The Management of Logistics in Large Scale Inventory Systems to Support Weapon System Maintenance

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Briefing Overview

- Problem Definition and Scope
- Background
- Challenges
- Solving the problem

Problem Definition

- Classic inventory problems
  - How much to stock?
  - When to order?
  - How much to order?
- Difficult problem without demand data
  - When will the stock location run out of inventory?
- Multiple Consumers, Multiple interrelated maintenance tasks
- No access to planning and production data
- Multiple-criteria optimization problem

Minimize Inventory Management Cost

- Holding Cost
  - Parts
  - Physical Space
  - Stocking Labor
- Penalty Cost
  - Idle workers
  - Delayed tasks
- Order Cost
  - Inventory Review
  - Shipping
  - Receiving
  - Forward Locating

Maximize Performance

- Inventory Bin Fill Rate
- Service Rate
- Inverse Waiting time

Background

- Bench stock inventory
- More than 400,000 stock locations
- More than 100,000 inventory items
- Over 1.8 million transactions over three years
- Multiple weapon systems:F-15, F-16, C-130, C-141, C-5, KC-135, B-1B, B-52, B-2, E-3, E-6A, FA-18, P-3, H-60, AV-8, and others.
- Multiple Sites: OCALC, OOALC, WRALC, JXNADEP, NINADEP, CPNADEP

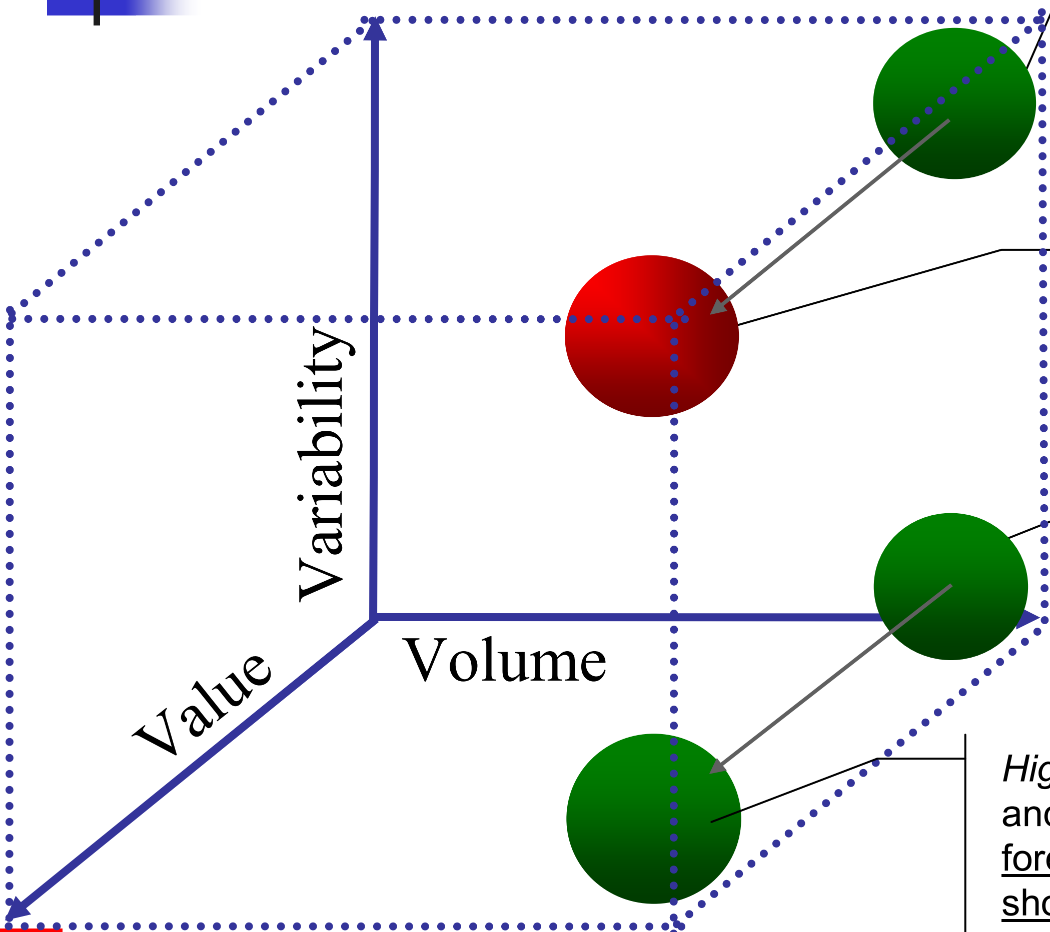
Challenges

- Detecting stock-out conditions
- Forecasting demand
- Identifying inventory policy errors
- Compensating for variability of the maintenance environment
- No access to planning and production data

More Challenges

- Exact item count in inventory location is unknown
- Accurate inventory review is not economically feasible
- Reorder level is an estimate
- Reorder quantity is fixed
- Items removed from the stock locations for direct use

