Build4 Scale

U.S. Department of Energy

Communication, Selection, and Negotiation

Module 5B Preparing for Scale-Up with ERP/MRP

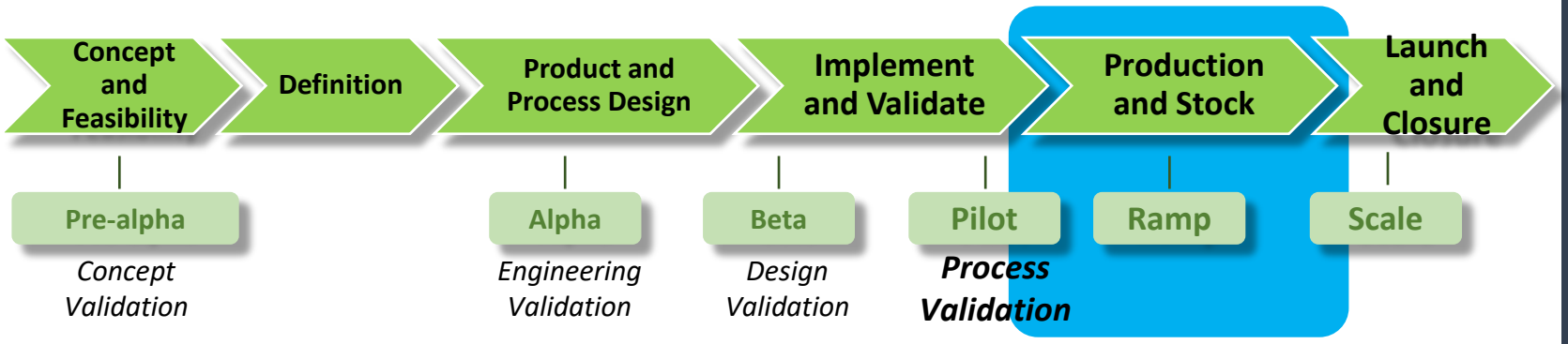
Motivation

Why is this module important?

- Start-ups are under pressure to get their products and designs ready quickly to scale-up production and lower costs
- Learn how to sustain a supply chain that can deliver products to the customer on time and in full using planning system tools
- Planning systems manage production processes when a company is scaling-up operations
- **Sales**: Everything a company does has to be in support of selling its product
- **Efficiency**: Thin profit margins in manufacturing force companies to produce and sell products as efficiently as possible
- **Technology**: Innovations that enable some companies to manufacture products more efficiently places pressure on other companies to follow

Scale-Up Production Tools

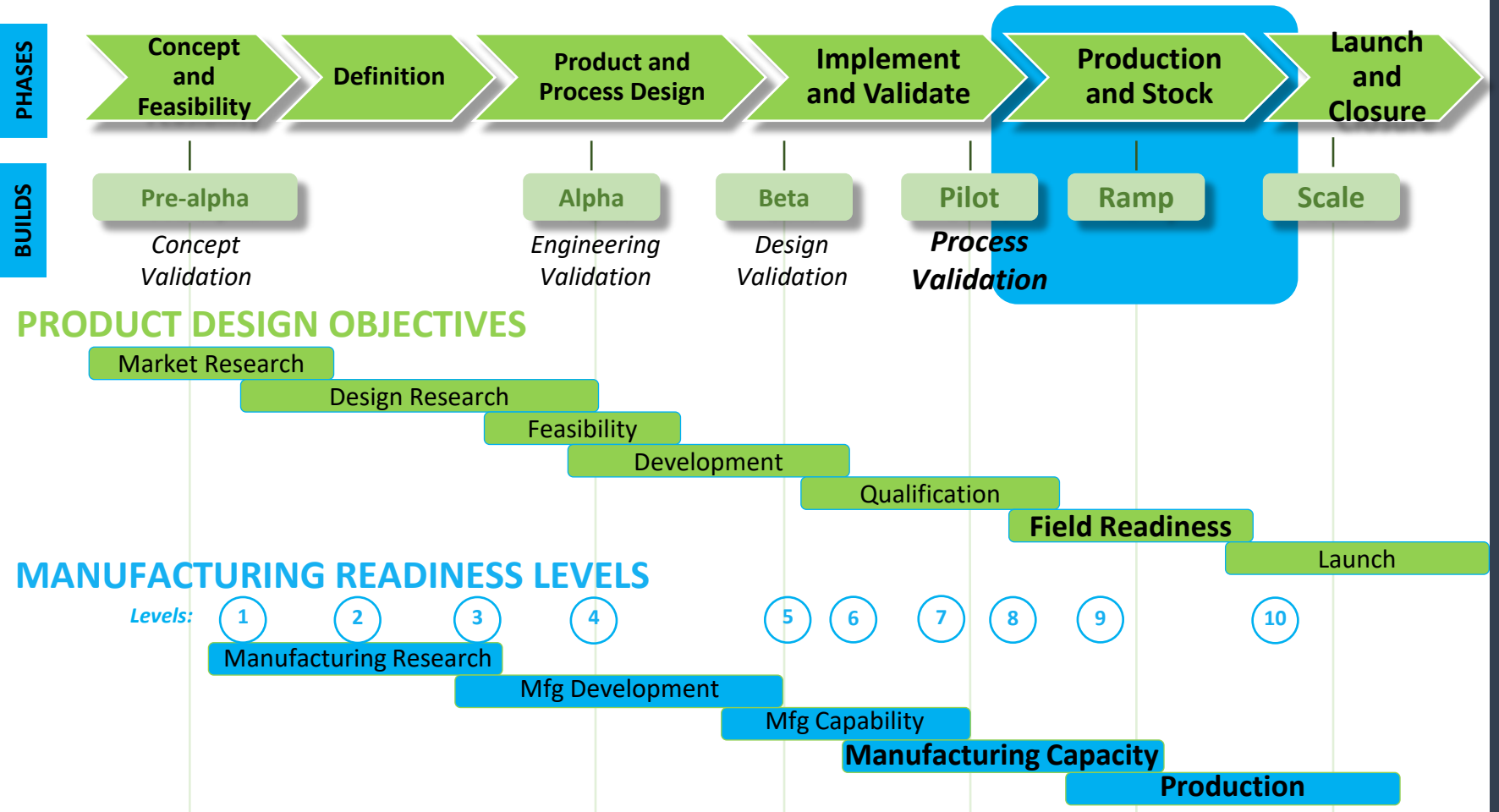
Where does this fit into the development cycle?



