**Information Technology**

# FIT 3138
# Real-Time Enterprise Systems

## Lecture 5

## ERP in Production and Supply Chain Management

# Unit Outline

| Week | W/C | Topic | Deadline: |
|------|-----|-------|-----------|
| 1 | 25/07 | Introduction to FIT3138;<br>Introduction to Enterprise Systems | |
| 2 | 01/08 | Systems Integration - Role of ERP in Business Functions and Processes | Assignment 1 handed out |
| 3 | 08/08 | The Development of ERP Systems | |
| 4 | 15/08 | ERP in Sales and Marketing & CRM | |
| 5 | 22/08 | ERP in Production and Supply Chain Management | |
| 6 | 29/08 | Accounting in ERP Systems | |
| 7 | 05/09 | Process Modelling & Improvement | Assignment 1 due<br>Assignment 2 handed out |
| 8 | 12/09 | ERP Implementation – Risk Management | |
| 9 | 19/09 | ERP Implementation – Data and System Integration and Configuration | |
| Mid-semester Break (26 Sep – 30 Sep 2022) | | | |
| 10 | 03/10 | ERP Implementation Issues: Managing Change | |
| 11 | 10/10 | Technologies supporting real-time enterprise | |
| 12 | 17/10 | Exam Review | Assignment 2 due |

# Objectives

- Describe the steps in the production planning process of a high-volume manufacturer such as Fitter Snacker

- Describe Fitter Snacker's production and materials management problems

- Describe how a structured process for Supply Chain Management planning enhances efficiency and decision making

- Describe how production planning data in an ERP system can be shared with suppliers to increase supply chain efficiency
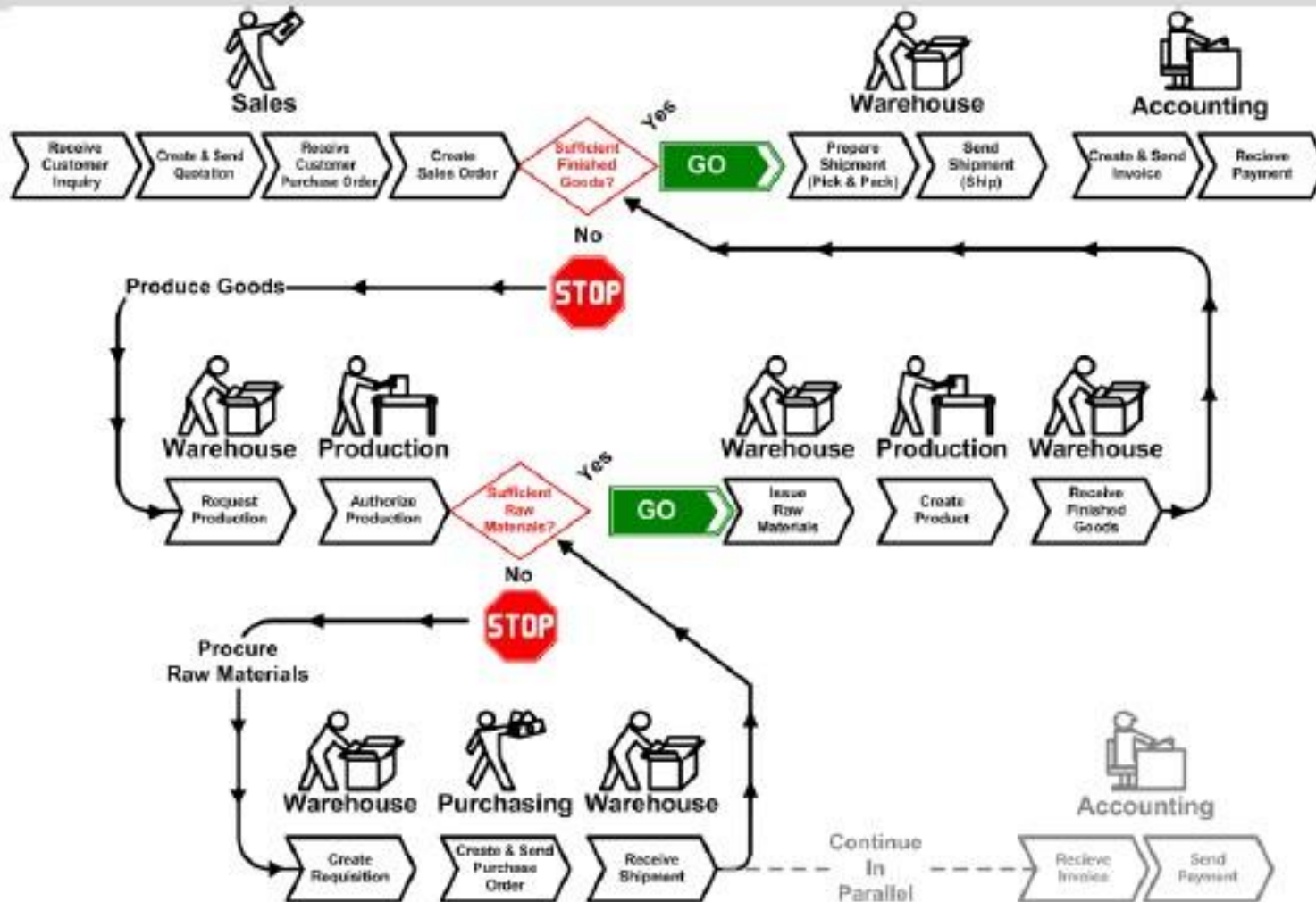
# Introduction

- Supply Chain Management (SCM) in an ERP system

- Fitter Snacker is part of a supply chain

- FS's SCM problems and how ERP can help fix them

# Integrated Processes
## Fulfillment + Procurement + Production

**An Overview**

### Scenario
- Make to order
- Procure to order
- Customer order triggers fulfillment
- Lack of inventory of bikes triggers production
- Lack of inventory of RM triggers procurement

# Production Overview

- To meet customer demand efficiently, Fitter Snacker must:
  - Develop a forecast of customer demand
  - Develop a production schedule to meet the estimated demand
- ERP system is a good tool for developing and executing production plans
- Goal of production planning is to schedule production economically

