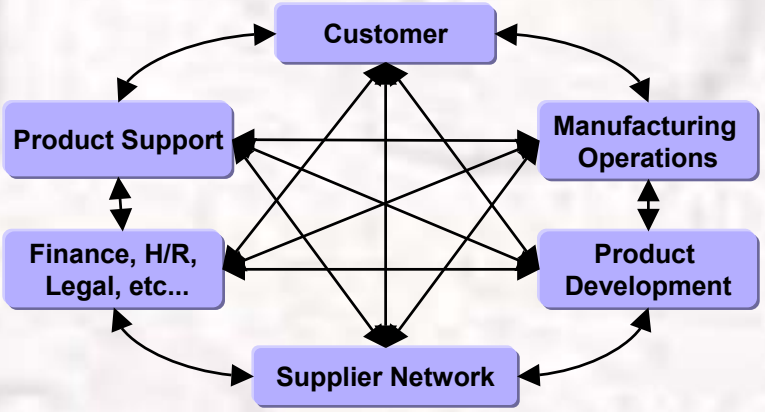
Role of Information Technology in the Lean Enterprise

Professor Debbie Nightingale

October 2, 2002

Integrated Enterprise



- Organization
- Processes
- Technology
- INFORMATION

Information is a Key Enabler!

Learning Objectives

- Enterprise Resource Planning
- Product Data Management
- IT as Enabler for Collaborative Business Models
- Enterprise IT issues

Manufacturing Resources Planning (MRP II) Definition

Manufacturing Resources Planning

A method for the effective planning of all resources of a manufacturing company.

