Leveraging Digital Technologies to Transform an Aerospace Shop

Presented at Business After Hours:

NEW ENGLAND AIR MUSEUM

12/10/20

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Today's talk - A perspective from a different altitude

Pre-COVID question :
How do we respond to skilled labor shortage in aerospace manufacturing?

Answer 1 : Econ 101 –supply and demand.
(30,000')   Pay them more and they will come.

Answer 2 : Look for low-cost aero
(10,000')   clusters, e.g. Southeast USA.
              State funded training programs

Answer 3 : Revenue = Function of capabilities
(ATC)   & market conditions
              Cost = Function of macro and
                      micro factors
              Optimize for revenue and cost using
              enabling technologies

Mr. Richard Aboulafia, Dr. Vivek Saxena & Dr. Kevin Michaels at an after hour panel in Seattle for Boeing suppliers

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Don't let a downturn go to waste!

SPOTLIGHT

Research shows that 9% of companies come out of a recession stronger than ever. Here's how they lay the groundwork for success.

Roaring Out of Recession

by Ranjay Gulati, Nitin Nohria, and Franz Wohlgezogen

		Promotion-focused moves		
		Market development	Asset investment	Both
Prevention-focused moves	Employee reduction	**Good** Sales 4.6% EBITDA 6.6%	**Bad** Sales 3-9% EBITDA 3-3%	**Worst** Sales 3.3% EBITDA -5.2%
	Operational efficiency	**Good** Sales 7.1% EBITDA 4-2%	**Good** Sales 8.4% EBITDA 8.4%	**Best** Sales 13.0% EBITDA 12.2%
	Both	**Bad** Sales 5-2% EBITDA 2.1%	**Bad** Sales 5-2% EBITDA -0.5%	**Good** Sales 9.2% EBITDA 4.6%

4700 public companies analyzed

Data over 3 recessions (1980s, 1990s and 2000s)

3 years prior and 3 years after recession considered; adjusted for industry averages

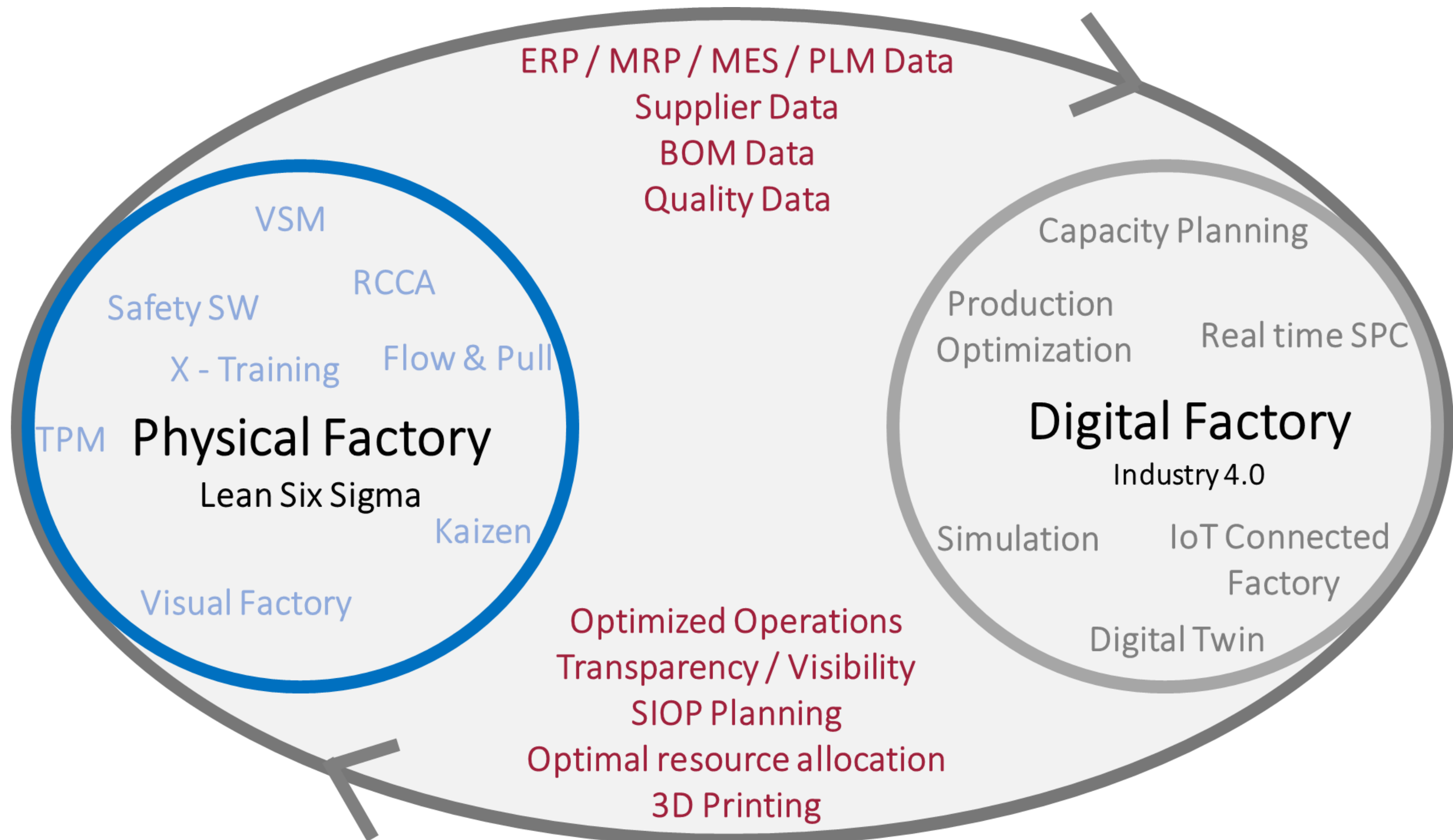Companies that used the 'lull' to improve operations came our best