# Production Overview (cont'd.)

Three general approaches to production

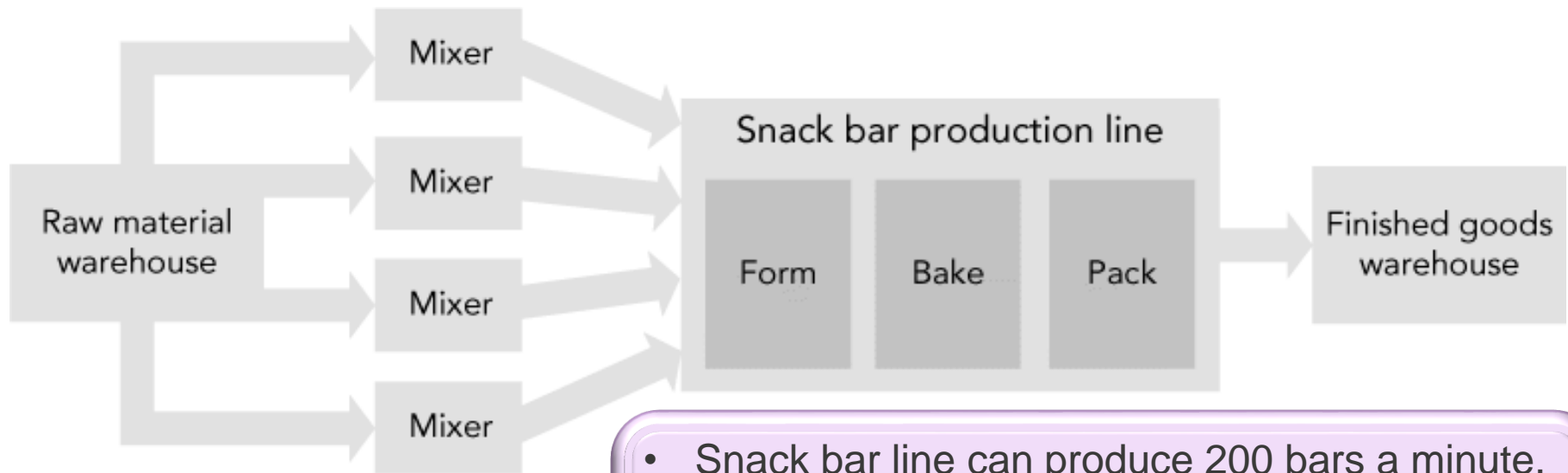**Make-to-stock** items: made for inventory (the "stock") in anticipation of sales orders
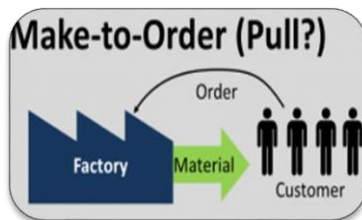
**Make-to-order** items: produced to fill specific customer orders

**Assemble-to-order** items: produced using a combination of make-to-stock and make-to-order processes

# An Example: Fitter Snacker's Manufacturing Process

- Fitter Snacker uses make-to-stock production



Diagram: Raw material warehouse → Mixer, Mixer, Mixer, Mixer → Snack bar production line (Form, Bake, Pack) → Finished goods warehouse

- Snack bar line can produce 200 bars a minute, or 12,000 bars per hour
- Entire production line operates on one shift a day
- Capacity: number of bars that can be produced

# Fitter Snacker's Production Problems

Fitter Snacker has problems deciding *how many* bars to make and *when* to make them

**Communication problems**

- FS's Marketing and Sales personnel do not share information with Production personnel
- Production personnel find it hard to deal with sudden increases in demand
  - >> Might cause shortages or stockout

**Inventory problems**

- Production manager lacks systematic method for:
  - >> Meeting anticipated sales demand
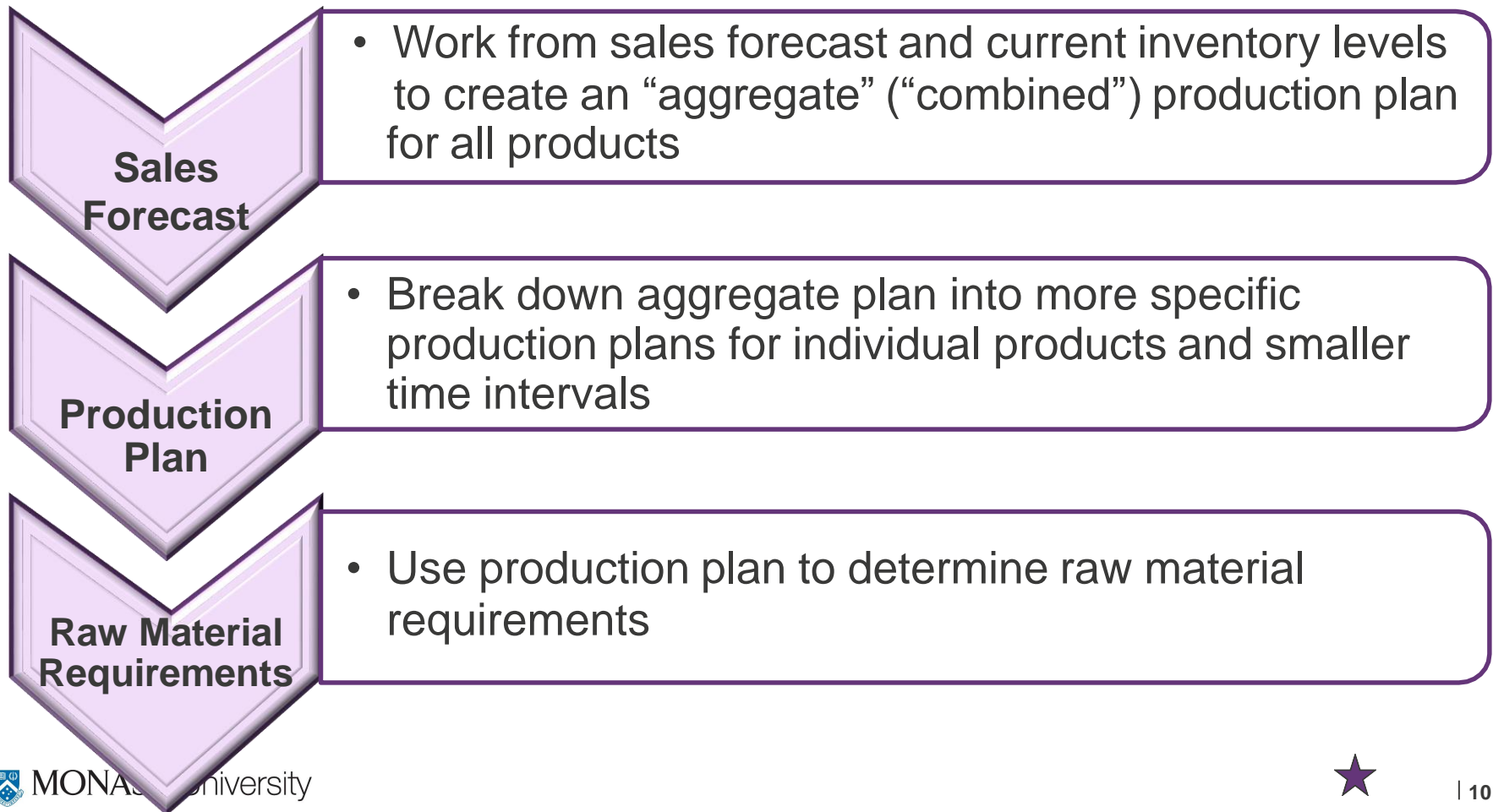  - >> Adjusting production to reflect actual sales

**Accounting and purchasing problems**

- **Standard costs**: normal costs of manufacturing a product
- Production and Accounting must periodically compare standard costs with actual costs and then adjust the accounts for the inevitable differences

# The Production Planning Process

Three important principles for production planning:

**Sales Forecast**

- Work from sales forecast and current inventory levels to create an "aggregate" ("combined") production plan for all products

**Production Plan**

- Break down aggregate plan into more specific production plans for individual products and smaller time intervals

