Concepts in Enterprise Resource Planning

Chapter 4

Production and Supply Chain Management Information Systems

Chapter 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

- Enterprise Resource Planning (ERP) has its roots in Materials Requirements Planning (MRP)
  - MRP is still a large part of ERP systems
- Supply Chain Management (SCM) looks at the entire supply system from raw materials to finished goods on the retail shelf
  - SCM: sharing long-range production schedules between a manufacturer and its suppliers, so raw materials can be ordered and delivered in a timely manner, thus avoiding stockouts or excess inventory.

Production Overview

- A production plan answers two questions:
  1. How many of each type of snack bar should we produce, and when?
  2. What quantities of raw materials should we order so we can meet that level of production, and when should they be ordered?
- A successful company must be able to make adjustments when customer demand differs from the forecast.

- An ERP system is a good tool for developing and executing production plans because it integrates the SCM functions of:
  - Production planning,
  - Purchasing,
  - Materials Management / Warehousing,
  - Quality Management, and
  - Sales and Accounting

Production Overview

- The goal of production planning is to schedule production economically so that goods can be shipped to customers to meet promised delivery dates in the most cost-efficient manner.
- Three general production approaches:
  - *Make-to-stock:* products are made for inventory/stock in anticipation of sales orders
    - Most consumer products are make-to-stock (e.g. cameras, canned corn, and books)
  - *Make-to-order:* products are made to fill specific customer orders
    - Expensive products or products made to customer specifications (e.g. airplanes and large industrial equipment)
  - *Assemble-to-order:* combination of make-to-stock and make-to-order
    - Final product assembled for a specific customer order from stock components (e.g. personal computers)

Fitter Snacker's Manufacturing Process

- Snack bar line produces:
  - 200 bars/minute, or 3,000 lb/hr
  - Each bar weighs 4 ounces
- Production line operates for one 8-hour shift per day
- Raw materials are mixed in one of four mixers
  - Mixers can produce 4,000 lb of dough per hour
- The 4 oz snacks are packed 24 to a display box with 12 display boxes packed to a case
- Changing from NRG-A to NRG-B bars takes 30 minutes for cleaning the equipment and changing the wrappers, display boxes, and shipping cases.
  - If two products are produced in one day, then a half-hour of capacity is lost in the changeover.
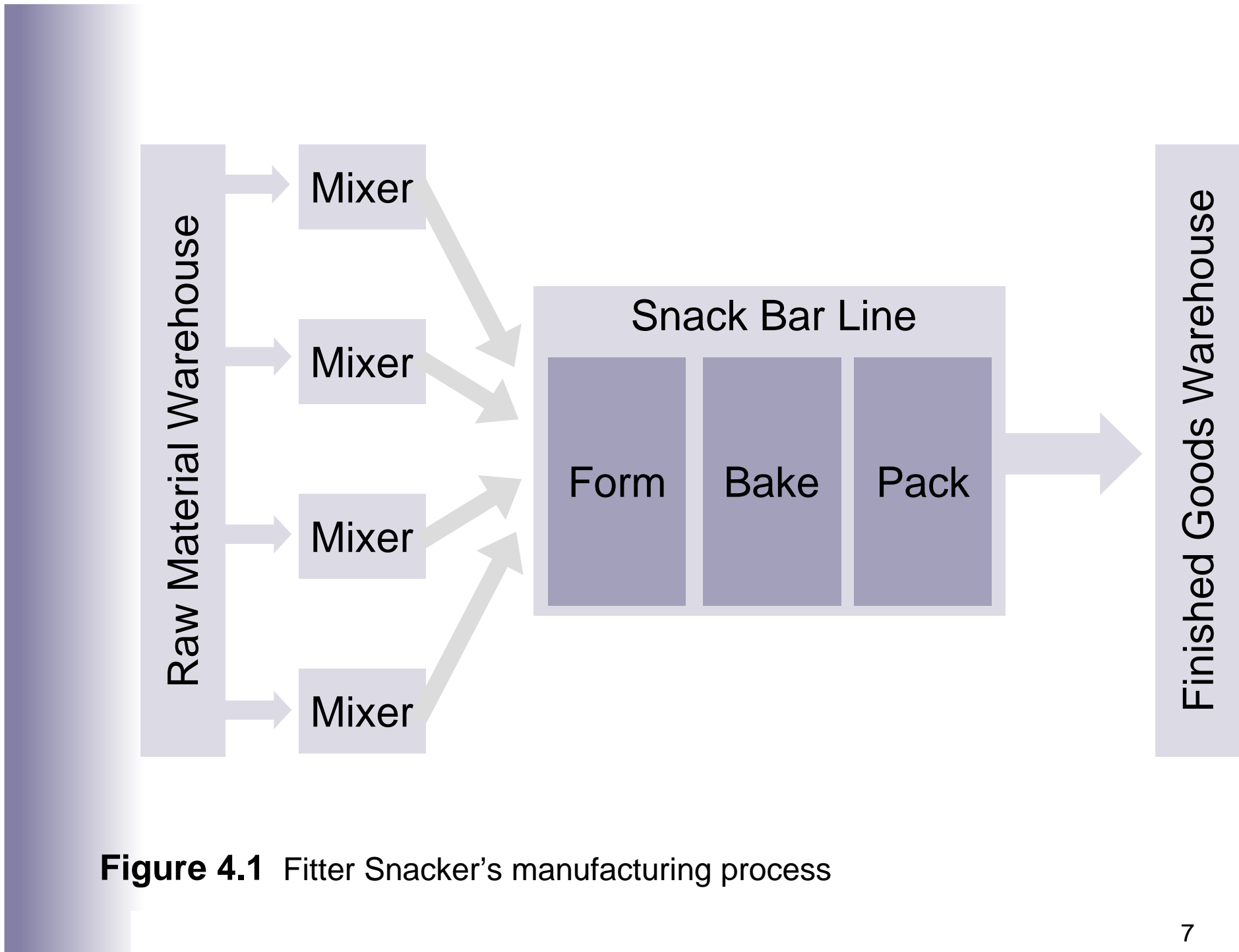
Figure 4.1 Fitter Snacker's manufacturing process

Fitter Snacker's Production Problems

- Fitter Snacker's production problem is deciding *how many* snack bars to make and *when* to make them

- Fitter Snacker's main production problems are in the areas of:

  1. Communication problems

  2. Inventory problems

  3. Accounting and purchasing problems

- All of which are exacerbated by Fitter Snacker's un-integrated information system