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Suppliers need to embrace the digital thread future; throughout product life cycle
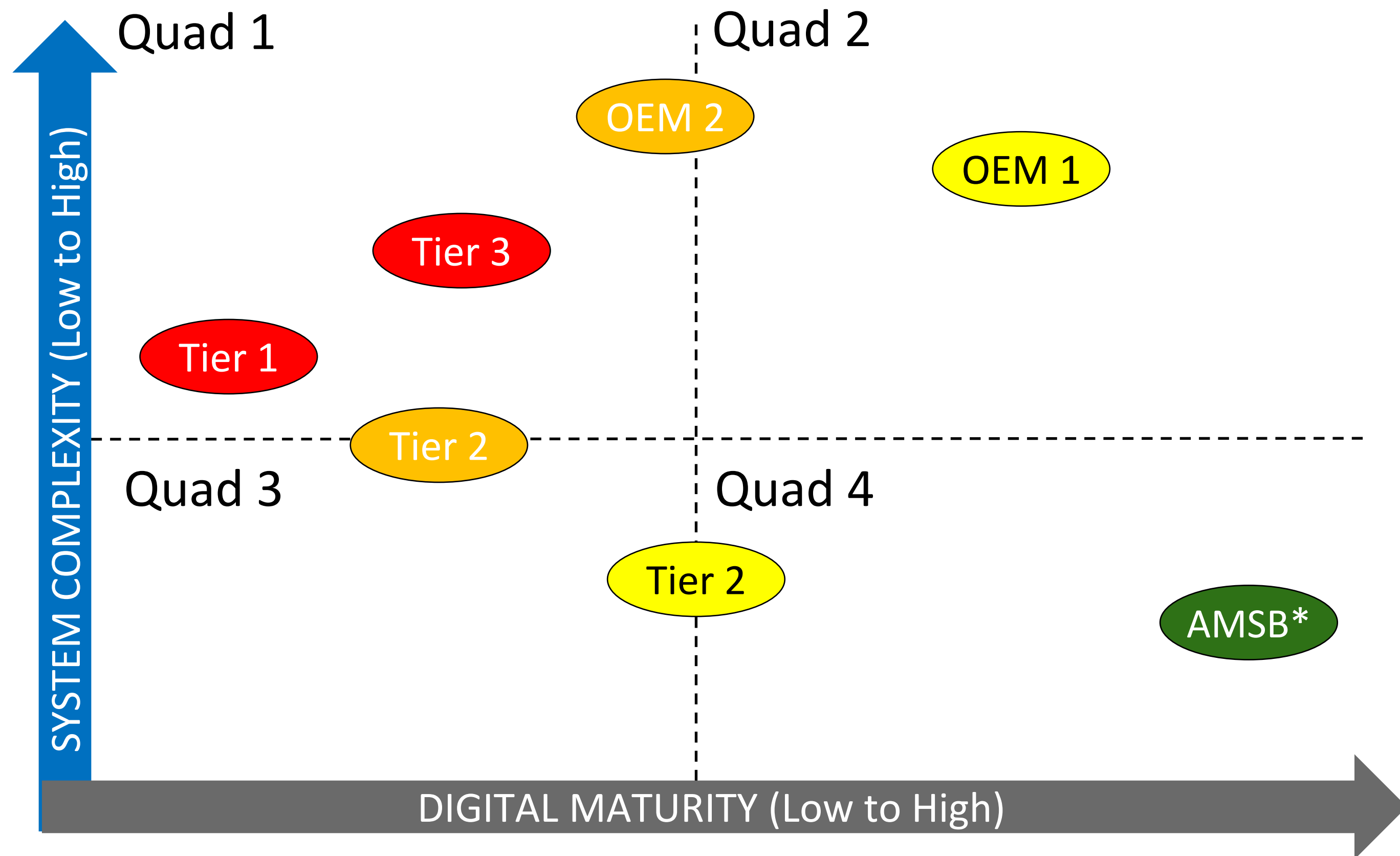
Lifecycle of Airframe/Engine

Normalized Fleet Size

EIS

Out of Production
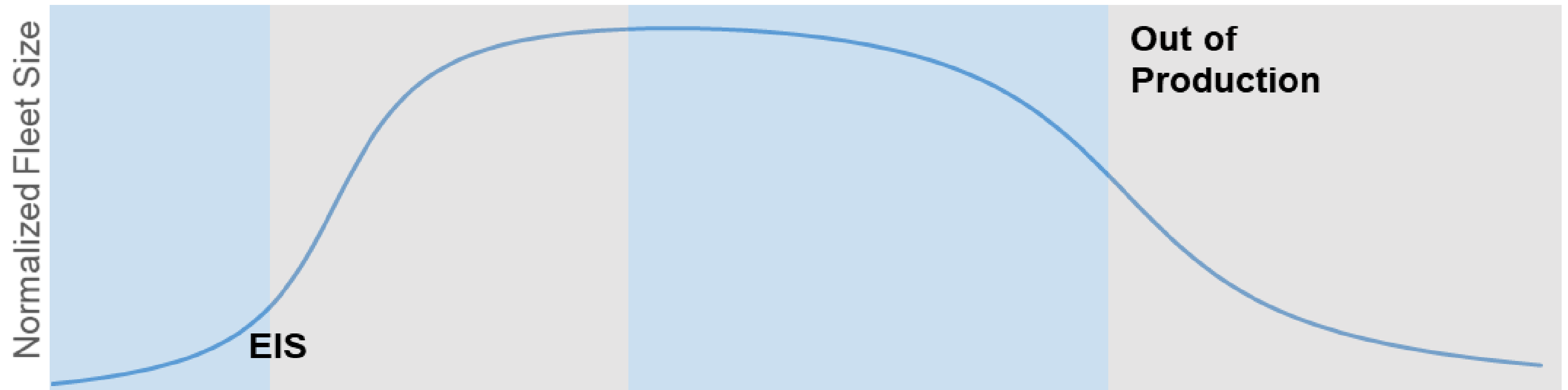
	Development	Growth	Maturity	Sunset
OEM's Objectives	Collaboration Quick turns Engineering Capability	Capacity Multi-source (domestic) to de-risk Short LTA's for flexibility	Aggressive cost reduction Move to low-cost sources	Delivery Quality Less aggressive on cost
Supplier's Objectives	Win content Relationship w/ Engineering	Invest in capacity Secure long LTA's	Internal cost-out Process improvement Internal low-cost source	Flexibility -unpredictable demand Maximize margins Re-engineer/repair tooling
Digital Technology Enablers	**Factory digital twin** 3D printing **SIOP Plans**	**Shop optimization** Automation **Sub-tier visibility**	More automation More sub-tier visibility	**Factory digital twin**

Industry 4.0: A modern factory is an adaptation of a cyber-physical system

ERP / MRP / MES / PLM Data
Supplier Data
BOM Data
Quality Data

Physical Factory
Lean Six Sigma

VSM
RCCA
Safety SW
X - Training
Flow & Pull
TPM
Kaizen
Visual Factory

Digital Factory
Industry 4.0

Capacity Planning
Production Optimization
Real time SPC
Simulation
IoT Connected Factory
Digital Twin

Optimized Operations
Transparency / Visibility
SIOP Planning
Optimal resource allocation
3D Printing

Complexity: Each shop represents a unique 'system' with its underlying factory physics

Shop characteristics that define complexity of operations –

a. Volatility in demand
b. Interdependent multiple sites
c. Product Variety
d. Depth of BOM
e. Number of unique work centers in a router
f. Intensity of outsourcing
g. Depth / Tiers of supply chain
h. Quality performance

	SCORE	
Low	Medium	High

EXAMPLE :

INCREASING SYSTEM COMPLEXITY

Compressor Case Machining   Cooled Turbine Blades   Fastener Mfg.