**Raw Material Requirements**

- Use production plan to determine raw material requirements

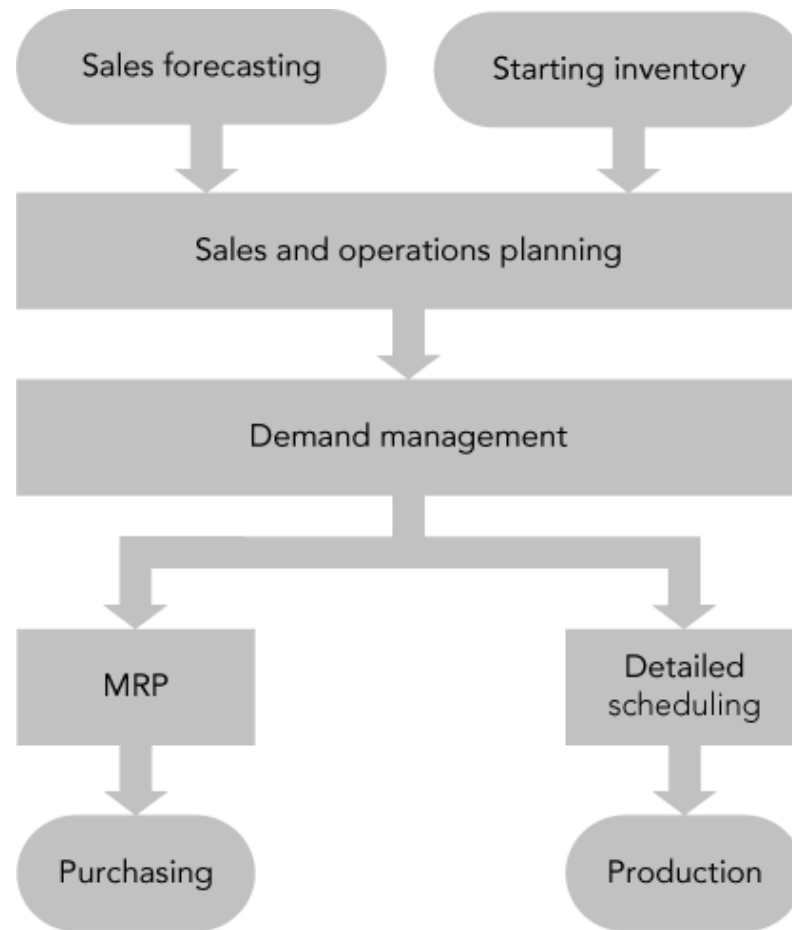# The SAP ERP Approach to Production Planning



Figure 4-2  The production planning process

# Sales Forecasting

- SAP's ERP system takes an integrated approach
  - Whenever a sale is recorded in Sales and Distribution (SD) module, quantity sold is recorded as a consumption value for that material

- Simple forecasting technique
  - Use a prior period's sales and then adjust those figures for current conditions

- In SAP ERP, sales forecast can be made using:
  - Historical sales data from the Sales and Distribution (SD) module
  - Input from plans developed in Controlling (CO) module

- CO module
  - Profit goals for company can be set
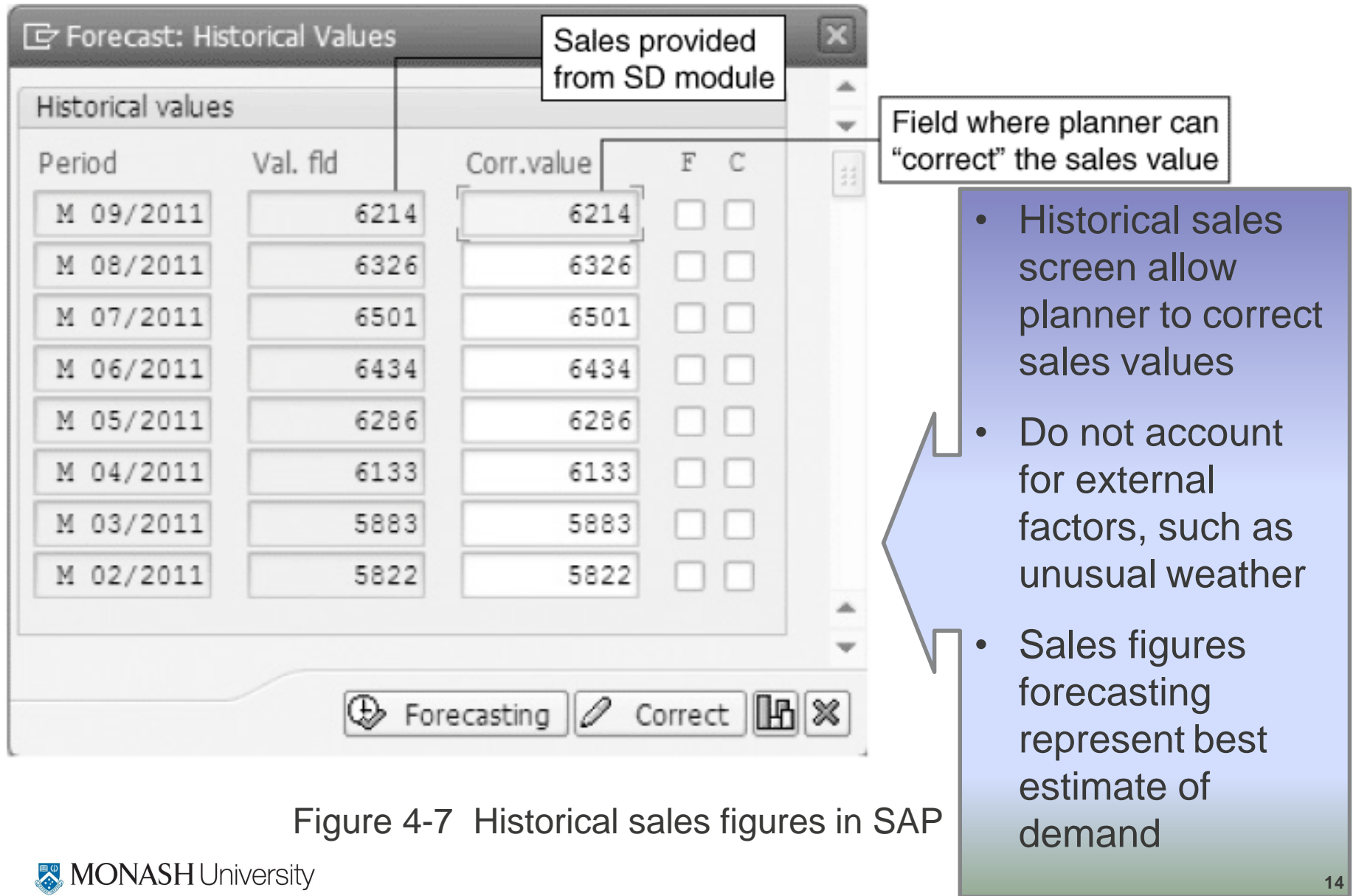  - Sales levels needed to meet the profit goals can be estimated

# Sales Forecasting – An example

| Sales forecasting | Jan. | Feb. | March | April | May | June |
|---|---|---|---|---|---|---|
| Previous year (cases) | 5734 | 5823 | 5884 | 6134 | 6587 | 6735 |
| Promotion sales (cases) | | | | | 300 | 300 |
| Previous year base (cases) | 5734 | 5823 | 5884 | 6134 | 6287 | 6435 |
| Growth: 3.0% | 172 | 175 | 177 | 184 | 189 | 193 |
| Base projection (cases) | 5906 | 5998 | 6061 | 6318 | 6476 | 6628 |
| Promotion (cases) | | | | | | 500 |
| Sales forecast (cases) | 5906 | 5998 | 6061 | 6318 | 6476 | 7128 |