Includes: Business Planning

Sales & Operations Planning

Production Planning

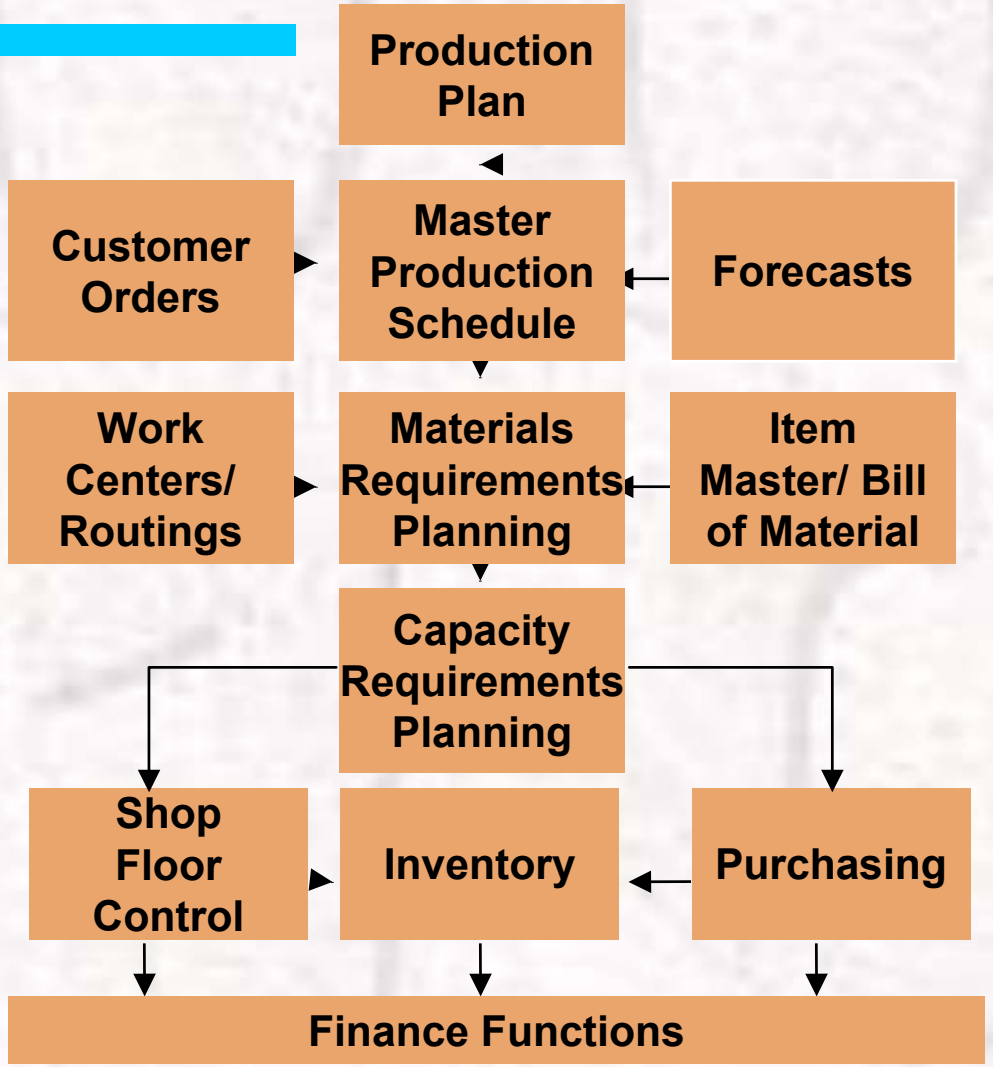
MPS/MRP/CRP

Execution Support for Resources and Material

All integrated with Finance

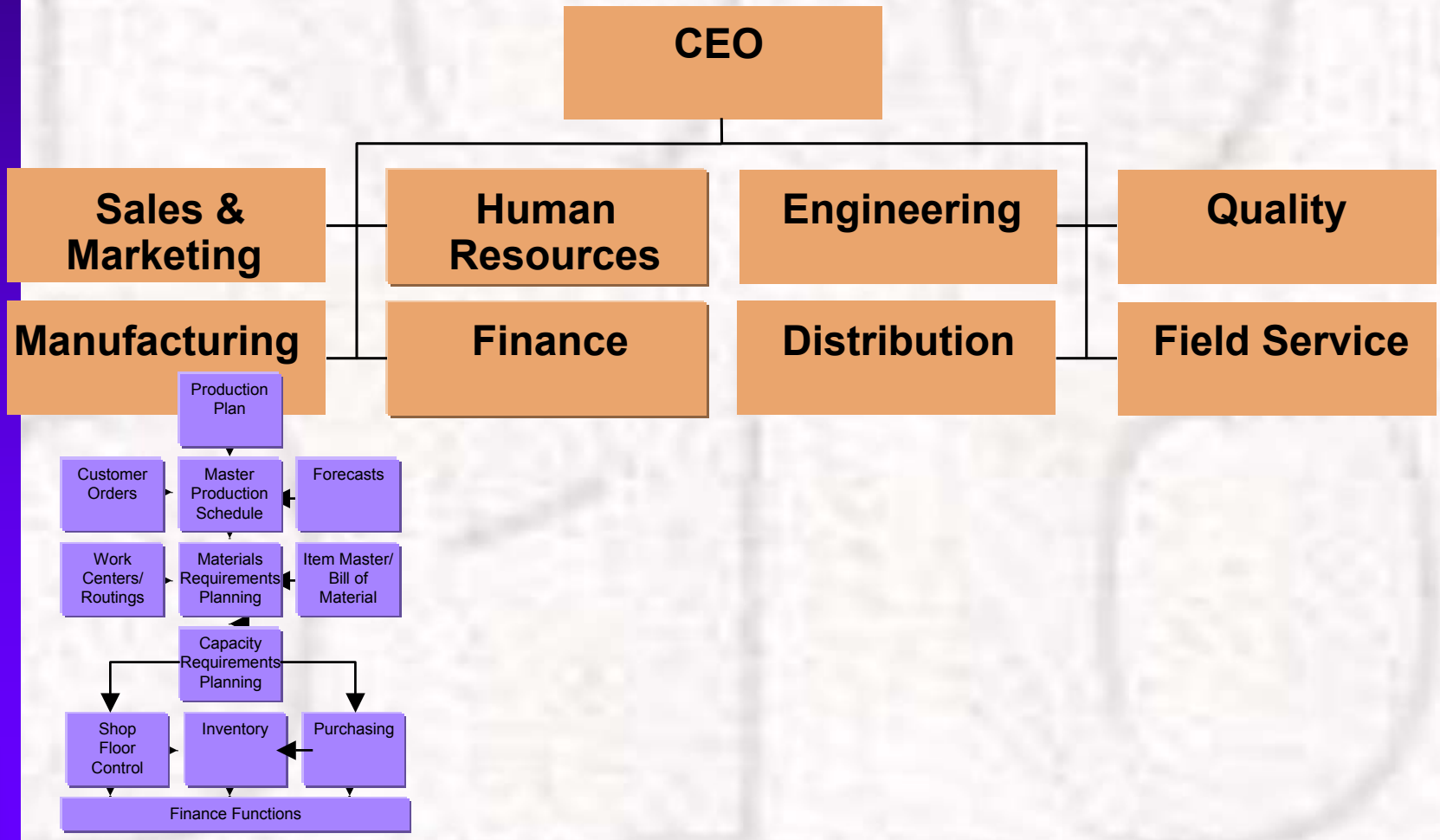
Source: APICS Dictionary

Typical MRP II Diagram



Source: T. Shaw

Typical Organization Chart vs. MRP II



Enterprise Resources Planning (ERP) Definition[1]

Enterprise Resources Planning

A method for the effective planning and controlling of ALL these sources needed to take, make, ship and account for customer orders in a manufacturing, distribution or service company.

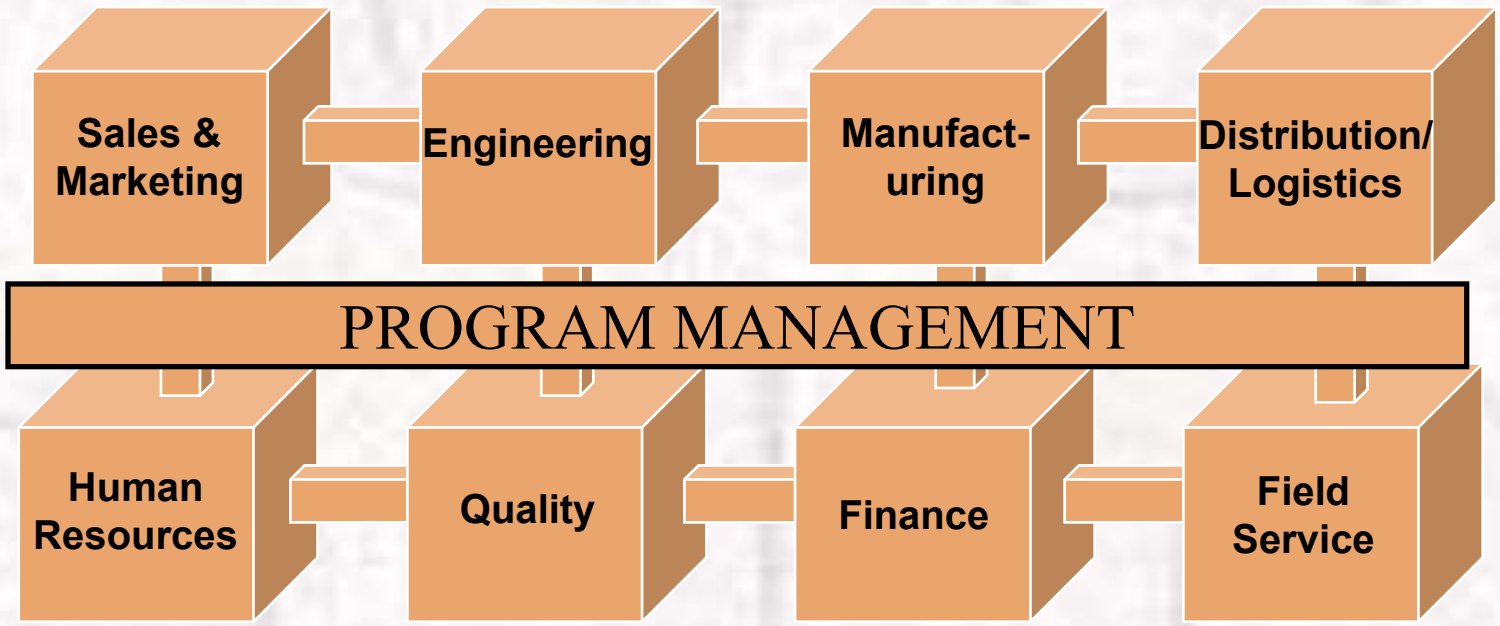
Includes:

Typical MRP II Functions
Sales Force Automation
Engineering Functions/PDM
Advanced Manufacturing Function
Distribution/Logistics Functions
Quality Functions
Field Service Functions
Complete Financial Functions
Human Resources Functions
Management Reporting

ERP is a System for the Entire Company - A Global Tightly Integrated Closed-Loop System

(1) Source:APICS Complex Industries Special Interest Group

Typical ERP Functionality



Engineering/Product Data Mgt.

- Document Creation, Management & Control
- CAD Interface/ Image Management
- Configuration Management
  - Change Order Creation & Control
  - Revision Control
- Engineering Data Management
- Product Information Management
- Technical Data Management
- Technical Information Management
- Engineering Item Data & BOMs

Manufacturing

- MRPII Functionality
  - MPS, BOM, Routings, MRP, CRP,PAC
- Sales & Operations Planning
- Integrated Production Configuration
- Statistical Inventory Control
- Flexible Product & Job Costing Options
- Kanban/JIT/Flow Manufacturing Support
- Theory of Constraints/Advanced Planning Systems

Sales and Operations Planning

- **Balance Market Demand With Resource Capability**
- **Develops a Contract Between Manufacturing and Marketing**
- **A Single Set of Numbers Upon Which to Base Plans and Schedules**
- **Manages Inventory and Backlog**
- **Forecasting**

Advance Planning and Optimizing System

- **Supply Chain Optimization**
- **Constraint-based multi-location master planning**
  - **Generation of feasible production plans across multiple plants**
- **Constraint-based factory level scheduling**
  - **Generation of feasible schedules (integrated with feasible production plan)**
- **Optimized distribution and transportation planning**
  - **Intelligent allocation of inventory through a network**

Distribution/Logistics

- Purchasing
- Supplier Reliability Analysis
- Distribution Requirements Planning
- Global Transportation Management
- Fleet Management
- Shipping & Receiving
- Import/Export
- Warehouse Management

Human Resources

- Requisition Management
- Applicant Tracking
- Employee Master
- Job Descriptions
- Employee Evaluations
- Training & Certification Management
- Payroll Deduction Accounting
- Benefits Tracking

Quality

- Quality Management Plans
- Quality Specifications/Requirements
- Test/Inspection Results
- Cause and Corrective Action Tracking
- Process/Product Certification
- Statistical Quality Control
- Cost of Quality Reporting
- Equipment & Tool Calibration Mgt