1. Communication Problems

- Communication problems exist in most companies
  - Magnified in a company without an integrated information system
- At Fitter Snacker, Marketing and Production do not communicate or coordinate planning
  - Marketing frequently excludes Production from meetings
  - Production is not always informed of sales promotions or unexpected planned orders
    - Can result in depleted inventory, overtime production, expedited shipments and material shortages
  - Production may not inform Marketing about planned maintenance, which will reduce production

2. Inventory Problems

- Production manager schedules production based on experience, rather than formal planning techniques
  - Primarily compares current warehouse inventory levels with "normal" amount (of finished goods that should be stocked)
    - May include informal communications with marketing personnel
  - Inventory information is not available in real-time, and does not recognize inventory that has been sold but not shipped
    - Inventory available to commit to future orders is not known

2. Inventory Problems

- Inventory shortages may mean unplanned production changeovers, resulting in:
    - Lost production capacity
    - Potential shortages of other products
    - For example, two large Wholesale Division orders arriving at the same time can deplete the entire available inventory of NRG-A bars.
        - In this case, the Production department must change the production of NRG-B bars so it can fill the orders for NRG-A.
        - This changeover means production of NRG-B bars must be delayed, and production capacity will be lost due to the unplanned production changeover.

2. Inventory Problems

- Actual sales data is not available on a timely basis, because:
  - It is hard to gather
  - Lack of organizational trust (between the Sales and Production departments)
    - This distrust may exist as a result of prior negative experiences or competition between the departments
- With access to sales forecasts and plans and real-time sales order data, production could make better decisions and manage inventory better

3. Accounting Problems

- Manufacturing costs are based on the number of bars produced each day, a number that is measured at the end of the snack bar production line.

- Most companies use **standard costs** to account for manufacturing costs

  - Standard costs are based on historical costs for materials, labor and factory overhead

  - Manufacturing costs are estimated by multiplying production quantities by standard costs

  - Requires that standard costs be adjusted periodically to conform with actual costs

3. Accounting Problems

- FS is not good at controlling raw materials purchases, and the production manager cannot give the purchasing manager a good production forecast.

- So the purchasing manager works on two tracks:
  - First, she tries to keep inventories high to avoid stockouts.
  - Second, if she's offered good bulk-quantity discounts on raw materials, she will buy in bulk, especially for items that have long lead-time for delivery.

- These purchasing practices make it difficult to forecast the volume of raw materials that will be on hand and their average cost.

Production Planning Process

- Production planning involves 3 important principles:

  1. Developing an aggregate production plan for groups of products

     - Work from a sales forecast and current inventory levels to create an "aggregate" production plan for all products.

     - Aggregate production plans help to simplify the planning process.

     - Aggregate plans should consider the available capacity in the facility

  2. Breaking down the aggregate plan into more specific plans for individual products using smaller time increments

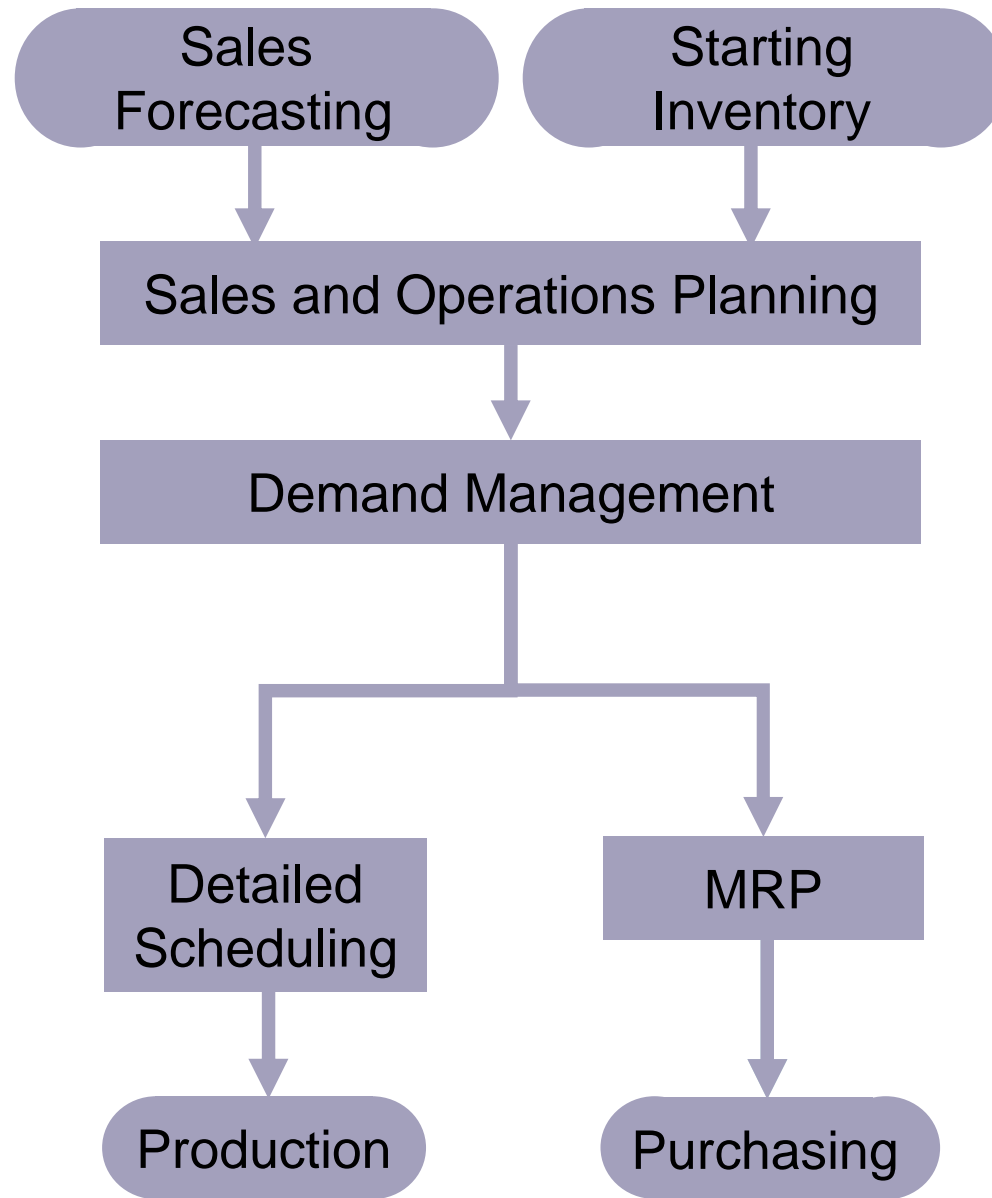 3. Use the production plan to determine raw material requirements

Figure 4.2 The production planning process

Production Planning Steps

- Sales Forecasting:
  - The process of developing a prediction of future demand for a company's products
- Sales and Operations:
  - Process of determining what the company should produce
  - Requires starting inventory levels and sales forecast
  - Capacity must be considered
  - Inventory may be built to meet demand for seasonal products

Production Planning Steps

- Demand Management:
  - Process of breaking production plan down into smaller time increments
  - Such as weekly or even daily production figures, to meet demand for individual products.
- Detailed Scheduling:
  - Development of a detailed production schedule based on production plan from demand management
  - Scheduling method depends on production environment
  - For Fitter Snacker, the detailed production schedule will determine when to switch between the production of NRG-A and NRG-B bars.

