THE UNIVERSITY of TENNESSEE KNOXVILLE

A Buffer Stock Improvement Model

Mil-spec Tent Supply Chain

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Problem Definition

Develop a Buffer Stock Strategy to Enhance the Supply Chain

- ❑ Credible, Dynamic, Repeatable and Transferable
- ❑ Useful to DLA and Industry Partners
  - → Understand the Supply Chain
  - → Model the Supply Chain
  - → Experiment with Model over Business and Operational Conditions

Problem Definition

Develop a Buffer Stock Strategy to Enhance the Supply Chain

- ❑ Develop a Buffer Stock Strategy
  - ✓ Quantity
  - ✓ Location
  - ✓ Timing
- Train Appropriate Personnel
- Implement Strategy and Track Surge Capability
- Transfer Model to Another Supply Chain

Project Status

Depth of Modeling:

Model 1: Camel and Bondcote Model

Breath of Modeling:

Model 2: Overall LME Supply Chain Model

Model 3: Overall MGPTS Supply Chain Model

Buffer Stock Strategy:

Model 4: Integrated Supply Chain Model

Model 5: Buffer Stock Model Capable of Supplying the Optimum Inventory at the Required Time.

Buffer Stock Model Assumptions & Variables

The model has simplifications and assumptions that can duplicate a more complex real world simulation.

Assumptions:

- 6 Mil-spec tent manufacturers in the Supply Chain.
- 13 suppliers sending raw materials to these 6 tent manufacturers.
- Random production times and working hours for manufacturer and supplier facilities.
- Random shipping schedules between suppliers and manufacturers.

Buffer Stock Model Assumptions & Variables

The model has simplifications and assumptions that can duplicate a more complex real world simulation.

Assumptions:

- Raw materials for suppliers arrive at facility at regular intervals.
- Purchase cost per unit, fixed cost per order, annual demand quantity of the product and annual holding cost per unit.

Model Variables:

- Length of simulation time = 1 Year = 8760 Hours (not including holidays.)
- Amount of buffer stock inventory to be injected monthly before and after every node of Supply Chain.

  (Initially set to Zero)

Tent Supply Chain Model Members

(mil –spec)

Tier I Suppliers

- TriVantage
- Flick Packaging Co.
- bfi blueridge films inc.
- THRUWAY FASTENERS
- LCR ELECTRONICS, INC.
- MTD Corporation
- BONDCOTE PERFORMANCE ENGINEERED COATED FABRICS
- Lea & Sachs, Inc.
- AADVANTAGE TENT FITTINGS
- ONEAL
- VELCRO Pioneers in Hook & Loop
- ACW

Pro Stead Engineered Plastics Inc.

Manufacturers

- CAMEL MANUFACTURING
- OUTDOOR VENTURE CORPORATION
- AC INCORPORATED
- JOHNSON OUTDOORS
- DIAMOND BRAND
- ANCHOR INDUSTRIES INC.

Distributor

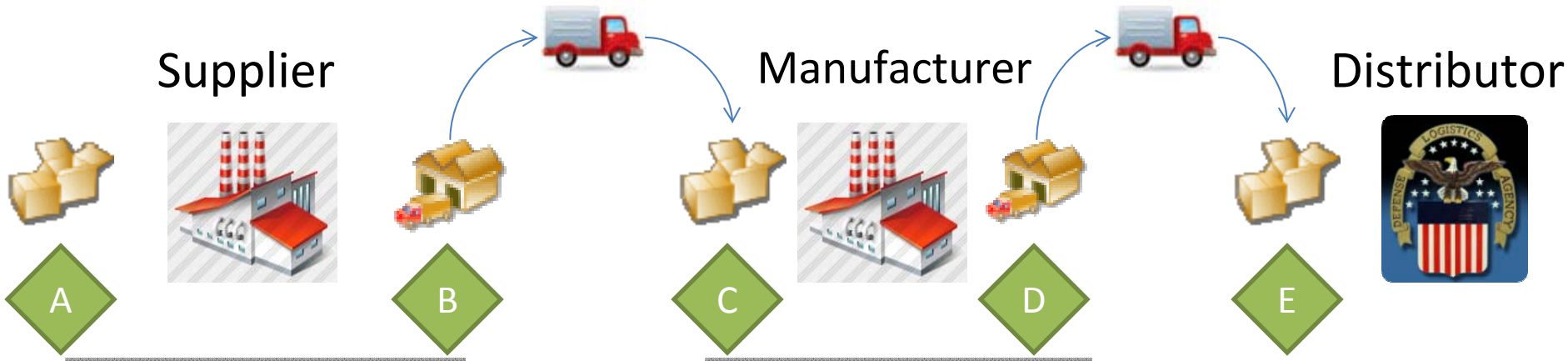
- DEPARTMENT OF DEFENSE UNITED STATES OF AMERICA
- DEFENSE LOGISTICS AGENCY

Model Variables

- Inventory is added at 5 locations along the Supply Chain i.e., before and after every node (supplier, manufacturer and distributor) indicated by the green diamonds below. These represent the Buffer Stock Strategy.

