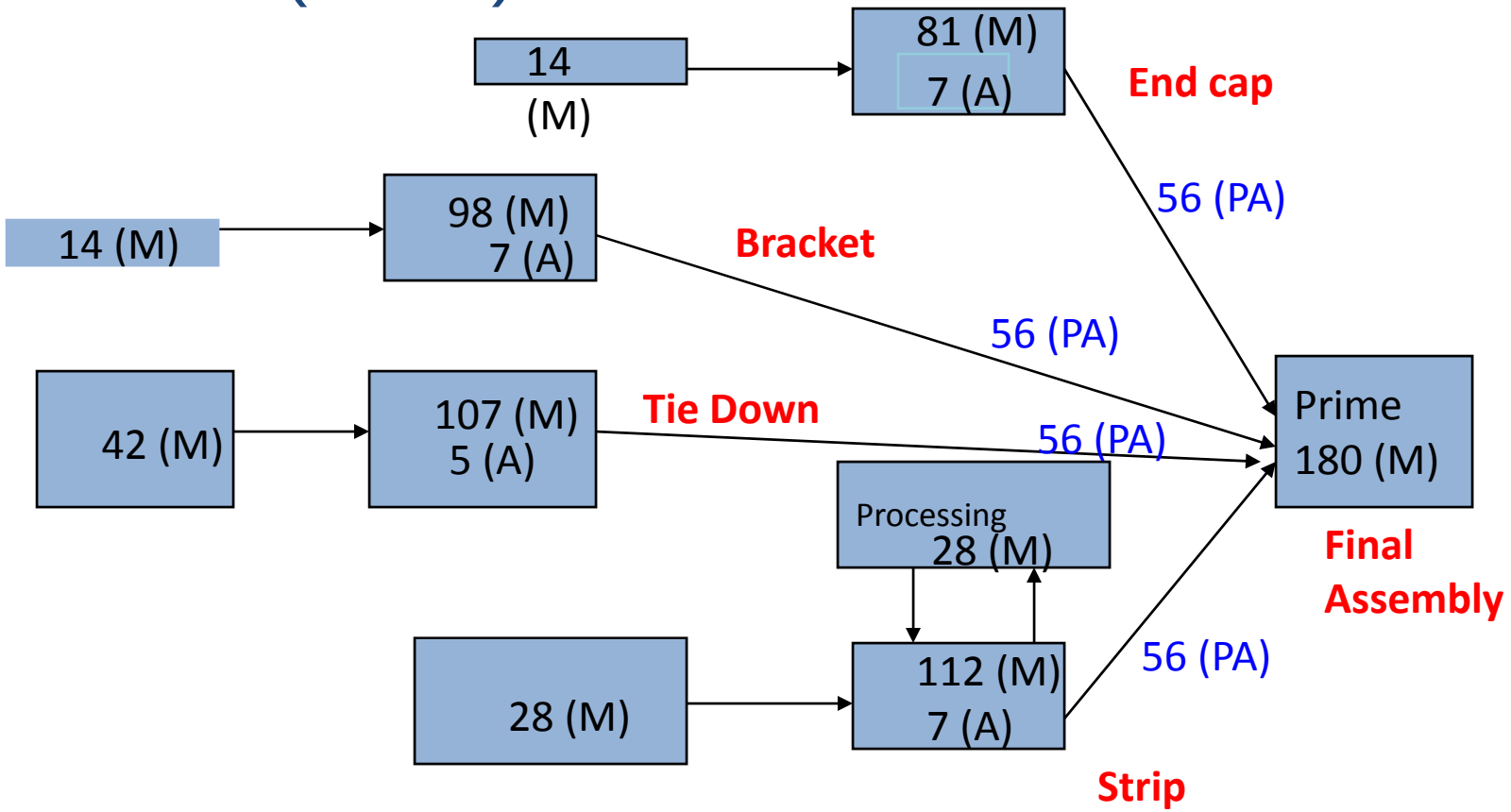
Supply Chain Map for Blade Assembly (1 of 2)



Notes:

(A) – Administrative Lead Times provided by supplier (calendar days)
(M) – Manufacturing Lead Times provided by supplier (calendar days)
(PA) – Prime Administrative Lead Times including dock to stock time (calendar days)

Supply Chain Map for Blade Assembly (2 of 2)



Notes:

(A) – Administrative Lead Times provided by supplier (calendar days)
(M) – Manufacturing Lead Times provided by supplier (calendar days)
(PA) – Prime Administrative Lead Times including dock to stock time (calendar days)