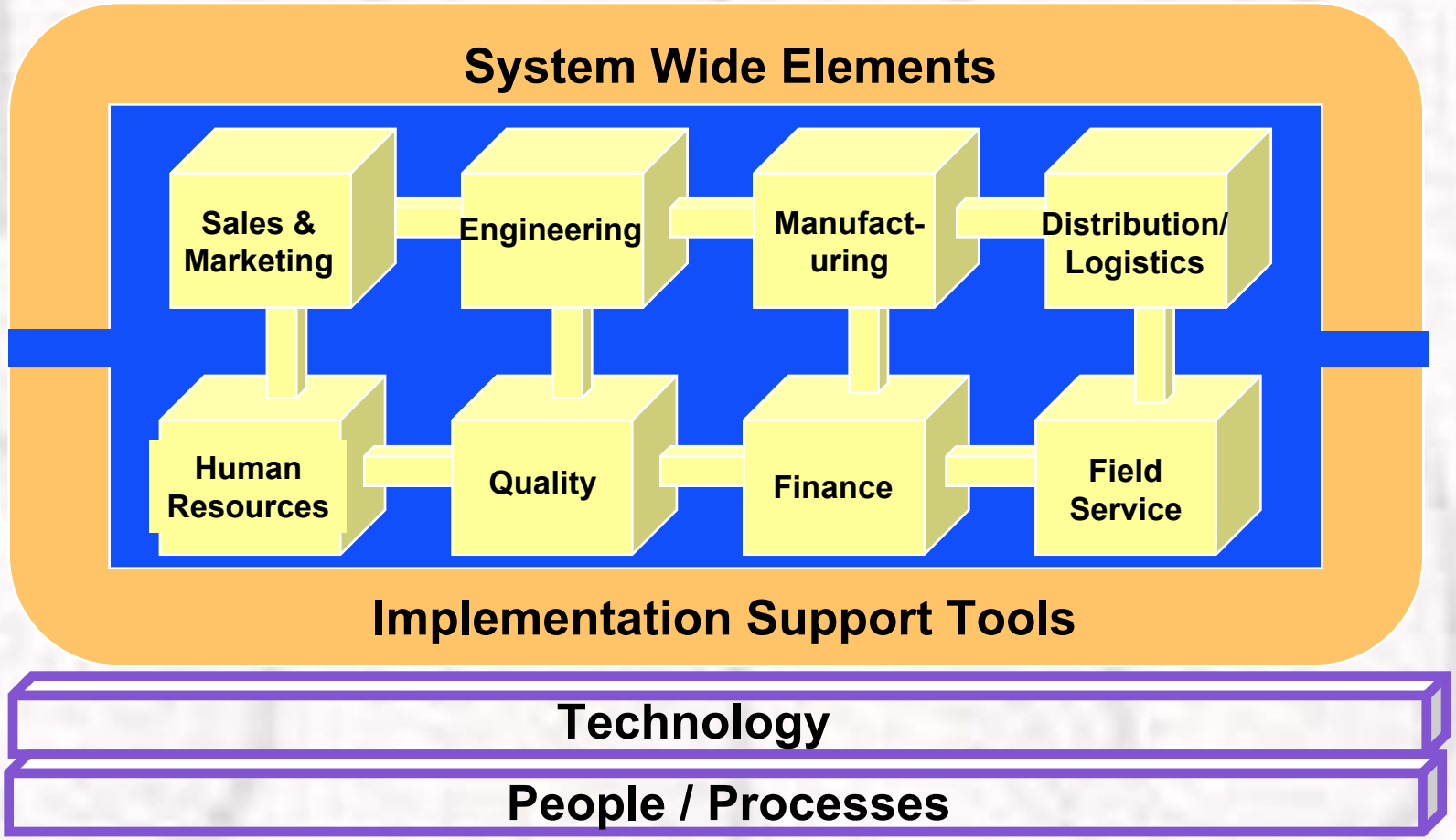
Finance

- Financial Budgets
- General Ledger
- Accounts Payable
- Accounts Receivable
- Payroll
- Fixed Assets
- Cash Management
- Activity Based Costing
- Financial Statements

Field Service

- Installation Management
- As-Maintained BOM
- Warranty Tracking
- Preventative Maintenance Scheduling & Control
- Service Order Planning & Control

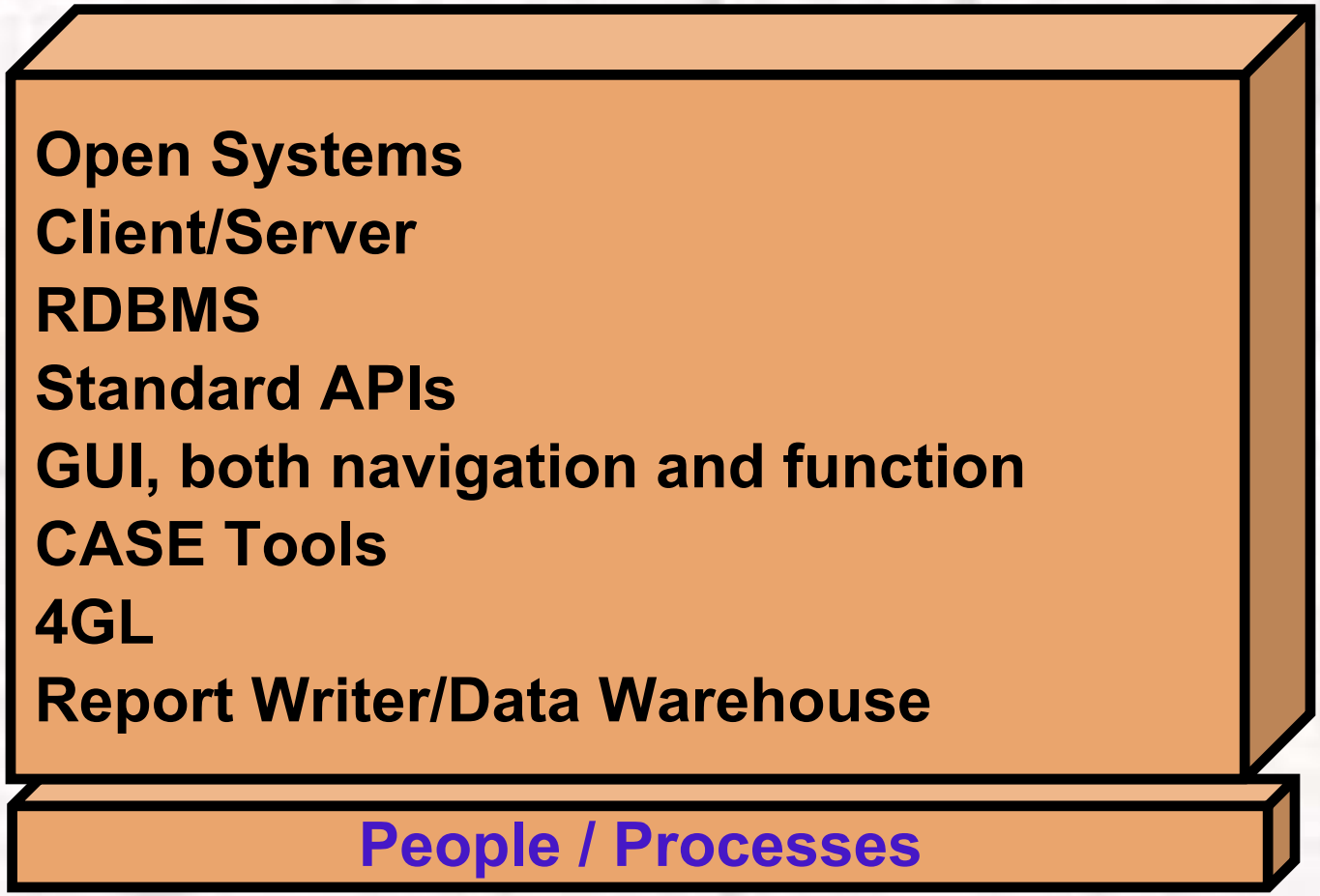
Typical ERP Integration



Typical ERP Integration

- System Wide Elements
- Project Management & Project Costing (EVM)
- Executive Management Information System
- Work Flow Management
- Multi-Company
- Multi-Currency
- Multi-Lingual
- Multi-Mode
- EDI / Electronic Commerce
- Web Enabled / Internet Communications
- Imaging & Multi-Media

Typical ERP Technology



Why ERP?

There Are Several Reasons Why a Company Will Consider The Implementation of a New Backbone Business System:

- **To Improve the Profitability of the Company**
- **To solve problems of Legacy Systems (Year 2000)**
- **To Be Able to Cope With New Production Requirements**
- **To Provide the Architectural Anchor for Rationalization of Acquisitions**
- **To Provide Interoperability of Its Organizations**
- **To Provide the Means for Supply Chain Management**

Why ERP? (continued)

Reduce Costs - How Will ERP Help?