Fitter Snacker's sales forecast for January through June

To make a forecast for Fitter Snacker:
    The previous year's sales data is used in combination with marketing initiatives to increase sales

**Forecast: Historical Values**

Sales provided from SD module

Field where planner can "correct" the sales value

| Historical values | | | | |
|---|---|---|---|---|
| Period | Val. fld | Corr.value | F | C |
| M 09/2011 | 6214 | 6214 | ☐ | ☐ |
| M 08/2011 | 6326 | 6326 | ☐ | ☐ |
| M 07/2011 | 6501 | 6501 | ☐ | ☐ |
| M 06/2011 | 6434 | 6434 | ☐ | ☐ |
| M 05/2011 | 6286 | 6286 | ☐ | ☐ |
| M 04/2011 | 6133 | 6133 | ☐ | ☐ |
| M 03/2011 | 5883 | 5883 | ☐ | ☐ |
| M 02/2011 | 5822 | 5822 | ☐ | ☐ |

Forecasting    Correct

Figure 4-7  Historical sales figures in SAP

- Historical sales screen allow planner to correct sales values

- Do not account for external factors, such as unusual weather

- Sales figures forecasting represent best estimate of demand

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**Forecast: Model Selection**

**Periods**

( • ) Period intervals

| | From | To |
|---|---|---|
| Forecast | 10/2011 | 10/2012 |
| Historical data | 10/2006 | 09/2011 |

( ) No. of periods

| No. of forecast periods | 0 |
|---|---|
| No. of historical values | 60 |

**Forecast execution**

( ) Constant models          ( ) Seasonal models

( ) Trend models             ( ) Season. trend models

( • ) Aut. model selection   ( ) Historical

**Forecast parameters**

Profile                      SAP

[ Forecasting ]  [ Historical... ]  [ Forecast profile... ]  [ Version... ]
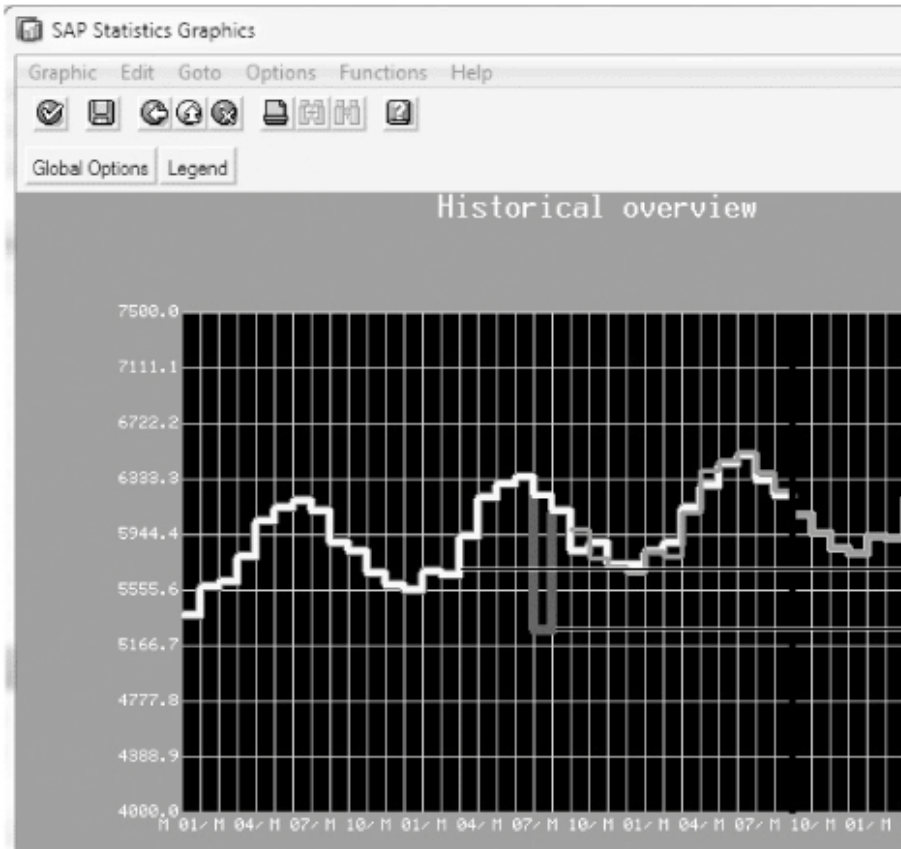
Forecasting model options in SAP ERP

**SAP Statistics Graphics**

Graphic  Edit  Goto  Options  Functions  Help

Global Options  Legend

Historical overview

Forecasting results presented graphically in SAP ERP

# Overview

Process of demand planning – derives a future demand program from past demand figures and begins with SOP

## Planning: Overview

**SAP**

LIS

Logistics information system

**Sales Operation Planning (SOP)**

Sales

Sales orders from Sales order Management – certain order by a certain date

MPS -Independent requirements -

**Demand Management**

MRP - Net requirements calculation to determine whether a material shortage exists

**Material Reqmts Planning (MRP)**

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**Production Execution**

Production execution is the processing of manufacturing orders through to manufacturing

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# Sales and Operations Planning

- Sales and operations planning (SOP)

  - Input: sales forecast provided by Marketing
  - Output: production plan designed to balance market demand with production capacity

    - Production plan is the input to the next step, demand management

**Fitter Snacker's sales and operations plan for January through June**

| Sales and operations planning | | Dec. | Jan. | Feb. | March | April | May | June |
|---|---|---|---|---|---|---|---|---|
| 1) Sales forecast | | | 5906 | 5998 | 6061 | 6318 | 6476 | 7128 |
| 2) Production plan | | | 5906 | 5998 | 6061 | 6318 | 6650 | 6950 |
| 3) Inventory | | 100 | 100 | 100 | 100 | 100 | 274 | 96 |
| 4) Working days | | | 21 | 20 | 23 | 21 | 21 | 22 |
| 5) Capacity (shipping cases) | | | 6999 | 6666 | 7666 | 6999 | 6999 | 7333 |
| 6) Utilization | | | 84% | 90% | 79% | 90% | 95% | 95% |
| 7) NRG-A (cases) | 70.0% | | 4134 | 4199 | 4243 | 4423 | 4655 | 4865 |
| 8) NRG-B (cases) | 30.0% | | 1772 | 1799 | 1818 | 1895 | 1995 | 2085 |

# Sales and Operations Planning (cont'd.)

- **Rough-cut planning**: common term in manufacturing for aggregate planning

  – Disaggregated to generate detailed production schedules

- Once SAP ERP system generates a forecast, the planner can view the results graphically

- Rough-cut capacity planning applies simple capacity-estimating techniques to the production plan to see if the techniques are feasible

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# Sales and operation plan with rough-cut capacity calculation in SAP ERP

# Sales and Operations Planning (cont'd.)

- Disaggregating the sales and operations plan

  - Companies typically develop sales and operations plans for product groups
  - SAP ERP system allows any number of products to be assigned to a product group
  - Sales and operation plan disaggregated

    - Production plan quantities specified for the group are the individual products that make up the group