- Factors impacting the Buffer Stock Strategy are illustrated in the blue boxes below.

- Transportation factors impacting the Buffer Stock Strategy.



- Capacity/shift
- # of shifts
- % of distribution
- Product mix

- Capacity/shift
- # of shifts
- % of distribution
- Product mix

Buffer Stock Strategy

Step 1:

The Simulation Model automatically and continuously checks for starving nodes.

Step 2:

The simulation automatically adds inventory to the starving nodes and tracks the time and amount of inventory added.

Step 3:

All data is automatically exported to an Excel file for further analysis.

Location: between Supplier 1 and Manufacturer 1

4 units of parts are required at time t=180 hours.

Simulation Model

output exported to Excel

Time (hours)

Bs1m1		Bs1m2		Bs1m3
180	0	180	0	180
180	0	180	0	180
180	0	180	0	180
180	0	180	0	180
190.6656	11	191.6656	11.66556	192.1656
191.1656	1	191.6656	0	192.1656
283.1656	92	336.1656	144.5	355.1656
287.1656	4	358.6656	22.5	378.1656
289.1656	2	358.6656	0	378.1656
333.1656	44	381.1656	22.5	385.1656
335.6656	3	381.1656	0	385.1656
355.1656	20	474.1656	93	479.1656
357.1656	2	480.6656	6.5	525.1656
361.1656	4	480.6656	0	548.1656
378.6656	18	525.6656	45	548.1656
383.1656	5	548.1656	22.5	642.1656
384.1656	1	548.1656	0	649.1656
475.1656	91	625.1656	77	649.1656
480.6656	6	647.6656	22.5	672.1656

Buffer Stock Automation (continued..)

Step 4:

These excel spreadsheets are utilized to determine the buffer stock strategy.

- Minimum buffer stock per month is determined for every part at every node.
- Based on this minimum buffer stock requirement, an EOQ model is utilized to determine
  - o How much to order
  - o At what time to order

Amount to order

Frequency of order

Reorder point

Bs1m1		Bs1m2		Bs1m3
180	0	180	0	180
180	0	180	0	180
180	0	180	0	180
180	0	180	0	180
190.6656	11	191.6656	11.66556	192.1656
191.1656	1	191.6656	0	192.1656
283.1656	92	336.1656	144.5	355.1656
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output is neat and simple numbers