Production Planning Steps

- Production:
  - Uses the detailed schedule to determine what products to produce and what staffing is required
- Material Requirements Planning:
  - Determines amount and timing of raw material orders
  - This process answers the questions, "What raw materials should we be ordering so we can meet a particular level of production, and when should we order them?"
- Purchasing:
  - Takes quantity and timing information from MRP and creates purchase orders, which It transmits to qualified suppliers

Sales Forecasting

- In SAP R/3, sales (consumption values for material) are automatically recorded when sales are made in the Sales and Distribution (SD) module
  - Additional detail (sales by region or sales office) can be recorded by the Logistics Information System (LIS)
  - Business Warehouse (BW) can be used for even more detailed sales analysis
- With an integrated information system, accurate sales data are easily available for forecasting

Simple Sales Forecast

- Sales based on simple adjustment to previous years sales values

- To make a forecast for Fitter Snacker, we can use the previous year's sales data in combination with marketing initiative to increase sales, look at the forecasts shown in Figure 4.3

- Note in Figure 4.3 that the forecast starts with the previous years' sales levels to reflect FS's seasonal sales fuctuations (sales are higher in the summer when more people are active).

Simple Sales Forecast

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

Figure 4.3 Fitter Snacker's sales forecast for January through June

- Note that there was a special marketing promotion last year. The estimated impact of this promotion was an increase in sales of 300 cases for May and June.

  - This increase must be subtracted from the previous year's sales values to get an accurate base measurement.

- FS's Marketing department anticipates a 3 percent growth in sales over the previous year, base on research reported in trade publications.

Simple Sales Forecast

- Finally, FS will be launching a special marketing promotion at the end of May to increase sales at the beginning of the summer season.

- FS marketing experts think this will result in an increase in sales of 500 cases of June.

Sales and Operations Planning (SOP)

- Input to SOP is sales forecast and beginning inventory
- Output is a production plan that balances market demand with production capacity
- Developing an SOP answers the question:

  "How can manufacturing efficiently produce enough goods to meet projected sales?"

- Fitter Snacker Production Capacity:

$$\left(200\,\frac{bars}{min.}\right)\left(60\,\frac{min.}{hr}\right)\left(8\,\frac{hr.}{day}\right) = 96{,}000 \text{ bars/day}$$

$$96{,}000 \text{ bars/day}\left(\frac{1}{24}\,\frac{box}{bars}\right)\left(\frac{1}{12}\,\frac{case}{box}\right) = 333.3 \text{ cases/day}$$

Sales and Operations Planning

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	6900	6700
3) Inventory		100	100	100	100	100	524	96
4) Working Days			22	20	22	21	23	21
5) Capacity (Shipping Cases)			7333	6667	7333	7000	7667	7000
6) Utilization			81%	90%	83%	90%	90%	96%
7) NRG-A (cases)	70.0%		4134	4199	4243	4423	4830	4690
8) NRG-B (cases)	30.0%		1772	1799	1818	1895	2070	2010

Figure 4.5 Fitter Snacker's sales and operations plan for January through June

- At the start of January, the production planner is projecting a beginning inventory of 100 cases.

- The first line in Figure 4.5 is the Sales Forecast, which is the output of the Sales forecasting process shown in Figure 4.3.

- The next line is the Production Plan, which is developed by the production planner in a trial-and-error fashion, observing the effect of different production quantities on inventory levels and capacity utilization.

25

Sales and Operations Planning

- The goal is to develop a production plan that meets demand without exceeding capacity and that maintains "reasonable" inventory levels (neither too high or too low).
  - This process requires judgment and experience.
- The third line, Inventory, is the difference between the Sales Forecast and the Production Plan.

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	6900	6700
3) Inventory		100	100	100	100	100	524	96
4) Working Days			22	20	22	21	23	21
5) Capacity (Shipping Cases)			7333	6667	7333	7000	7667	7000
6) Utilization			81%	90%	83%	90%	90%	96%
7) NRG-A (cases)	70.0%		4134	4199	4243	4423	4830	4690
8) NRG-B (cases)	30.0%		1772	1799	1818	1895	2070	2010

(6900-6476) + 100 = 524

26

Sales and Operations Planning

- The production planner has developed a plan that maintains a minimum planned inventory of 100 cases.

  - This inventory, called "safety stock", is planned so that if sales demand exceeds the forecast, sales can be met without altering the production plan.

- Notice that in May, the Production plan is greater than the May Sales Forecast, and the inventory is 524. Why?

  - Because the planner wants to build up inventory to handle the increased demand in June, which results from the normal seasonal increase in snack bar sales and additional demand from the planned promotional activities.

Sales and Operations Planning

- The fourth line is Working Days, an input based on the company calendar.

- Using the number of working days in a month, the available capacity each month is calculated in terms of the number of shipping cases.

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	6900	6700
3) Inventory		100	100	100	100	100	524	96
4) Working Days			22	20	22	21	23	21
5) Capacity (Shipping Cases)			7333	6667	7333	7000	7667	7000
6) Utilization			81%	90%	83%	90%	90%	96%
7) NRG-A (cases)	70.0%		4134	4199	4243	4423	4830	4690
8) NRG-B (cases)	30.0%		1772	1799	1818	1895	2070	2010

Number of working days in a month * the production capacity of 333.3 cases per day
22*333=7333 cases

Sales and Operations Planning

- With the available Capacity now expressed in terms of shipping cases, it is possible to determine the capacity utilization for each month by dividing the Production Plan (line 2) by the available Capacity (line 5) and expressing the result as a Utilization percentage (line 6).