Insights: Inventory Segmentation



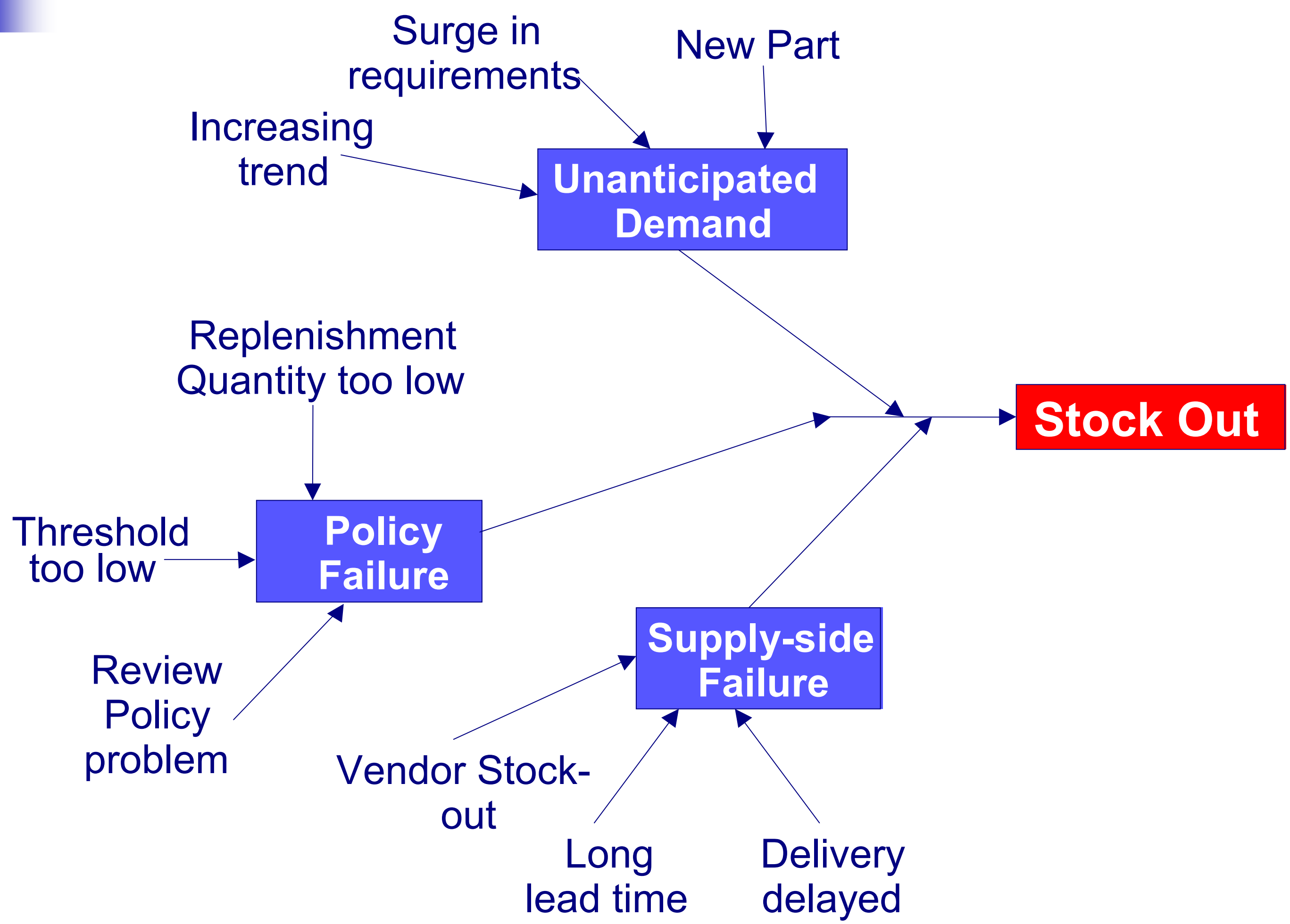
Low value parts with *highly variable* and *high volume* demand can have high reorder thresholds (safety stock) to avoid stockouts without incurring excessive inventory costs.

High value parts with *highly variable* and *high volume* demand would benefit from demand forecasts based on anticipated needs to minimize the value of stock on hand.

Low value parts with *low variability* and *high volume* demand could be "auto-replenished" based on historical demand patterns – lowering inventory review costs.

High value parts with *low variability* and *high volume* demand could be forecasted to assist suppliers, but should be reviewed more frequently to minimize overstock conditions.