Enable Reduced Resource Requirements due to:

- **Fully Integrated Systems Where Everyone Has Instant Access to the Latest Accurate Information**
- **One Data Base, Data Is Added Only Once and Used by All**
- **The System Allows Interoperability of the Internal and External Supply Chain**
- **On Line (Vs.Batch) System Elements - Data Is There Automatically**
- **Work Flow Is Managed Efficiently Through System Action Messages and Routing of Decisions**
- **Paperless Systems Allow Efficient On-line approvals**

ho is Using and Installing ERP?
America's Most Successful Compani

6 out of the top 10 companies

7 of the 10 most profitable companies

9 of the 10 companies with the highest market value

7 of the top 10 pharmaceutical companies.

7 of the top 10 computer companies.

7 of the top 10 petroleum companies.

6 of the top 10 electronics companies.

8 of the top 10 chemical companies.

8 of the top 10 food companies.

Learning Objectives

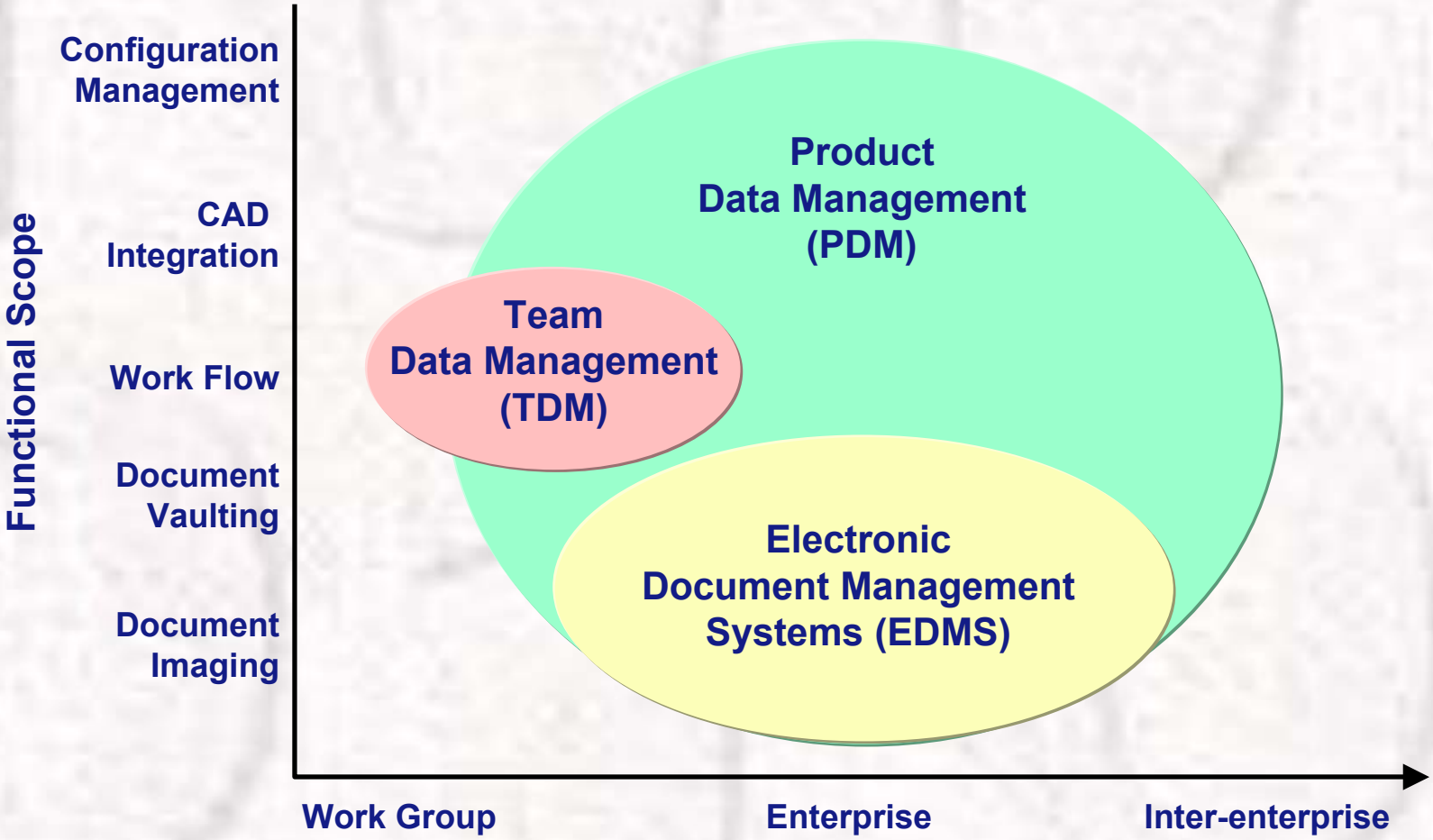
- Enterprise Resource Planning
- Product Data Management
- IT as Enabler for Collaborative Business Models
- Enterprise IT issues

PDM Functional Components

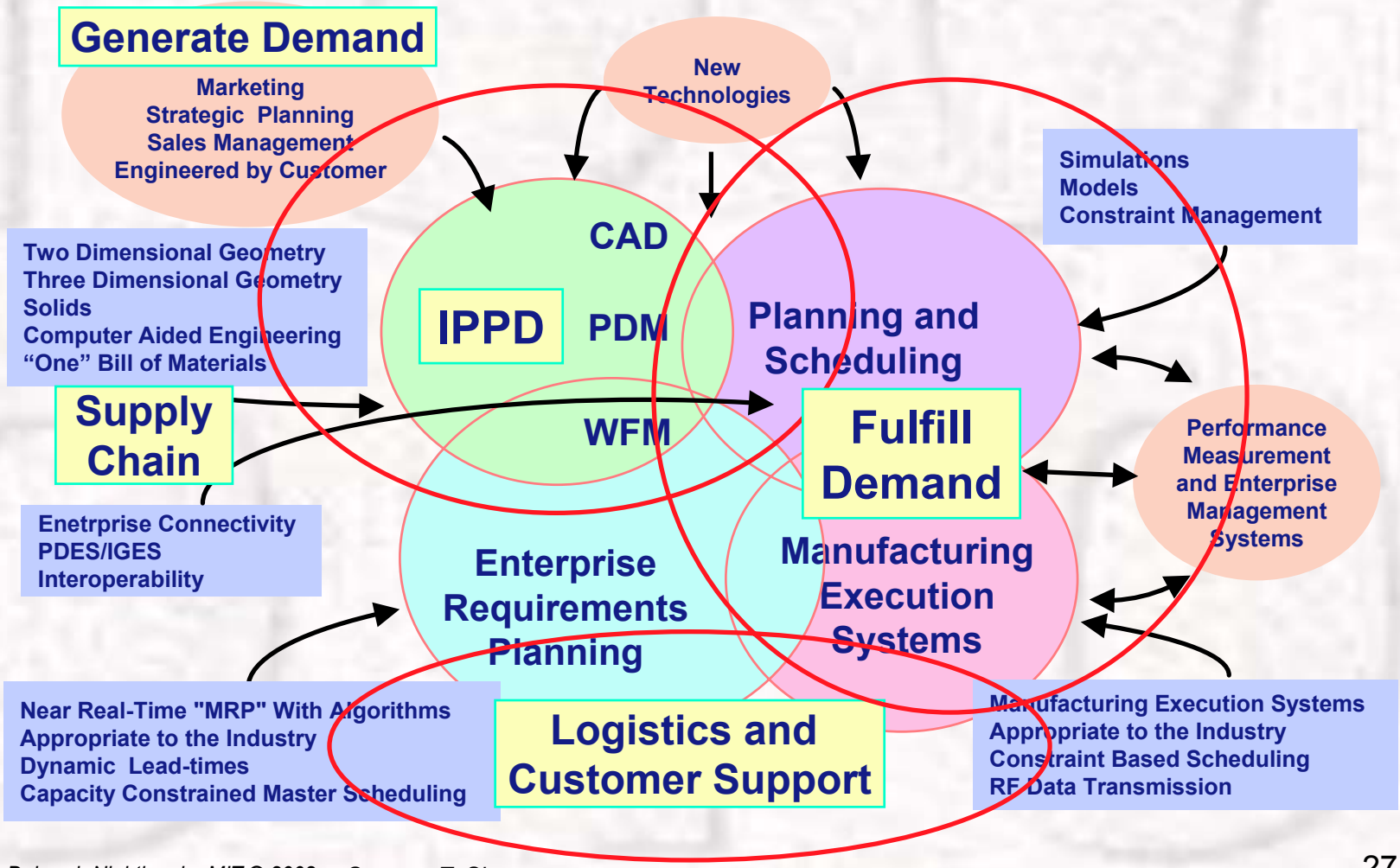
- Electronic Vault
- View and Markup
- Work Flow
- Tools and Integration-ware
- Electronic Collaboration
- Configuration Management
- Project Management
- Design Retrieval/ Component Libraries
- Scanning and Imaging