- This capacity calculation lets us see whether we have the capacity necessary to meet the production plan.

- While higher levels of capacity utilization mean that Fitter Snacker is producing more with its production resources, this percentage must be kept below 100 percent to allow for production losses due to production changeover, equipment breakdowns, and other unexpected production problems.

Demand Strategies

- When demand is forecasted to exceed capacity, a company might:
  - Choose not to meet all forecasted sales demand or reduce promotional expenditures
  - Use overtime to increase capacity
    - Will increase labor cost per unit
  - Inventory levels can be built up in earlier periods
    - Will increase inventory holding costs and inventory may be lost (the risk that product held in inventory might pass their expiration date before being sold by retailers)
  - Try a hybrid approach to the capacity problem to find the right balance:
    - reduce sales promotions slightly,
    - increase production in earlier months, and
    - plan for some overtime production.

Figure 4.6 Sales and Operations Planning Screen in the SAP R/3 system

Sales forecast: historical sales data from the SAP R/3

Production that is planned to meet the sales forecast

The gray color indicates that it is a calculated result

The user specify a target stock level in terms of the number of days of demand it would cover.

The SAP system uses the Factory Calendar that specifies company holidays and planned shutdowns to determine the number of working days in a month when calculating the Target Days Supply

Forecasting in SAP R/3

- Because the SAP R/3 system is integrated, accurate *historical sales values* are readily available for forecasting
- In forecasting, "correcting" historical sales data is valid if:
  - Production was not able to meet demand, so that the historical sales data does not represent actual demand
  - Unusual conditions like weather affected demand
  - The effect of sales promotions needs to be "backed out" of the data
- In the SAP R/3 system, a number of forecasting models are available

Historical Sales Data

Sales provided from Sales and Distribution (SD) module

Forecast: Historical Values				
Historical values				
Period	**Val. fld**	**Corr.value**	**F**	**C**
M 08/2004	6326	6326	☐	☐
M 07/2004	6501	6501	☐	☐
M 06/2004	6434	6434	☐	☐
M 05/2004	6286	6286	☐	☐
M 04/2004	6133	6133	☐	☐
M 03/2004	5883	5883	☐	☐
M 02/2004	5822	5822	☐	☐
M 01/2004	5733	5733	☐	☐

Field where planner can "correct" the sales value

Forecasting   Correct

Figure 4.7 Historical sales levels for Fitter Snacker

33

Forecasting Models in SAP R/3

This screen allows the user to specify a number of forecasting parameters, including whether the model should allow for trends and seasonal variations.

Once the SAP R/3 system generates a forecast, the planner can view the results graphically, as shown in Figure 4-9

While the SAP R/3 system also provides the standard statistical measures of forecast accuracy, human judgment is frequently the best determinant of whether the forecast results make sense.

Figure 4.8 Forecasting model options in the SAP R/3 system

Evaluating Forecasts

- Using graphs to evaluate forecasts is frequently the best method

Historical Sales Values

Forecasted Sales
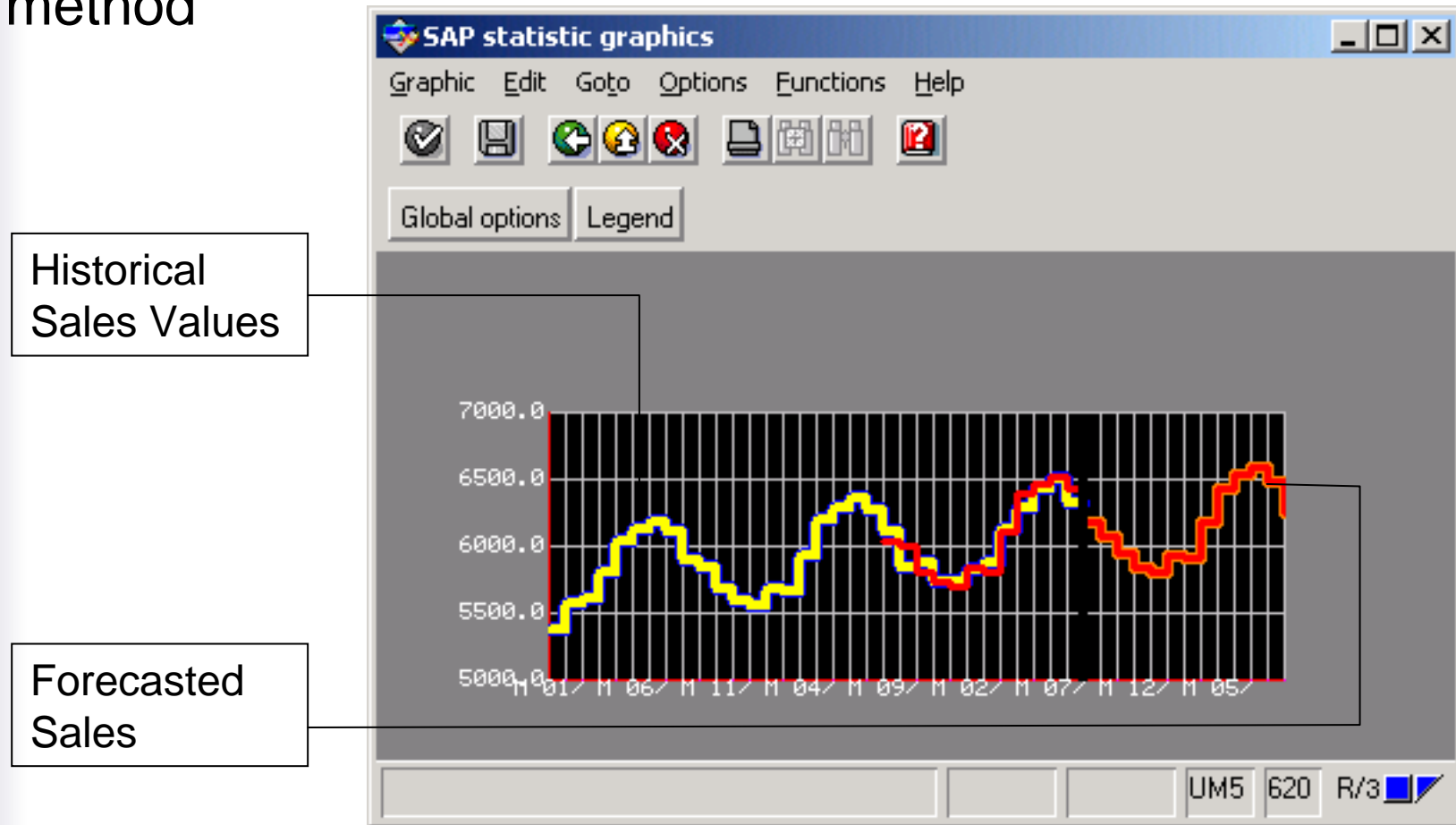
Figure 4.9 Forecasting results presented graphically in the SAP R/3 system