**Real-time Sales & Operations Planning**

Develop Precise Forecasts

transferred to

Balance Supply & Demand

Analytics at the Core

Synchronize

Shape Demand

Execute & Monitor

# Product group structure in SAP ERP

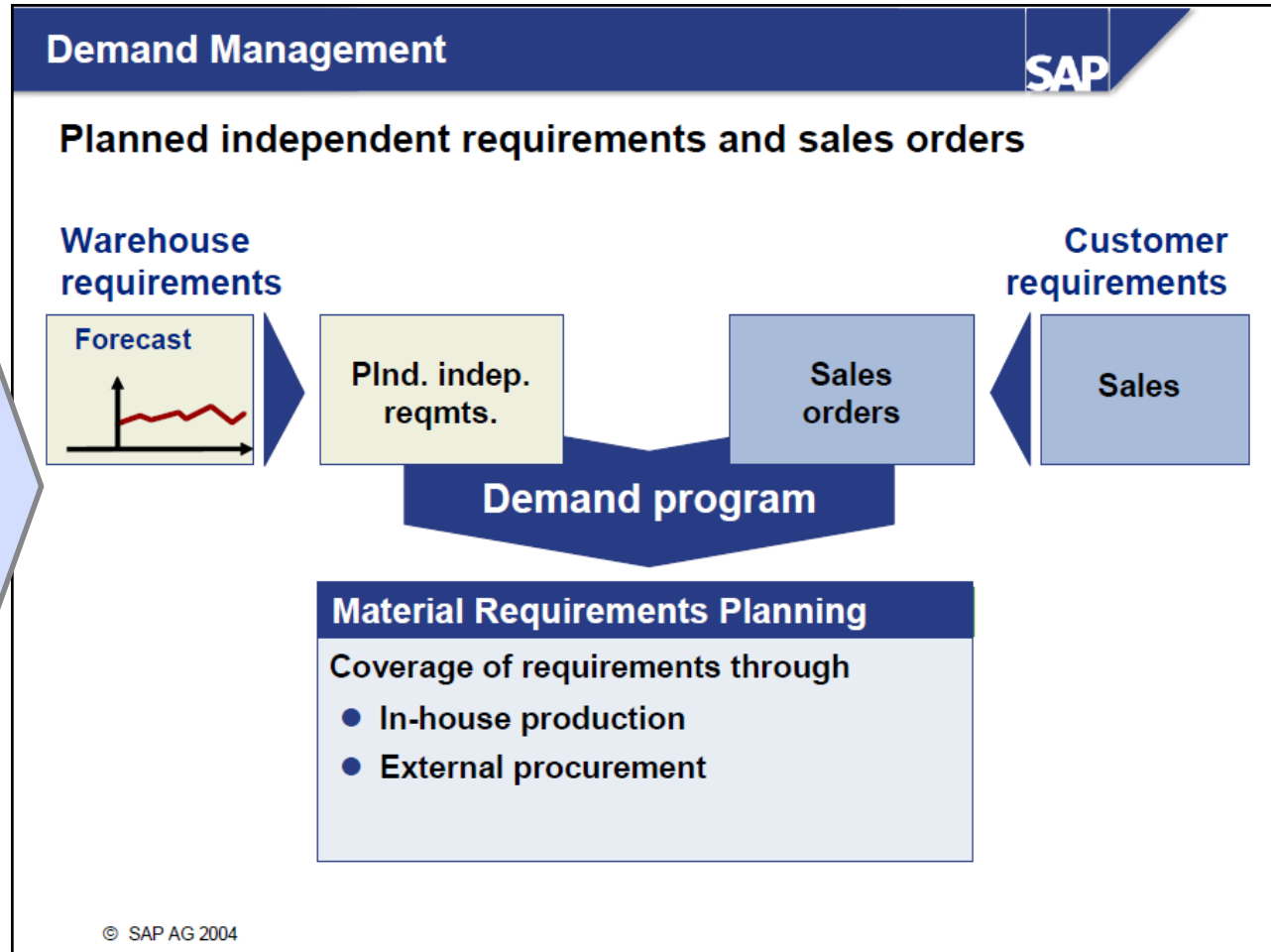# Stock/Requirements List (for NRG-A bars) after disaggregation



Anticipated demand for NRG-A bars from sales and operations plan

# Demand Management

DM creates a forecast of market demand for the products you sell. Forecast is based on customer contracts, planned sales orders and other demands.

Planned independent requirements are warehouse requirements. Eg in make to stock you initiate the purchase of materials without waiting for sales orders



**Demand Management** — SAP

**Planned independent requirements and sales orders**

Warehouse requirements

Forecast → Plnd. indep. reqmts.

Customer requirements

Sales orders ← Sales

**Demand program**

**Material Requirements Planning**

Coverage of requirements through
- In-house production
- External procurement

© SAP AG 2004

# Demand Management

- Links the sales and operations planning process with detailed scheduling and materials requirements planning processes

- Output: **master production schedule (MPS)**

    - Production plan for all finished goods

- For Fitter Snacker, MPS is an input to detailed scheduling, which determines what bars to make and when to make them

# Demand Management - Example

| Demand management | Week 1<br>1/3–1/7 | Week 2<br>1/10–1/14 | Week 3<br>1/17–1/21 | Week 4<br>1/24–1/28 | Week 5<br>1/31 | Week 5<br>2/1–2/4 |
|---|---|---|---|---|---|---|
| Monthly demand    NRG-A | 4134 | 4134 | 4134 | 4134 | 4134 | 4199 |
| NRG-B | 1772 | 1772 | 1772 | 1772 | 1772 | 1799 |
| Working days in week | 5 | 5 | 5 | 5 | 1 | 4 |
| Working days in month | 21 | 21 | 21 | 21 | 21 | 20 |
| MPS    NRG-A | 984 | 984 | 984 | 984 | 1037 | |
| Weekly demand    NRG-B | 422 | 422 | 422 | 422 | 444 | |

| Demand management | Jan 3 | Jan 4 | Jan 5 | Jan 6 | Jan 7 |
|---|---|---|---|---|---|
| Monthly Demand    NRG-A | 4134 | 4134 | 4134 | 4134 | 4134 |
| NRG-B | 1772 | 1772 | 1772 | 1772 | 1772 |
| Working days in month | 21 | 21 | 21 | 21 | 21 |
| MPS    NRG-A | 197 | 197 | 197 | 197 | 197 |
| Daily demand    NRG-B | 84 | 84 | 84 | 84 | 84 |

Fitter Snacker's production plan for January: The first five weeks of production are followed by a day-by-day disaggregation of week 1