LogicTools Inventory Analyst

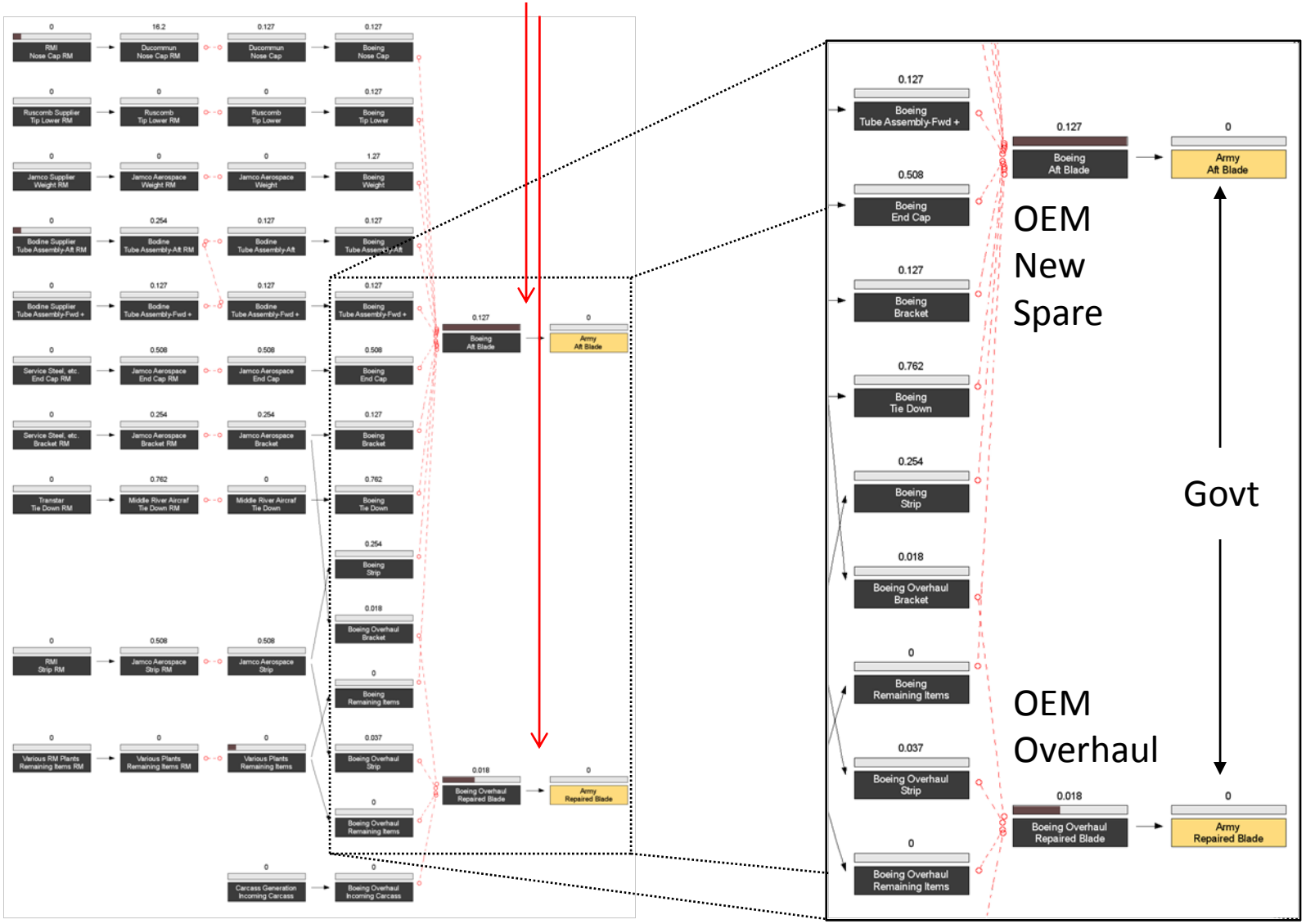
Creating A Push-Pull Boundary

Key Assumptions

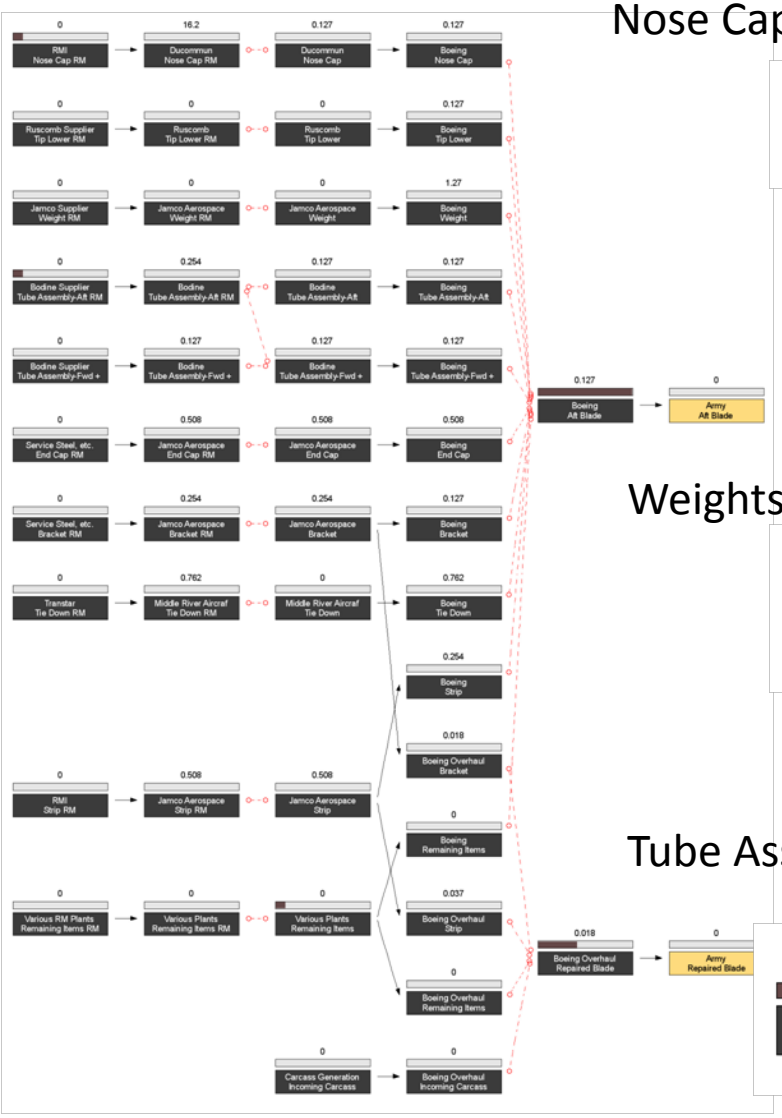
- There are nine critical items in the blade supply chain (Nose Cap, Two Tube Assemblies, Tip Lower, End Cap, Strip, Tie Down, Weight, Bracket)
- All other items are categorized as “Remaining Items”
- The cost of the blade is $175,790
  - The OEM pays 50% of that cost for the parts needed to assemble a blade, broken down as follows:
    - The Nose Cap and End Cap each comprise 15% of the OEM’s’s cost for the entire blade
    - The two Tube Assemblies and the Tip Lower each comprise 10% of the OEM’s cost for the entire blade
    - The Strip, Tie Down, Weight, and Bracket each comprise 5% of the OEM’s cost for the entire blade
    - The remaining 20% is the cost of the “remaining items”
  - First tier suppliers pay 50% of the OEM’s cost for the parts needed to assemble their products

Structure of IA Model

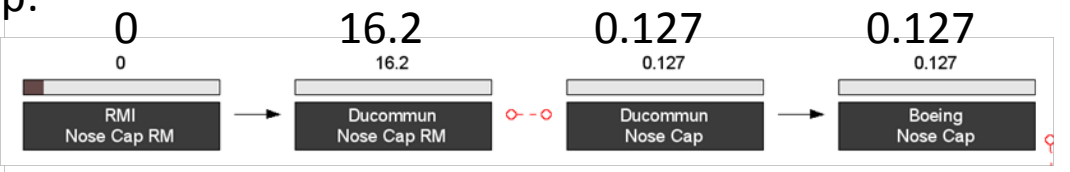
Committed Service Time



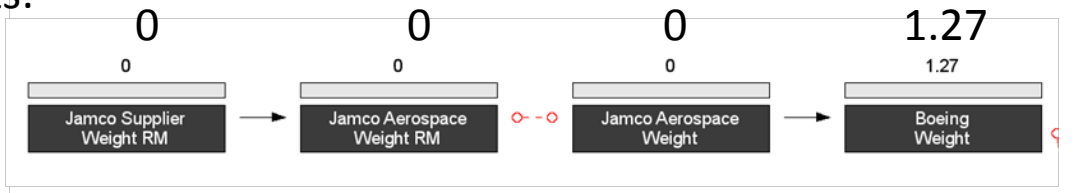
Committed Service Time: 750 days



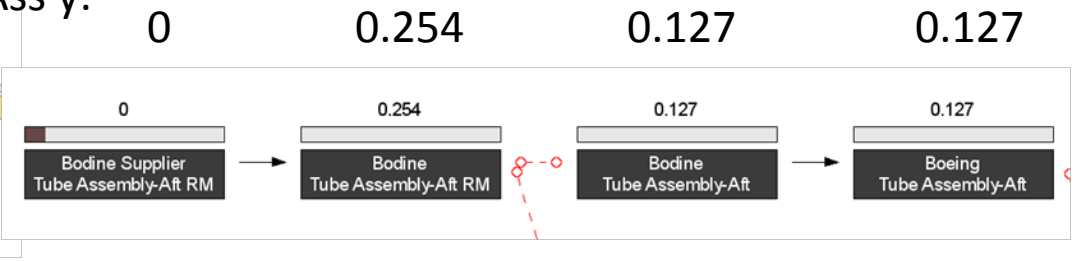
Nose Cap:



Weights:

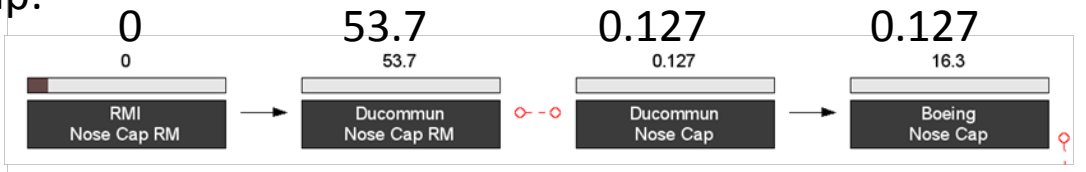


Tube Ass'y:

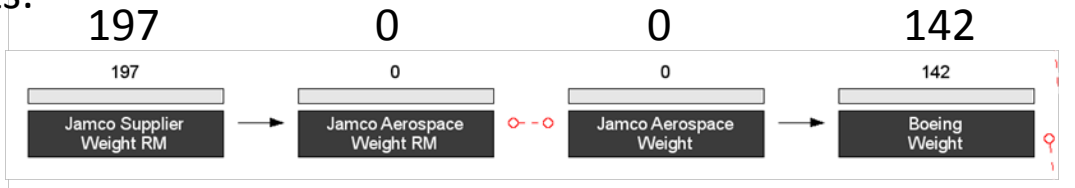


Committed Service Time: 240 days

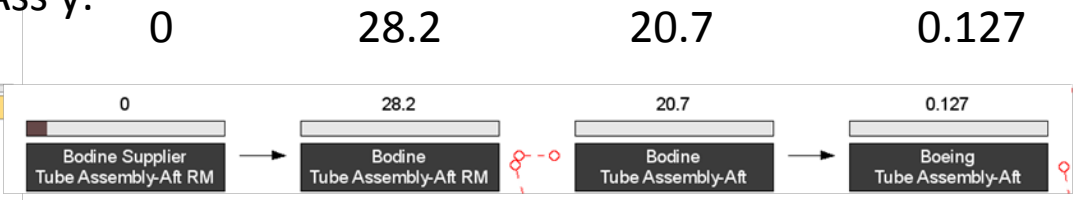
Nose Cap:



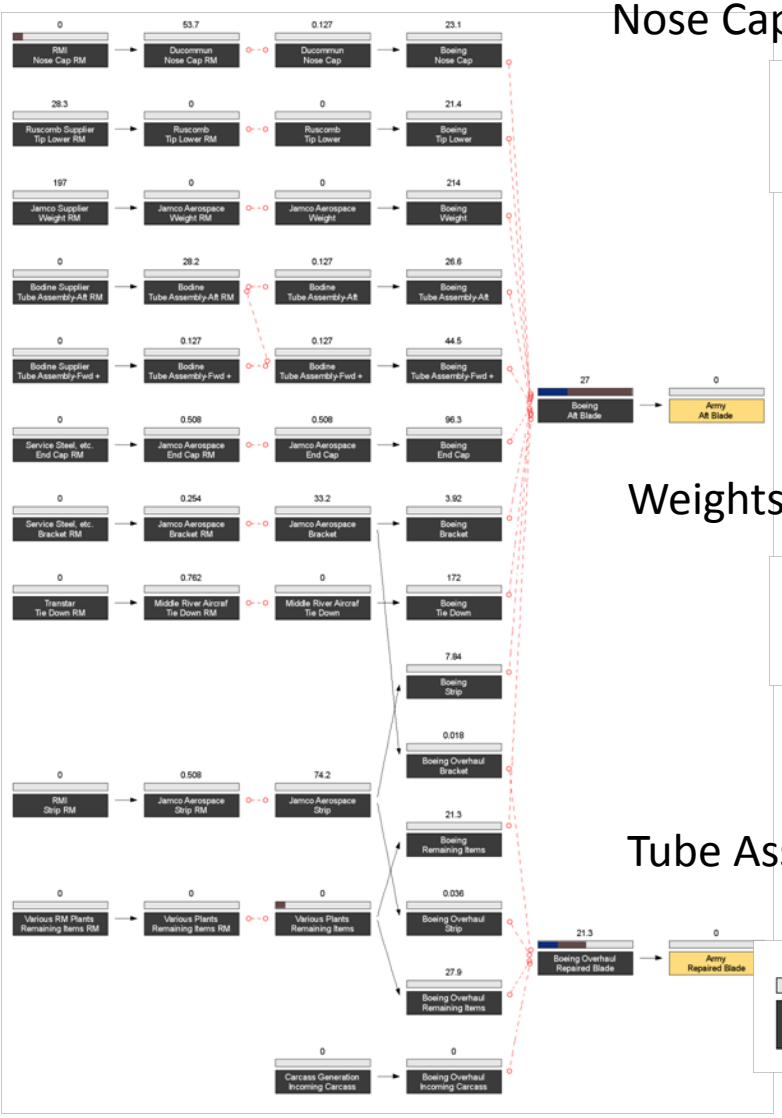
Weights:



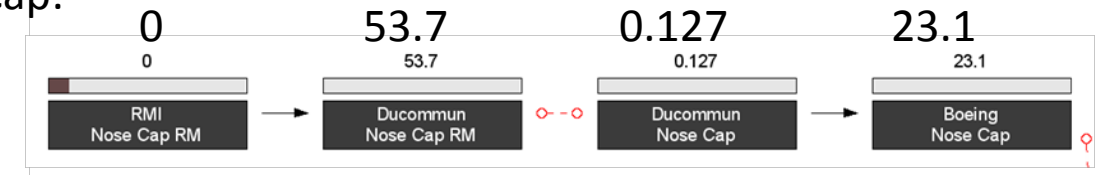
Tube Ass'y:



Committed Service Time: 30 days

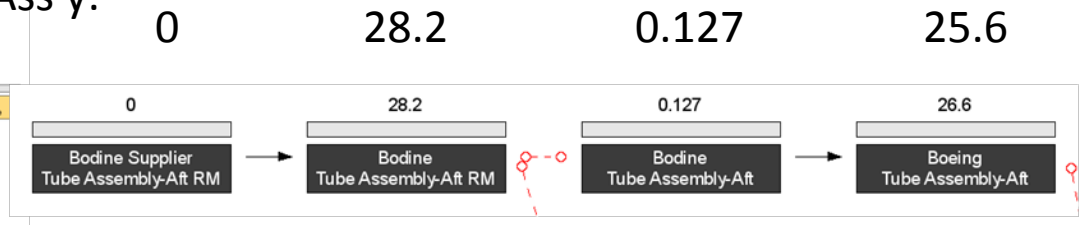


Nose Cap:

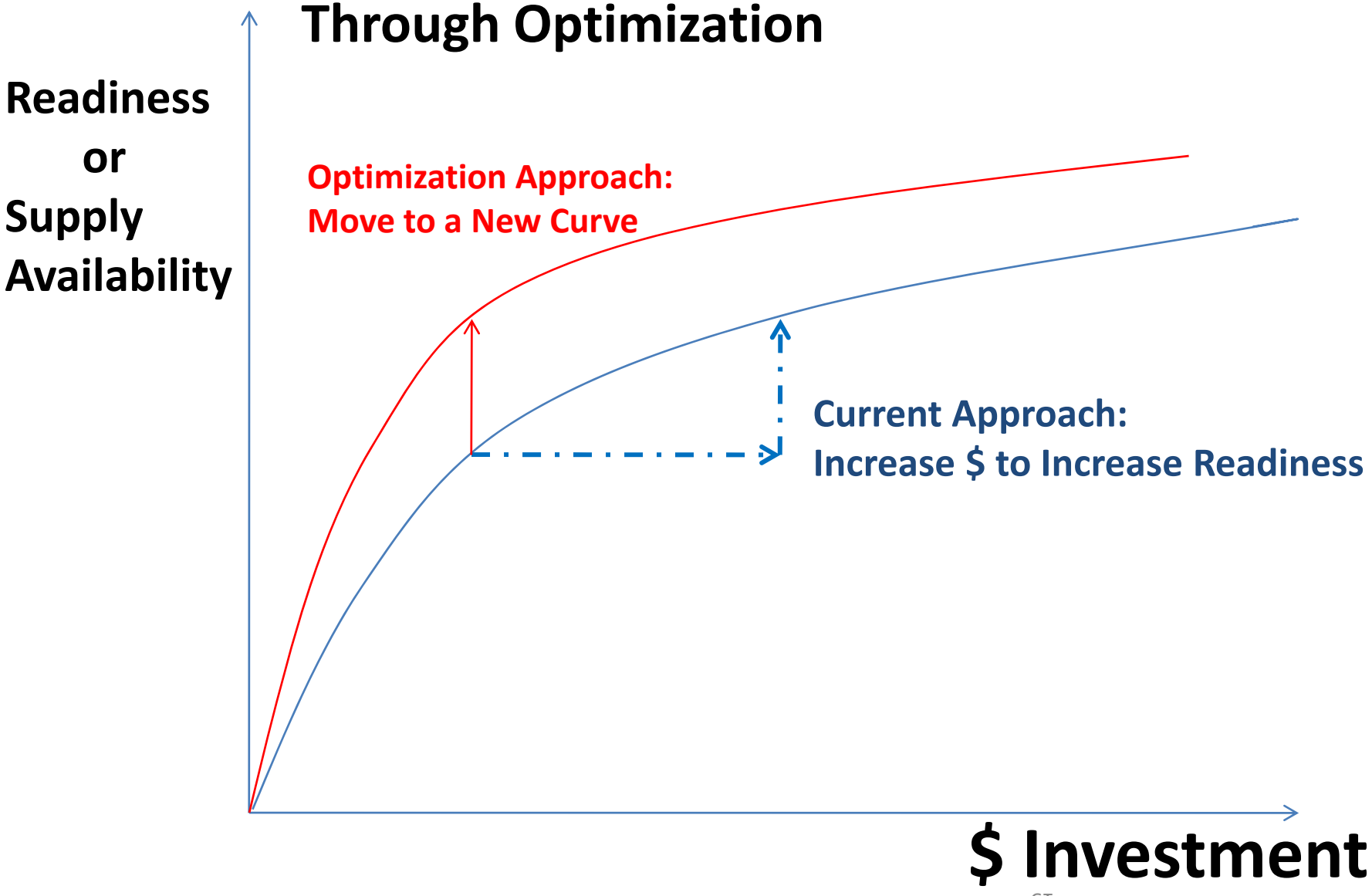


Weights:

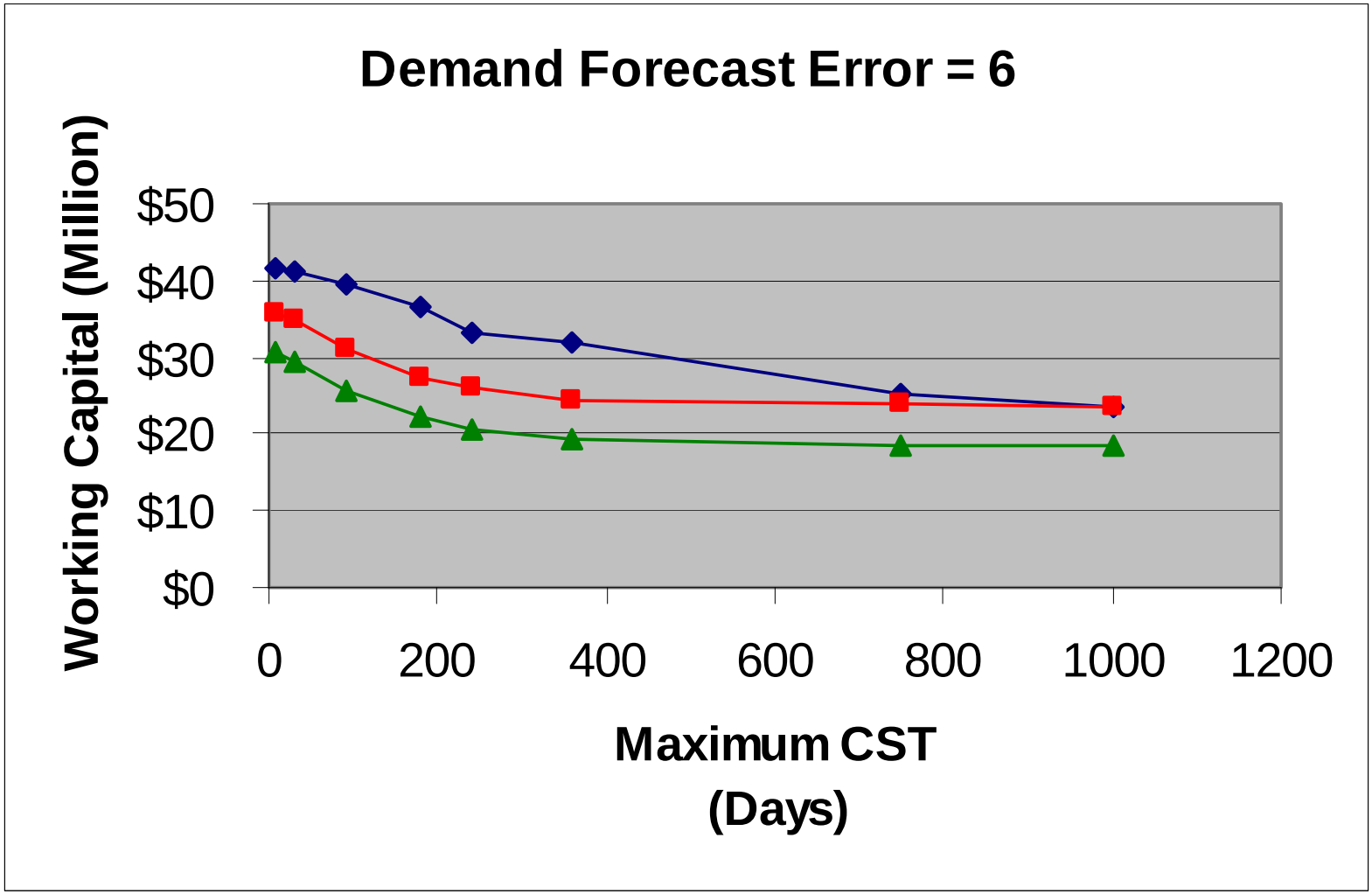
Tube Ass'y:



Move to New Performance Curve Through Optimization



Working Capital Vs. CST

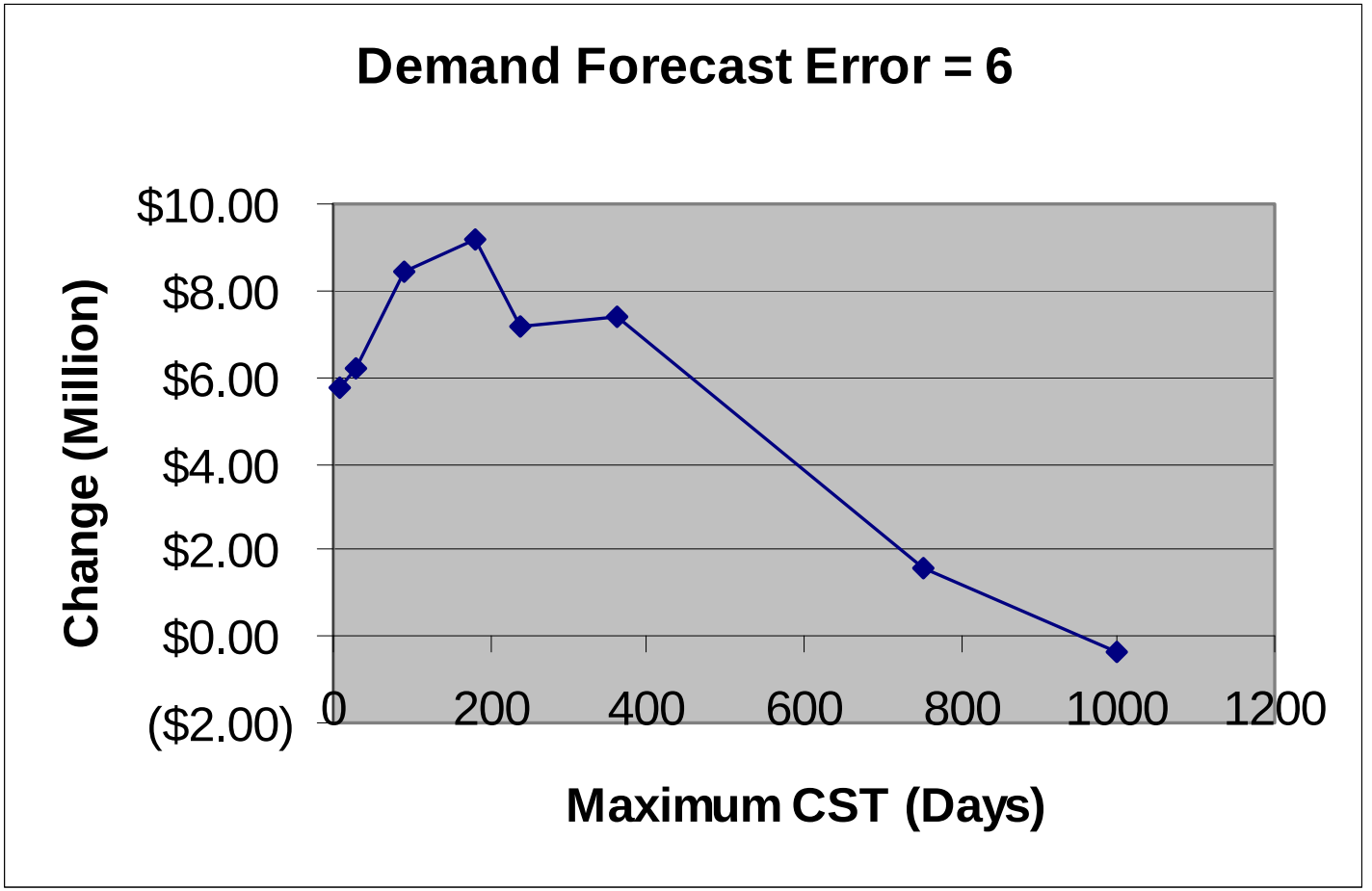


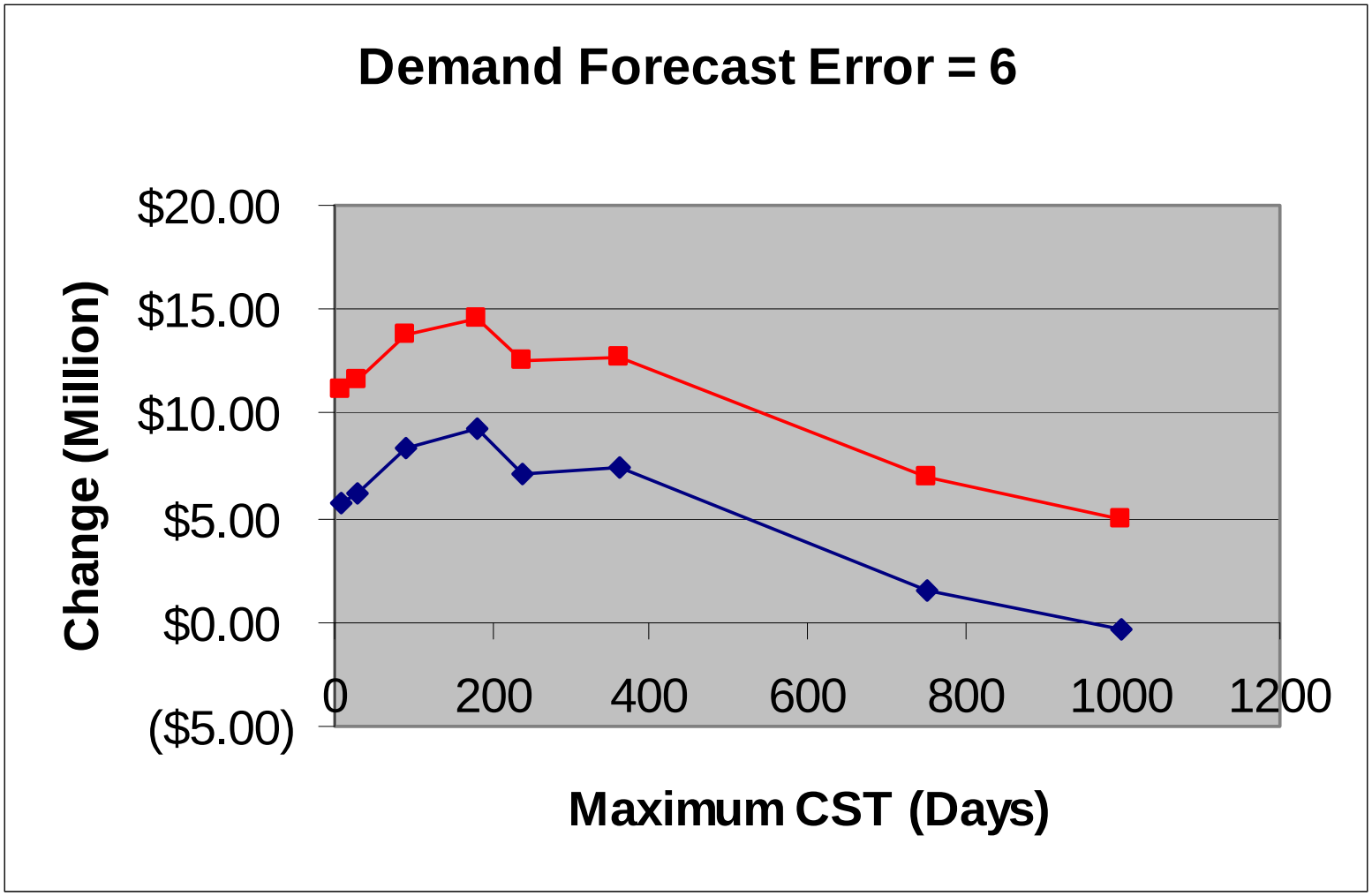
No stocking

Stocking

Stocking, OEM PLT = 120 days

Reduction in Working Capital Vs. CST Non-Stocking Vs. IA Optimization