SOP Effectiveness

- ERP systems provide sophisticated SOP tools, but require commitment from both parties (marketing and manufacturing) to be successful
  - Without cooperation and agreement on forecasts, sales promotions and production plans, a company will have:
    - Excess quantities of some products
    - Shortages of others
    - Higher costs due to overtime and expedited shipping
  - Successful SOP needs a culture of cooperation, which requires top management support to develop

Disaggregating SOP

- Planning is done on aggregate product groups to make the process easier to manage and evaluate

- Aggregate plans must be disaggregated to that more detailed plans can be made for individual products

- In SAP R/3, the product group hierarchy, which is defined with fixed percentages for each member, is used to determine production quantities for each product

- With Fitter Snacker, the product group consists of two products
  - NRG-A typically accounts for 70% of sales
  - NRG-B typically accounts for 30% of sales

Figure 4.11 Product Group Structure in SAP R/3 System

Stock/Requirements List

- The Stock/Requirements List shows:
  - Current stock
  - Required materials
  - Material receipts planned
  - Material availability
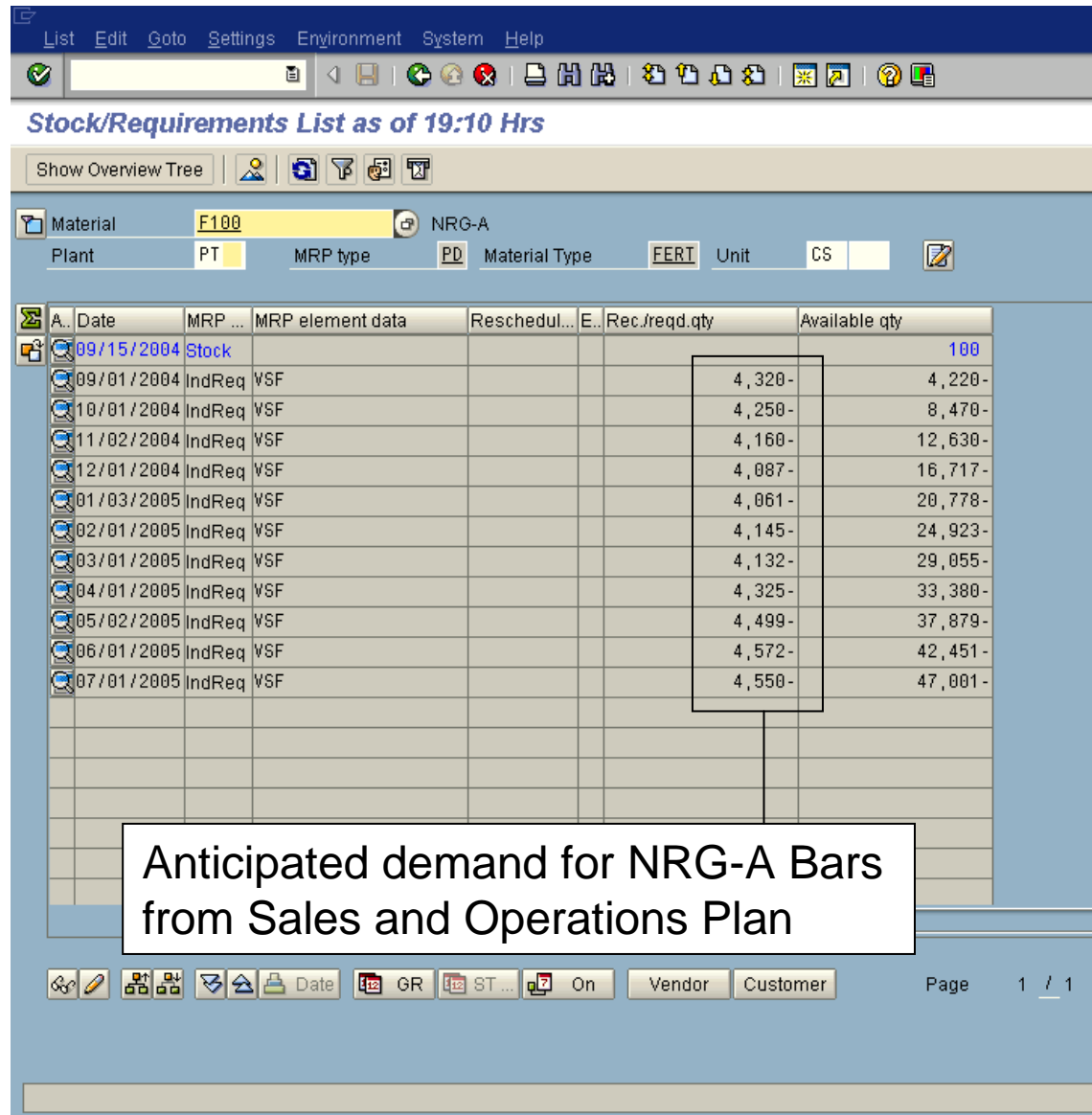
Figure 4.12 Stock/Requirements List for NRG-A bars after disaggregation

Demand Management

- Demand Management links SOP with Detailed Scheduling and MRP via the Master Production Schedule (MPS)

- Fitter Snacker's Demand Management process splits the Monthly SOP plan into weekly and daily increments

  - Demand Management process in SAP R/3 uses the factory calendar to determine the number of working days in a particular week or month

Weekly Disaggregation

	Week 1
Demand Management	**1/2 - 1/5**
Monthly Demand NRG-A	4134
NRG-B	1772
Working Days in Week	4
Working Days in Month	22
MPS NRG-A	752
Weekly Demand NRG-B	322

$$4134\left(\frac{4}{22}\right) = 752$$

$$1772\left(\frac{4}{22}\right) = 322$$

Daily Disaggregation

Demand Management		Jan 2
Monthly Demand	NRG-A	4134
	NRG-B	1772
Working Days in Month		22
MPS	NRG-A	188
Daily Demand	NRG-B	81

$$\left(\frac{4134}{22}\right) = 188$$

$$\left(\frac{1772}{22}\right) = 81$$

Jan (3 days): 4,134*3/22 = 563.7
Feb (2 days): 4,198*2/20 = 419.8
Week5, total = 563.7+419.8 = 983.5 cases