# Demand Planning Process

**Past sales order quantities form a basis for the forecasting of future demands.**

**One off events such as trade fairs can be included in the forecast.**

**The demand plan is released as a planned independent requirement.**

**These form the basis for purchasing and production planning.**



The Demand Planning Process

SAP

Aggregated historical data

Future demand forecast

Update

Release

Sales orders

Consumption possible

Planned independent requirements

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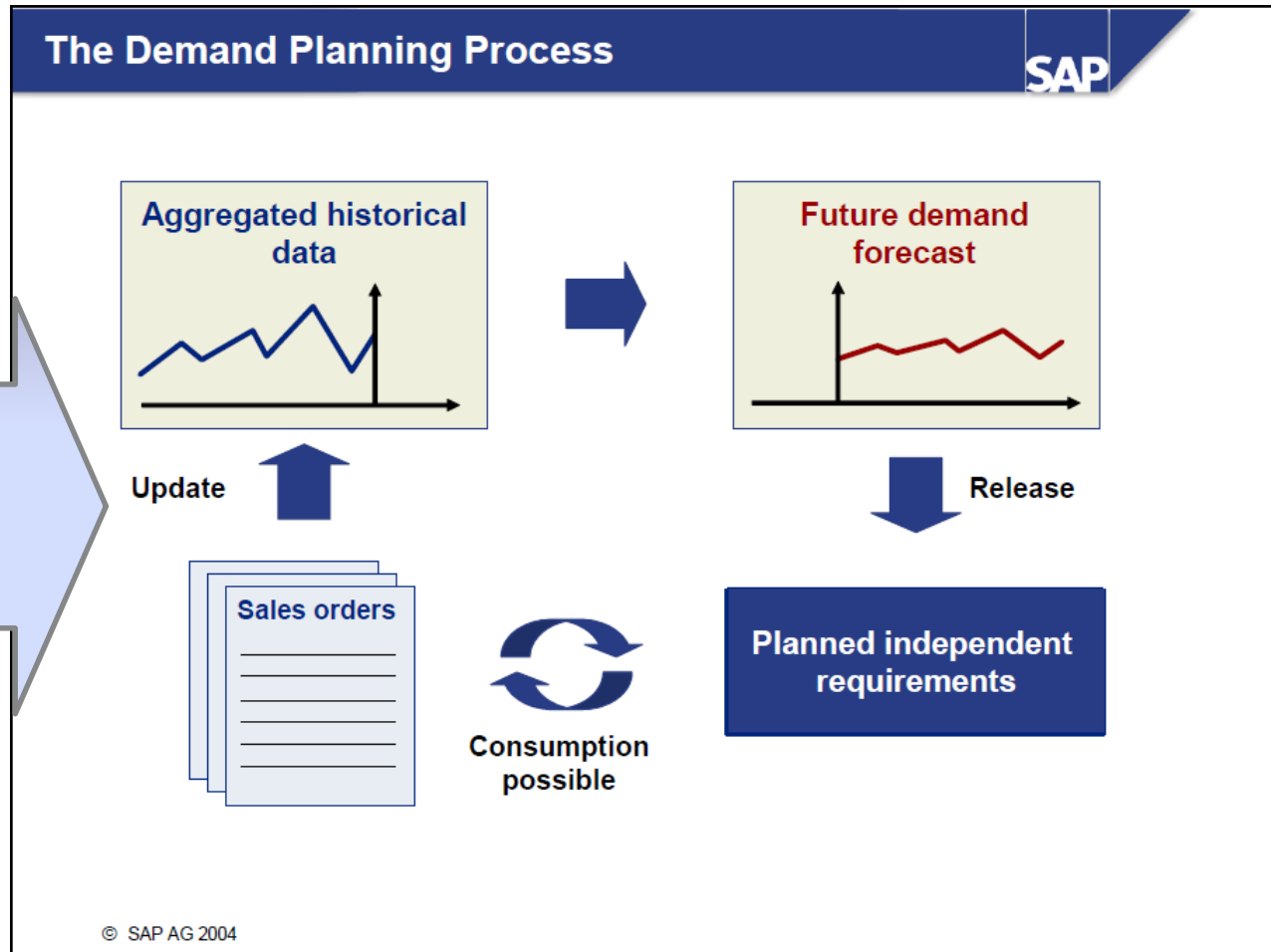
# Materials Requirements Planning (MRP)



Video : What is MRP

# Materials Requirements Planning (MRP)

- Determines required quantity and timing of the production or purchase of subassemblies and raw materials needed to support MPS

- **Bill of material (BOM)**: list of the materials (including quantities) needed to make a product

Eg:The bill of material (BOM) for Fitter Snacker's NRG bars

| Ingredient | Quantity | |
|---|---|---|
| | NRG-A | NRG-B |
| Oats (lb.) | 300 | 250 |
| Wheat germ (lb.) | 50 | 50 |
| Cinnamon (lb.) | 5 | 5 |
| Nutmeg (lb.) | 2 | 2 |
| Cloves (lb.) | 1 | 1 |
| Honey (gal.) | 10 | 10 |
| Canola oil (gal.) | 7 | 7 |
| Vit./min. powder (lb.) | 5 | 5 |
| Carob chips (lb.) | 50 | |
| Raisins (lb.) | 50 | |
| Protein powder (lb.) | | 50 |
| Hazelnuts (lb.) | | 30 |
| Dates (lb.) | | 70 |

# Materials Requirements Planning (MRP) (cont'd.)

- Lead times and lot sizing

  – **Lead time**: cumulative time required for the supplier to receive and process the order, take the material out of stock, package it, load it on a truck, and deliver it to the manufacturer

  – **Lot sizing**: determining production quantities and order quantities





| LOT Size Chart | |
| --- | --- |
| LOT | NUMBER OF UNITS |
| Standard | 100,000 |
| Mini | 10,000 |
| Micro | 1,000 |
| Nano | 100 |

# Materials Requirements Planning (MRP) - Example

| Oats Lead time = 2 weeks | | Week 1 | Week 2 | Week 3 | Week 4 | Week 5 |
|---|---|---|---|---|---|---|
| MPS (cases) | NRG-A | 984 | 984 | 984 | 984 | 1037 |
| | NRG-B | 422 | 422 | 422 | 422 | 444 |
| MPS (500 lb. batches) | NRG-A | 142 | 142 | 142 | 142 | 149 |
| | NRG-B | 61 | 61 | 61 | 61 | 64 |
| Gross requirements (lb) | | 57,850 | 57,850 | 57,850 | 57,850 | 60,700 |
| Scheduled receipts | | 44,000 | 44,000 | | | |
| Planned receipts | | | | 88,000 | 44,000 | 44,000 |
| On hand | 29,650 | 15,800 | 1,950 | 32,100 | 18,250 | 1,550 |
| Planned orders | | 88,000 | 44,000 | 44,000 | | |

Figure 4-17  The MRP record for oats in NRG bars, weeks 1 through 5

# Materials Requirements Planning in SAP ERP

- MRP process creates planned orders to meet dependent requirements

- The main purposes of an MRP system are:

  - Control inventory levels : "order the right quantity of the right part at the right time".

  - Assign the correct priorities to items.

  - Plan the capacity.

- Stock/Requirements List shows:

  - Planned orders

  - Purchase requisitions (PurRqs)

  - Purchase orders (POitem)

The output of MRP is either a *planned (production) order* or a *purchase order/requisition*.

The MRP list in SAP ERP

The Stock/Requirements List in SAP ERP

# Materials Requirements Planning in SAP ERP

- Planner can convert a planned order to a purchase order from Stock/Requirements List by double-clicking the planned order line



Conversion of a planned order to a requisition

# Materials Requirements Planning in SAP ERP (cont'd.)

- Integrated information system allows Purchasing to make the best decision on a vendor based on relevant, up-to-date information

- Once Purchasing employee decides which vendor to use, the purchase order is transmitted to vendor

  - System can be configured to fax order to vendor, transmit it electronically through EDI (electronic data interchange), or send it over the Internet

# Source Overview screen for supplier selection



Source Overview for Item 00010

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
Material: R380 — Oats
Quantity: 44,000 — LB

| Vendor | Name | Info/agmt. | Item | Net price | Crcy | Realistic D... | POrg | Pln |
|---|---|---|---|---|---|---|---|---|
| 100000 | Climax Cereals | 5300002200 | | 0.20 | USD | 11/04/2011 | 00PR | 00: |
| 100100 | Grand Rapids | 5300002300 | | 0.20 | USD | 11/04/2011 | 00PR | 00: |
| 100200 | Oshtemo Oats | 5300002400 | | 0.20 | USD | 11/04/2011 | 00PR | 00: |

Source of supply   Vendor   Price simulation   Price simulation/all   Vendor eval.