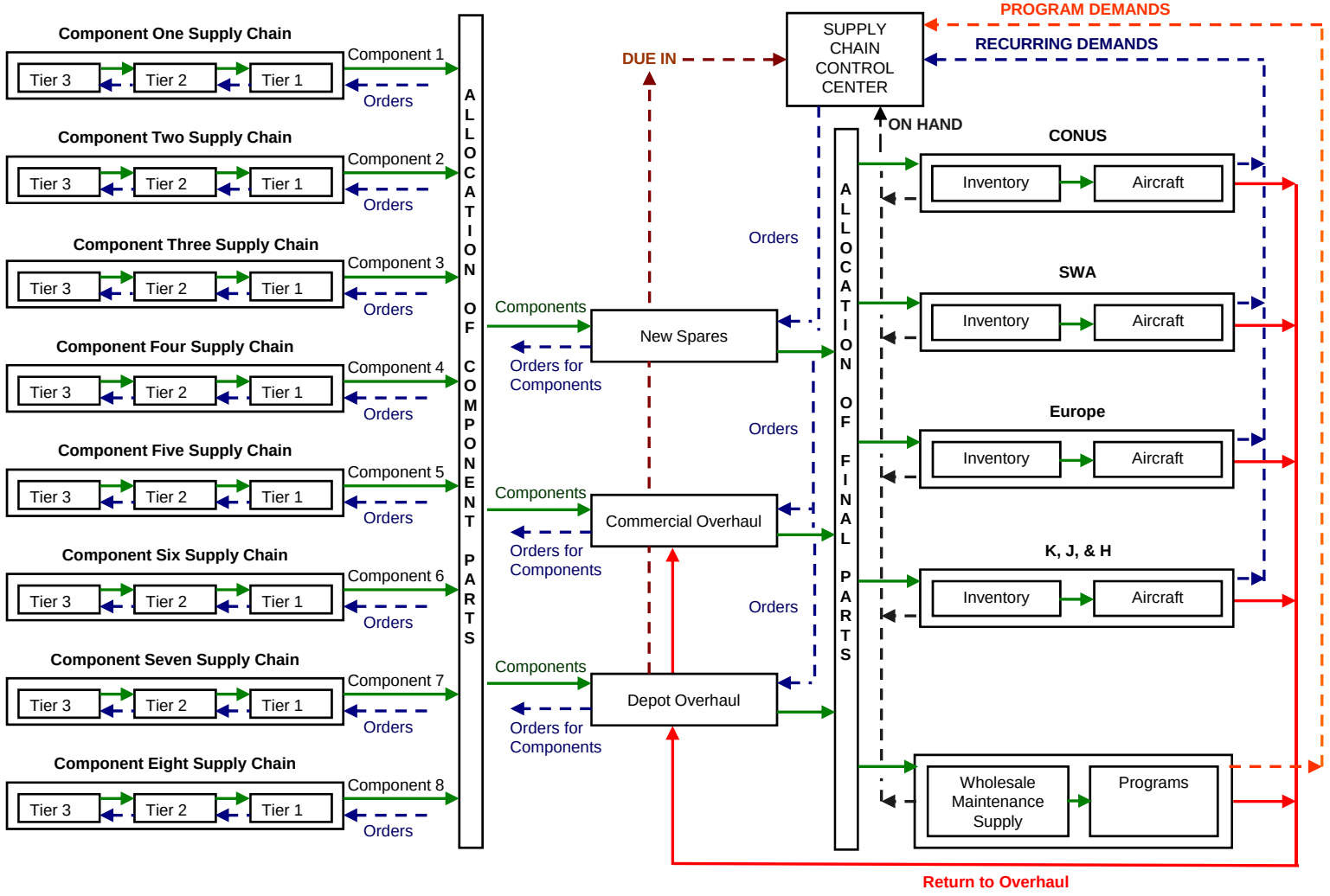

Demand Forecast Error = 6
$20.00
$15.00
$10.00
$5.00
$0.00
($5.00)
Change (Million)
0
200
400
600
800
1000
1200
Maximum CST (Days)
No Change in PLT (180 days)
PLT Reduced to 120 days