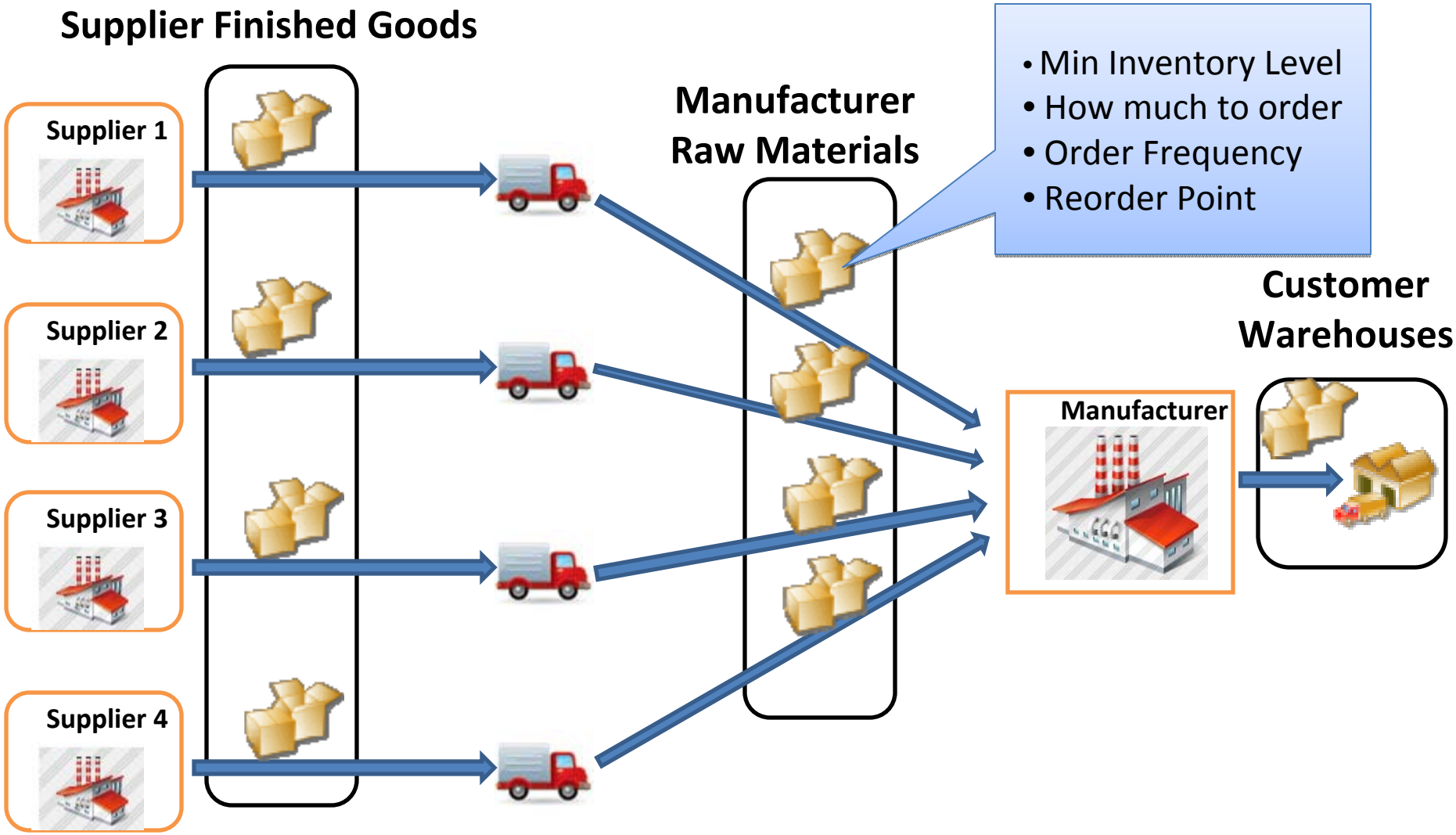
Bs1m1

7th	
8th	4
9th	37
10th	40
11th	40
12th	37
Max	43
Min	37
Average	39
Total	473

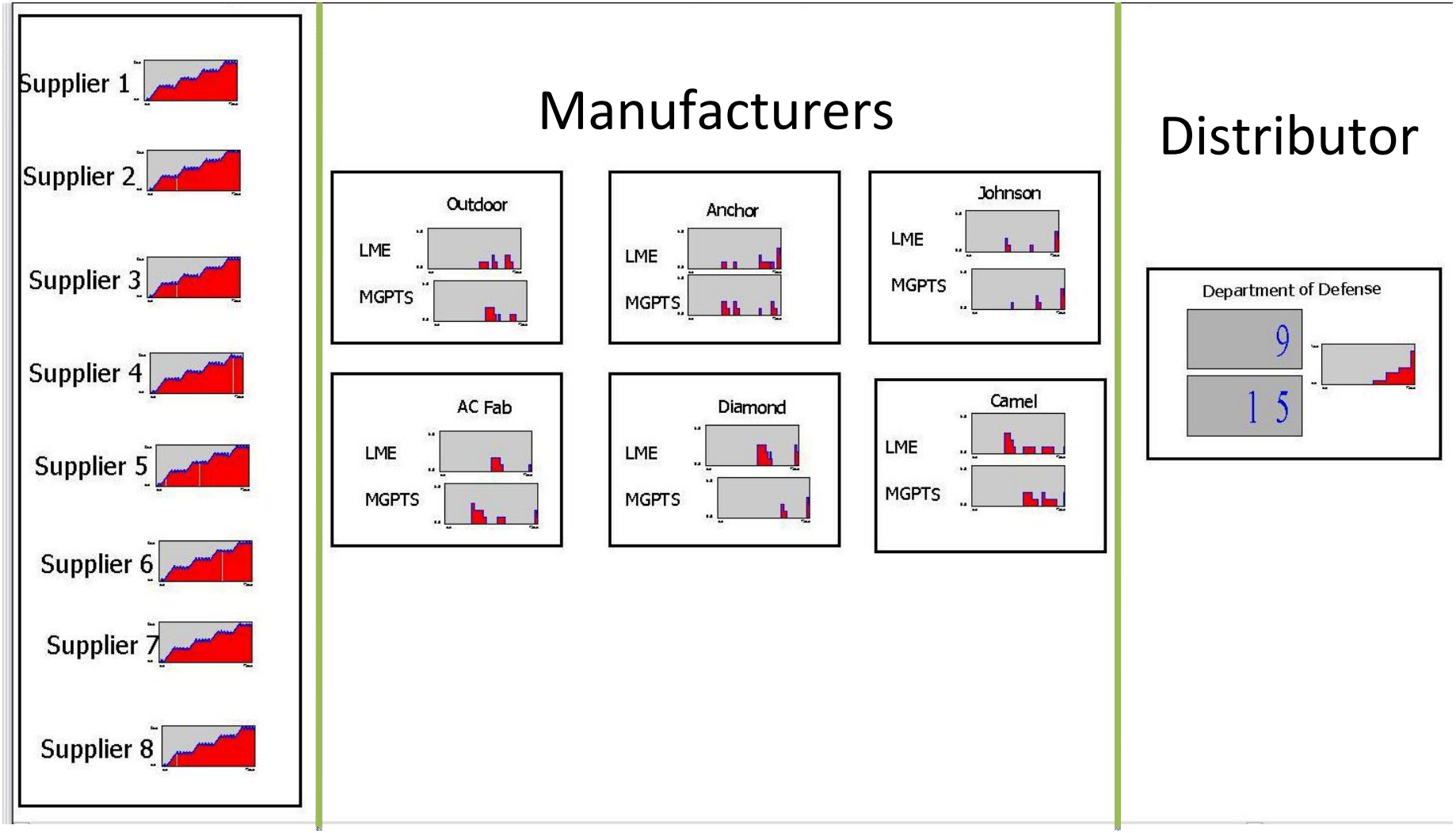
Bs1m1

Q* (units)	T* (months)	first order point (in months)	next ROP (in months)	ROP in inventory level
131.15	3.05	2.10 months	3.05 months	40.85 units
113.14	3.54	3.07 months	3.54 months	14.86 units
105.83	3.78	3.56 months	3.78 months	6.17 units
128.06	3.12	2.25 months	3.12 months	35.94 units
105.83	3.78	3.56 months	3.78 months	6.17 units
56.57	7.07	3.07 months	7.07 months	32.00 units

