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Advanced Planning and Scheduling

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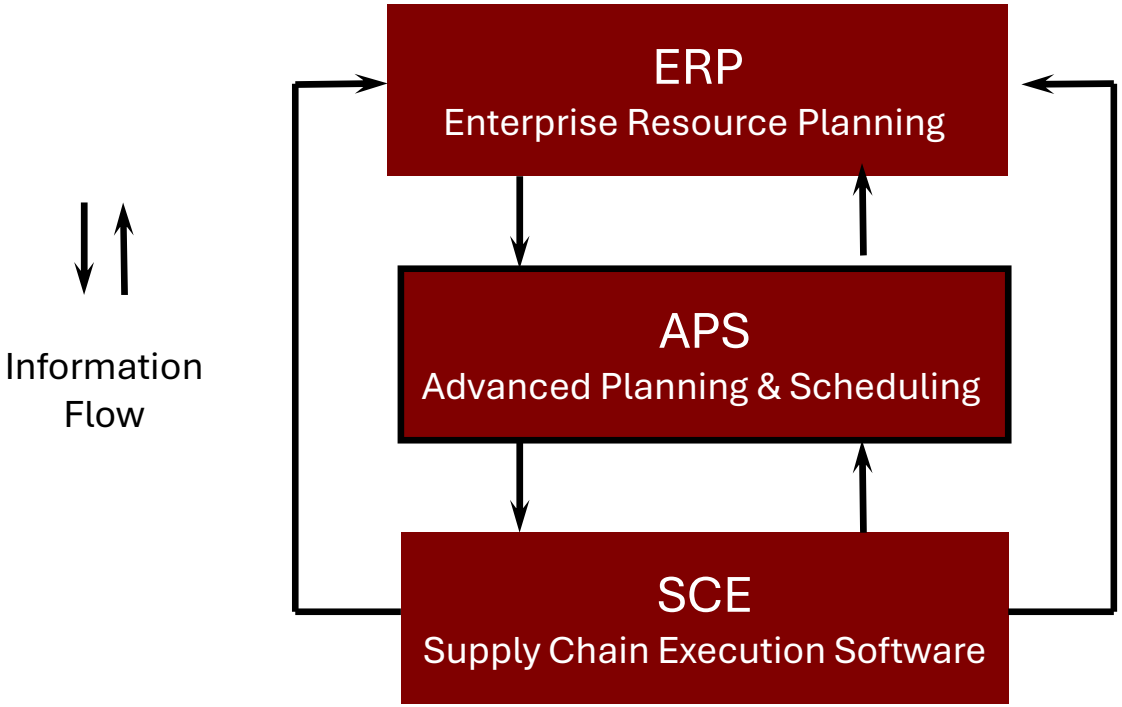
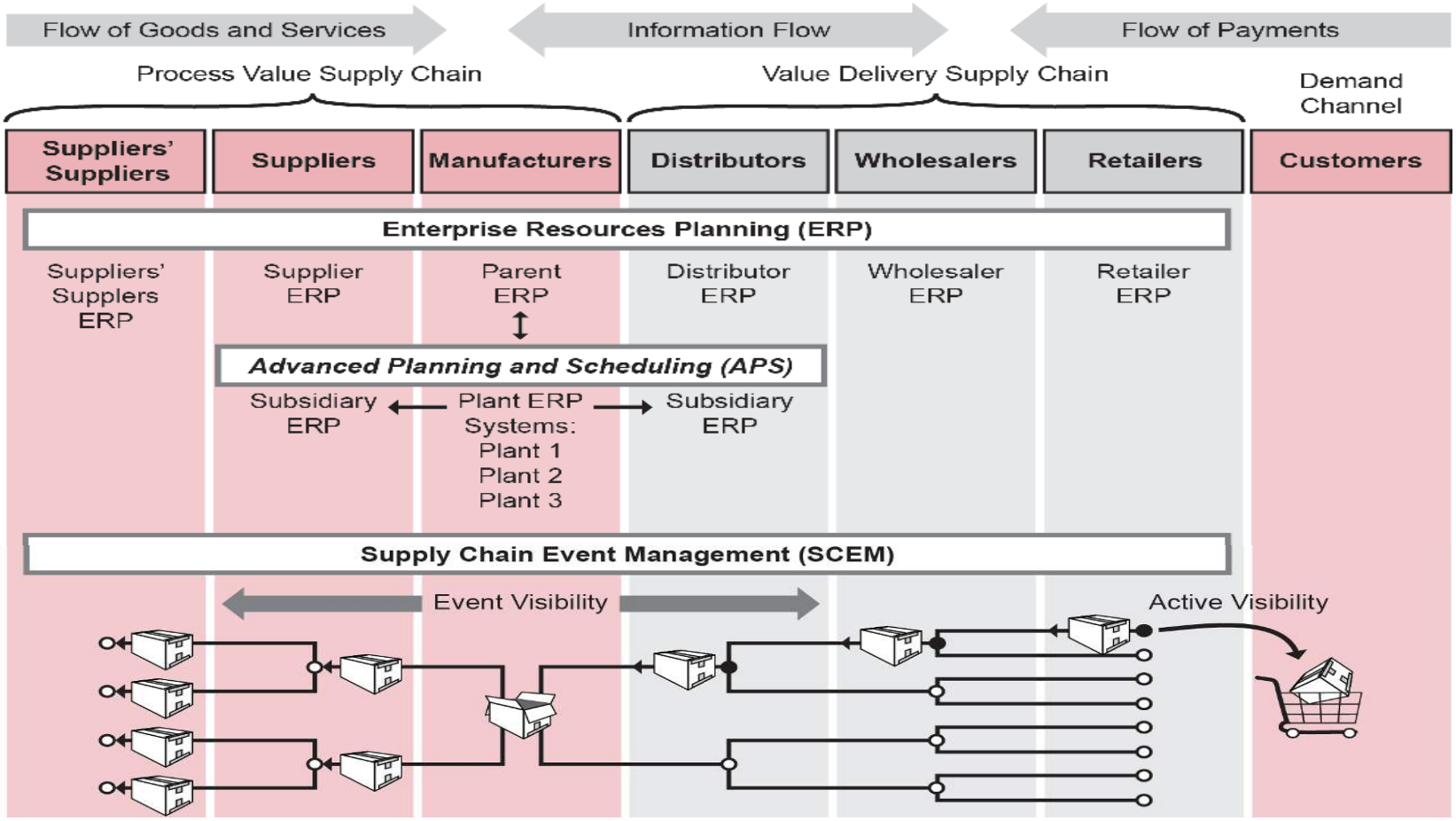
1. Terminology