The Digital Scorecard: How urgently do you need to invest in 'digital'?

Quad 1   Quad 2

SYSTEM COMPLEXITY (Low to High)

OEM 2

OEM 1

Tier 3

Tier 1

Tier 2

Quad 3   Quad 4

Tier 2

AMSB*

DIGITAL MATURITY (Low to High)

Advisory Aerospace OSC has a proprietary methodology to evaluate Digital Maturity of a shop that accounts for Infra-structure, Standard Work and Culture

*Additive Manufacturing Service Bureau

Digital tools bring visibility and step changes in efficiency

Descriptive Analytics
- Production Visualization
- Spend Analytics
- Capacity Analytics

Predictive Analytics
- Sales Loading Tool
- Stockout Analysis
- OTD Predictions
- Revenue Forecast

Prescriptive Analytics
- Factory Digital Twin
- Shop Optimization
- Stochastic Simulation

Spreadsheets

Database
(ERP / MRP / MES)

Factory Data (IoT)

Server Application
(Cloud / On Premise)

Browser
(Laptop / Desktop / Mobile)

User

Data Aggregation   **Advanced Analytics**   **Visualization**
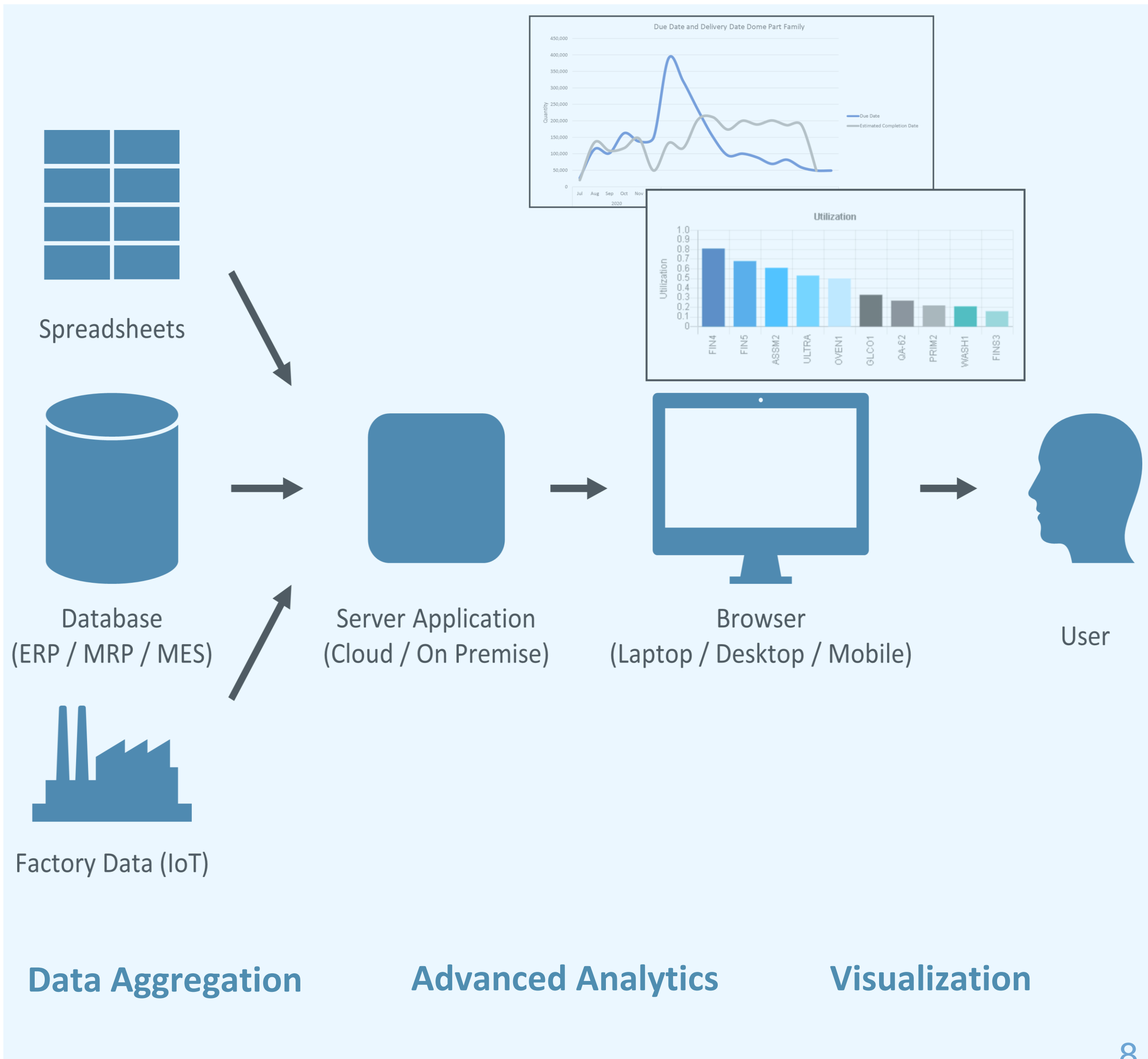
Descriptive Analytics: Real time and complete visibility of the value chain