- When building strategic partnerships with suppliers (Module 5A), these tools equip you to manage and monitor the supply chain so you can take steps to improve on-time delivery to customers (Module 5C)
- Enterprise Resource Planning (ERP) tools document ERP
- Manufacturing Resource Planning (MRP-2) tools select the appropriate system(s)

Scale-Up Production Tools

Where does this fit into the development cycle?



Module Outline

- Learning objectives
- Background on MRP/ERP systems
  - —Overview of MRP/ERP
  - —History of MRP/ERP systems
  - —Value of MRP/ERP systems
- Implementing an MRP/ERP
  - —MRP/ERP readiness
  - —MRP/ERP selection
  - —Integrations with other platforms

Learning Objectives

- LO1. Understand the function and value of ERP and MRP systems
- LO2. Determine whether an ERP or MRP is appropriate for you
- LO3. Recognize the appropriate time to implement an ERP or MRP system

What This Module Addresses

- What ERP and MRP systems are
- History of ERP and MRP systems
- What ERP and MRP systems can do for a company
- When an ERP or MRP system is needed
- How to select an ERP or MRP system

Resource Planning Systems

Basics

- **Enterprise Resource Planning** (ERP) is a process by which a company (often a manufacturer) manages and integrates the important parts of its business. An ERP management information system integrates areas such as planning, purchasing, inventory, sales, marketing, finance, and human resources
- **Material Requirements Planning** (MRP) is a production planning and inventory control system. An MRP integrates data from production schedules with that from inventory and the bill of materials (BOM) to calculate purchasing and shipping schedules for the parts or components required to build a product. It is used for ordering and stocking materials to meet customer demand

Resource Planning Systems

What are they?

- Resource planning systems (ERP/MRP) streamline and integrate core back-end business processes
- These processes include:
  - —Purchasing
  - —Production planning
  - —Quality control
  - —Manufacturing
  - —Scheduling
  - —Inventory control
  - —Supply chain management
  - —Finance
  - —Shipping/receiving
  - —Sales orders
- By integrating these processes together, changes in one process are automatically and immediately reflected in other processes so the entire company can stay in sync

Example: fulfilling sales orders automatically reduces the item count in inventory

Resource Planning Systems

Why are they needed?

- Start-ups are under pressure to get their products and designs ready quickly to scale-up production and lower costs
- ERP/MRP systems manage production processes when a company is scaling-up operations
- **Sales**: Everything a company does has to be in support of selling its product
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Resource Planning Systems

Technology drives manufacturing

- MRP and ERP systems help a company determine how technology can be applied to improve their manufacturing processes
- Manufacturing is more than just a process of turning raw materials and resources into a finished product; manufacturing is the value added to production of merchandise for use or sale
- Technology and innovation play a key role in manufacturing. As technology advances, companies need to continually evaluate how and when to incorporate new technologies

Resource Planning Systems

How will they help my company?

- ERP and MRP systems have many tools to help companies use resources and materials more efficiently
- ERP/MRP systems help companies:
  - —Manage inventory, production equipment, and resources
  - —Coordinate with suppliers
  - —Turn raw materials into finished products
  - —Fulfill customer orders
- Understand the specific needs of your business so that you can select the right ERP/MRP system for your company
- ERPs and MRPs have a number of similarities. In general, an MRP is more specialized for manufacturing and shop-floor operations, while an ERP covers more general business processes

Resource Planning Systems

Video introduction to ERP

Source: Jonar https://www.youtube.com/watch?v=PVRgIXLWDHs&t=3s

Resource Planning Systems

History of ERP/MRP

- ERP/MRP systems are the culmination of a series of iterative advancements in technology
- Before computers, maintaining accurate records of on-hand inventory and usage was difficult because of the time and overhead required
- Factories needed a way to maintain the supply of materials used to produce finished products