Options to evaluate vendors

# MRP system inputs/outputs

In the MRP there are three major inputs:

- **Inventory status**

  Stock of materials used in production. It is updated as stock is received from vendors and as stock is sent out to manufacture the final product

- **MPS**

  Provides a diary showing which jobs will be done, the order in which they will be done, which work group or machine will do the work and when each job should start and end.

- **BOM**

  Is a listing of all components, including partially assembled pieces and basic parts that make up an end product

Inventory Status

Master production Schedule

(In SAP this is optional)

Bill of Materials

M.R.P. System

Inventory transactions data

Changes to planned orders

Order releases

Planned order schedule

Storage materials handling

Purchase orders

Planning reports

Performance reports

Exception reports
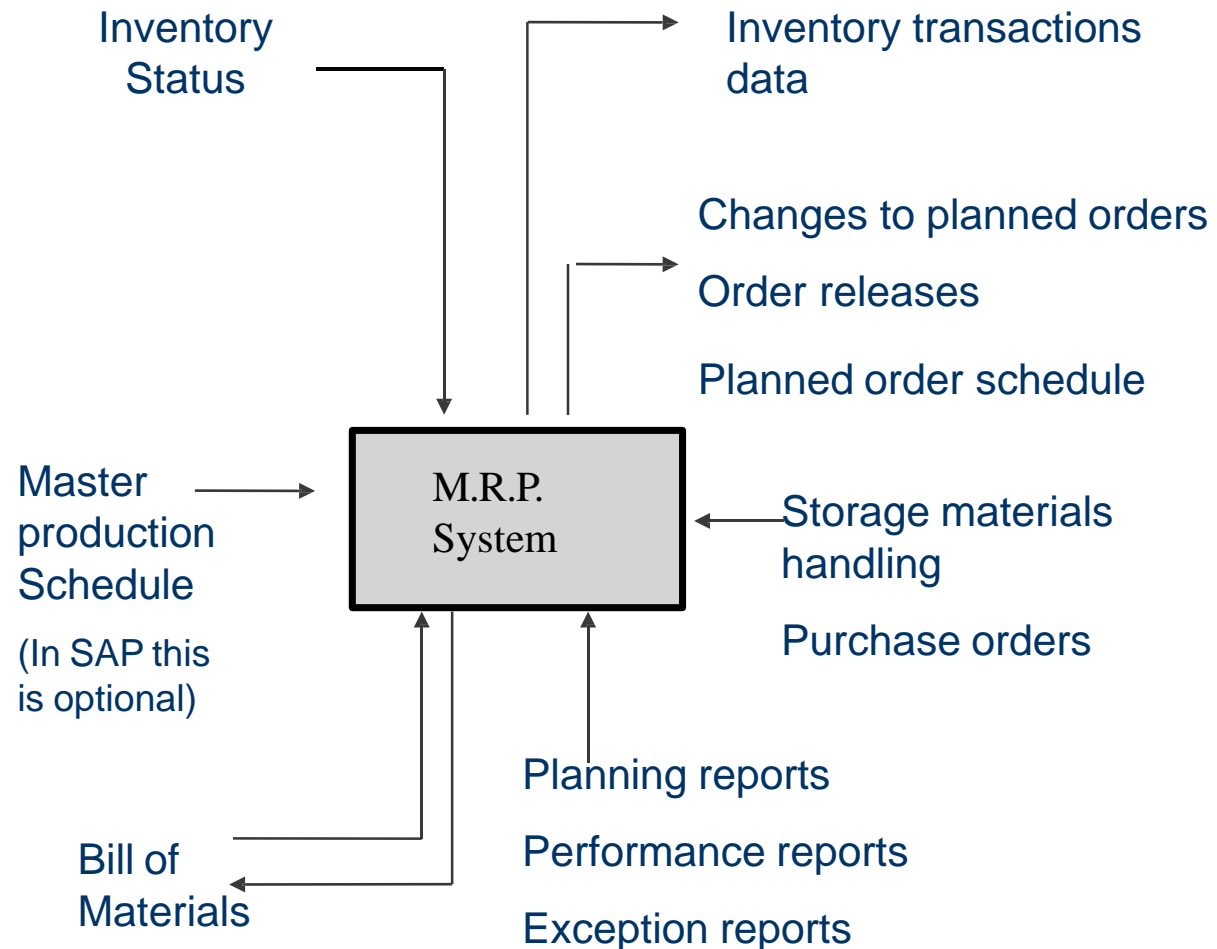
# Detailed Scheduling

Detailed plan of what is to be produced, considering capacity and available labor

One key decision in detailed production scheduling:

- How long to make the production runs for each product

Production run length requires a balance between setup costs and holding costs to minimize total costs to the company

- Production runs should be decided by evaluating the cost of equipment setup and holding inventory

**Integrated information system simplifies this analysis**

- Automatically collects accounting information that allows managers to better evaluate schedule trade-offs in terms of costs to company

# Detailed Scheduling (cont'd.)

- Fitter Snacker uses repetitive manufacturing

- Repetitive manufacturing environments usually involve production lines that are switched from one product to another similar product

– Production lines are scheduled for a period of time, rather than for a specific number of items

# Providing Production Data to Accounting

- In the manufacturing plant, ERP packages do not directly connect with production machines

- Data can be entered into SAP ERP through a PC on the shop floor, scanned by a barcode reader or radio frequency identification (RFID) technology, or a mobile device

- In an integrated ERP system, the accounting impact of a material transaction can be recorded automatically

# Providing Production Data to Accounting (cont'd.)

- Once FS accepts shipment, Receiving must notify SAP ERP system of the arrival and acceptance of the material

  – Goods receipt transaction

- Receiving department must match goods receipt with purchase order that initiated it

- When receipt is successfully recorded, SAP ERP system immediately records the increase in inventory levels for the material