Assemblies & Sub-assemblies

BOM Details in Shop or at Sub-Tiers
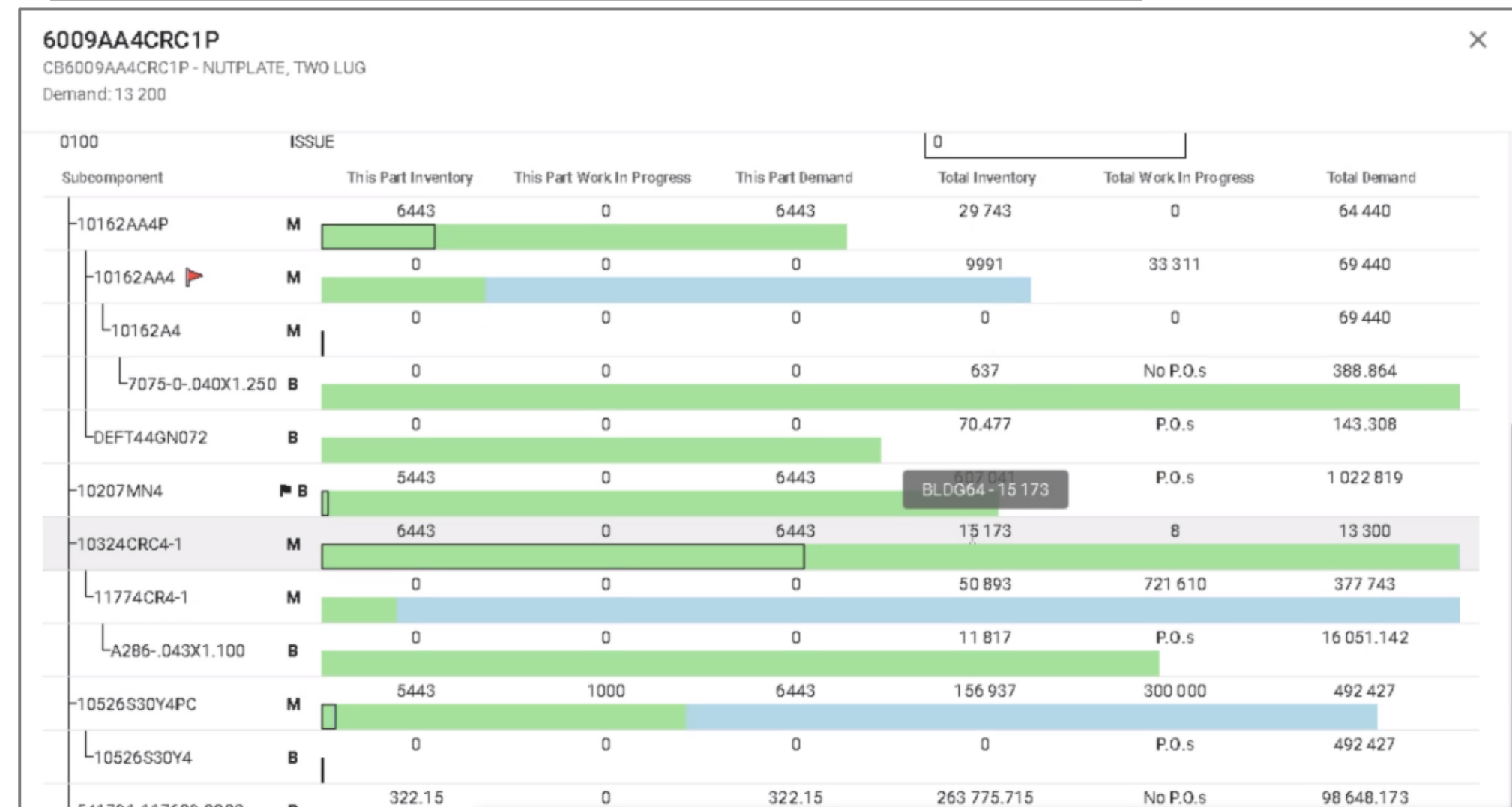
Real Time Visibility of Shop & Sub-Tier Value Chain

Online tool for complete production status

Identification of late POs and Quality Holds

Live data mined from multiple data streams including ERP / MES / Spreadsheets

Both 'make' (M) and 'buy' (B) parts included

Bought parts tracked in inventory and in open POs with suppliers

Best estimates of future deliveries with confidence levels & Early Alerts

Predictive Analytics: Complete alignment of sales, operations, planning and finance

Input Data

Work Center Detail

Projected Deliveries / Revenue / Margins Impact of What-If's

Factory Digital Twin through simulation of shop operations for high fidelity scenario planning

Proceedings of the 2016 Industrial and Systems Engineering Research Conference
H. Yang, Z. Kong, and MD Sarder, eds.