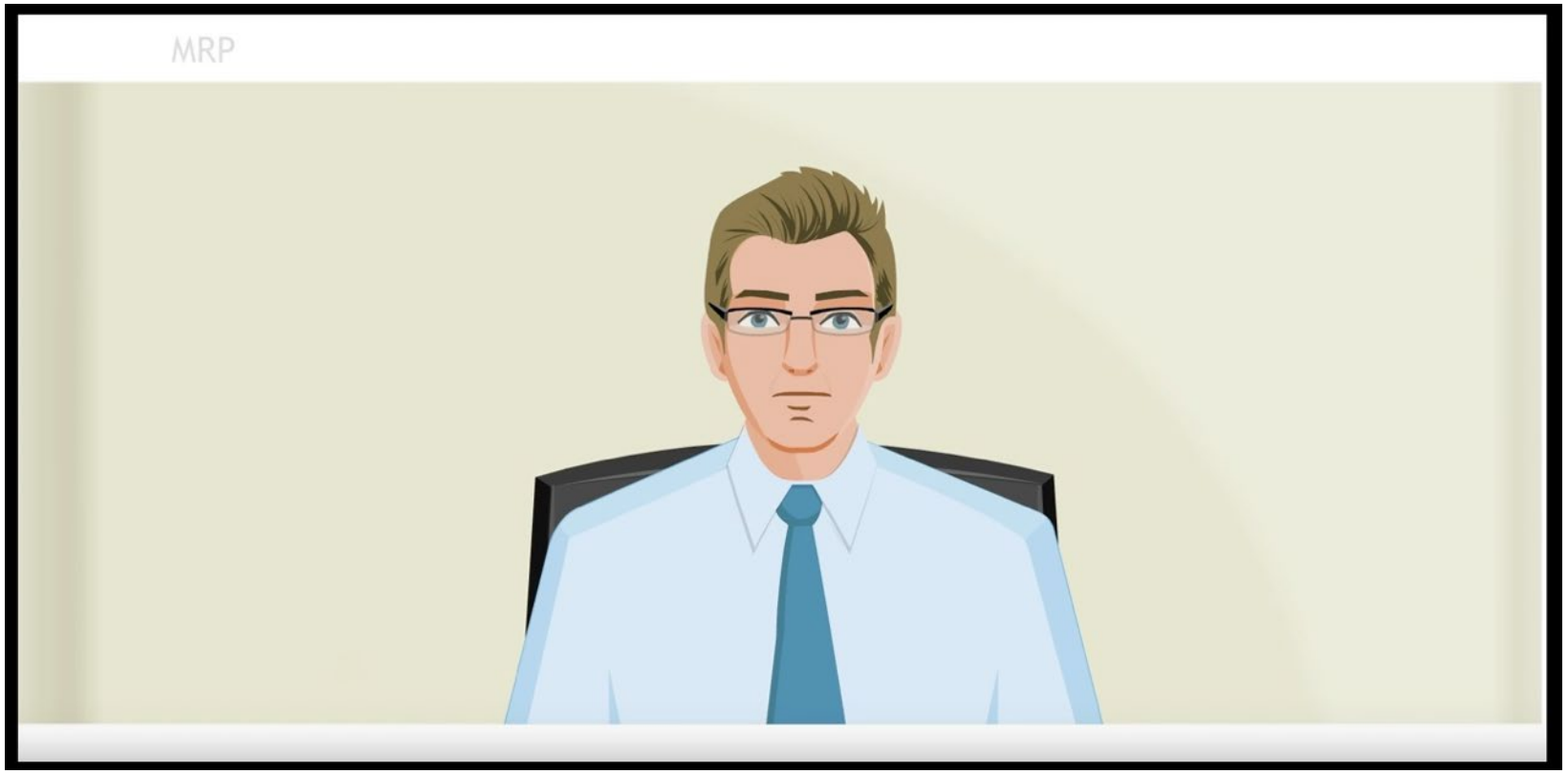
History Of ERP/MRP

Material requirements planning (MRP-1)

- In 1964, Joseph Orlicky developed the first system to manage large volumes of materials for manufacturing and distribution
- This early system became known as Material Requirements Planning (MRP-1)
- MRP-1 helps companies answer three specific questions:
  - —What items are required?
  - —How many are required?
  - —When are they required?

Material Requirements Planning

Video introduction to MRP

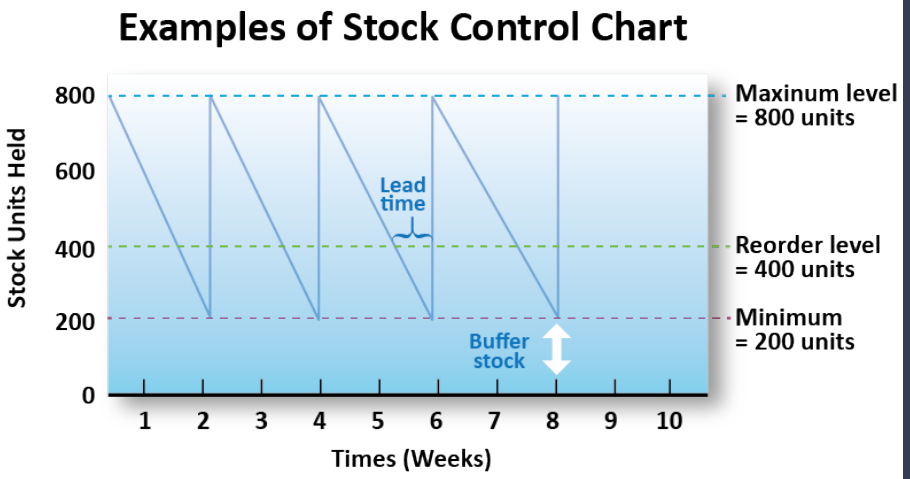


Source: Supply Chain Academy https://www.youtube.com/watch?v=jLPnYpZx980

Material Requirements Planning

General principles

- Lead time is the time between order and receipt of materials
- Materials must be re-ordered before existing material runs out
- When stock reaches the reorder level, more inventory is purchased
- Buffer stock is the additional stock you plan to keep to allow for unexpected changes to usage or lead time



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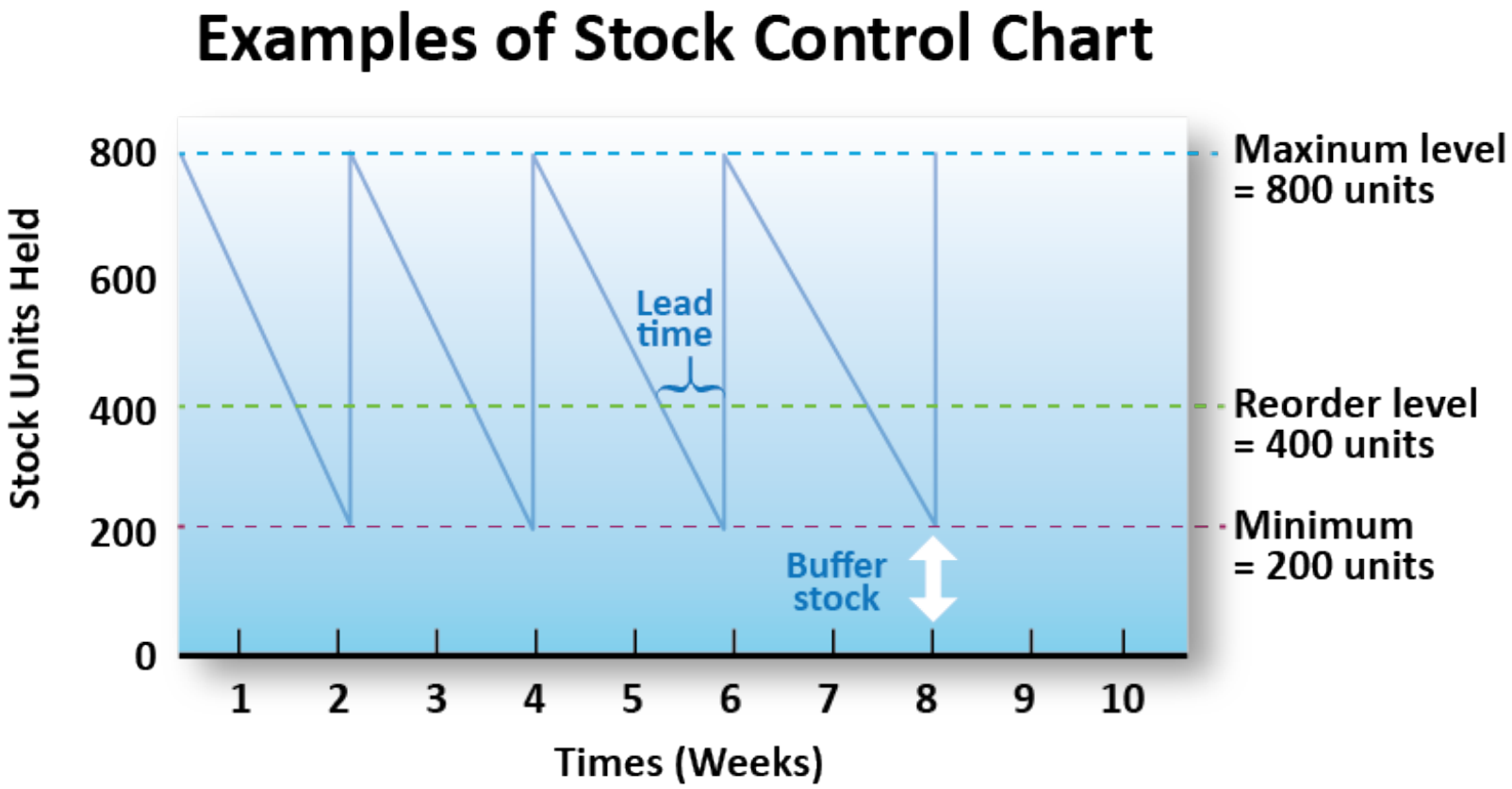
Material Requirements Planning

General principles (cont.)



