Supply chain tactical planning and OM research

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Intent and Overview

• What do I mean by tactical planning for supply chains?
• How is this done in practice?
• Where has OM research provided some value?
• What’s required to have some impact?
• Where else might OM research provide some value?
Supply Chain Tactical Planning

• Tactical planning entails:
  – Countermeasures for variability and uncertainty
  – Tactics for managing economies of scale in supply, production and distribution

• For given design decisions and accounting for system constraints and inflexibilities

• Often synonymous with mid-term planning
Examples of tactical decisions

• Strategic safety stock placement
• Review intervals & replenishment frequencies
• Demand management, e.g., customer service times, order acceptance, ….
• Master production scheduling, e.g., smoothing
• Planned lead times
• Capacity buffers & dynamic capacity planning
Observations on practice

• MRP framework remains pervasive because of software and the inherent appeal of the underlying model
• The MRP model assumes a deterministic world, driven by a demand forecast
• The MRP model relies on MPS function and on planned lead times to simplify and decompose the planning problem
Observations on practice

• Limited accommodations for uncertainty:
  – Re-planning, with time fences and frozen schedules
  – Safety stocks – primarily for FGs and RMIs
  – Inflated planned lead times → create a hidden safety stock in form of WIP
Observations on practice

- Advent of APSs has provided capability to incorporate constraints and optimize economies of scale – largely at MPS level.
- APS also provide useful input to demand management issues, e.g., order acceptance, delivery date quotation, etc.
Where has OM research provided some value?

• Limited impact on architecture of APSs and on the engines for APS modules
  – Hierarchical planning (Hax Meal, 1975)
  – OR algorithms for large-scale MIPs
  – Proprietary heuristics for bottleneck identification and scheduling
Where has OM research provided some value?

• Much more impact on setting safety stocks across supply chain

• Published research-based applications
  – Deere, Caterpillar
  – HP, Kodak
  – Philips
  – IBM

• Commercialization of research into software by Optiant, SmartOps, LogicTools
KIMES 100
Supply Chain: Before

<table>
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<th>Safety Stock Cost</th>
<th>$131,962.24</th>
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<tr>
<td>Pipeline Stock Cost</td>
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Currently Displayed: Icon View

NOT OPTIMIZED
Supply Chain: Lead Times

[Diagram showing the flow of components and processes with lead times associated with each step.]
Supply Chain: Costs
Supply Chain: Optimized

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<tr>
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*** OPTIMIZED ***

Diagram showing the flow of components and processes in a supply chain.
Supply Chain: Implemented
Supply-Chain
History of Effort

• 1994 – 1996
  – Problem definition stage; summers on-site at Kodak
  – Development of model and software for solving assembly and distribution networks
  – Produce a master’s thesis
  – Transfer model to Kodak for testing
History of Effort

• 1997 – 1999
  – LFM interns apply model at HP, Kodak, ALCOA
  – CTS project with Lucent
  – Continued knowledge transfer with Kodak
  – Develop version 2.0 of model and software; solve spanning tree networks; implemented on PC
  – Model and software used in supply chain electives
  – PhD thesis on supply chain configuration
History of Effort

• 2000 – present -- commercialization
  – HP San Diego interested in “industrial strength” version
  – Ruark and Willems enter MIT $50K and co-found Optiant
  – Continual enhancements to both UI and algorithms to meet industry needs
  – HP and Optiant participate in 2003 Edelman competition.
History of Effort

• 2000 – present -- academic
  – Publication of core model – MSOM, 2000
  – Research on extensions & enhancements
    • General networks (Humair, Willems)
    • Non stationary demand (Graves Willems)
    • General review periods (Bossert Willems)
    • Configuration decisions (Graves Willems)
  – Ongoing work to incorporate forecast evolution model; contracting considerations; capacity
Learnings from Experience

- Value from simple, applicable tools that satisfy a need and support tactical decisions
- Importance of software platform to deliver the model
- Virtuous cycle between industry application, research and education
- Research requires investment and patience, as well as significant in-kind contribution from partner companies
- Collaboration informs teaching and research
Challenges from Applied Research

• Managing expectations and risks – what can be delivered and in what time frame?
• Pick partners carefully; e.g., find company innovators who can navigate through the bumps and set-backs in the implementation and testing processes
• Meeting traditional academic requirements for outputs
• Need to combine OR with computer implementation expertise
Where else might OM research provide some value?

• Decision support for “other” tactics
  – How to set planned lead times?
  – Where to locate and how to size capacity buffers?
  – How to plan capacity for demand upside, e.g., capacity reservations and options, dual sourcing, etc?
  – How to manage order backlog and smooth MPS
Where else might OM research provide some value?

• Decision support for contracting with supply partners
  – How to coordinate tactics between manufacturer and supplier – e.g., safety stocks, capacity buffers, time fences?
  – How to assure consistency and alignment across supply contracts?
  – How to determine amount of visibility to provide to supply base?
Wrap Up:
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