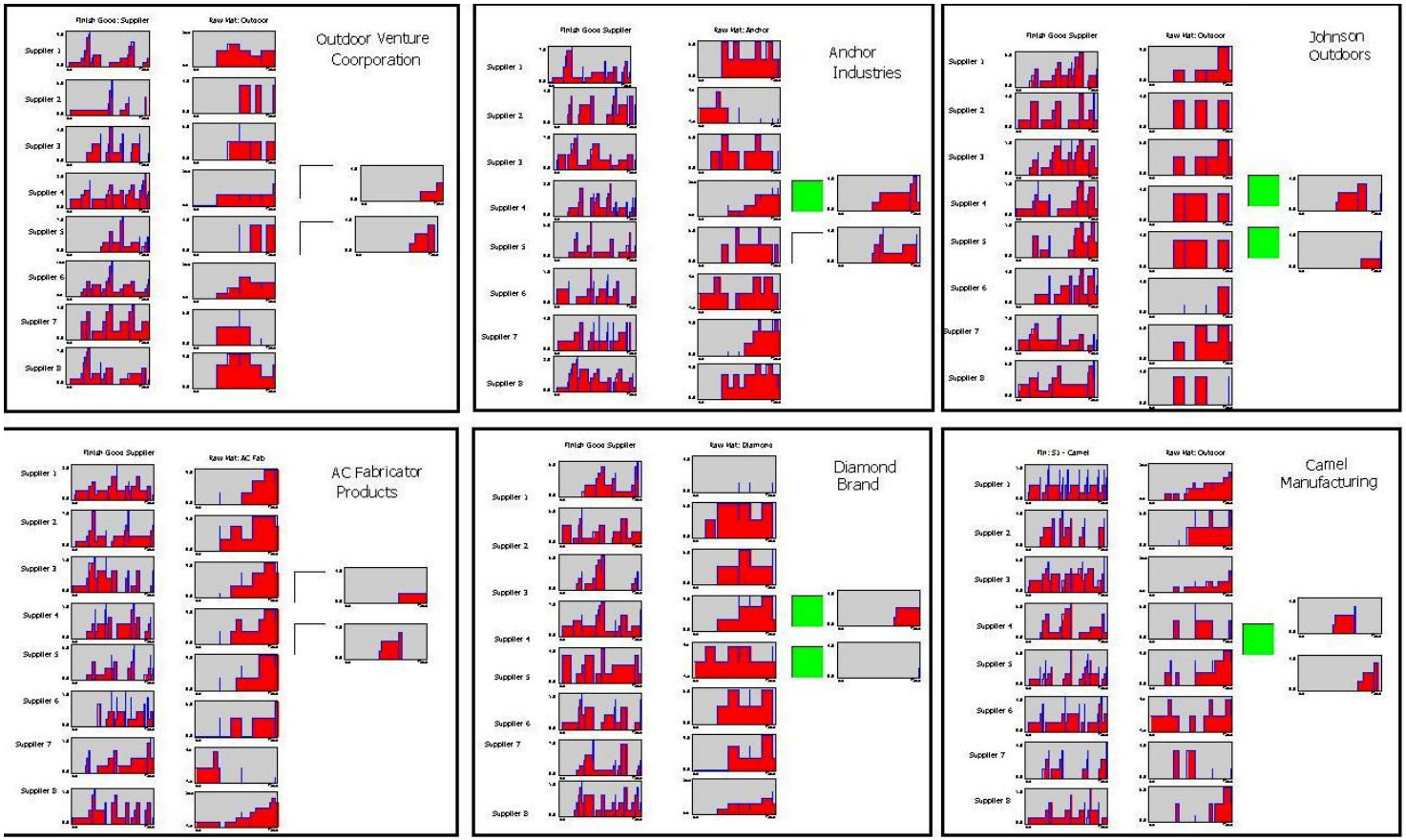
Solutions offered by the Model

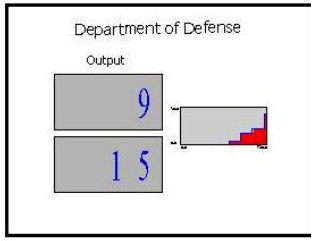


Model Schematic Section

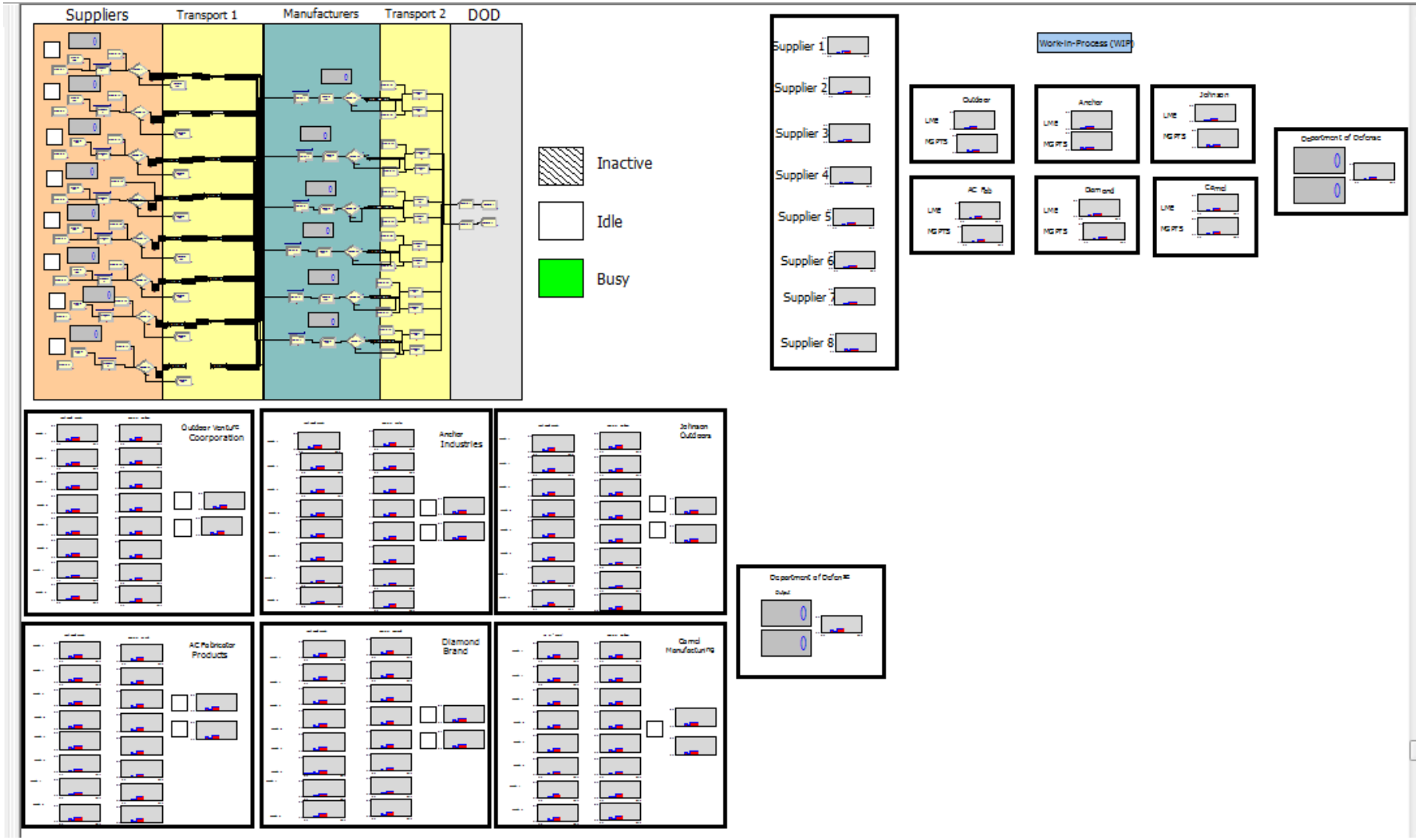


Methodology of Placing Buffer Stock