Saw-tooth Stock Control Chart depicts usage and replenishment of inventory over time

Material Requirements Planning

Master production schedule

- Demand for a product is usually not constant and varies monthly
- A master production schedule incorporates forecasted fluctuations in demand to determine how many units of an item need to be purchased
- The table shows the schedule for one item
- It is time consuming to compute many items manually

Month	January	February	March	April	May	June
Beginning inventory	400	450	375	275	225	275
Demand forecast	1800	1500	1100	900	1100	1600
Safety stock (0.25 x demand forecast)	450	375	275	225	275	400
Production requirement (demand forecast + safety stock - beginning inventory)	1850	1425	1000	850	1150	1725
Ending inventory (beginning inventory + production requirement - demand forecast)	450	375	275	225	275	400

Example of Master Production Schedule

The MRP-1 system calculates requirements automatically and uses the information for reordering material

Material Requirements Planning

Example – Master production Schedule

Month	January	February	March	April	May	June
Beginning inventory	400	450	375	275	225	275
Demand forecast	1800	1500	1100	900	1100	1600
Safety stock (0.25 x demand forecast)	450	375	275	225	275	400
Production requirement (demand forecast + safety stock - beginning inventory)	1850	1425	1000	850	1150	1725
Ending inventory (beginning inventory + production requirement - demand forecast)	450	375	275	225	275	400

The MRP-1 system calculates them automatically and uses the information for reordering material

Material Requirements Planning

Strengths

- Incorporating inventory usage and lead time allows companies to maintain lower stock levels to cover production
- Employing usage rates to drive purchasing helps protect the company from overspending
  - —Usage rates are the consumption of materials based on customer demand or a demand plan (ex. how many widgets are needed, when to build the order).
- This frees up cash for other operational and investment activities

Material Requirements Planning

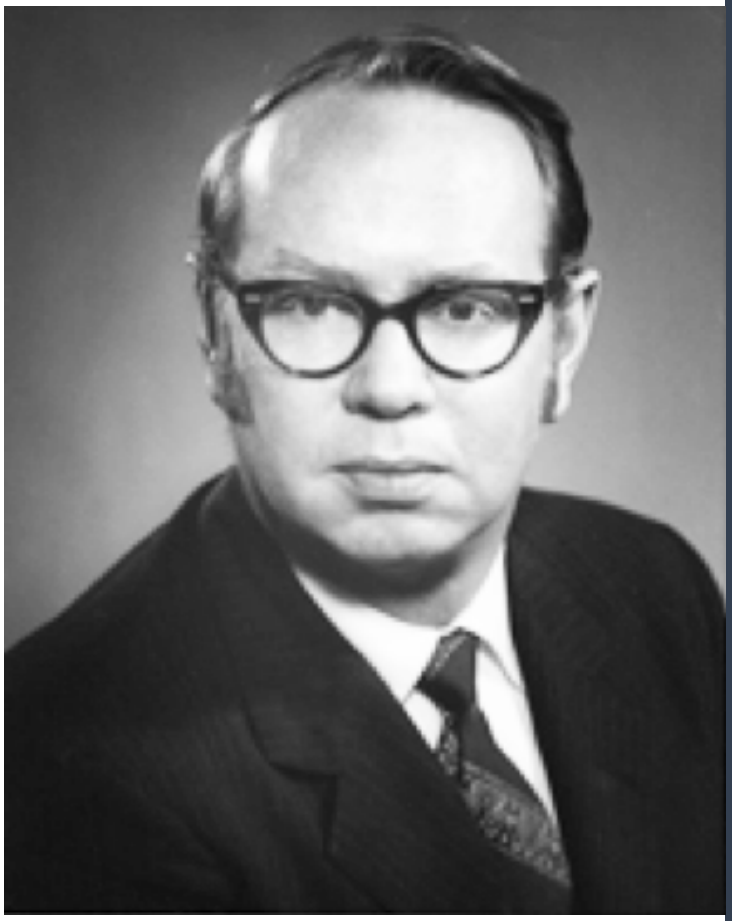
Concerns

- Lack of support for other manufacturing functions made it difficult to plan production and react to changes in customer demand
- This also made it difficult to keep the inventory quantities in the system correct. Time-consuming manual entry and data reconciling was required to account for other processes

History Of ERP/MRP

Manufacturing resource planning (MRP-2)

- In 1983, Oliver Wight developed the first Manufacturing Resource Planning (MRP-2) system
- To improve inventory handling, MRP-2 supported manufacturing processes like daily production planning, bill of materials (BOM, and managerial accounting)



Manufacturing Resource Planning

Example - Planning daily production

- A Daily Production Plan or **Master Production Schedule** (MPS) tells how many units to build each day, and can be based on either forecast or demand
- MRP-2 supports daily production planning. As inventory is used for production, the recorded quantity of available inventory automatically updates
- Inventory levels are also affected by drop shipments, product returns, and defective materials

Production Plan for Week 2 – December 2009					
Demand Management (Date)	12/7	12/8	12/9	12/10	12/11
Monthly Demand: Product A	4,000	4,000	4,000	4,000	4,000
Working Days in Month	23	23	23	23	23
MPS Daily Demand: Product A	174	174	174	174	174

Manufacturing Resource Planning

Bill of materials (BOM)

- MRP-2 supports a multi-level BOM that lists the components, assemblies, and parts required to make a product
- It provides a display of all items that are in parent/child relationships
- Top-down production planning can take place, from finished product to individual components

Indented BOM for Product 0125
5-Gal Carpet Cleaner

Ind. Level	Part Number	Part Description	Type	Unit	Qty. Per Assembly	Unit Cost	Lead Time	Total Lead Time
0	⊟ 0125	5-Gal Carpet Cleaner	3	Ea	.	9	7	7
1	⊟ 1115	Customer Pack	1	Ea	1	6	7	14
2	– 1959	Instruct Set	2	Ea	1	8	7	21
2	– 6221-1	Bottled Concentrate	2	Ea	1	150	105	119
1	⊟ 2104	5-Gal Tank Assembly	1	Ea	1	30	14	21
2	– 5319	Valve Assembly	2	Ea	1	137	91	112
2	– 5746	Hose	2	In	10	45	28	49
2	⊟ 7350	5-Gal Tank Subassembly	1	Ea	1	25	14	35
3	– 0403	Clamp	2	Ea	1	22	14	49
3	– 1201	Gasket	2	Ea	2	3	7	42
3	⊟ 4209	Painted Tank Top	1	Ea	1	18	14	49
4	– 5640	Steel	2	Lbs	2	115	70	119
3	⊟ 5706	5-Gal Painted Tank Bottom	1	Ea	1	38	21	56
4	– 5640	Steel	2	Lbs	3	115	70	126

Reminder: Parent/child relationship refers to a sub-assembly composed of addition parts. For example, a fuel pump is a sub-assembly (parent); this is composed of components (children), including pump housing, impeller, filter, electronic board, piping, seals etc.