Discrete-Event Simulation For Shop Performance Improvement Under Complex Relationship of Material Inputs to Assembled Kits
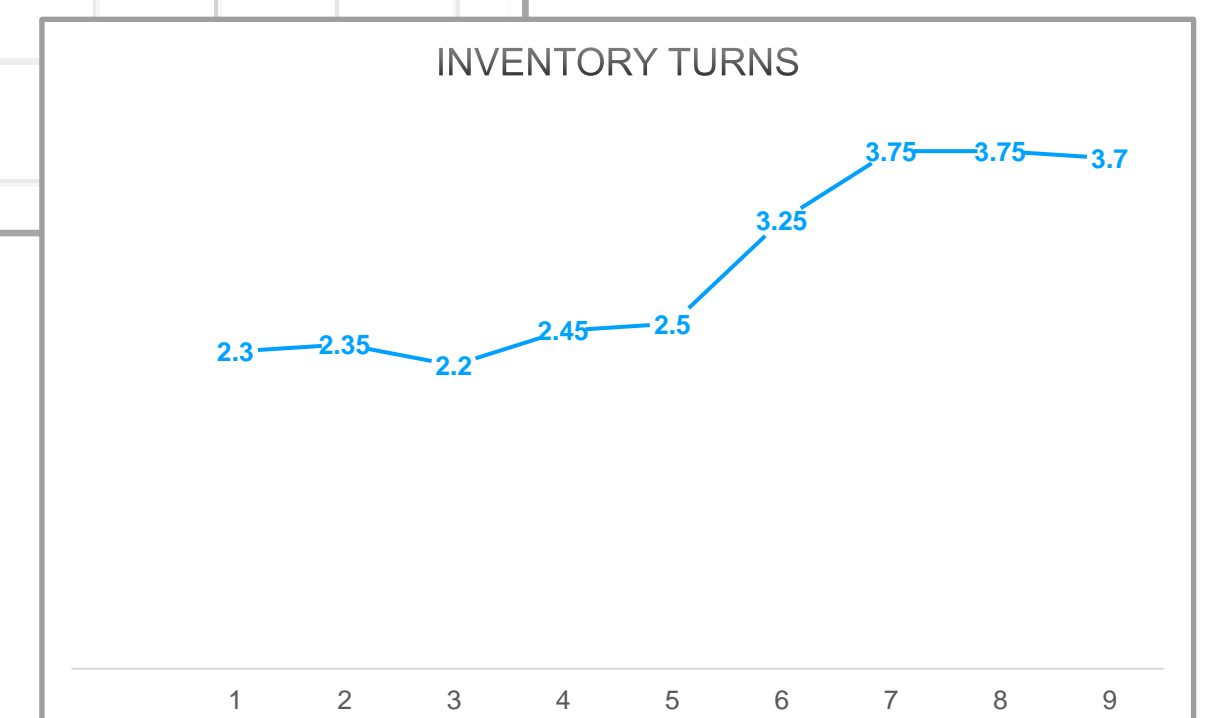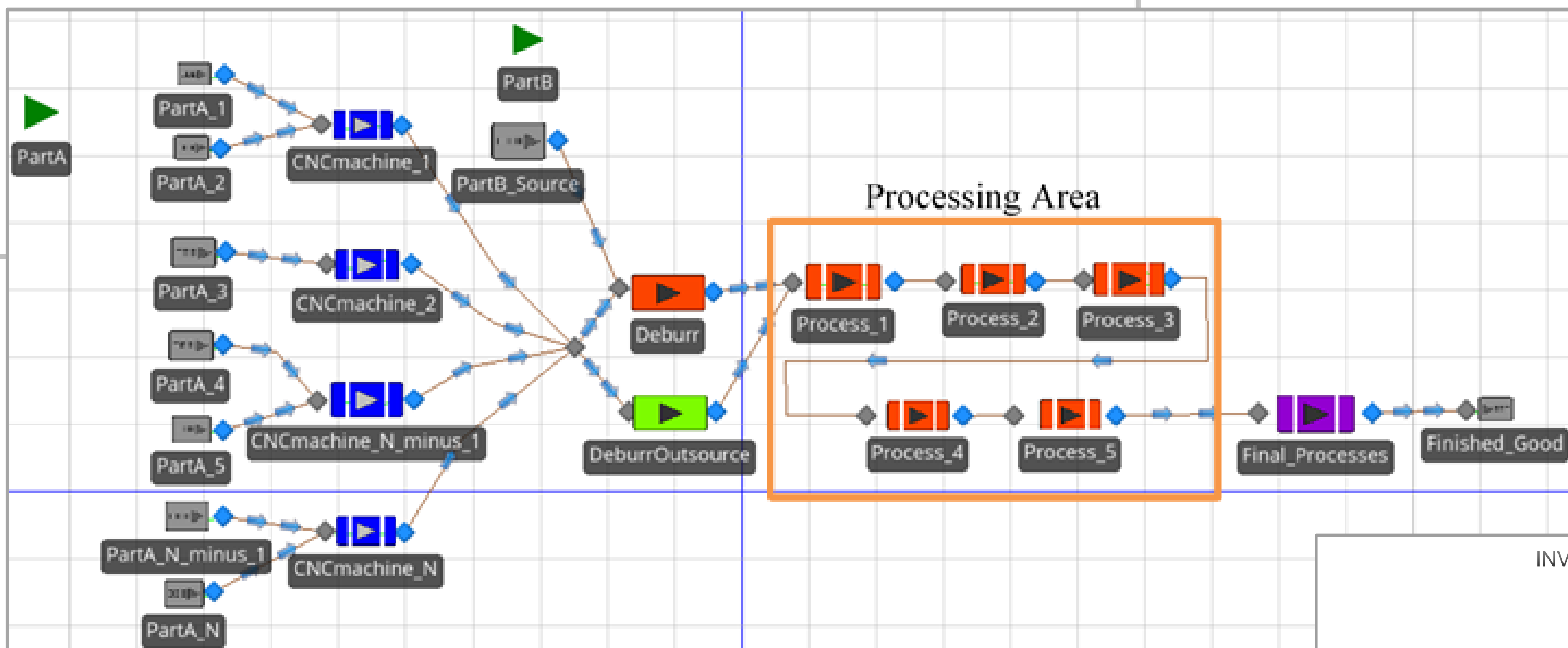
Prescriptive Analytics: True shop optimization to drive step change in OTD