Demand Management		Week 1	Week 2	Week 3	Week 4	Week 5	
		1/2 - 1/5	1/8 - 1/12	1/15 - 1/19	1/22 - 1/26	1/29 - 1/31	2/1 - 2/2
Monthly Demand	NRG-A	4134	4134	4134	4134	4134	4198
	NRG-B	1772	1772	1772	1772	1772	1799
Working Days in Week		4	5	5	5	3	2
Working Days in Month		22	22	22	22	22	20
MPS	NRG-A	752	940	940	940	984	
Weekly Demand	NRG-B	322	403	403	403	422	

Demand Management		Jan 2	Jan 3	Jan 4	Jan 5	Jan 6
Monthly Demand	NRG-A	4134	4134	4134	4134	4134
	NRG-B	1772	1772	1772	1772	1772
Working Days in Month		22	22	22	22	22
MPS	NRG-A	188	188	188	188	188
Daily Demand	NRG-B	81	81	81	81	81

Figure 4.14 Fitter Snacker's production plan for January: The first five weeks of production are followed by a day-by-day disaggregation of week 1.

Material Requirements Planning

- Material Requirements Planning (MRP) is the process of determining the quantity and timing of production and/or purchase quantities needed to support the Master Production Schedule (MPS)

- MRP would allow Fitter Snacker to accurately plan its raw material purchases

- To understand MRP, you must understand:
  - the bill of material
  - the material's lead-time, and
  - the material's lot sizing.

Bill of Material

- The Bill of Material (BOM) is a list of materials and quantities needed to make a product
- For Fitter Snacker, the BOM is the "recipe" for a 500 lb. batch of snack bar dough

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

Figure 4.16 The bill of material (BOM) for Fitter Snacker's NRG bars

Lead Times and Lot Sizing

- The BOM can be used to calculate how much of each material is required to produce a finished product
- Determining the timing and quantity of purchase orders requires information on lead-times and lot sizing
- For purchased products, the lead time includes:
  - Time for supplier to receive and process order
  - Time to take material out of stock, package it, load it on a truck and deliver it to the manufacturer
  - Time required at manufacturer to receive the material:
    - Unload the truck
    - Inspect the materials
    - Move to storage location or production line

Lead Times and Lot Sizing

- Lot sizing is the process of determining production or order quantities

- In many cases, lot sizes for purchased items are constrained by packaging and transportation

- For Fitter Snacker:

  - Oats need to be purchased in multiples of 44,000 lb. hopper truck quantities

  - Wheat Germ needs to be purchased in multiples of 2,000 lb bulk containers

  - Protein powder needs to be purchased in multiples of 1,250 lb. pallet quantities

MRP Process

- The MRP Process for oats requires the following steps:

  1. Convert MPS quantities from cases to 500 lb. batches

  2. Multiply the number of batches by the lb/batch quantities from the BOM to determine gross requirements

  3. Subtract existing raw material quantities and released purchase orders from gross requirements to determine net requirements

  4. Plan purchase orders in multiples of the 44,000 lb lot size, allowing for the 2-week lead time, to meet the net requirements in Step 3

MRP Process

Each shipping case weighs 72 pounds

(On hand + Scheduled receipts) -Gross requirements

$$752\left(\frac{72}{500}\right)=108.3$$

Oats Lead Time = 2 weeks		Week 1	Week 2	Week 3	Week 4	Week 5
MPS	NRG-A	752	940	940	940	984
(cases)	NRG-B	322	403	403	403	422
MPS	NRG-A	108	135	135	135	142
(500 lb. batches)	NRG-B	46	58	58	58	61
Gross Requirements (lb)		44,090	55,087	55,087	55,087	57,667
Scheduled Receipts		44,000	44,000			
Planned Receipts				88,000	44,000	44,000
On Hand	11,650	11,560	473	33,386	22,299	8,632
Planned Orders		88,000	44,000	44,000		