Manufacturing Resource Planning

Bill of materials (BOM) (cont.)

Indented BOM for Product 0125
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3	– 0403	Clamp	2	Ea	1	22	14	49
3	– 1201	Gasket	2	Ea	2	3	7	42

Enterprise Resource Planning

Basics

- Despite the advances in MRP-2, manufacturing companies sought to further integrate their processes into the system. Even non-manufacturing companies looked for solutions to integrate their processes
- Beginning in the 1990s, the capabilities of some MRP-2 systems were further expanded to include more functions like supply chain integration, shipping, and order management
- As their scope expanded to encompass processes outside of manufacturing and materials, the enhanced MRP-2 systems became known as **Enterprise Resource Planning** (ERP) systems

Enterprise Resource Planning

Production equipment management

- Equipment and resources are the primary constraints on production. It is vital that they are utilized in an optimal manner.
- ERP systems allow companies to manage their production equipment as independent asset resources
- For any production job, an equipment item can be assigned to a job or process
  - —This prevents the equipment item from being scheduled for multiple jobs at the same time

- Additionally, ERP systems can schedule down-time and maintenance to maximize the life of equipment

Enterprise Resource Planning

Supplier integration and coordination

- Manufacturers also compete as participants in integrated supply chains, requiring closer coordination with suppliers
- As discussed in module 5A, managing communication with suppliers is important part of developing a strategic partnership
- Many modern ERP systems have the ability to share data directly with suppliers' systems, providing real-time information on orders and delivery status
- This opens up a new dimension for manufacturers to competitively improve efficiencies and service levels

Enterprise Resource Planning

Data sharing with suppliers

- One of the most common methods for communicating with suppliers and other trading partners is called **electronic data interchange** (EDI)
- Instead of sending an email or fax for each individual event, EDI enables companies' computers to communicate directly with each other
- This dramatically reduces processing time and improves overall accuracy. Suppliers have near-instant access to pertinent information
- However, there are often data management challenges a company must overcome to successfully implement an EDI integration

Enterprise Resource Planning

Challenges with data sharing

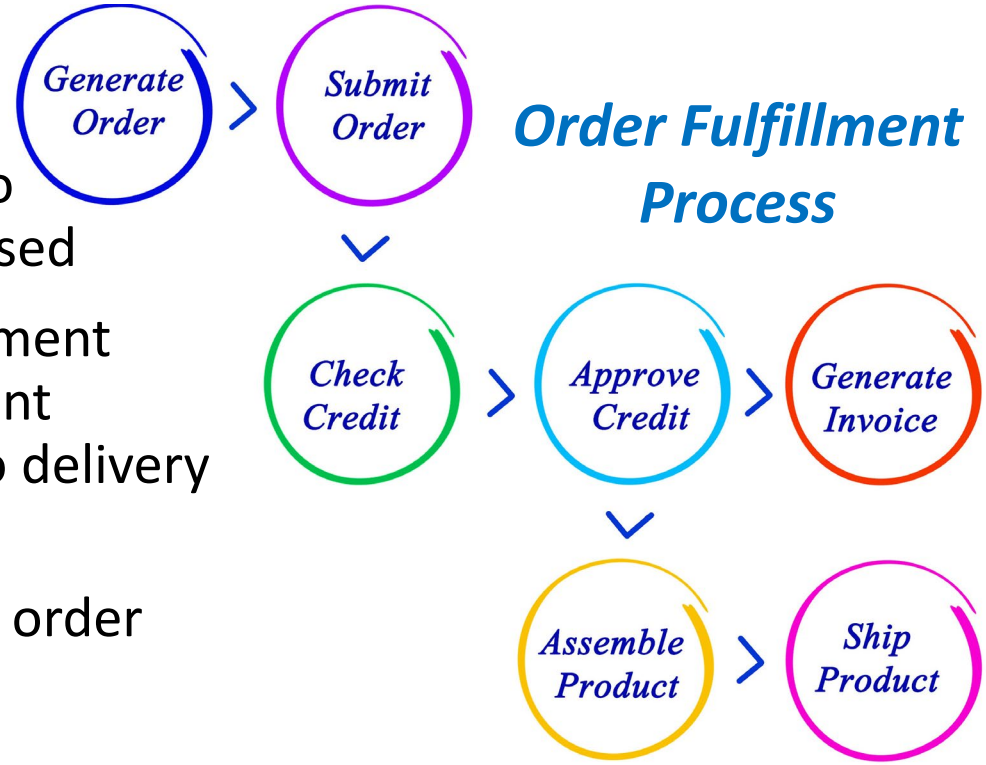
- Each integration costs both parties considerable time and effort to set up. While the EDI format is standardized, the manner that data is organized and made available is often unique for each individual company
  - —Data integrations have to contend with different labels and data formats for every trading partner
  - —Often vendors have their own proprietary portal, which may require writing custom APIs in order to interface with and access data
- Substantial culture and process changes may be required to accommodate a data integration
- In any data integration, appropriate roles and permissions must be set up to protect sensitive information

Enterprise Resource Planning

From order to delivery

ERP streamlines the order-entry process in several ways:

- Indicates whether or not an item is available when entering an order. If it is not available, a request to make or purchase it is triggered
- Flags items that are committed to an order so they are not otherwise used
- Checks a customer's payment records to see if a payment must be received prior to delivery
- Triggers a "go" in the shipping process once all order conditions are met



Enterprise Resource Planning

Delivering the final product

- When processing a shipment, the ERP will usually issue a picking ticket, packing list, and shipping labels
- The picking ticket informs the warehouse which items to pull from stock, how to package them, and how to deliver them
- The packing list shows the contents of a delivery and is usually provided to the customer in one of the packages for identification purposes.

Enterprise Resource Planning

Delivering the final product (cont.)