Input Data

BOM

Inventory

Part Routings & Process Times

Setup Times

Purchase Parts LT's

Demand Schedule

Dispatch
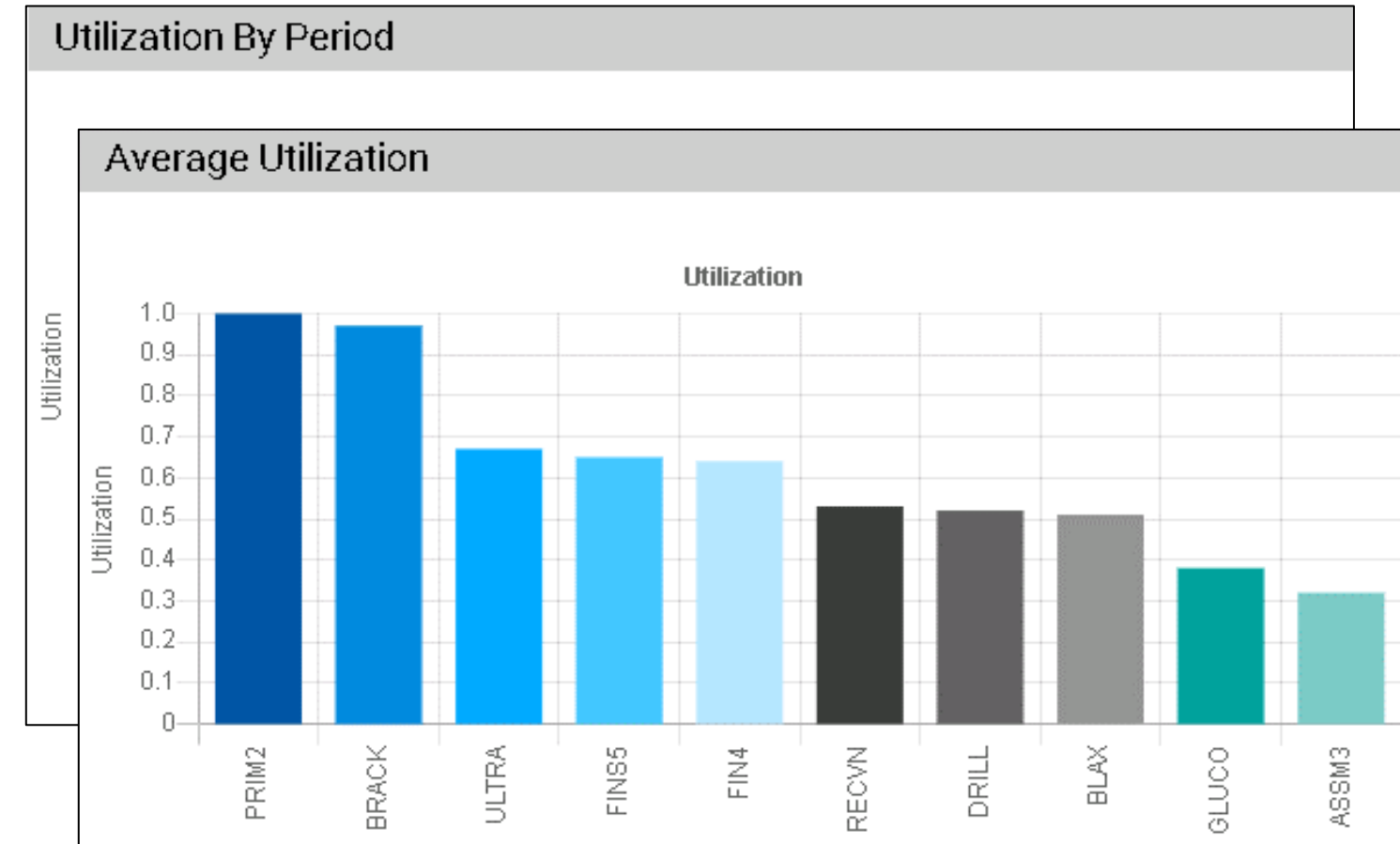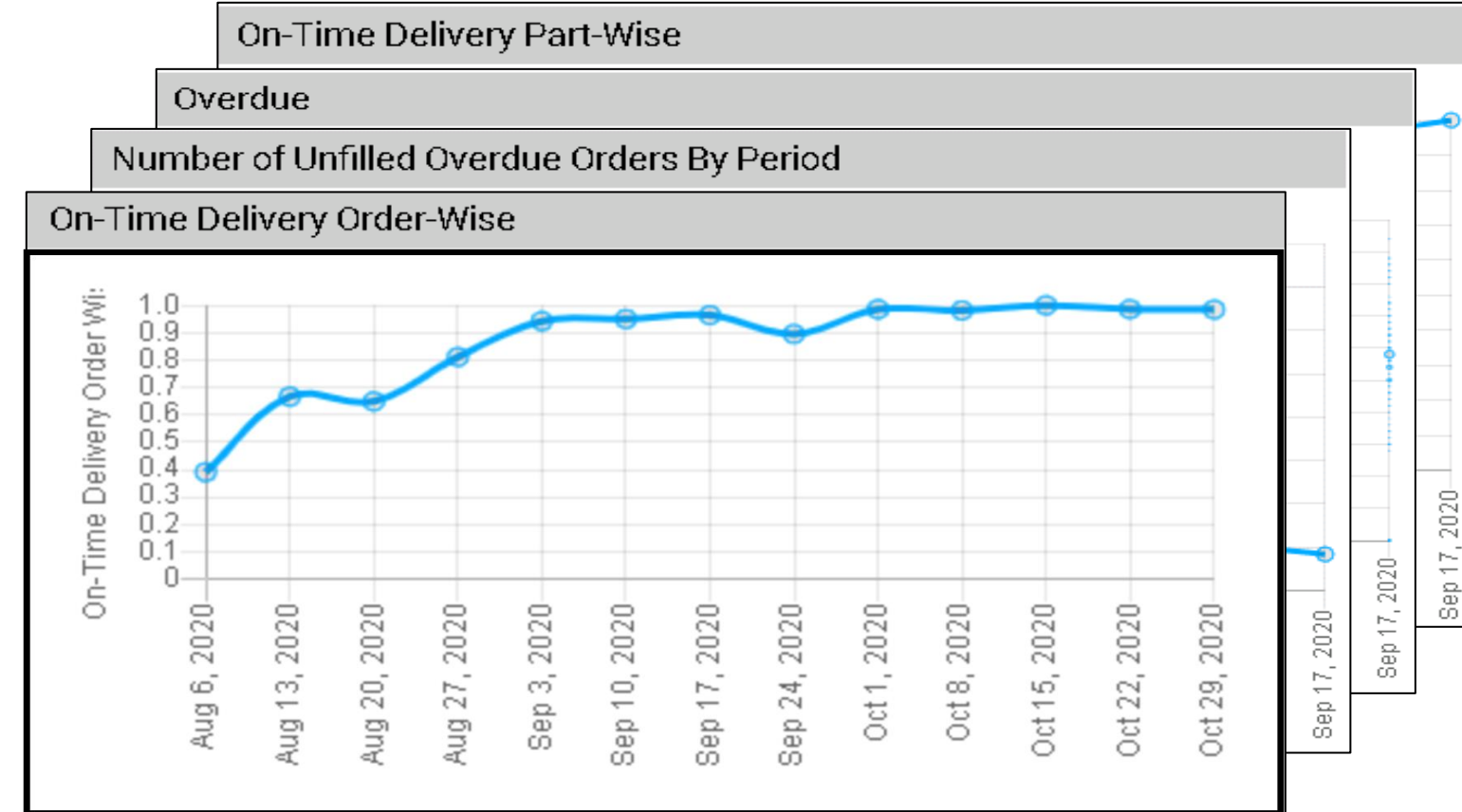
Optimizing the Digital Twin