Source: T. Shaw, Andersen consulting

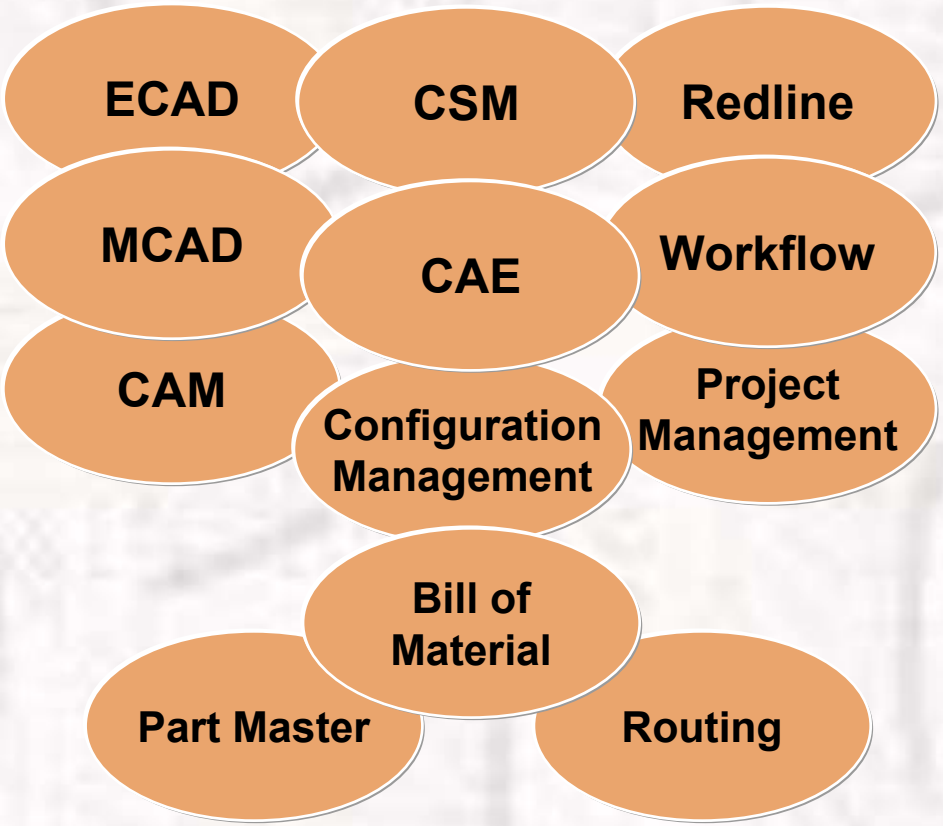
An "Industrial Strength" PDM Enables All Participants Involved with Design Intent to Share and Disseminate All Heterogeneous Product Data



The "Big M" or Enterprise View Encompasses all Components of the Product Life Cycle