- Shipping labels provide the shipper with instructions about how and where to ship the package
- If shipping out of country, a commercial invoice must be included so packages will clear customs

Reminder: A commercial invoice is a customs document. It is used as a customs declaration provided by the person or corporation exporting an item across international borders

Enterprise Resource Planning

Customer relationship management

- Manufacturers also need to respond immediately to the needs of high-priority customers (such as distributors or resellers)

An ERP helps by:

- Automatically transmitting order status updates and shipment tracking information directly to customers
- Maintaining details about the key contacts for each customer
- Providing remote access so field reps may obtain real-time information and update orders from their mobile devices while off-site
- Alerting users of issues within supply chain, such as lead-time changes, material rejections, and transportation delays

Enterprise Resource Planning

The future of ERP

- A confluence of cloud-based computing and big data has allowed companies to adopt a “Best-of-Breed” approach for their ERP needs
- Instead of depending on a single ERP suite to handle all processes, companies can mix different applications to handle different aspects of their businesses and “stitch” them together with integration middleware
- The greater flexibility in selection facilitates customized business solutions
- With ERP systems hosted on cloud servers, companies need not maintain dedicated IT assets
- This makes ERP systems accessible from any computer or mobile device

ERP versus MRP

Which one is for you?

Early-generation ERP and MRP systems had more distinct differences from one another, but modern ERP and MRP systems have become more similar:

- MRP systems are specialized for manufacturing and will have more robust production and shop floor control. The trade-off is that they don't have support for as many business process (such as human resources or order entry) as an ERP, requiring other software solutions to support them
- While ERP will support more of the business processes overall, it may not perform some functions as well as an MRP system
- If you are handling production or final assembly in-house, you probably need solid MRP capabilities to help manage the shop floor because better oversight and control of the production processes is required

Enterprise Resource Planning

When should you get an ERP?

While there is no firm answer as to when is the right time to get an ERP, there are some things to consider:

- It is best to wait until you have a stable revenue stream
- Typically, companies need an ERP when:
  - —They have more than 50 employees
  - —Track more than 200 SKU* numbers
  - —Sell more than 1,000 units per month
  - —Ship products from multiple locations

**Note*: A stock keeping unit (SKU) is a product and service identification code for a store or product, often portrayed as a machine-readable bar code that helps track the item for inventory

Enterprise Resource Planning

Case study 1 - Fuze Energy Drink

- Sought a cost-effective solution to:
  - —Manage growing inventory
  - —Plan production and match supply to demand
  - —Obtain financial information for efficient decision making
- Desired a web-hosted ERP for Fuze Energy Drinks. Selected Sage Accpac ERP to provide an adaptable enterprise resource planning solution for finance, CRM, and operations
  - —Automation ensured timely controls on products going out of stock

Note: for more detail on this case study: http://www.investopedia.com/articles/investing/111214/lg-case-study-successful-enterprise-resource-planning-system.asp

Enterprise Resource Planning

Readiness

- Selecting and implementing an ERP involves a great deal of potential risk. Failed ERP implementation has the potential to fatally cripple your business
- Buying an ERP system is kind of like buying a car: it's a very expensive purchase with many different factors and options to consider
- An ERP system imposes top-down changes to all business process, affecting everyone in the organization
- Change management discipline and agility are critical to successful ERP implementations

Enterprise Resource Planning

Readiness (cont.)

- If you do not adequately weigh your requirements and research the system, you could make a very expensive mistake that ultimately cripples your business

Note: Before selecting an ERP system, outline your needs in order of priority, and create a value stream map of the process. Consider completing the process manually to confirm the process steps. The goal is to have the ERP system you select meet your needs, and not force your process to meet the operating requirements of an ERP system. Salespeople demonstrating an ERP system can overwhelm you with features and benefits. Take care that you are not drawn to the "bells and whistles" before you identify and understand the 5% of the ERP system performance that will make up 95% of your use.

Enterprise Resource Planning

Risk management

- Implementing a new ERP system involves a great deal of risk
- A failed ERP implementation can fatally cripple a business
- Client disappointment trends around three factors:
  - —Deficiency in the requirements-gathering process. Clients often under-report all critical requirements
  - —Absence of, or deficiency in, change-management disciplines
  - —Underestimating the amount of ERP/MRP training required prior to and during the go-live event
- Make sure that you have a clearly laid out implementation plan with full management support!

Enterprise Resource Planning

Case study 2 - Hershey

- Hershey suffered a failed ERP implementation that cost hundreds of millions of dollars due to strategic errors on their part
- To meet aggressive scheduling demands, Hershey's implementation team cut corners on critical testing phases
- Hershey scheduled ERP implementation during their busy season
- When the system went live, Hershey was incapable of processing more than $100 million in sales orders, even though the product was in stock

Read the full details here*:*
https://www.pemeco.com/wp-content/uploads/2013/09/Hershey_ERP_Case_Study.pdf

Enterprise Resource Planning

Case study 3 - Kentwool

- Kentwool signed an ERP implementation contract with NetSuite based on assurance that they could meet their business requirements
- Kentwool accepted NetSuite at their word and failed to perform reference checks and feature validations
- NetSuite failed to deliver the ERP software by the promised completion date
- Kentwool was charged an additional $288,000 above the original estimate of $246,000 for all functionality requested

Enterprise Resource Planning

Best practices

- Document **ALL** your requirements and weight them in order of importance
- Any requirement not discovered before you purchase will become apparent after installation, by which point it may be too late to do anything about it

Enterprise Resource Planning

Best practices (cont.)

General functions and features to look for:

- Inventory control
- Purchasing/receiving
- Production forecasting
- Bill of material support
- Master production scheduling
- MRP capabilities
- Shop floor control
- Quality control
- Document control
- Order processing
- Sales analysis
- Customer service/call management
- Customer relationship management (CRM)
- Accounts payable/receivable
- General ledger
- HR/payroll
- Fixed asset and capital expenses
- Budgeting
- Technical support

Enterprise Resource Planning

Assessing business processes

- All processes and requirements must be assessed when selecting an ERP/MRP

Sales Quotation Process		
Trigger	**Subprocesses**	**Result**
Customer requests quote.	Define customer requirements, develop cost estimate, negotiate price, terms, and conditions, close the sale.	Quote is won or lost
Case for Action		**Vision**
• We are losing deals because of the length of time it takes to develop bids • There are insufficient engineers to develop accurate cost proposals • We are losing money because of errors in cost estimates on fixed bid deals • Our current process is a combination of Oracle and individual spreadsheets		• We will standardize the quote process to facilitate training of new engineers. • We will streamline the quote process to provide quick turnaround on quotes. • We will achieve zero errors on cost estimates. • Sales reps will be able to tell the status of any quote instantly.
Actors/Participants	**Mechanisms**	**Metrics**
• Outside sales reps • Sales engineers • Customer service • Sales management	• Oracle sales quote system • Excel worksheets • Quotation request form • D&B credit check	• 16 outside sales reps • 4 sales engineers • Average 47 quotes per month, peak 93 in Q3 last year. • Average quote value: $533K • 14% of quotes have errors in costing that exceed 10% of quote value • 43% win ratio today, down from 57% in 2001