Optimized KPIs

# Case 1: Step improvement in OTD using shop optimization

SITUATION

- $70M supplier to defense & space OEMs; vertically integrated shop

- 40% on-time delivery performance with 10-20% volatility for over a year

- Orders booked to grow 2X in 3 years

- 500k component-level part numbers

- Founded in 1960s, relying heavily on tribal knowledge, poor systems

APPROACH

- Detailed capacity analysis by part & process to individual machine level

- Coaching of Operations leadership & supply chain management team

- Assessment of talent pool in all operations functions

- IT systems evaluation

- Application of Advisory Aero optimization tool OptimizerAero™

▶ 5 year capacity assessment

▶ 1st pass yield at bottlenecks

Planning Optimizer - Input

Developed By:
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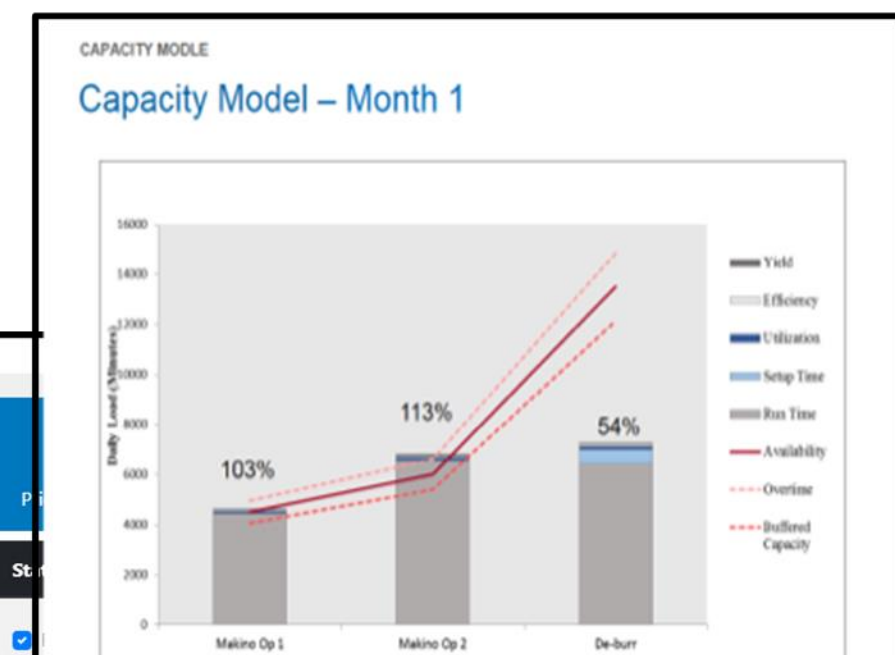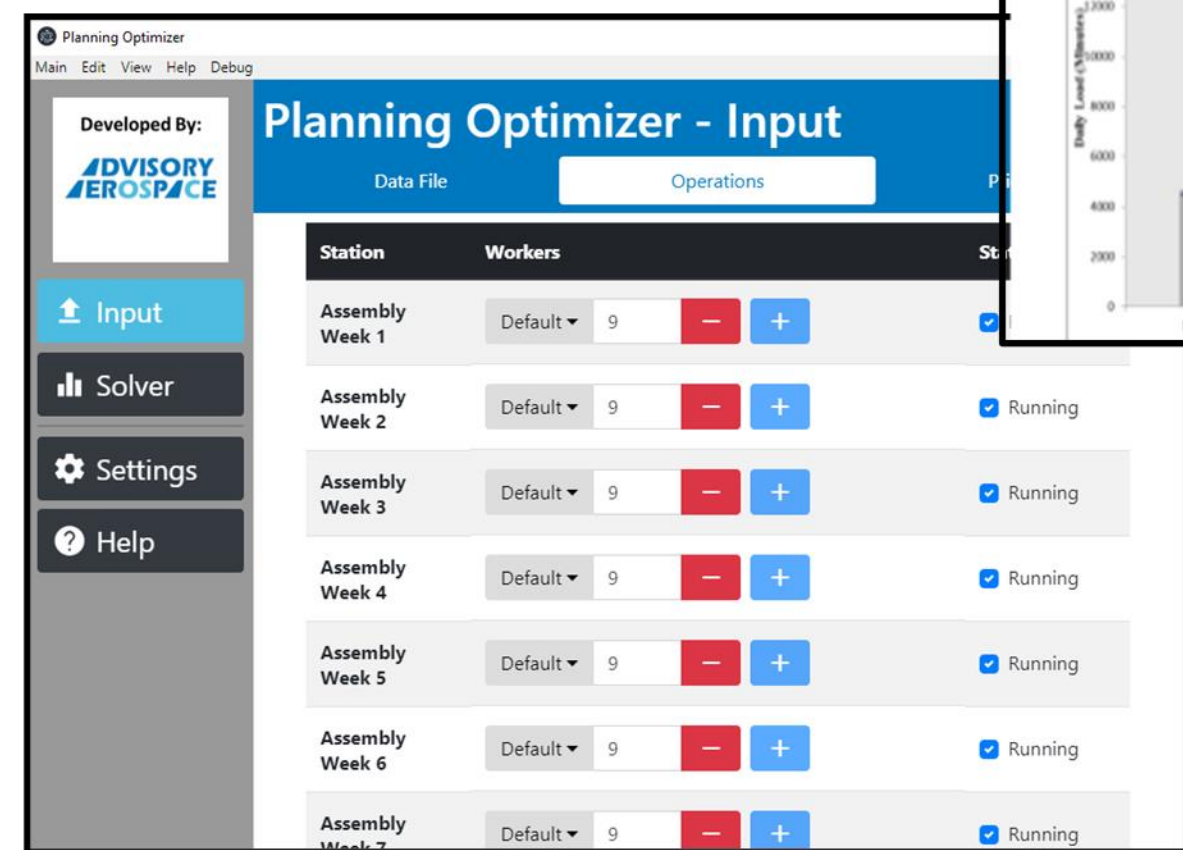
◀ Optimize shift structure, batch size, production scheduling, outsourcing

80%
Delivery Performance up from 40% & Rising

Implementation of S&OP process Machine Monitoring (IoT) OptimizerAero
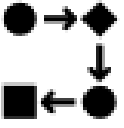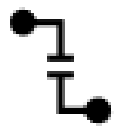
Hiring of new operations & supply chain leaders

Change of Shift Structure Restructuring of departments Buffer stock sizing

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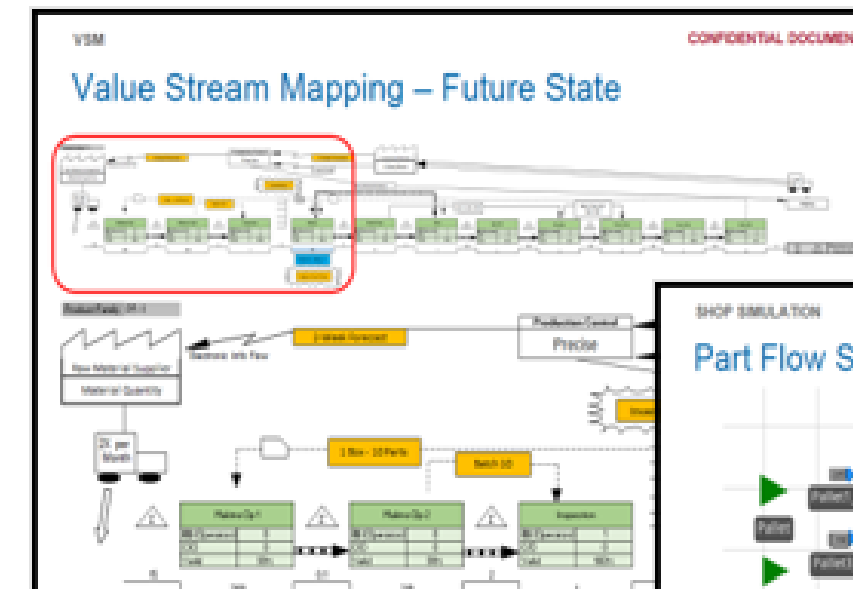# Case 2: Cash flow improvement using simulation