Stock Out Triggers

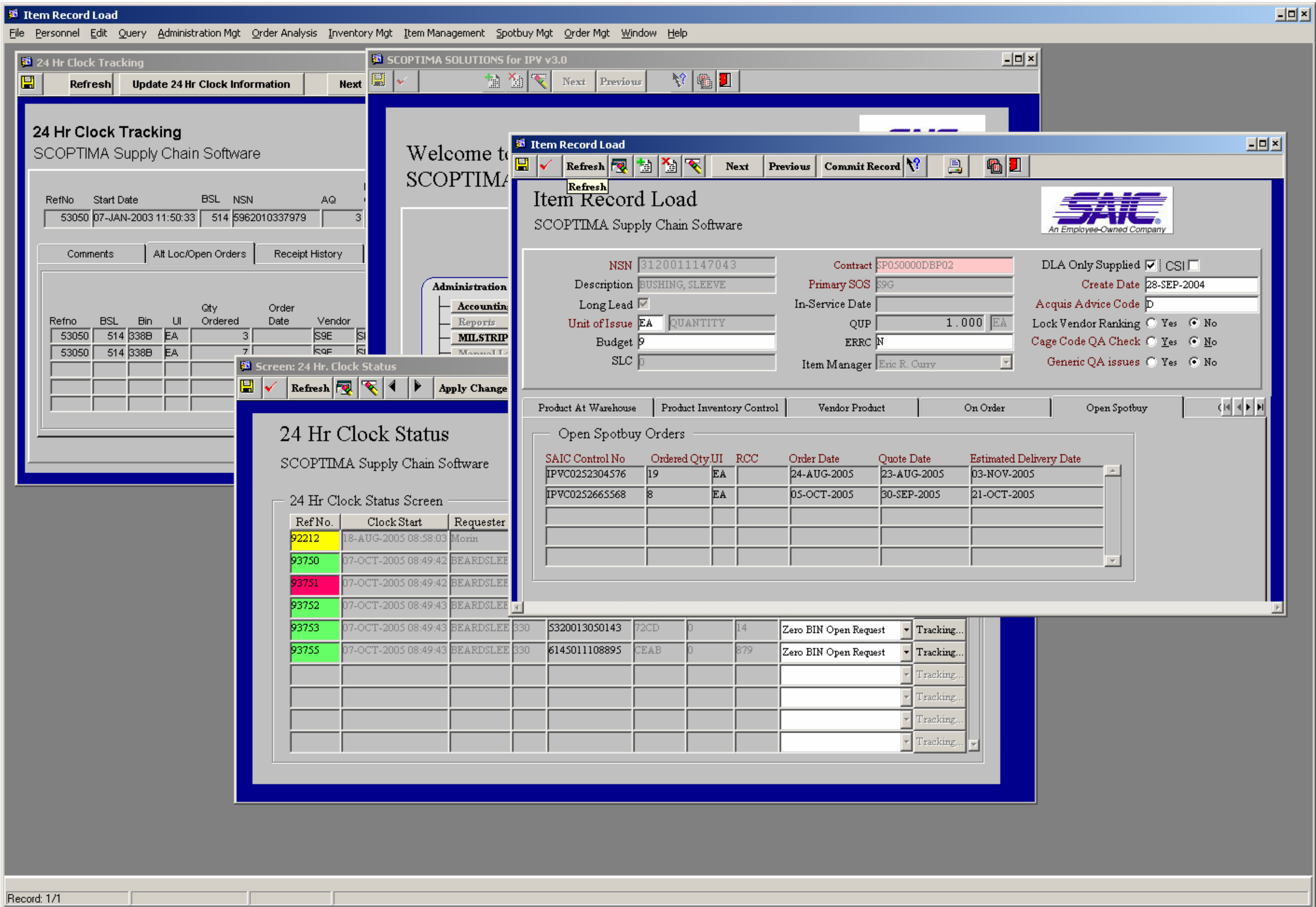


Solving the problem: Daily

- Unmanned Bench Stock Location
  - Material is placed in a bin and mechanic takes what he needs
  - If a bin is empty, inventory manager is notified and generates an emergency PR to Vendor
  - Conduct physical review of each bench stock location twice per week to create routine replenishment
- Emergency Requirements Management
  - Each emergency requirement is tracked from birth to death
- Stock outage Management
  - Intensive management to ensure parts are in the bin
  - Focuses manager on potential problems
- Web based asset visibility
- EDI Ordering and Invoicing