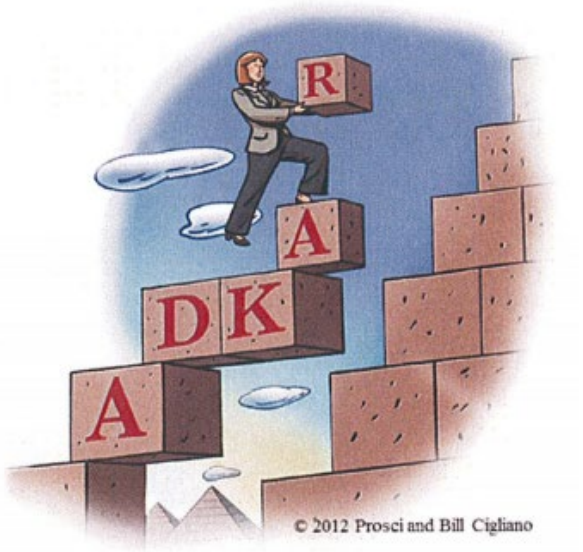
Process cards can help understand needs for each process

Change Management ERP Process

Success rate of sell supported

The five building blocks for successful change

Awareness
Desire
Knowledge
Ability
Reinforcement®



ERP systems impose top-down changes to all processes.
Change management discipline and agility are vital to success!

Change Management ERP Process

Success rate of sell supported (cont.)

Five Tenets of Change Management:

1. We change for a reason
2. Organizational change requires individual change
3. Organizational outcomes are the collective result of individual change
4. Change management is an enabling framework for managing the people side of change
5. Applying change management helps realize the benefits and desired outcomes of change

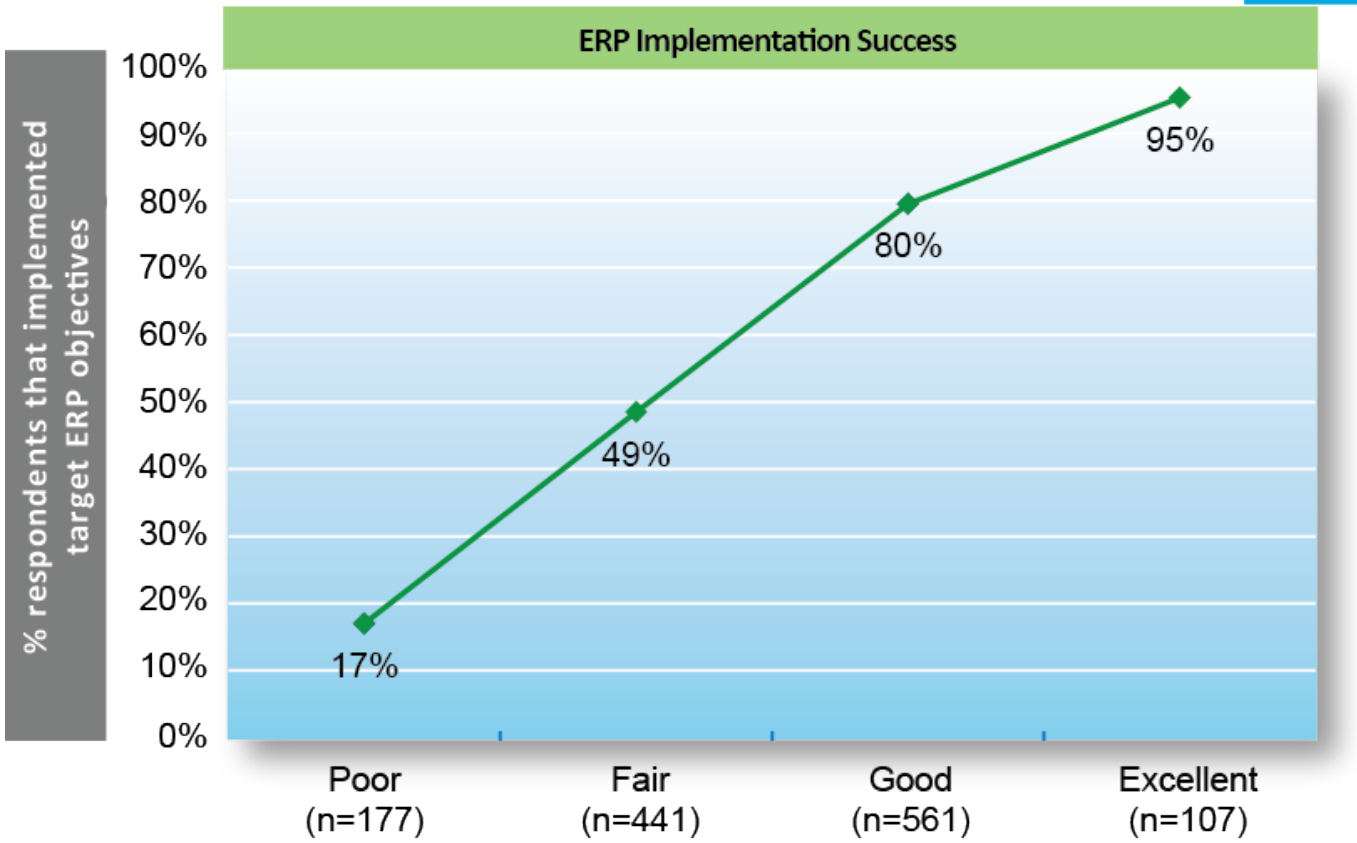
Resources

Change management

- Change management http://prosci.com/
- Change management http://www.change-management.com/
- Association of Change Management Professionals http://www.acmpglobal.org/
- Best practices in change management http://mnasq.org/wp-content/uploads/presentations/BestPracticesinChangeManagement.pdf

Change Management ERP Process

Success rate of sell supported (cont.)