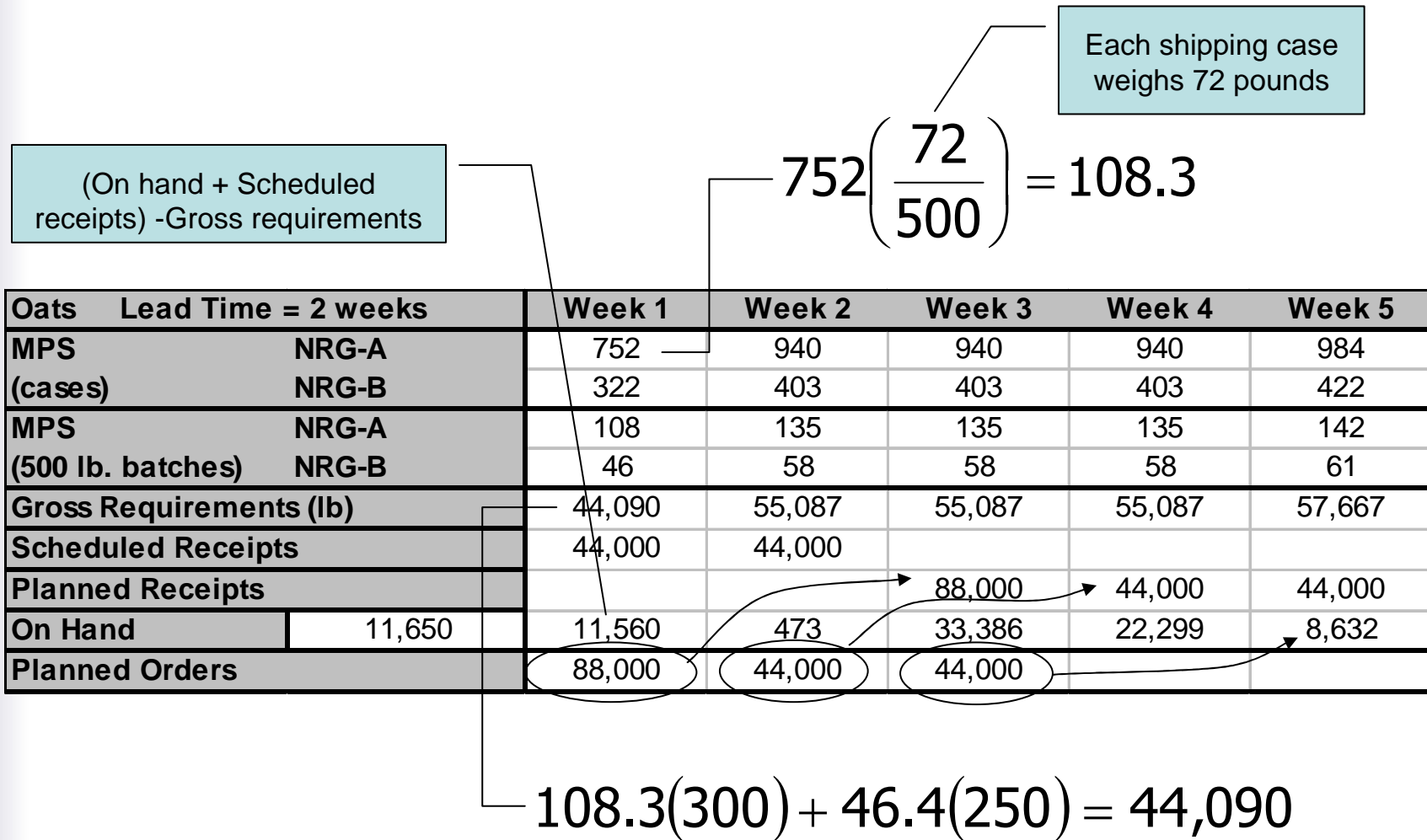$$108.3(300)+46.4(250)=44,090$$

Figure 4.17 The MRP record for NRG bars (oats), weeks 1 through 5

MRP Process

- Many times, a planner may intervene to tell the system to adjust the planned order.

- For example, notice that the on-hand quantity of oats in week2 is only 473 pounds.

  - This means that at the start of week2, there will only be enough oats to mix one batch of dough.

  - If the scheduled order does not arrive early enough on the first day of week2, the production line could be shut down.

SAP R/3 MRP and MRP Records

- MRP list is similar to Stock/Requirements List
- MRP list shows results of MRP calculations
- Stock/Requirements shows results of MRP calculations, plus any changes that have occurred since the MRP calculations were performed:
  - Planned orders converted to production orders
  - Material receipts
- MRP calculations can require significant computer resources, so are usually performed daily or even less frequently

MRP List as of 11/10/2004, 22:10 Hrs

Show Overview Tree   ✓ On

| Material | R380 | Oats |
| Plant | PT | MRP type | PD | Material Type | ROH | Unit | LB |

A..	Date	MRP ...	MRP element data	Reschedul...	E.	Rec./reqd.qty	Available qty
	11/10/2004	Stock					11,650
	01/03/2005	PldOrd	0000005132/STPO	42		44,000	55,650
	01/03/2005	IndReq	VSF			44,090-	11,560
	02/01/2005	PldOrd	0000005133/STPO			44,000	55,560
	02/01/2005	IndReq	VSF			55,087-	473
	03/01/2005	PldOrd	0000005134/STPO	42		88,000	88,473
	03/01/2005	IndReq	VSF			55,087-	33,386
	04/01/2005	PldOrd	0000005135/STPO			44,000	77,386
	04/01/2005	IndReq	VSF			55,087-	22,299
	05/02/2005	PldOrd	0000005136/STPO	42		44,000	66,299
	05/02/2005	IndReq	VSF			57,667-	8,632

Date   GR   ST ...   On   Vendor   Customer   Page   1 / 1

Planned Orders (PldOrd)

Dependent Requirements (DepReq)

- The MRP process creates Planned Orders to meet these dependent requirements.

- The Planned Orders are recommendations by the system to create orders (in this case, Purchase Orders) for oats.

Figure 4.18 The MRP List in SAP R/3

54

Stock/Requirements List as of 22:32 Hrs

Show Overview Tree

| Material | R380 | | Oats | | | |
| Plant | PT | MRP type | PD | Material Type | ROH | Unit | LB |

A..	Date	MRP ...	MRP element data	Reschedul...	E..	Rec./reqd.qty	Available qty	St..
	11/10/2004	Stock					11,650	
	01/03/2005	POitem	4500000000/00010			88,000	99,650	100
	01/03/2005	IndReq	VSF			44,090-	55,560	
	02/01/2005	PurRqs	0010000001/00010 *	03/01/2005	15	44,000	99,560	
	02/01/2005	IndReq	VSF			55,087-	44,473	
	03/01/2005	PldOrd	0000005137/STPO			44,000	88,473	
	03/01/2005	IndReq	VSF			55,087-	33,386	
	04/01/2005	PldOrd	0000005138/STPO			44,000	77,386	
	04/01/2005	IndReq	VSF			55,087-	22,299	
	05/02/2005	PldOrd	0000005136/STPO			44,000	66,299	
	05/02/2005	IndReq	VSF			57,667-	8,632	

Double-clicking on a planned order brings up a window where the planned order can be converted to a purchase Requisition (a request to Purchasing to create a purchase order)

GR   ST ...   On   Vendor   Customer   Page   1 / 1

Figure 4.19 The Stock/Requirements List in SAP R/3

55

Planned Order to Purchase Requisition

- Planned orders are "recommendations" from the MRP calculation process on what materials should be ordered/produced to meet the master production schedule (MPS)

- Planned orders must be converted to purchase requisitions before the purchasing department will begin the process to create a purchase order

- Planned orders can be converted to purchase orders manually, or the SAP R/3 system can convert a group of planned order to purchase orders

  - e.g. all planned orders that should be placed this week can be converted to purchase requisitions

Planned Order to Purchase Requisition

Planned order release and receipt dates

Additional Data for MRP Element			
Plnd order	0000005137 External proc.	Order finish	03/01/2005 GR pr.time 0
Order qty	44,000 LB	Order start	02/18/2005 Proc. type F
Scrap	0	Planned opening	02/17/2005 Order type NB

✓ ⚭ ✎ 🖧 -> Pur.req. | ✴ ✖

Option to convert planned order to purchase requisition

Figure 4.20 Conversion of Planned Order to Purchase Requisition

Purchase Requisition to Purchase Order

- The purchasing department converts purchase requisitions into purchase orders
- Purchasing specialists may group items from different purchase requisitions on one purchase order to save costs
- Purchasing specialists may produce more than one purchase order for the items on a requisition
- The SAP R/3 system provides tools to help the purchasing specialist select the best supplier (vendor) for a material
  - Once the purchase order is complete, it is transmitted to the supplier (vendor)
  - A number of methods (mail, fax, EDI, internet) are available for transmitting purchase orders