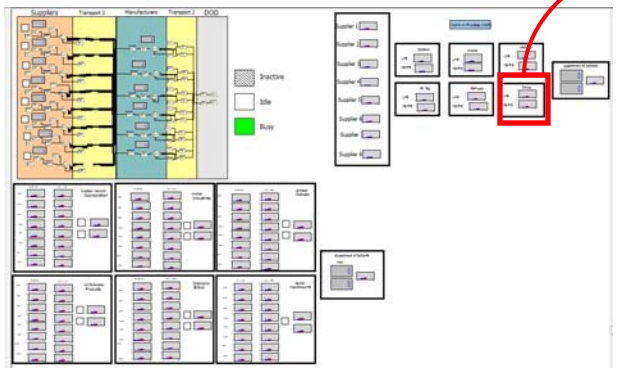


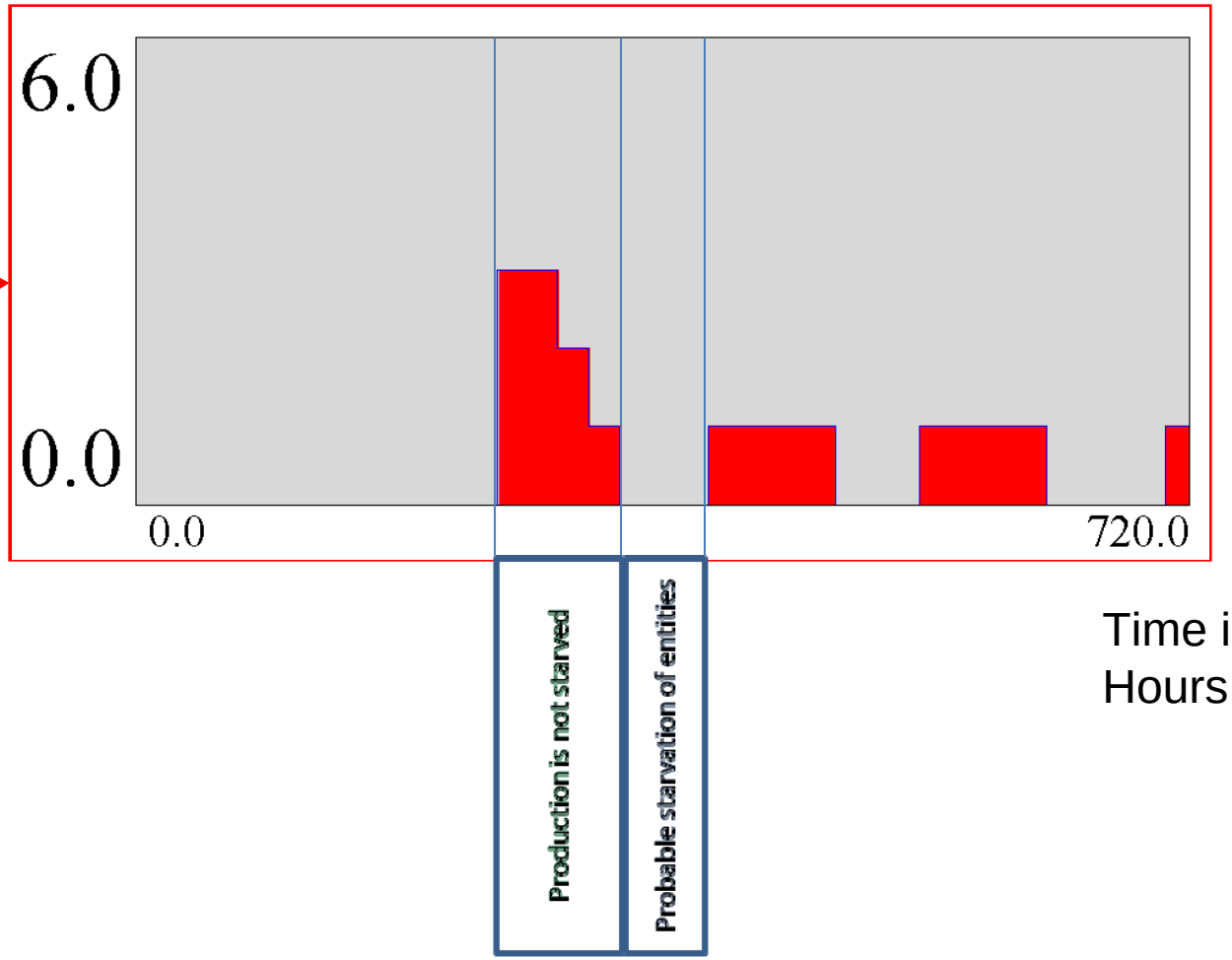


Simulation Model

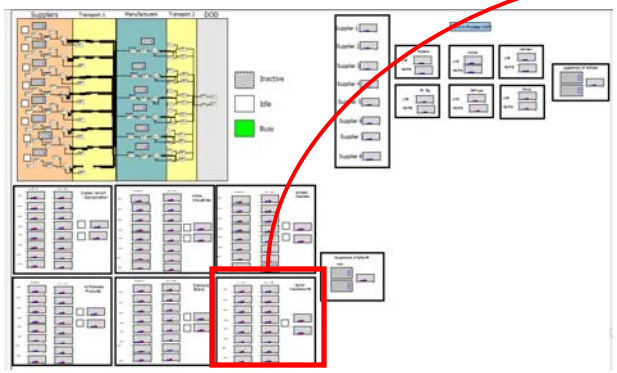


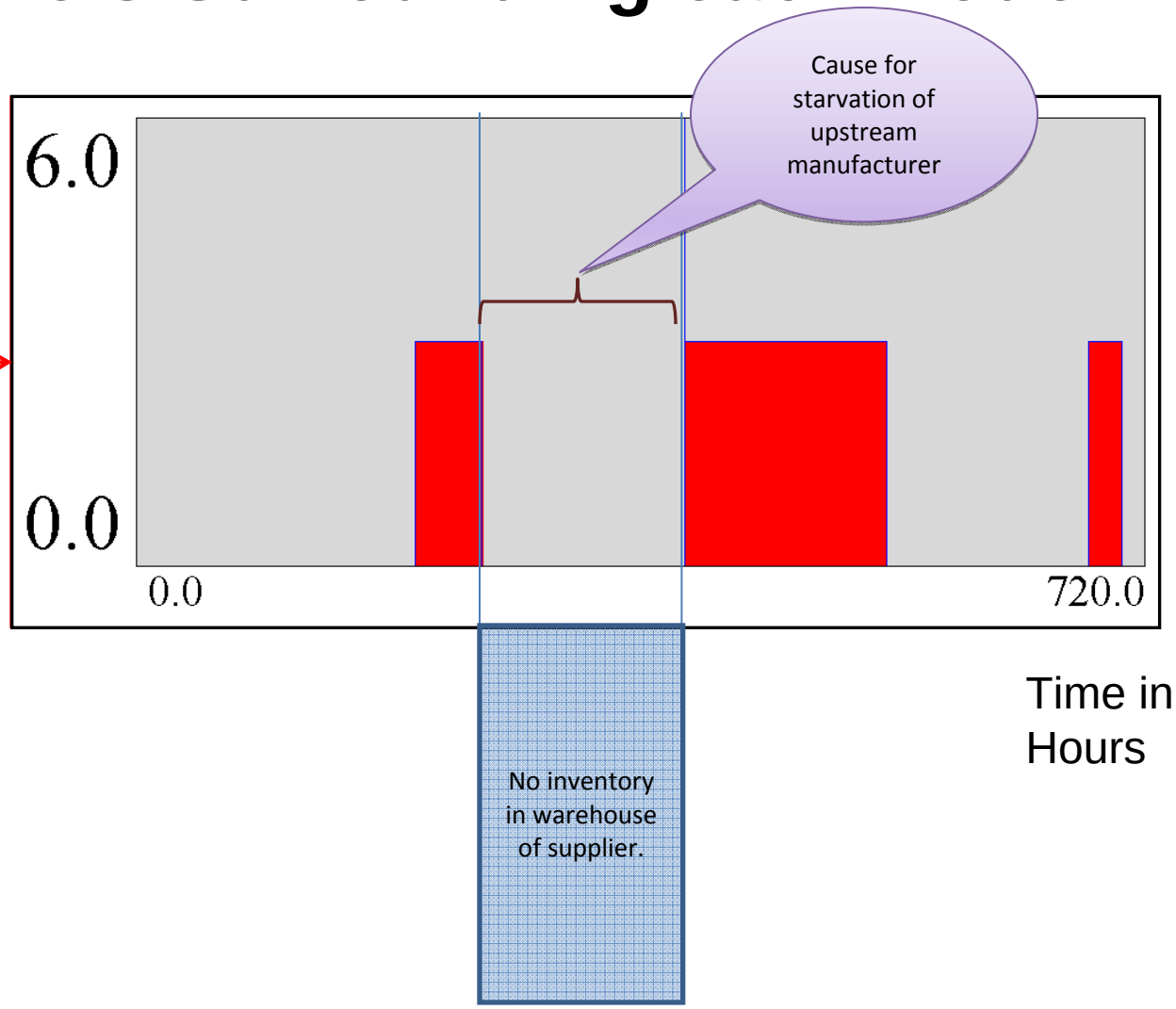
Supply Chain Starvation



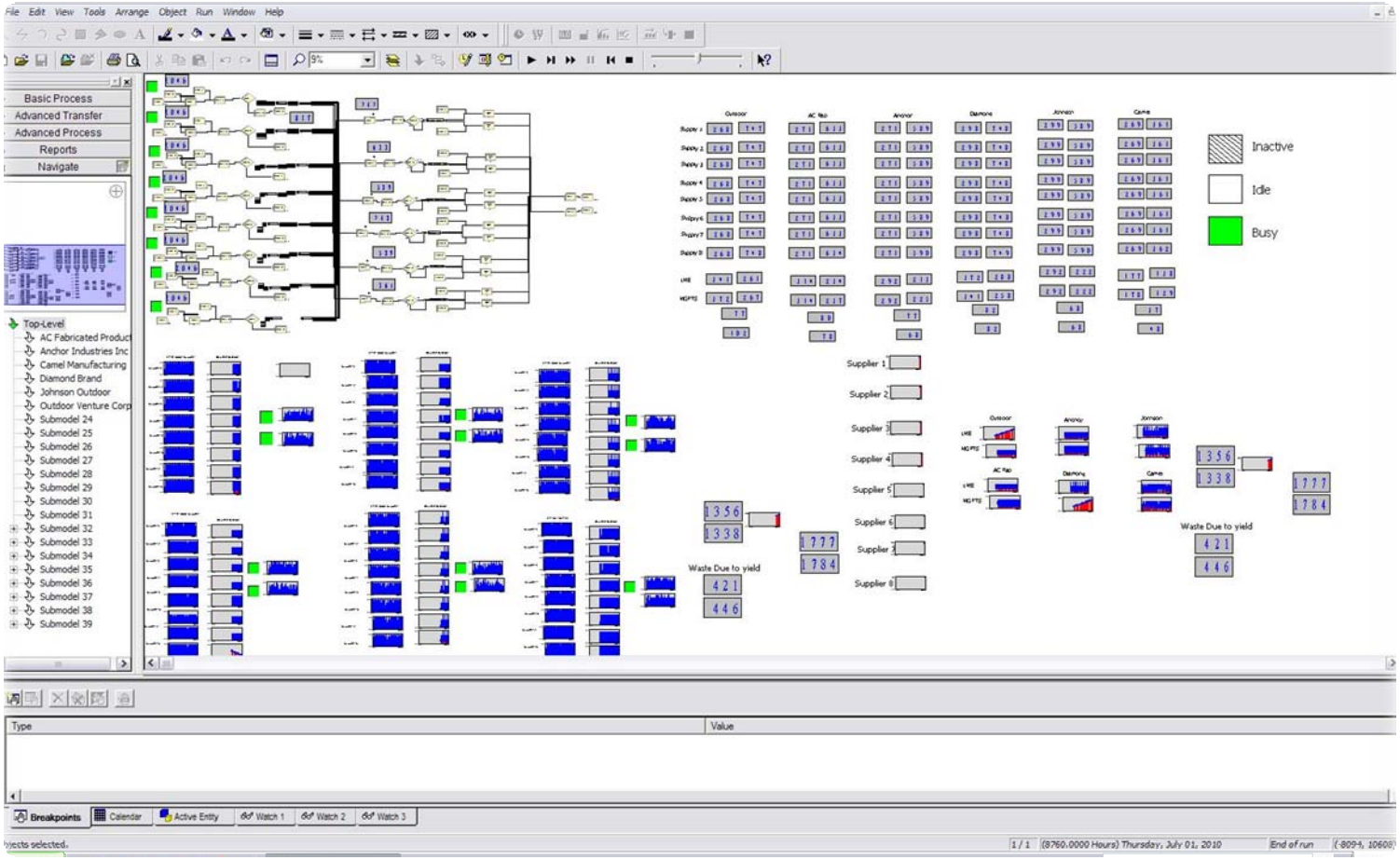