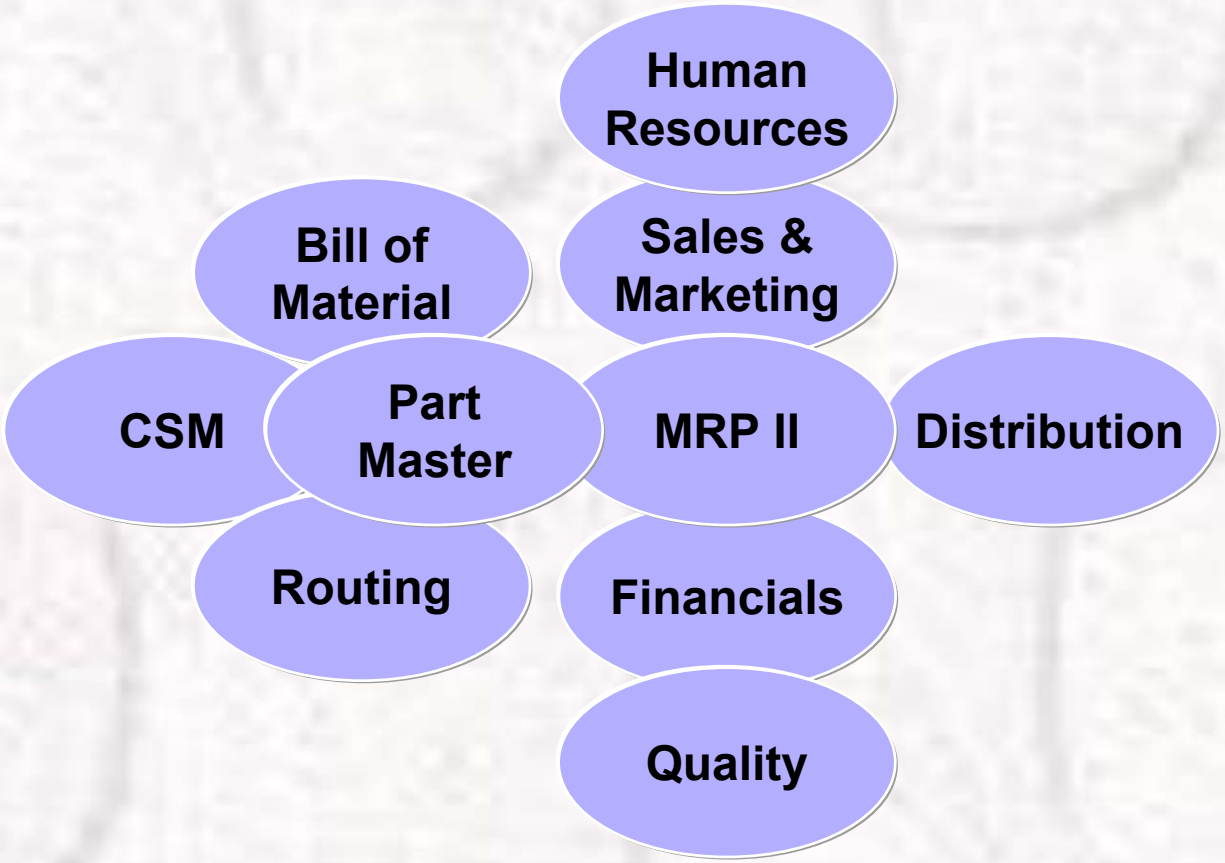


PDM Systems View of Functionality

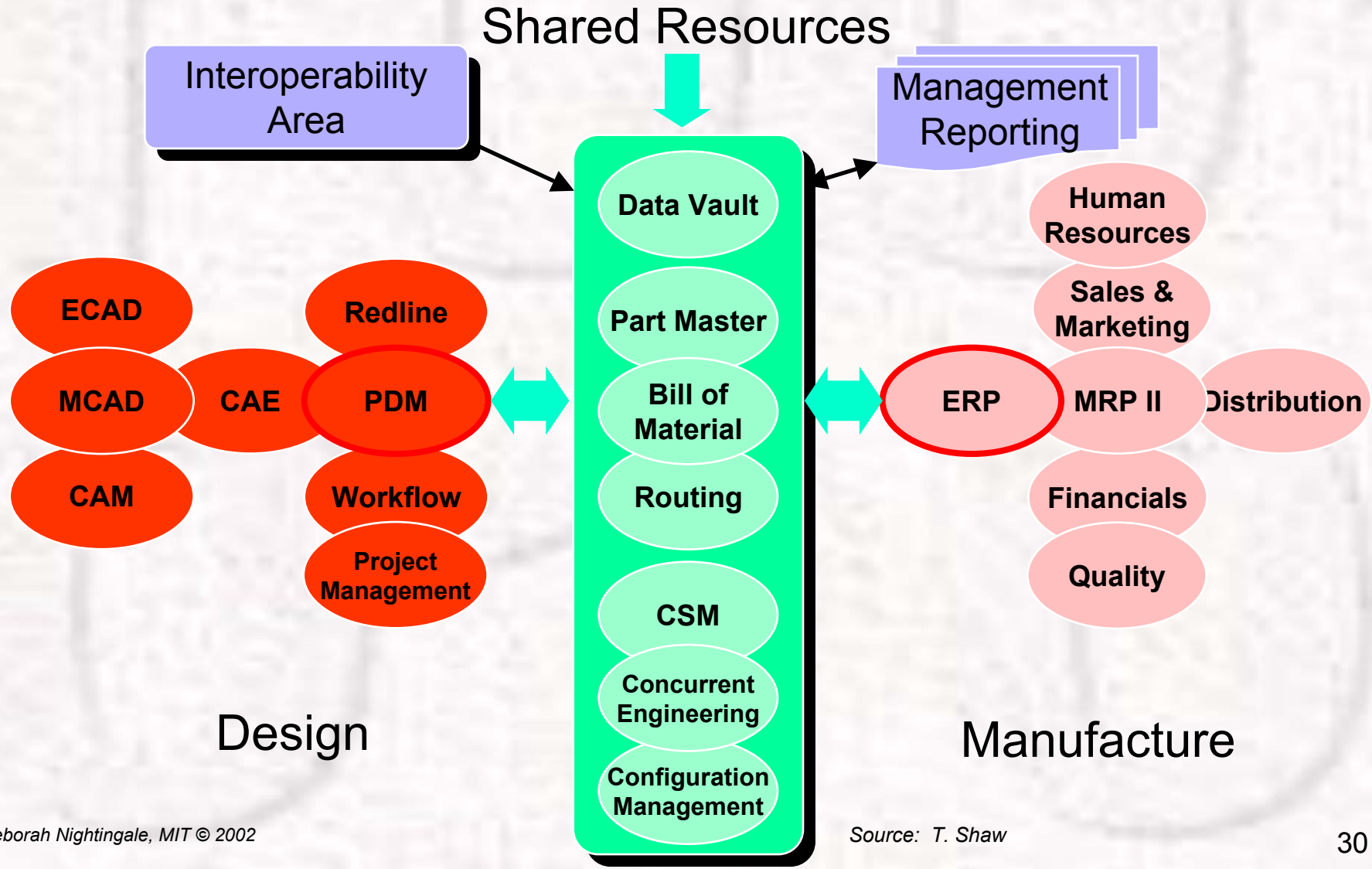


 Source: T. Shaw

ERP Systems View of Functionality



The Enterprise View of PDM-ERP Functionality



A Robust PDM Product Interfaces with Most Core Processes and Their Best Practice Implementation

Generate Demand

- Global Requirements - Local Interpretation
- Ultimate Customer Knowledge/ Understanding/ Characterization
- Real Time Market Intelligence
- Solutions Provider
- Customer(s) Chain Life Cycle Characterization
- Information Technology Resources Optimization

Develop Products/Processes

- Rapid Cycle Time Execution
- Team Based Program/Project Implementation
- 6 s Process Variability
- Information Technology Resources Optimization
- Multi-Discipline, Multi-Function Team Composition
- Integrated Development Processes
- Integrated Product/Process Release

Fulfill Demand

- Single Bill of Materials
- Integrated Supply Chain
- Low Process Variability: Cpk ^{3} 1.6
- Just-in-Time Inventory Strategy
- Information Technology Control of Operations

Support/Service Customer

- Instantaneous Delivery
- Real Time Services Solutions
- Near Real Time Customer Reaction Assessment
- Service Actions Data Base

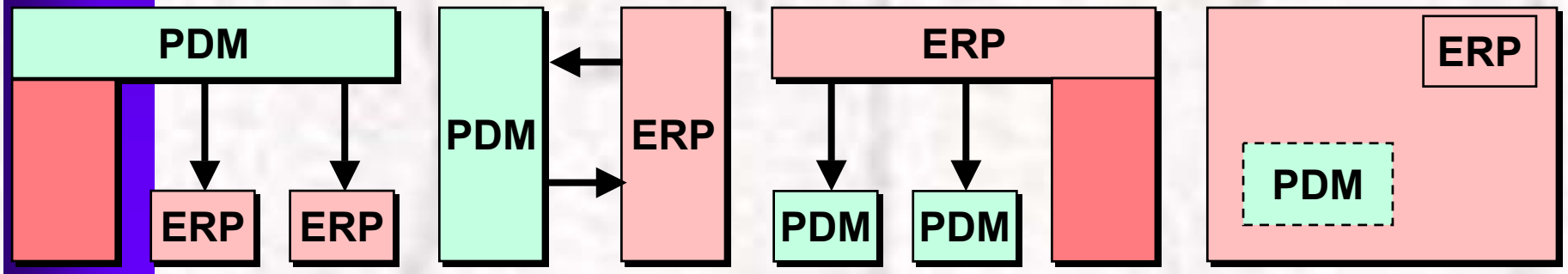
Emerging Best Practices

- Highly Segmented Market Intelligence
- Full System/Product/ Process Modeling/ Simulation
- Real Time Supply Network Integration
- Adaptive Maintenance

Source: T. Shaw

PDM-ERP Will Dictate the Industry's Future for Integration and Interoperability

- "Single System" versus "Integrated Systems" Solution
- Examples of Each Model Are Successfully Used
- Many Issues Impact Appropriate Decision
  - Scope, focus, objective, business, interoperability



Integrated vs. Best of Breed

Ferrari Dealership

2002 Ferrari Roadster

385hp Engine
Tiptronic Transmission
Multi Link Transaxle
Motronic Fuel Injection
Ferrari Designed Pirelli Tires

(all components specifically designed to Ferrari specifications)

Big Al's Auto Nirvana

2002 *Best of Breed* Ferrari Roadster

Corvette 5.0 Liter Engine
BMW M3 Transmission
Porsche Transaxle
Maserati Fuel Injection System
Mercedes Designed Michelin Tires

Interfaces and Problem Resolution ??

- ***One Call to your local Ferrari Service Mgr***
- ***You are Covered by a Single Warranty***

- ***Do you call the Service Mgr from….. Corvette, BMW, Porsche, Maserati or Mercedes ??***

Source: T. Shaw

ERP Issues

1. **ERP - a Strategic Enterprise Decision**
   - Providing interoperability of systems
   - Integrating supply chain
   - Enabling collaborative partnering
2. **Implementation - can't be outsourced!**
   - Core cadre of key process owners
   - Minimum dependence on third party providers
3. **Process Re-Engineering**
   - Examine existing processes
   - Upgrade to best practices BEFORE implementing ERP
4. **Data Conversion**
   - Cleansed and accurate population of new data bases in essential

ERP Issues (continued)

5. **Stress Testing**
   - Akin to a major system qualification
   - Often short changed since it occurs late in implementation
6. **Stabilization of Systems**
   - Minimum of 60 days after going live
   - Requires contingency plan for addressing by deliverables
7. **Discipline - No cheating allowed!**
   - Enterprise management must insist all data/reports come from ERP
   - Significant cultural change
8. **Education and training**
   - Personnel involved need extensive training
   - At least 10% of implementation budget

ERP Issues (continued)

9. **Implementation Cycle Time**
   - Critical to assign outstanding program managers and capable people
   - Up to 100 people at one time
   - Cycle times of 15 months can be achieved
10. **Cost -- why are ERP systems so expensive?!!!**
   - ERP rolls all or most legacy systems, their licensing costs, maintenance costs, etc. into one systems
   - ROI can be VERY SIGNIFICANT!