- Supply Chain Management Software
  - Supply Chain Planning Software (SCP):
    - model building and planner support in manufacturing and distribution
  - Supply Chain Execution Software (SCE):
    - warehouse management
    - transportation management
    - inventory management
  - APS is part of the SCP software

1. Terminology



Comprehensive SC Management System (Extended ERP)



Comprehensive SC Management System (Extended ERP)

Advanced Planning and Scheduling (APS) is a software-driven approach and management process used in manufacturing and supply chains to optimize production and logistics by balancing resources, demand, and constraints. It uses advanced algorithms to create detailed, real-time schedules, improving efficiency, reducing lead times, and helping companies adapt to disruptions by making data-driven decisions instead of relying on manual methods like spreadsheets.

Supply chain event management (SCEM) is the process of monitoring and managing supply chain events in real-time to respond quickly to disruptions and delays. It involves using integrated software to monitor activities, notify relevant parties of exceptions, simulate different scenarios, control processes, and measure performance. The goal is to provide proactive visibility so companies can mitigate potential problems before they become major issues.

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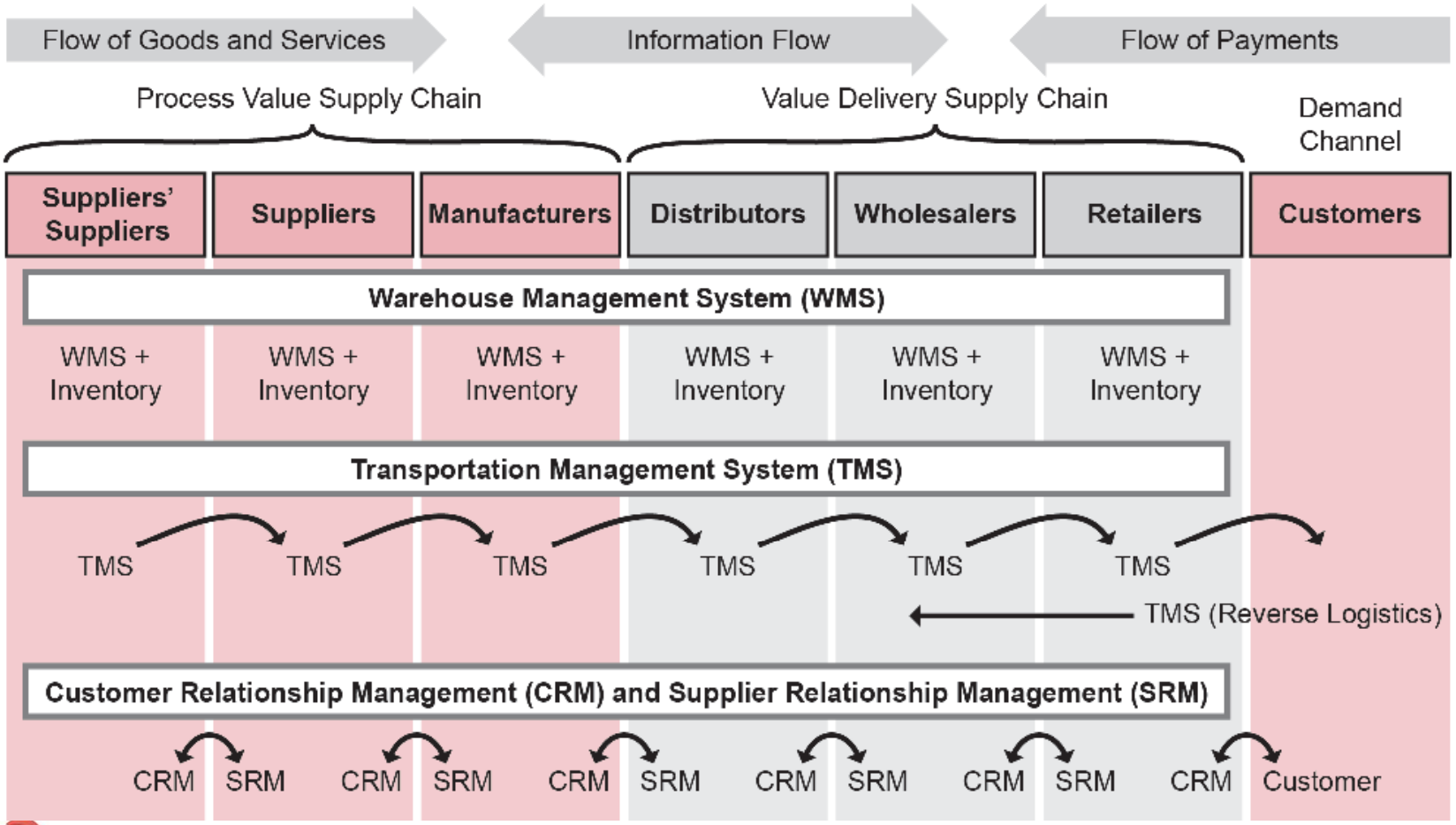
Topic 1: Supply Chain Technology Applications

Comprehensive SC Management System (continued)



2. Definitions

- Planning
  - term: weeks or months in advance
  - deals with aggregate data of demand and capacity
  - balances the load and capacities of different resources over time
- Scheduling
  - term: hours or days in advance
  - deals with individual jobs and tasks, specific tools and capabilities
  - generates assignments of specific tasks to specific tools at specific times