Inventory Levels Surrounding each Node





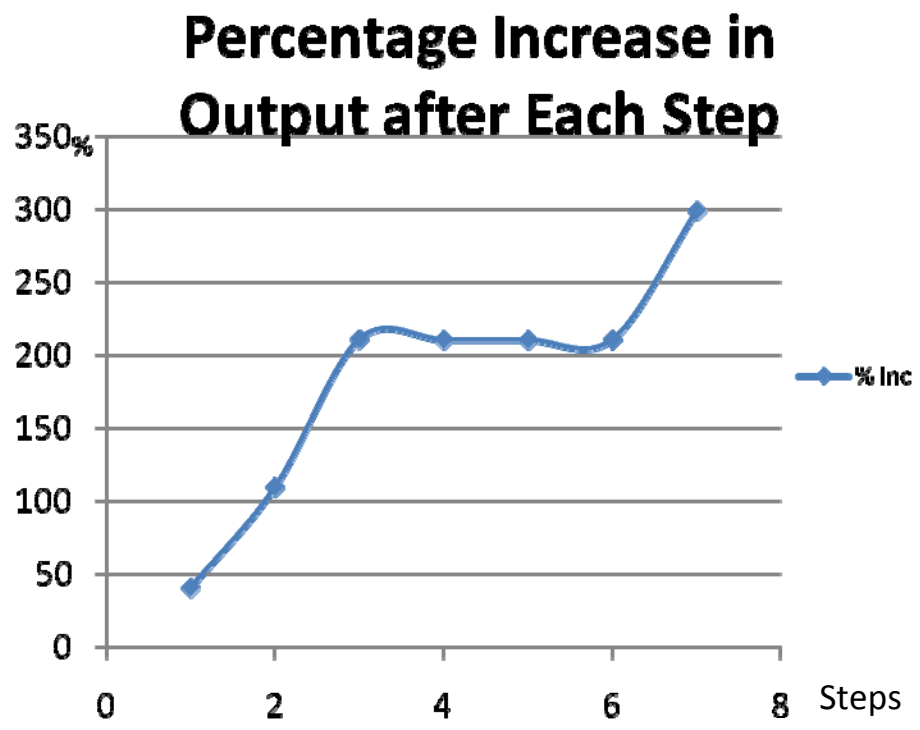
Impact of Automated Buffer Stock Model



Output before buffer stock automation: 912

Output after buffer stock automation: 2694

Percentage Increase : 110%

Identifying Capacity Improvement Opportunities using the Automated Buffer Stock Model

Steps to increase output of Supply Chain	Percentage increase of output of Supply Chain
Step 0 : Base Model : Low Speed Model	0 %
Step 1: Suppliers Work Hours Increased 8 to 12hrs	40.79 %
Step 2: Increased % of Distribution and Activating Buffer Stock Model	195.72 %
Step 7: Increased Work Hours at 2 Manufacturers from 8 to 12 hours and 12 to 24 hours at another Manufacturer	299.01 %