Enterprise Supply Chain System: SCOPTIMA™

- Oracle DBMS with custom user and system interfaces
- User-friendly interface for management queries
- Maintains record of supply chain events
  - Bin scan to generate potential order (hand-held device)
  - Order generation based on rule set (automated)
  - EDI order placement to vendor(s)
  - Order receipt and replenishment (physical inspection and confirmation)
  - EDI invoicing
- Supports analysis to identify historical demand patterns and relationships through simulation and data mining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File Personnel Edit Query Administration Mgt Order Analysis Inventory Mgt Item Management Spotbuy Mgt Order Mgt Window Help
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Refresh
Update 24 Hr Clock Information
Next
24 Hr Clock Tracking
SCOPTIMA Supply Chain Software
RefNo Start Date BSL NSN AQ
53050 07-JAN-2003 11:50:33 514 5962010337979 3
Comments
Alt Loc/Open Orders
Receipt History
Refno BSL Bin UI Qty Ordered Order Date Vendor
53050 514 338B EA 3 S9E
53050 514 338B EA 7 S9E
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Item Record Load
SCOPTIMA Supply Chain Software
An Employee-Owned Company
NSN 3120011147043
Description BUSHING, SLEEVE
Long Lead
Unit of Issue EA QUANTITY
Budget 9
SLC 0
Contract SP050000DBP02
Primary SOS S9G
In-Service Date
QUP 1.000 EA
ERRC N
Item Manager Eric R. Curry
DLA Only Supplied CSI
Create Date 28-SEP-2004
Acquis Advice Code D
Lock Vendor Ranking Yes No
Cage Code QA Check Yes No
Generic QA issues Yes No
Product At Warehouse
Product Inventory Control
Vendor Product
On Order
Open Spotbuy
Open Spotbuy Orders
SAIC Control No Ordered Qty UI RCC Order Date Quote Date Estimated Delivery Date
IPVC0252304576 19 EA 24-AUG-2005 23-AUG-2005 03-NOV-2005
IPVC0252665568 8 EA 05-OCT-2005 30-SEP-2005 21-OCT-2005
Screen: 24 Hr. Clock Status
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24 Hr Clock Status
SCOPTIMA Supply Chain Software
24 Hr Clock Status Screen
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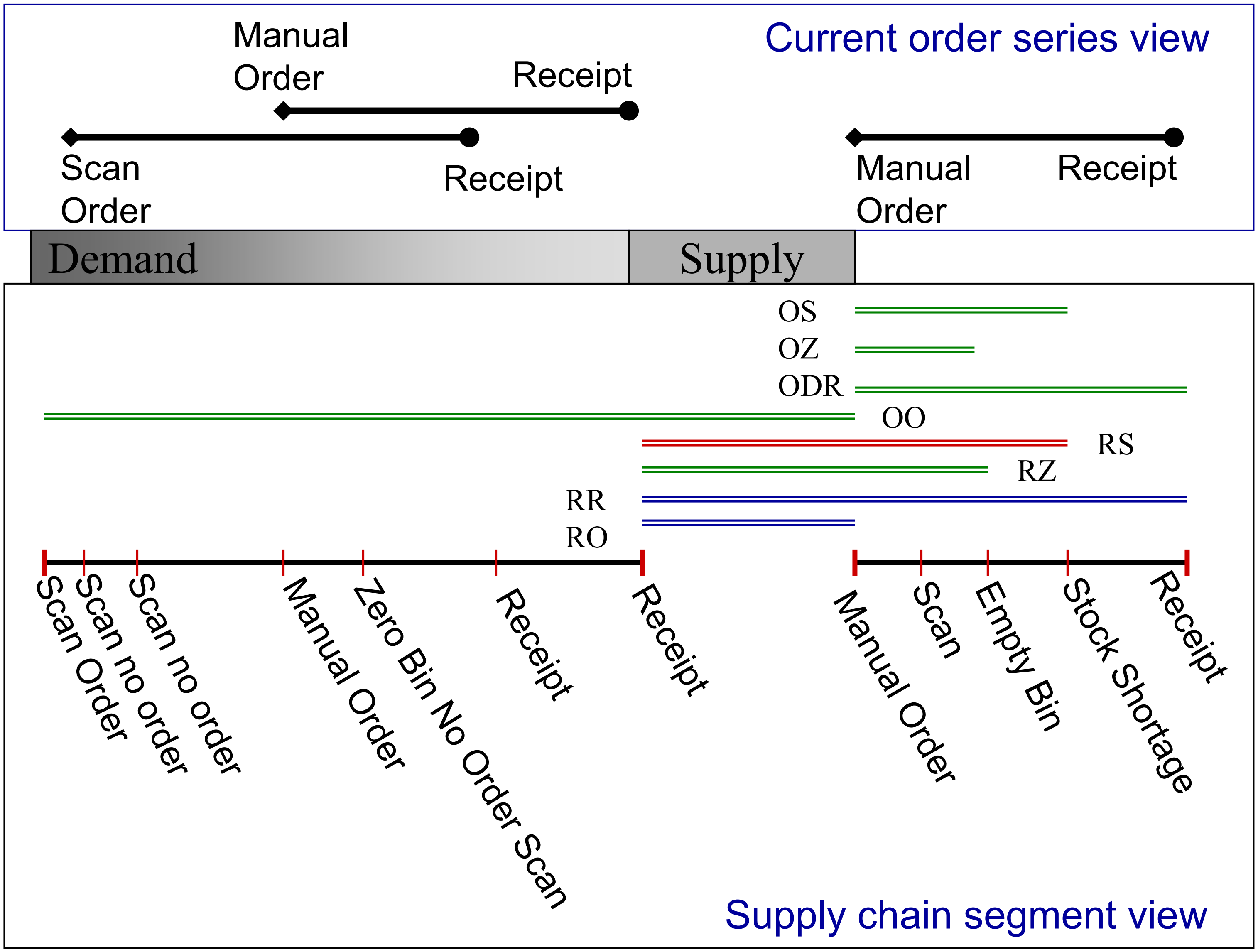
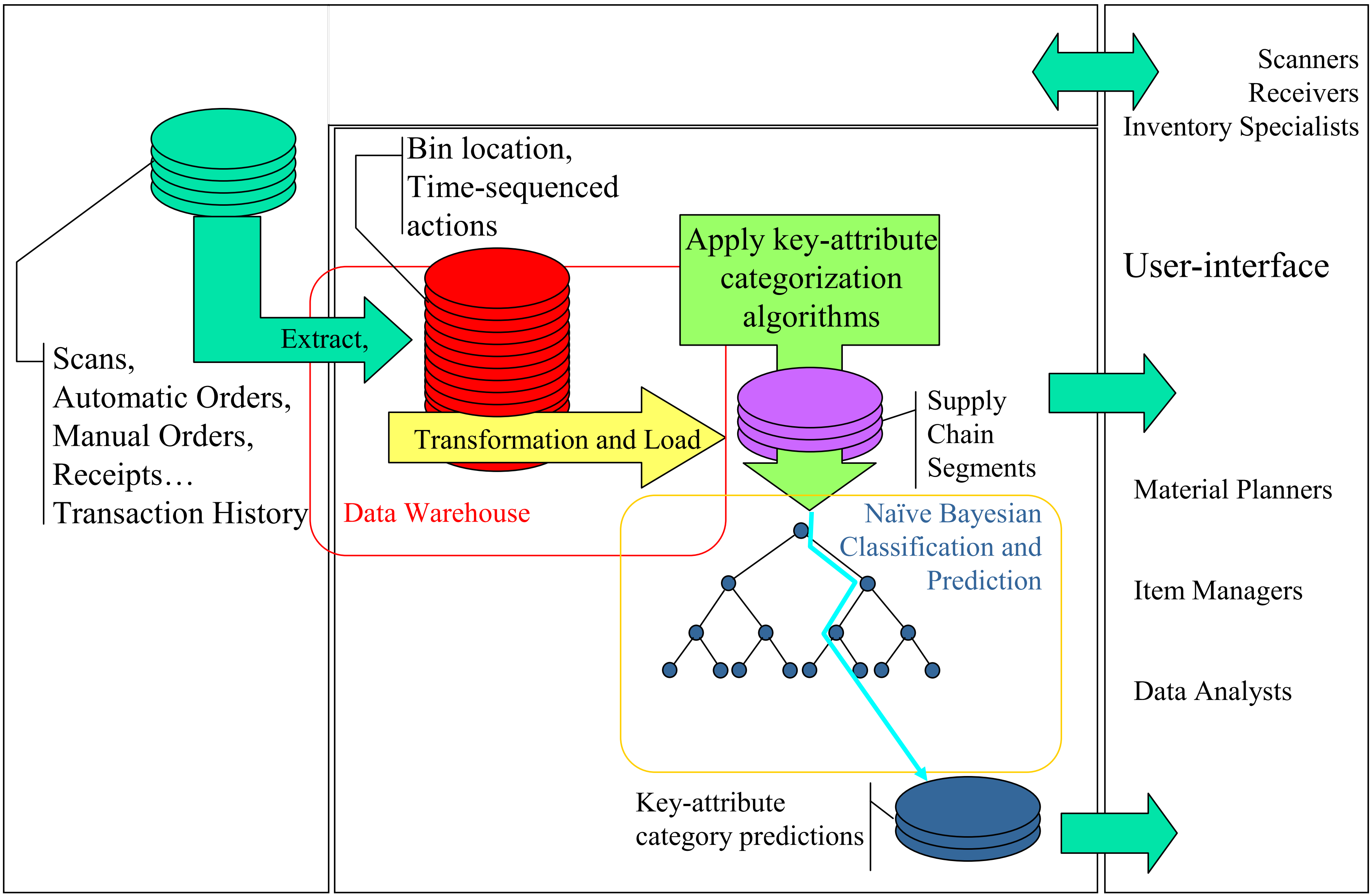
Applying Technology