3. What has to be planned (1)

- Strategic level
  - location, size and number of plants, distribution centers and suppliers (= basic structure of the supply chain)
  - sourcing and deployment plans for each plant, each distribution center and each customer
  - flow of goods through the network

3. What has to be planned (2)

- Tactical level
  - sales and operations planning
  - manufacturing planning
  - distribution planning
  - aggregated product groups are used

3. What has to be planned (3)

- Operational level
  - scheduling is done on a plant-by-plant basis
    - production scheduling
    - warehouse scheduling
    - transportation scheduling

4. Evolution in planning

- Tools and Techniques
  - manual planning boards
  - spreadsheets
  - MRP/ERP based systems
  - Advanced Planning and Scheduling systems
    - finite capacity
    - constraint management

4. Evolution in planning

- Spreadsheet based systems
  - spreadsheets are bespoke
  - become very difficult to extend and maintain
  - can usually only be maintained by their authors
  - no validation: data entry and changes to plans are very error prone

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4. Evolution in planning

- MRP
  - calculates component requirements based on the Master Production Schedule (MPS), Bill of Material and inventory data
  - determines batch sizes for purchasing and manufacturing to meet customer demand
  - assesses whether work should be rescheduled in order to smooth out any peaks in capacity utilization (CRP)

4. Evolution in planning

- MRPII
  - MRP II systems share information with other functional departments, outside the operations area (i.e., purchasing, sales, cost accounting).
  - includes the allocation of production equipment and labor

4. Evolution in planning

- ERP
  - an ERP-system is a packaged business software system that enables a company to
    - automate and integrate the majority of its transaction-oriented business processes
    - share common data and practices across the entire enterprise
    - to produce and access information in a real-time environment
  - MRP is the planning engine

4. Evolution in planning

- Planning limitations of MRP/ERP based systems
  - assume infinite materials and resource (equipment and labor) capacity
  - plans and schedules are calculated using simple lead time assumptions
  - it is a top-down, one-pass, sequential process
  - the cycle MPS/MRP/CRP must be repeated several times if necessary
  - MRP is a batch process that takes hours to complete
  - feasibility of the plan is only tested during scheduling after the MRP run
  - focus is on calculation and transaction processing (no what-if simulation and no decision support)

5. Current trends

- Commercial pressures are getting stronger: customers are demanding
  - faster response
  - precise delivery dates
- Product variety increases
- Rate of new product introduction increases

Business demands a more precise plant resource management technology: APS

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6. Steps to APS

- APS is the result of a convergence of
  - new technology
  - evolving management theory
  - application of mathematical techniques from other disciplines

6. Steps to APS

- 1st step: Finite Capacity Scheduling (FCS)
  - FCS compensates for the “infinite loading” assumption inherent in MRP
  - MRP produces work orders, and the FCS system fits the jobs into its existing capacity
  - material and capacity are planned simultaneously rather than sequentially, insuring that the resulting plan is within resource availability as meeting material requirements

6. Steps to APS

- 2nd step: Memory-Resident Fast Planning
  - a technological rather than a conceptual advancement
  - conventional MRP logic is employed, but the processing speed and abundant memory of modern computers are exploited to accomplish the planning process in a few minutes rather than many hours
  - simulation (what-if analysis) is possible

6. Steps to APS

- 3rd step: Advanced Planning and Scheduling (APS)
  - combines the finite capacity approach and memory-resident fast planning
  - determines a plan that meets all demand needs and supply limitations (feasible plan)
  - optimizes the plan, based on mathematical modeling techniques
  - recommends a best overall solution that considers both material and resource availability

7. APS key features

- Constraint management
- Concurrent planning
- Synchronized planning
- Modeling
- Optimization
- Simulation
- Available-to-promise capability
- Capable-to-promise capability