SITUATION

- Manufacturing client supplied part kits for a high-volume platform
- Kits waiting for a few parts at shipping stressed entire shop
- Optimal Production Schedule?
- Optimal Batch Sizes?
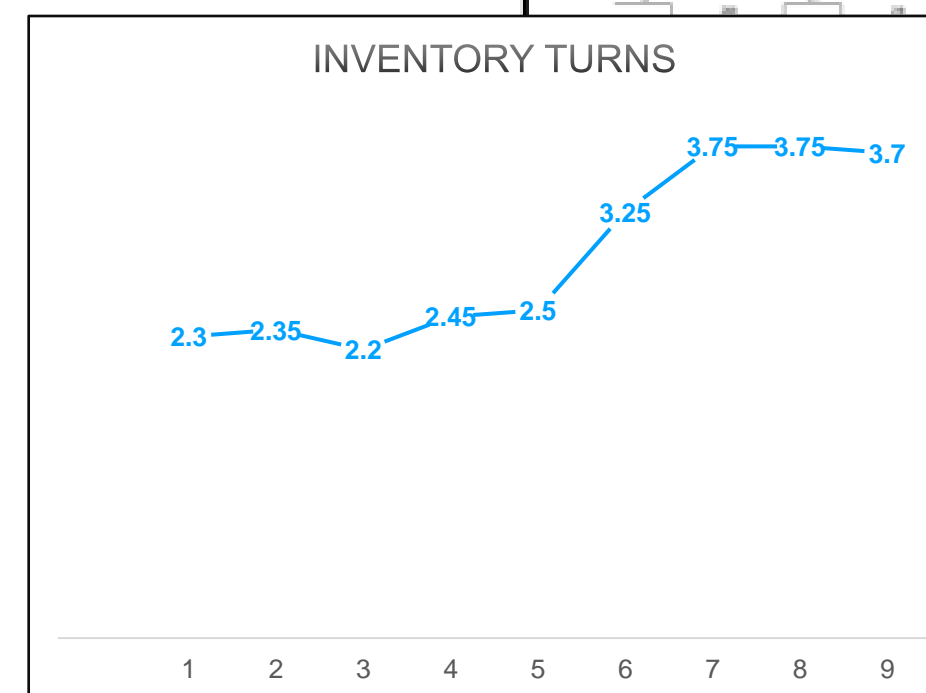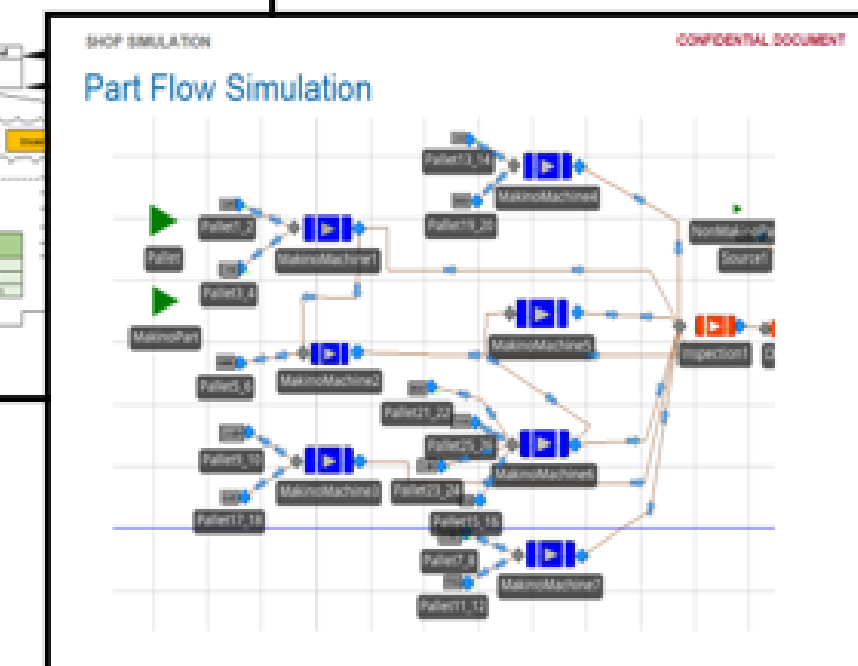- How to optimize Inventory for maximum delivery performance?

APPROACH

- Conduct Value Stream Map and Implement Pull System
- Collect Process Cycle time data at all stations (including variability)
- Verify capacity utilization and identify bottlenecks
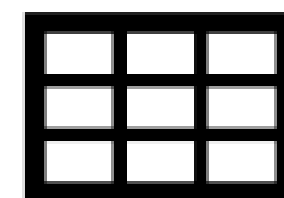- Analyze "What if" scenarios with discrete event simulation

- Identification of Bottlenecks
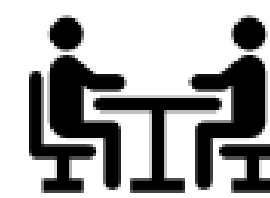- Process Level Capacity Analysis

VSM — Value Stream Mapping – Future State
CONFIDENTIAL DOCUMENT

SHOP SIMULATION — Part Flow Simulation
CONFIDENTIAL DOCUMENT

- Stochastic Shop Simulation

INVENTORY TURNS

2.3 — 2.35 — 2.2 — 2.45 — 2.5 — 3.25 — 3.75 — 3.75 — 3.7

1 2 3 4 5 6 7 8 9

- Sizing Impact on Lead Time

Strategic Buffer Implemented & Batch Size Optimized

Identified Optimal Outsourcing Plan

Pull system implemented and operators trained to use it

30% Reduction in inventory while increasing fill rate by double digits

Thank you.

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14525 Highway 7, Suite 345
Minnetonka, MN 55345 USA
734-249-0961
Vivek.Saxena@AdvisoryAero.Com
www.advisoryaero.com