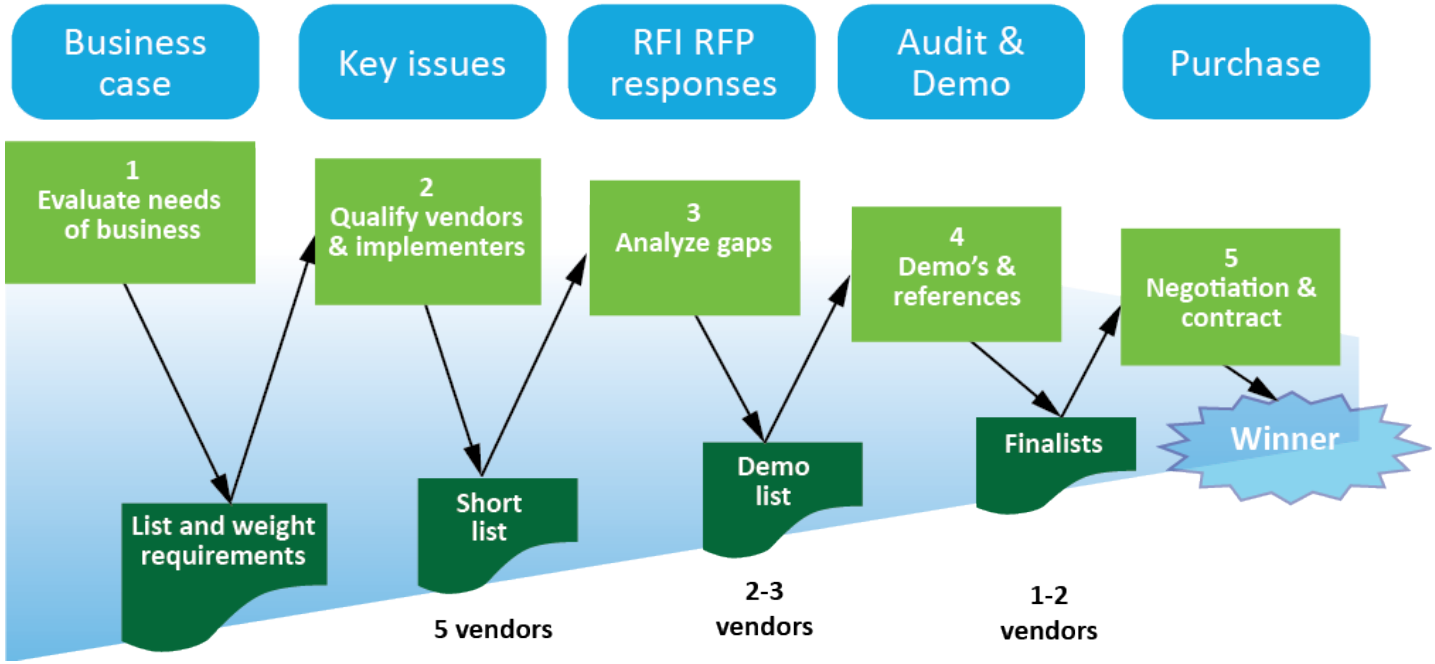
ERP systems impose top-down changes to all processes

Change management discipline and agility are vital to success

Resource Planning Systems

Selection process funnel

- Selecting an ERP/MRP system requires a significant investment of time and resources. There are thousands of features and functions that must be evaluated against your company's specific requirements



Resource Planning Systems

Key strengths

Increases customer satisfaction:

- Decreases customer response time and turn time* to provide a more consistent customer experience
- Mobile access provides reps in the field visibility to order information

Quality management:

- You can define inspection plan criteria and monitor results

**Note*: Turn time is the amount of time from receipt of order through delivery (often called lead time).

Resource Planning Systems

Key strengths (cont.)

Cost control:

- Material management controls let you have the right amount of inventory at the right time, reducing inventory overstock
- Better shop floor controls help reduce wasteful overproduction and defects

Supply chain coordination:

- Coordinate with your supply chain partners more effectively: vendors, contract manufacturers (CM) , and 3rd party logistics/distributors (3PL)
- Global visibility of inventory status
- Plan for and manage multiple production and shipping locations

Resource Planning Systems

Key strengths (cont.)

Plan, execute, and manage risk:

- Provides visibility of capabilities needed to make strategic decisions
- Measures progress and success of strategic initiatives and marketing campaigns
- Identifies weak spots and areas to improve throughout the enterprise

Resource Planning Systems

The right system at the right time

- ERP and MRP Systems can add significant value to manufacturing companies
- Choosing the right time to acquire an ERP/MRP is as important as which system to choose
- Understand the needs of your company so you can make an informed decision that meets your needs

Resource Planning Systems

Further topics to research

Like any investment, the more you put into your MRP/ERP systems, the more you get out of them. To maximize the return on your investment, we recommend the following topics for further research:

- Intro to supply chain management
- Demand management
- Master planning
- Material requirements planning
- Capacity management
- Production activity control
- Aggregate inventory management
- Item inventory management
- Purchasing and physical distribution
- Lean and quality systems
- Theory of constraints

List Of Terms

In glossary

- Manufacturing Resource Planning (MRP) is defined as a method for the effective planning of all resources of a manufacturing company. Ideally, it addresses operational planning in units, financial planning, and has a simulation capability to answer "what-if" questions and extension of closed-loop MRP.
- Enterprise Resource Planning (ERP) is the integrated management of core business processes, often in real-time and mediated by software and technology.
- Sales is activity related to selling or the amount of goods or services sold in a given time period.
- Efficiency is the (often measurable) ability to avoid wasting materials, energy, efforts, money, and time in doing something or in producing a desired result.
- Technology is the collection of techniques, skills, methods, and processes used in the production of goods or services or in the accomplishment of objectives, such as scientific investigation.
- Process Validation is the analysis of data gathered throughout the design and manufacturing of a product in order to confirm that the process can reliably output products of a determined standard.
- Material Requirements Planning (MRP) is a production planning, scheduling, and inventory control system used to manage manufacturing processes.
- Beginning Inventory is products or services that a business starts with during a new fiscal year.
- Demand Forecast is the art and science of forecasting customer demand to drive holistic execution of such demand by corporate supply chain and business management.
- Safety Stock term used by logisticians to describe a level of extra stock that is maintained to mitigate risk of stock-outs (shortfall in raw material or packaging) due to uncertainties in supply and demand.
- Ending Inventory is the amount of inventory a company has in stock at the end of its fiscal year.

List Of Terms

In glossary (cont.)

- **Master Production Schedule (MPS)** is a plan for individual commodities to be produced in each time period such as production, staffing, inventory, etc. It is usually linked to manufacturing where the plan indicates when and how much of each product will be demanded.
- **Electronic Data Interchange (EDI)** is the concept of businesses communicating electronically certain information that was traditionally communicated on paper.