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7. APS key features

- Constraint management
  - defining manufacturing limitations (bottlenecks)
  - modeling the key capabilities and constraints of all the resources, processes and materials
  - developing plans that are within those constraints

7. APS key features

- Concurrent planning
  - simultaneous development of
    - demand planning
    - manufacturing planning
    - distribution planning
    - procurement planning

7. APS key features

- Synchronized planning
  - changes to one planning process are automatically reflected in all planning processes and in all planning levels

7. APS key features

- Modeling
  - representation of the structure of the supply chain (network model)
  - level of detail must be appropriate for the planning level
    - strategic
    - tactical
    - operational

7. APS key features

- Modeling Components
  - user interface
  - data input
  - data management utilities
  - model generation program

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7. APS key features

- Optimization
  - solving the generated model by minimizing total supply chain costs or maximizing total supply chain net revenues
  - based on
    - mathematical algorithms (linear or mixed integer programming)
    - constrained models to reduce the number of possible combinations
    - rule based optimization (expert systems)
    - genetic algorithms

7. APS key features

- Simulation
  - a way to quickly analyze the implication of alternative decisions

7. APS key features

- Available to Promise (ATP) capability
  - the capability to check either
    - the true delivery date or
    - the impact of a requested delivery date on the whole plan

    for a new or proposed customer order

8. APS advanced features

- Capable-to-promise (CTP)
- Real-time planning
- Collaborative planning between supply chain partners

8. APS advanced features

- Capable-to-promise (CTP)
  - extends ATP by taking into account capacity information
  - considers availability of both materials and capacity, giving a more realistic picture of whether demand can be satisfied

8. APS advanced features

- Real-time planning and execution
  - computers get more powerful
  - planning cycles can be shortened
  - plans and schedules can be tailored in real-time to meet specific business goals

8. APS advanced features

- Collaborative planning
  - customers enter and review forecasts
  - suppliers share production capacity

9. APS benefits

- Improved
  - resource utilization
  - customer service levels
  - communication throughout the supply chain
  - relationships with key customers and suppliers
- Reduced
  - operating costs
  - cycle time
  - inventory
- Increased
  - throughput

10. APS selection

- APS types can be described in terms of
  - the supply chain structure (network model)
    - sourcing-centric (ex. Car manufacturers)
    - manufacturing-centric (ex. Industrial equipment)
    - distribution-centric (ex. Consumer electronics)
  - the level of the planning process
    - strategic
    - tactical
    - operational

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10. APS selection

- 2 approaches
  - all-in-one package (APS included in ERP/MRP)
    - many compromises are made
  - add-on
    - the system can be custom tailored to the unique needs of your individual company

10. APS selection

- Current strategies of ERP vendors
  - forming alliances with APS vendors
  - acquiring APS developers and integrating the systems together
  - developing their own APS capabilities

10. APS selection

- Key points to consider

  - relevancy of system to your needs and industry
  - modeling capabilities
  - customization possibilities
  - optimization capabilities
  - possibility to change a plan/schedule
  - ability to define and incorporate new product and processes, and how easy this can be done
  - integration with ERP/MRP systems
  - real-time responsiveness
  - supplier’s experience

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11. APS implementation

- ERP/MRP and APS: which should be implemented first?
  - Accurate input data is a critical factor: an ERP/MRP system supplies the basic data infrastructure for APS
  - ERP and APS are complementary
  - Required data:
    - customer due dates
    - BOM
    - routings
    - work center definitions (process time, set-up time, practical capacity)
-

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11. APS implementation

- Is the company ready for implementing APS?
  - APS requires substantial changes
  - companies must be prepared to change supply chain management processes, and train the people who will use the technology

11. APS implementation

- Implementation steps
  - check for accurate input data
  - build a model for your business without constraints
  - check the model
  - add practical constraints a few at a time
  - build a realistic model with realistic constraints
  - implement the APS system

12. Future APS systems

- Internet-based communication with external suppliers and customers
- Optimization across the extended supply chain
- Information sharing via the Internet
  - supplier resources and capacity
  - demand forecasts
  - production schedules