- Data Warehousing
- Data Mining
- Simulation
- Time-series Forecast modeling
- Dynamic data display

Key Transaction Events



SCOPTIMA™ Data Mining



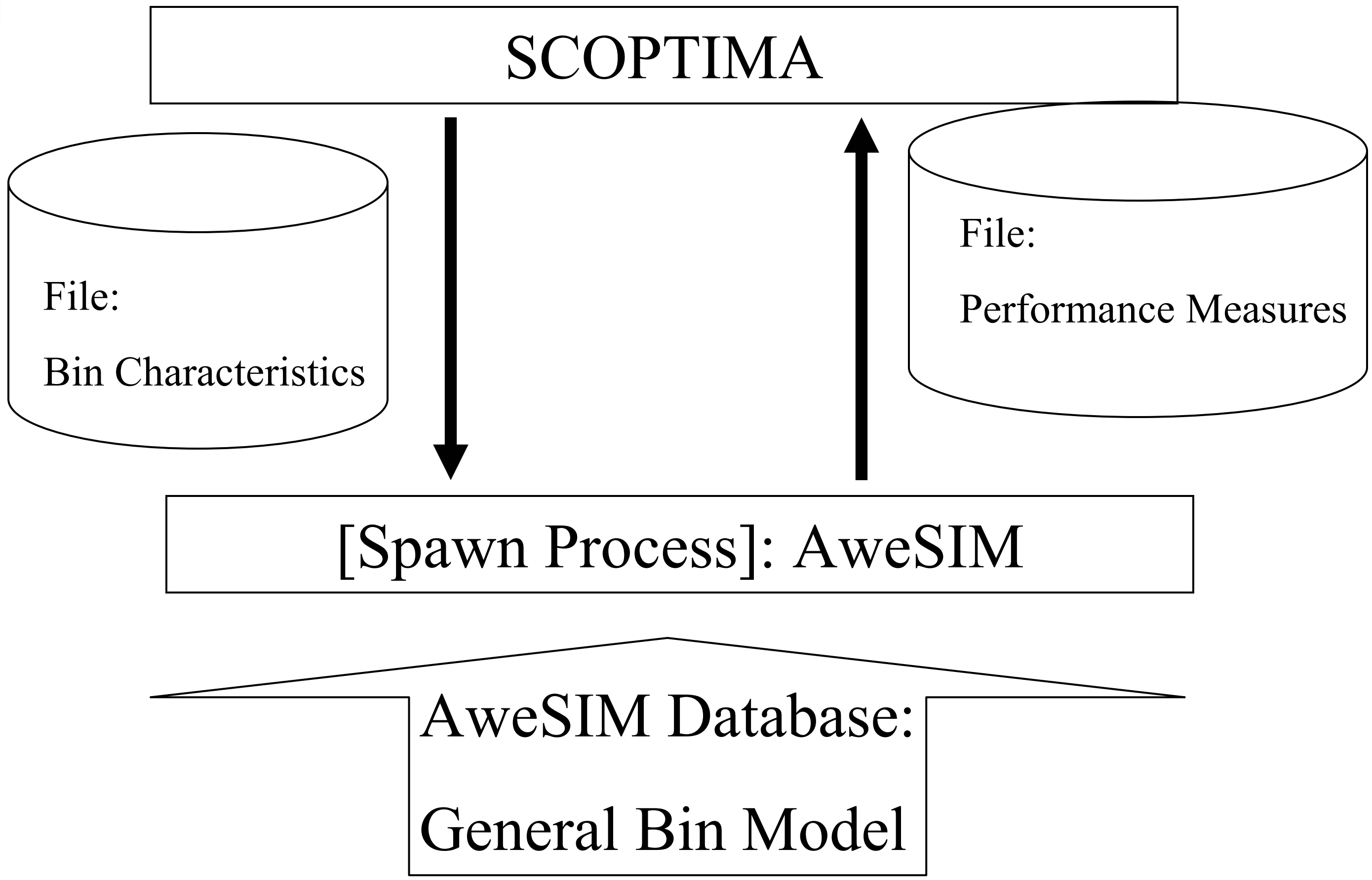
Integration of SLAM and SCOPTIMA™

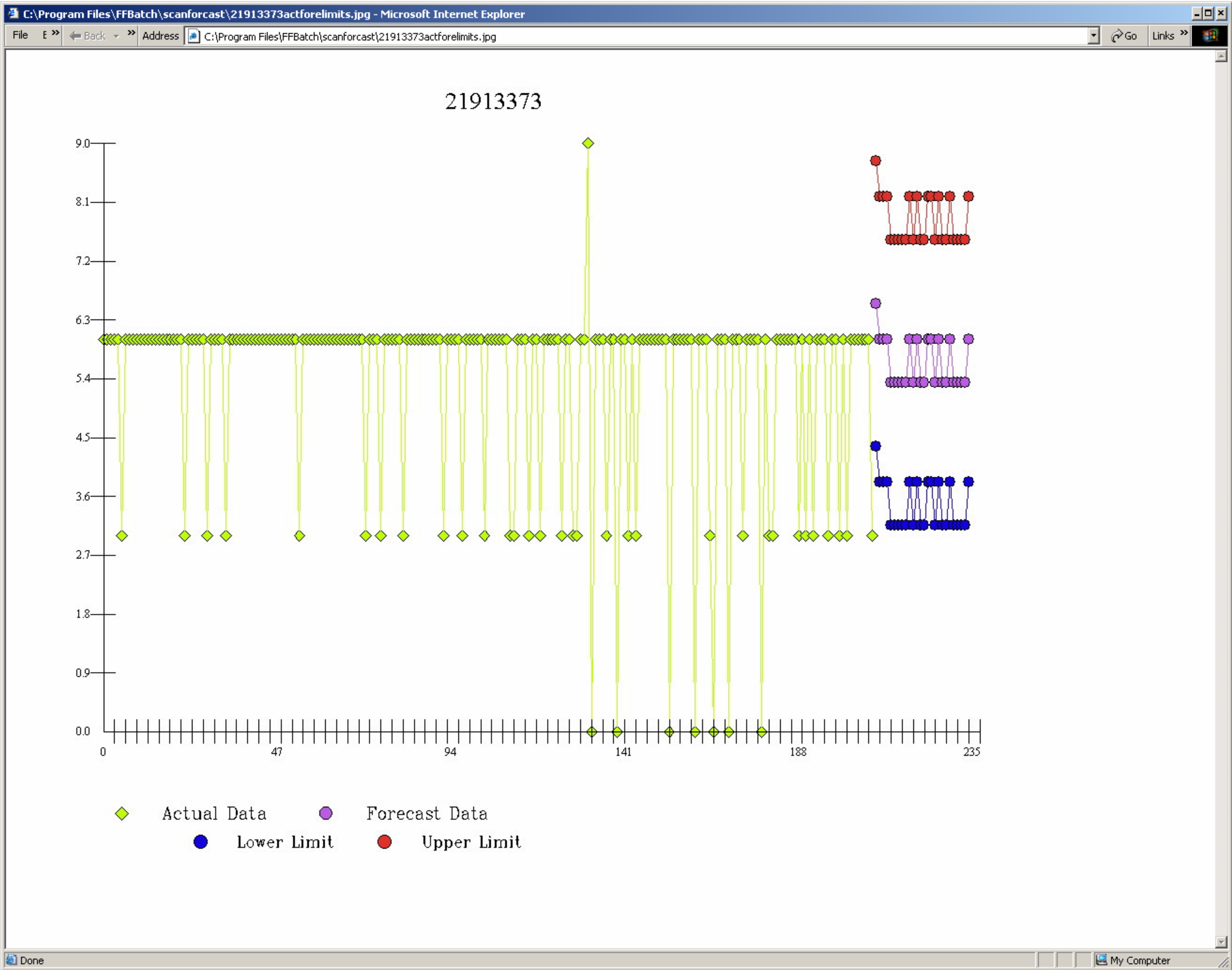
- Automatically run simulation of Bin Q,r strategy to verify results
- Support SCOPTIMA decision making using simulation
  - Verification of Q,r changes when bin agent determines need for change
- "Agent" based approach
- Automated

Integration

- Spawn process from SCOPTIMA to invoke AweSIM model
- Interface via Data Files or Database
- Results returned to SCOPTIMA via Data Files or Database