Learning Objectives

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The Vision of Collaborative Business

Everyone Shares Information

"Seamless flow of information"

Source: LEM Overarching Principle

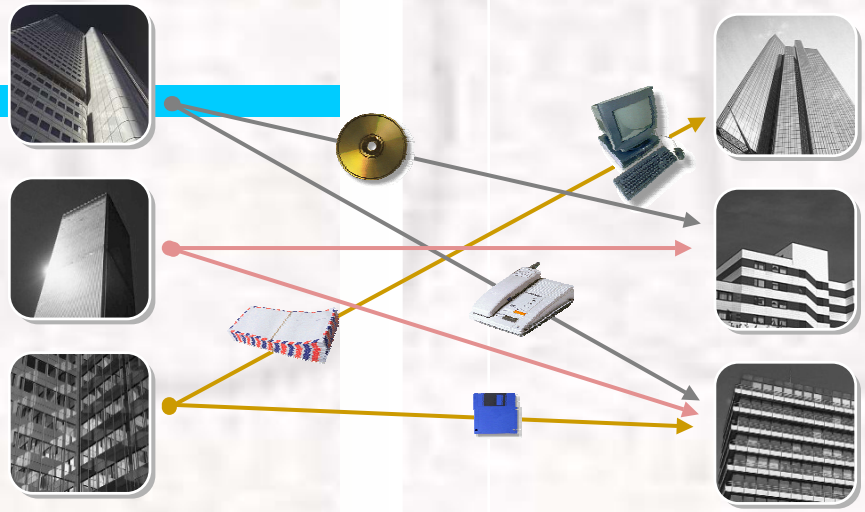
Customers, employees, suppliers and business partners working together as one successful entity.

Personal, Collaborative Solutions on Demand

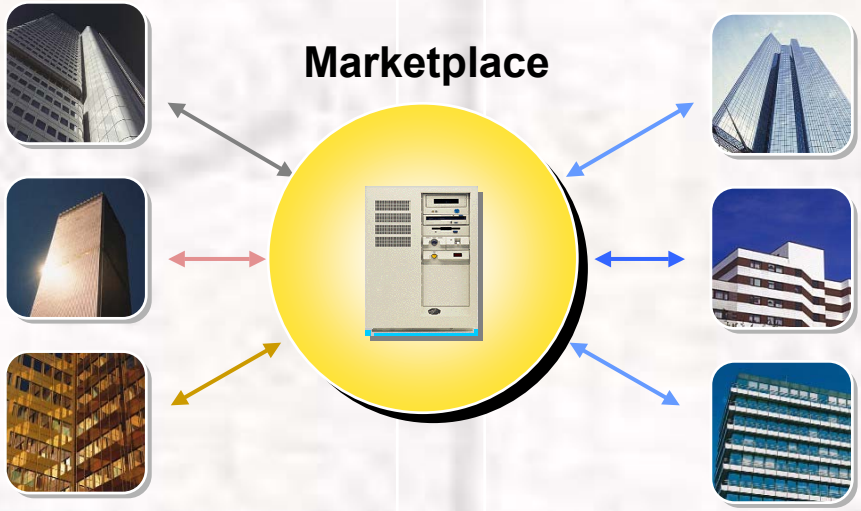
- **Marketplaces**
  Collaboration hubs
- **Workplaces**
  Portals for personalized, universal, role-based access
- **e-Business Applications**
  e-Commerce, CRM, SCM, Business Intelligence,
  Logistics, Financials, Human Resources
- **Application Hosting**
  Throughout the solution life cycle

Electronic Marketplaces / Portals / Internet Hubs

Old World



New World



Integration Continues to be Key

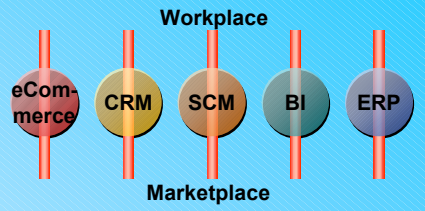
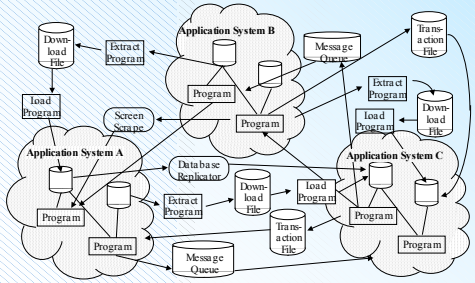
Needed:

- A plan
- Openness
- Partners' components
- Cross company synchronization
- Federated Marketplaces
- Common messaging semantics

Strategic nature of integration

High

Low

Short term fix: Buy/build tactically 	**A real plan: integration architecture** 
Hacker's heaven 	**Go to the lab:** ?

Time before plan changes

High

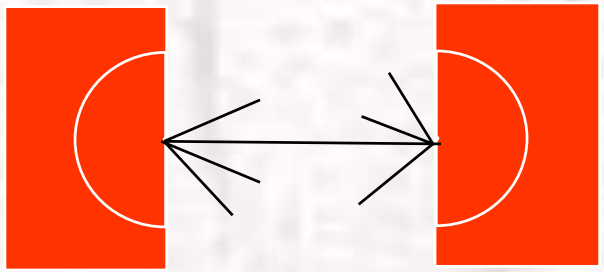
Deborah Nightingale, MIT © 2002

Source: T. Shaw

New Type of Inter-Enterprise Apps

- Components migrate into marketplaces
- Serving multiple companies at a time
- Hosted
- Ubiquitious
- Personalized
- Self help
- Partner software built-in
- Integrated with back-end
- Scalability, performance, availability and security

A)



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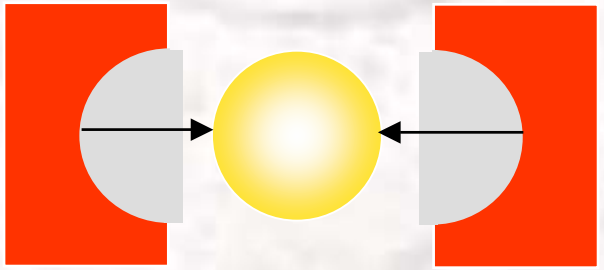
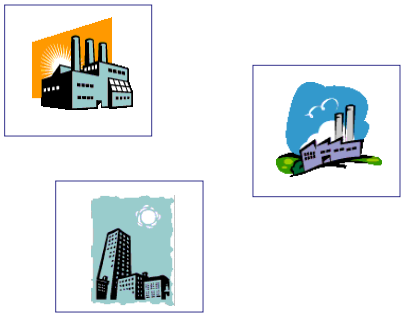


- Supply Chain Optimization
  - MRO Procurement
  - Direct Procurement
  - Planning and Optimizing
  - Analysis
- Relationship Management
  - Sales
  - Service
  - Marketing

Evolution of Business Solutions

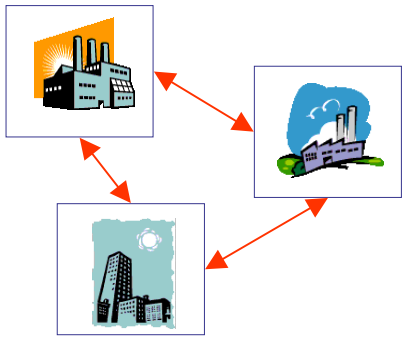
Enterprise Resource Planning

- Objectives
  - Cost and Efficiency
  - Automation
  - Best-Practice Business Processes
- Integration of business processes
- Process-orientation
- Focus on internal systems