# Providing Production Data to Accounting (cont'd.)



Figure 4-23  Goods receipt screen in SAP ERP

**Concepts in Enterprise Resource Planning, Fourth Edition**

# ERP and Suppliers

- Fitter Snacker is part of a supply chain

  - Starts with farmers growing oats and wheat

  - Ends with a customer buying an NRG bar from a retail store

- ERP systems can play a key role in collaborative planning
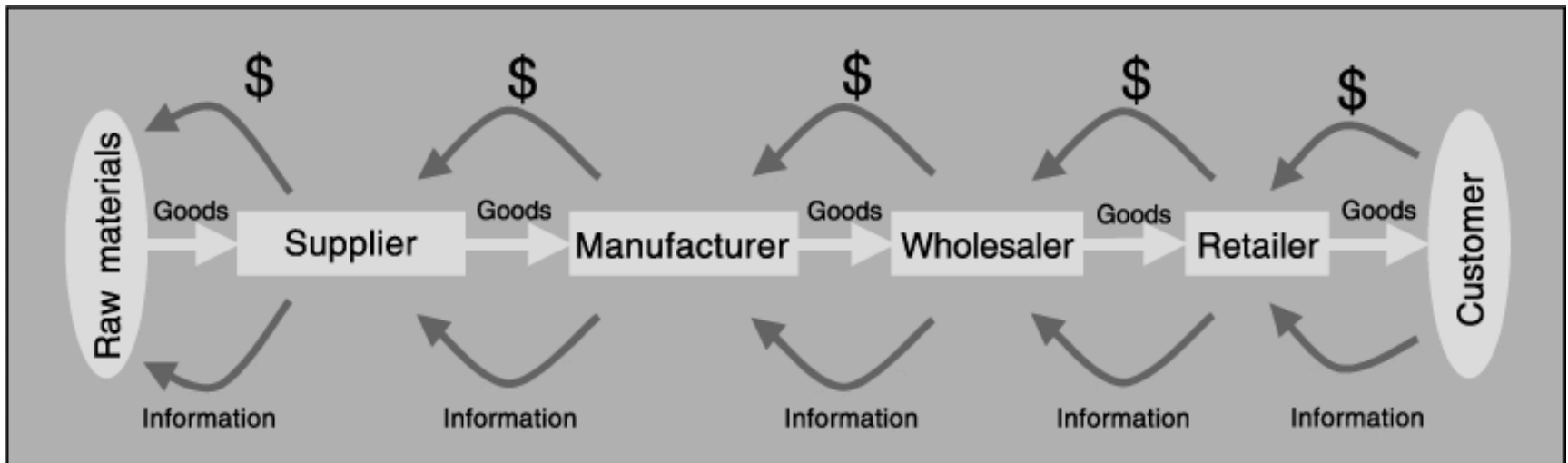
# ERP and Suppliers (cont'd.)

- Working with suppliers in a collaborative fashion requires trust among all parties

    – Company opens its records to its suppliers

    – Suppliers can read company's data because of common data formats

- Advantages

    – Reductions in paperwork

    – Savings in time

    – Other efficiency improvements

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# The Traditional Supply Chain



Video : What is the Supply Chain ?

# The Traditional Supply Chain (cont'd.)

- EDI and ERP

  - Before ERP systems were available, companies could be linked with customers and suppliers through electronic data interchange (EDI) systems

  - Well-developed ERP system can facilitate SCM

    - Needed production planning and purchasing systems already in place

  - With ERP system, sharing production plans along the supply chain can occur in real time

# Supply Chain Management
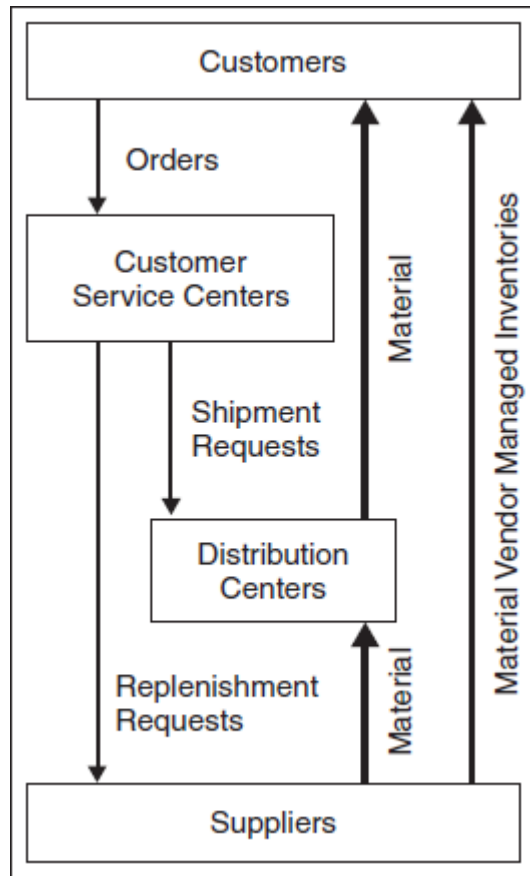


According to the *Council of Supply Chain Management Professionals (CSCMP)* definition:

Supply chain management … "encompasses the planning and management of all activities involved in sourcing and procurement, conversion, and all logistics management activities. Importantly, it also includes coordination and collaboration with channel partners, which can be suppliers, intermediaries, third-party service providers, and customers. In essence, supply chain management integrates supply and demand management within and across companies."

Collaboration in Supply Chain Information. *Source:* Sanjay Jain, Supply Chain Management Tradeoffs Analysis, in *Proceedings of the 2004 Winter Simulation Conference*, R. G. Ingalls, M. D. Rossetti, J. S. Smith, and B. A. Peters, eds.

# ERP System and Supply Chain

- Traditionally SCM (Supply Chain Management) was not part of ERP because the domain of SCM was to link the company with external partners, whereas the focus of ERP was mainly on the internal functions of the company.

- A fully-integrated ERP system may include both CRM and SCM that provide an efficient and flexible operational environment between the company and its business partners, suppliers, distributors, customers  and other stakeholders.

- SCM provides a link for services, materials, and information across the value chain of the organisation. They may include procurement, outsourcing, manufacturing flow management, order fulfilment, forecasting, etc.

- The SCM strategy must be aligned with the corporate strategy of the organization.

- A strong SCM implementation is necessary for e-Business.

# The Measures of Success

- Performance measurements
  - Metrics
  - Show the effects of better supply chain management

- Cash-to-cash cycle time
  - Time between paying for raw materials and collecting cash from customer

- SCM costs
  - Include cost of buying and handling inventory, processing orders, and information systems support

# The Measures of Success (cont'd.)

- **Initial fill rate**

  - Percentage of the order that the supplier provided in the first shipment

- **Initial order lead time**

  - Time needed for the supplier to fill the order

- **On-time performance**

  - If supplier agreed to requested delivery dates, tracks how often supplier actually met those dates

# Summary

- ERP system can improve the efficiency of production and purchasing processes

    - Efficiency begins with Marketing sharing a sales forecast

    - Production plan is created based on sales forecast and shared with Purchasing so raw materials can be ordered properly

- Companies can do production planning without an ERP system, but an ERP system increases company's efficiency

    - ERP system that contains materials requirements planning allows Production to be linked to Purchasing and Accounting

    - This data sharing increases a company's overall efficiency

# Summary (cont'd.)

- The successful integration of these processes together with process optimisation enable organisations to obtain value by:
  - increasing customer satisfaction,
  - increasing productivity and
  - decreasing overall operating costs
- Companies are building on their ERP systems and integrated systems philosophy to practice supply chain management (SCM)
  - SCM: company looks at itself as part of a larger process that includes customers and suppliers
  - Using information more efficiently along the entire chain can result in significant cost savings
  - Complexity of the global supply chain
    - Developing a planning system that effectively coordinates information technology and people is a considerable challenge

# End of Lecture 5



_**References**_:

- Ellen Monk, Bret Wagner. (2013). Concepts in Enterprise Resource Planning. (4e) Course Technology, Cengage Learning. Chapter 4

- Motiwalla, L. & Thompson, J. (2015). Enterprise systems for management. (2e) Pearson. Chapter 11