Architecture

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Go
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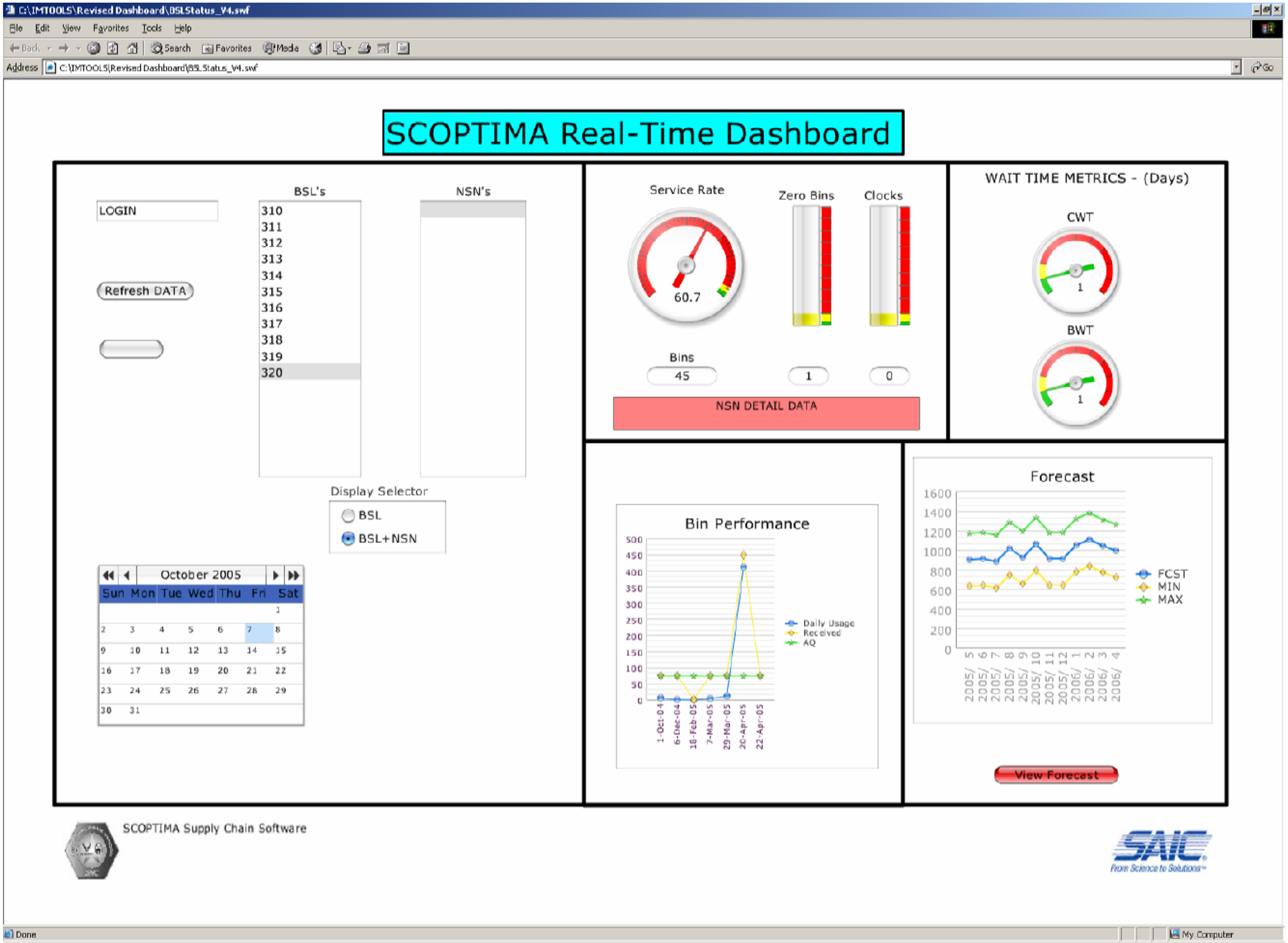
235
Actual Data
Forecast Data
Lower Limit
Upper Limit
Done
My Computer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File Edit View Favorites Tools Help
Address C:\IMTOOLS\Revised Dashboard\BSLStatus_V4.swf
SCOPTIMA Real-Time Dashboard
LOGIN
Refresh DATA
BSL's
310
311
312
313
314
315
316
317
318
319
320
NSN's
Display Selector
BSL
BSL+NSN
October 2005
Sun Mon Tue Wed Thu Fri Sat
Service Rate
60.7
Zero Bins
Clocks
Bins
45
1
0
NSN DETAIL DATA
WAIT TIME METRICS - (Days)
CWT
BWT
Bin Performance
Daily Usage
Received
AQ
Forecast
FCST
MIN
MAX
View Forecast
SCOPTIMA Supply Chain Software
SAIC
From Science to Solutions
Done
My Computer

Conclusion

- Challenging Supply Chain Problems
- Complex inventory model
- Integrated Enterprise System
- Advanced technology solutions

Dr. Hank Grant

Dr. Grant joined the faculty at the University of Oklahoma in December of 1993 as Director of the School of Industrial Engineering and Southwestern Bell Professor. He is currently Director of the Center for the Study of Wireless Electromagnetic Compatibility and Dugan Professor of Industrial Engineering. Prior to joining the University of Oklahoma, he was with the National Science Foundation in Washington, DC, where he directed programs in Production Systems, Engineering Design, and Operations Research. Dr. Grant was instrumental in the startup and development of two Industrial Engineering software companies: Pritsker Corporation and FACTROL. Dr. Grant is a Fellow of the Institute of Industrial Engineers and is a member of the following societies: INFORMS, Tau Beta Pi and The Institute of American Entrepreneurs. Dr. Grant received his Ph.D. from Purdue University in Industrial Engineering in 1980.

Eugene Beardslee

Eugene Beardslee is the software system architect of the Industrial Prime Vendor (IPV) project's enterprise system: SCOPTIMA Supply Chain Software. For the past five years, Mr. Beardslee has managed and directed the design, development, implementation and maintenance of all aspects of this logistics support software. Recipient of the 2003 SAIC Achievement Award for Excellence in Program Performance: Technology Development and Analysis, he has guided three successful Manufacturing Production and Engineering research projects focused on improved inventory and replenishment process performance. Mr. Beardslee has over 18 years experience in the production of software systems with over 12 years designing Oracle software systems. He is a member of the IEEE Computer Society, the Association for Computing Machinery and the Institute of Industrial Engineers. Mr. Beardslee received his Bachelor of Science degree in Computer Science in 1988, and his Master of Arts in Computer Resources and Information Management in 1997.