Inventory Analyst Conclusions

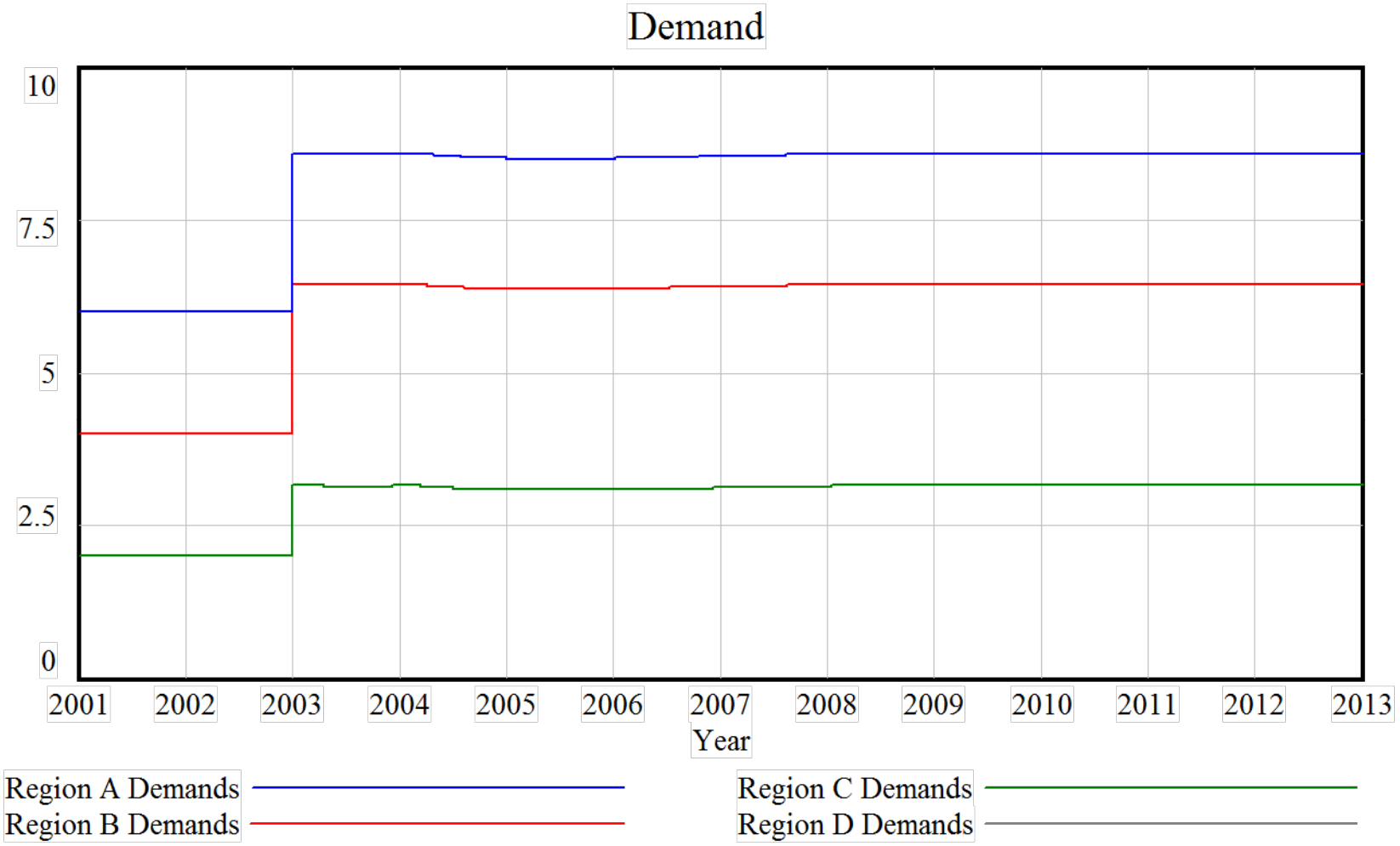
- **Increasing safety stock levels in the manufacturing supply chain can both reduce lead times and reduce the amount of working capital invested to achieve desired service times;**
- **Increasing safety stock levels even for the one component with the greatest lead time produces noteworthy results;**
- **Increasing safety stock levels furthermore reduces the risk of shortages and longer lead times in the event of an unexpected increase in demand, a problem that has existed for aviation spares.**

Strategy Evaluation
Using Dynamic Modeling

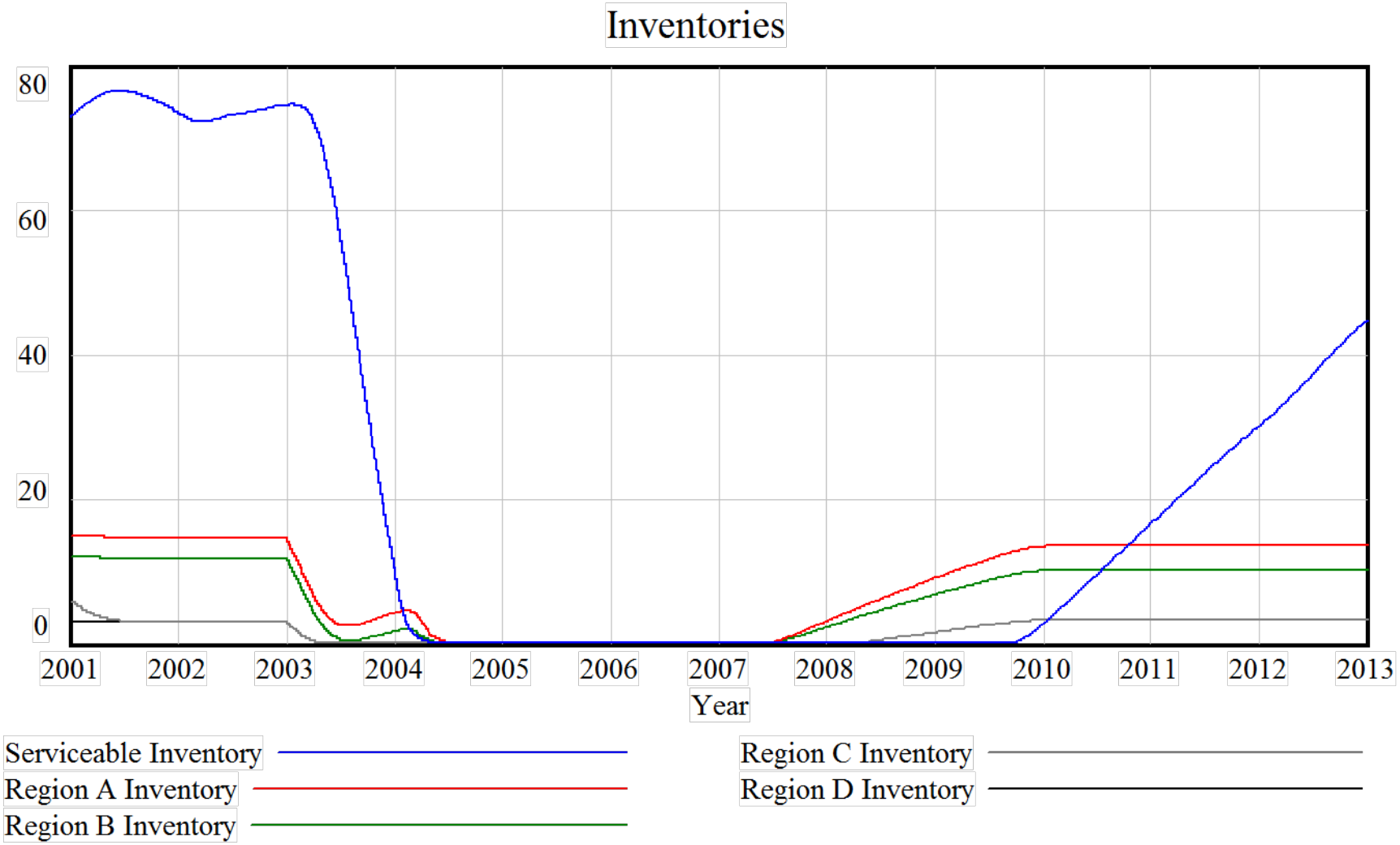
Structure of Supply Chain for Aviation Spare Parts