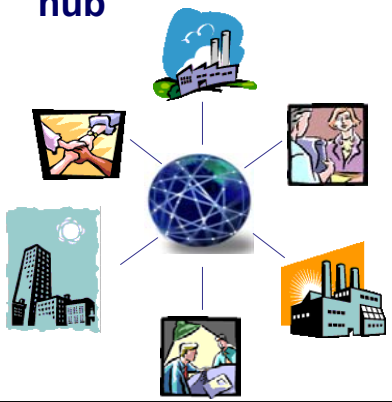
Inter-Enterprise Cooperation

- Objectives
  - Cost and Efficiency
  - Optimization
  - Supply Chain Excellence
- Cooperation across enterprises
- Process-orientation
- Focus on point-to-point linking



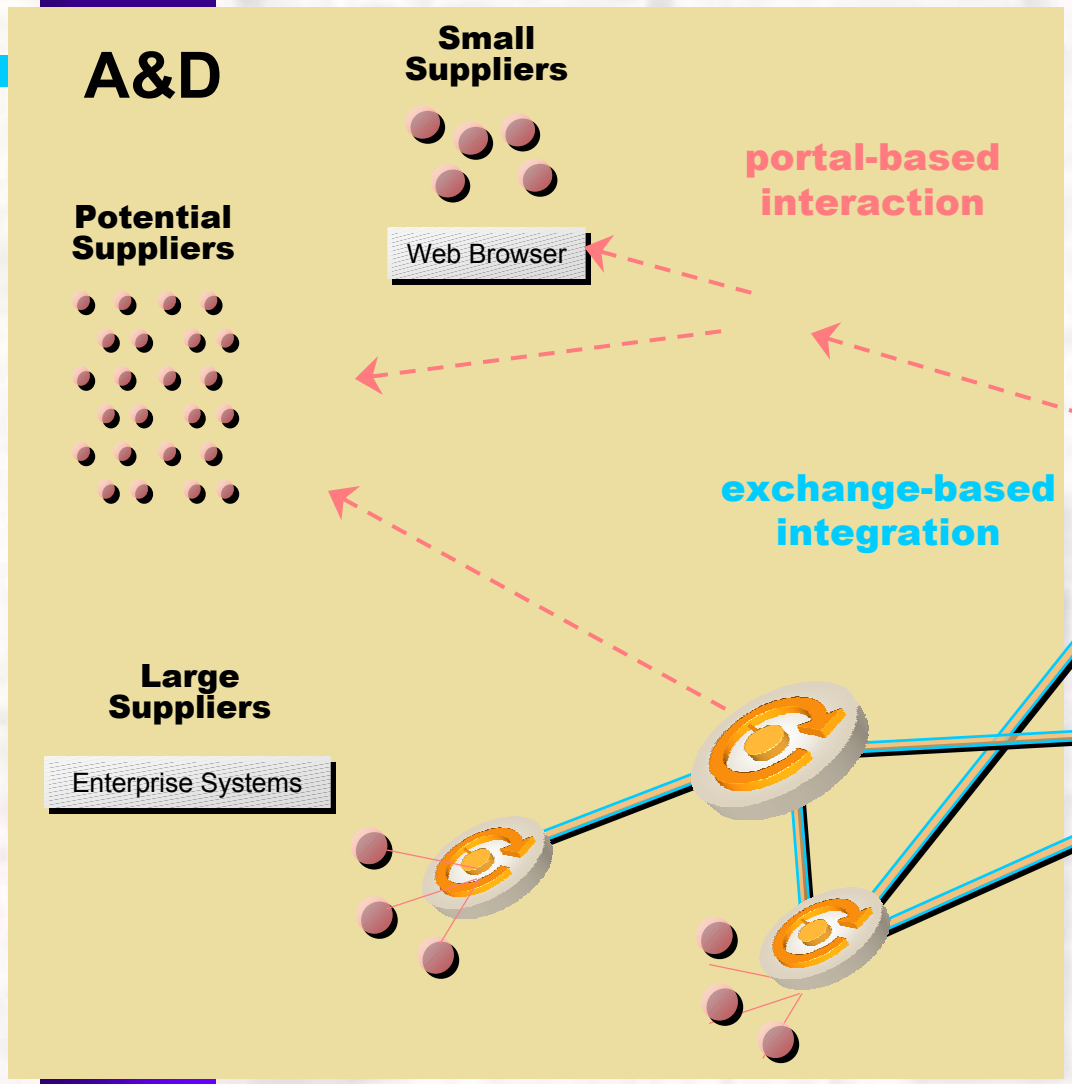
Business Collaboration

- Objectives
  - Create Value
  - Flexibility
  - Customer Relationship Management
- Collaboration within business communities
- User-orientation
- Focus on the Internet hub



Source: T. Shaw

Example: SRM Collaboration Application on a Web Services Architecture



Web Services Architecture

Portal Infrastructure

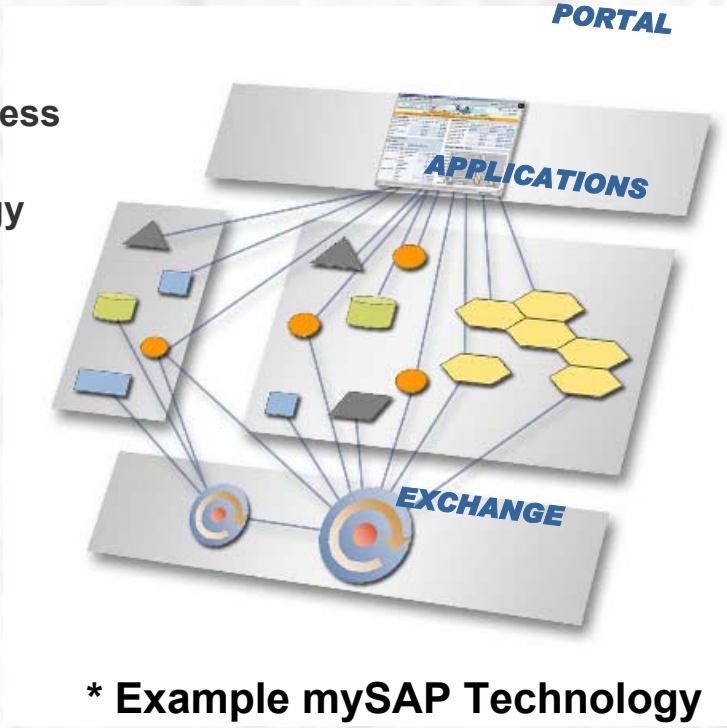
- User-centric collaboration
- Unification of underlying sources for seamless navigation
- Device independent presentation technology

Web Application Server

- Web services provision
- Open standards-based connectivity through native Web technology
- Platform independent infrastructure

Exchange Infrastructure

- Process-centric collaboration
- Common business process semantics for seamless integration
- Application-independent business process collaboration



*** Example mySAP Technology**

Learning Objectives

- Enterprise Resource Planning
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ERP Evolving Reality

- ERP systems are being implemented in companies of all sizes
- ERP is generally viewed as a business solution, not an IT solution
- Results on cost reduction for IT operations are mixed
- A single ERP system does not provide end-to-end solution - most companies use systems for specialized functionalities or decision-making processes
- ERP simplifies and standardizes systems across the firm
- ERP systems are very stable, able to handle large transaction processing
- ERP systems significantly improve data availability and quality
- Most companies are pleased with their ERP systems

Source: Mabert, Soni and Venkataraman, "Enterprise Resource Planning: Common Myths Versus Reality"

Is There a Lean Way to Implement Enterprise Information Systems?

1. **Address process**
   - **Simplify/eliminate waste**
   - **Determine "best practice"**
   - **Standardize across enterprise**
2. **Determine enterprise processes information requirements**
3. **Integrate information using ERP/PDM systems**
4. **Implement across extended enterprise**
   - **Supplier**
   - **Partner**
   - **e-commerce/e-business**