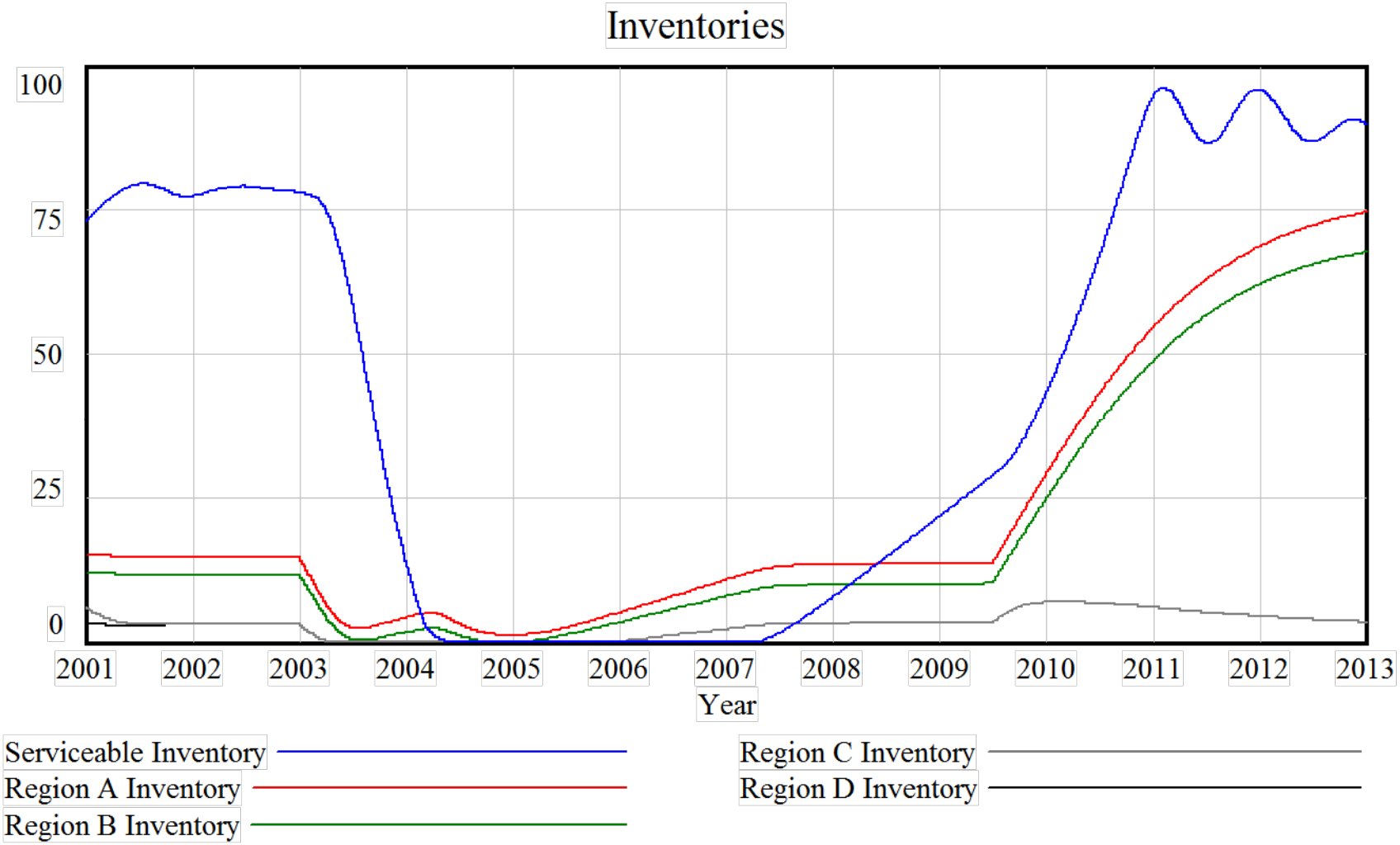
Sharp Increase in Demand 2003



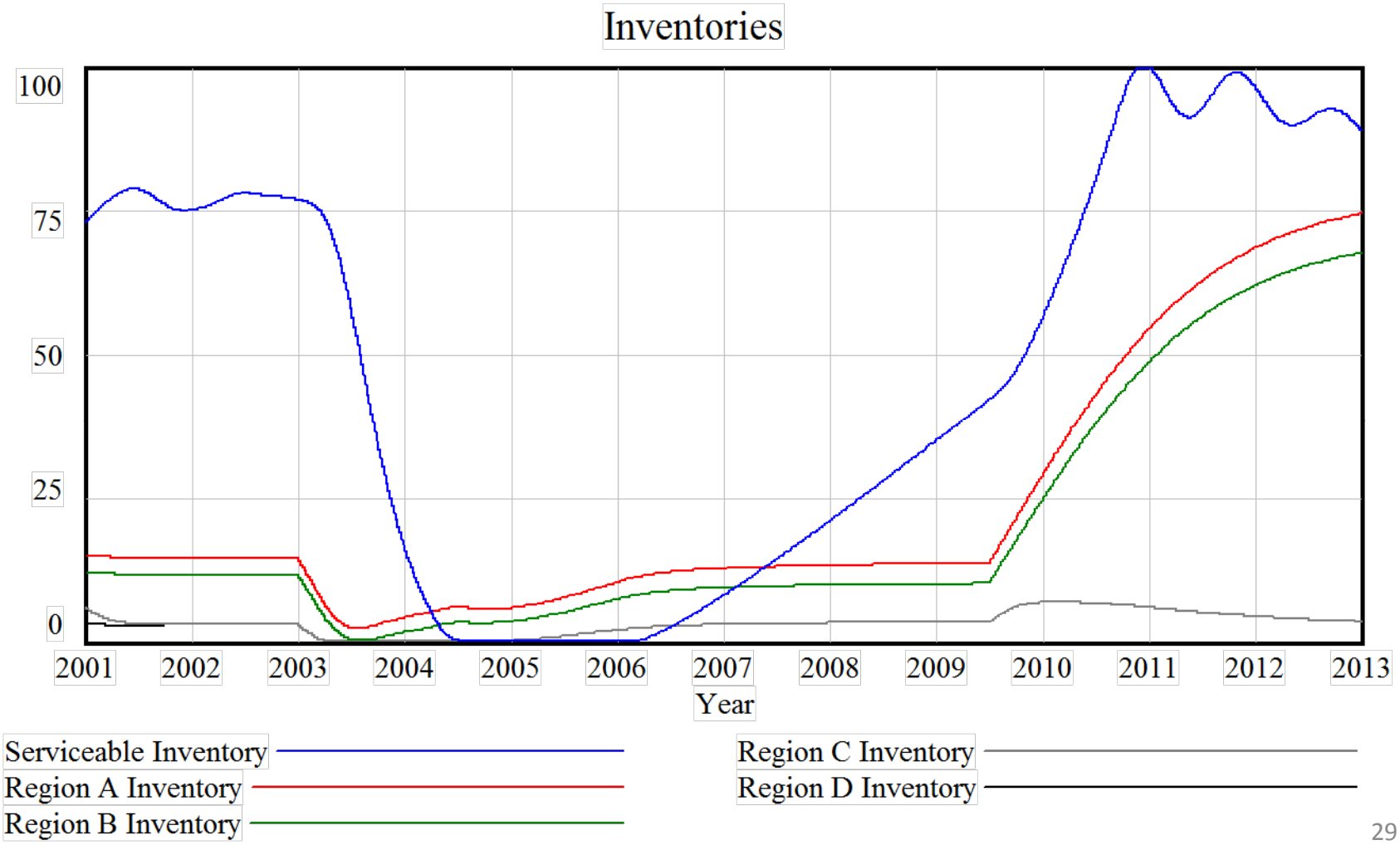
Base Case: Blade Inventories



Alternative Case A: Inventories With Stocking Policy



Alternative Case B: Inventories With Stocking Policy & OEM PLT Reduction



Summary & Conclusions

- Forecasts Are Always Wrong;
- The Longer the Forecast Horizon, the Worse the Forecast;
- Holding Inventory of Final Goods is a Very Expensive Way of Dealing with Uncertainty;
- Push-Pull Boundaries Enhance Abilities to be Adaptive and Responsive and Efficiently Mitigate Risks of Forecast Errors

Questions or Comments?

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