Figure 4.21 Source Overview screen for supplier selection

Detailed Scheduling

- Detailed scheduling is a complex process
- Scheduling frequently involves a balance between:
  - *Long production runs*, which reduces lost capacity due to equipment setups, and
  - *Short production runs*, which result in lower inventory levels
- The manufacturing process that Fitter Snacker uses is known as **repetitive manufacturing**
- Repetitive manufacturing environments usually involve production lines that are switched from one product to another similar product

Linking Production and Accounting

- Data can be entered into the SAP R/3 system through a PC, bar code scan, or wireless PDA

- Because SAP R/3 is integrated, information entered for a material movement will be used to automatically update accounting records

  - One data entry activity provides data for two functions (materials management and accounting) simultaneously, providing data consistency

- For example, the Goods Receipt screen simplifies the connection between the *material received* from the supplier and the *purchase order* that created it

- Accurate data requires company personnel to consistently and accurately enter information into the system
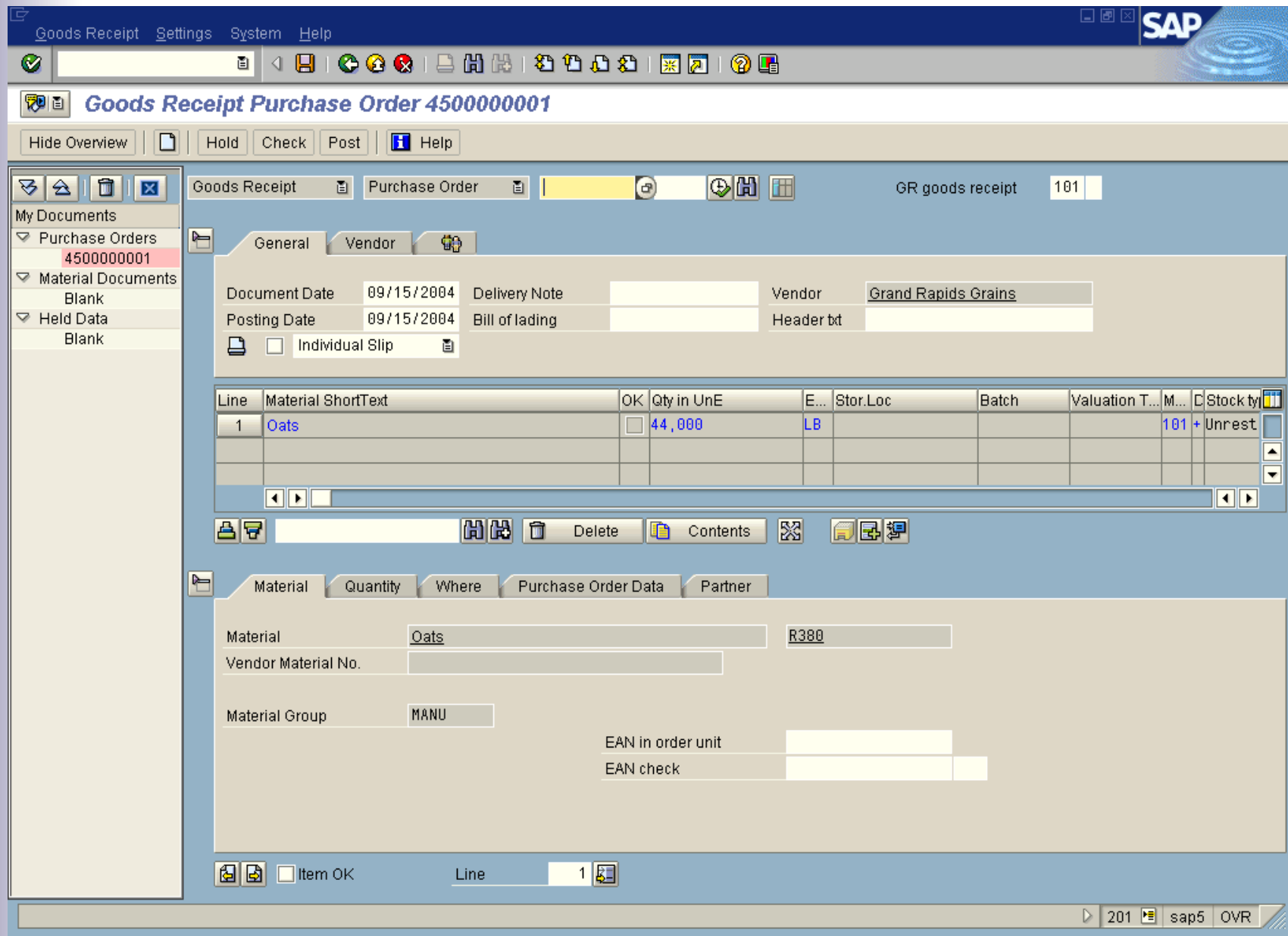
Goods Receipt Purchase Order 4500000001

Hide Overview | Hold | Check | Post | Help

My Documents
- ▽ Purchase Orders
  - 4500000001
- ▽ Material Documents
  - Blank
- ▽ Held Data
  - Blank

Goods Receipt   Purchase Order   GR goods receipt   101

General | Vendor

| Document Date | 09/15/2004 | Delivery Note | | Vendor | Grand Rapids Grains |
| Posting Date | 09/15/2004 | Bill of lading | | Header txt | |

☐ Individual Slip

Line	Material ShortText	OK	Qty in UnE	E...	Stor.Loc	Batch	Valuation T...	M...	C	Stock ty
1	Oats	☐	44,000	LB				101	+	Unrest

Delete | Contents

Material | Quantity | Where | Purchase Order Data | Partner

| Material | Oats | R380 |
| Vendor Material No. | | |

| Material Group | MANU |

EAN in order unit
EAN check

☐ Item OK   Line   1

201   sap5   OVR

Figure 4.23 Goods receipt screen in SAP R/3

62

Linking Production and Accounting

- When the receipt is successfully recorded, the SAP R/3 system immediately records the increase in *inventory levels* for the material.

- On the accounting side of the system, the value of the inventory shown in the *general ledger account* will be automatically increased as well.

- This is an important feature of an integrated information system:

    - the goods receipt is recorded once, but the information is immediately available to both manufacturing and accounting-and the information is consistent.

ERP and Suppliers

- Fitter Snacker is part of a supply chain that starts with farmers growing oats and wheat germ and ends with a customer buying an NRG bar from a retail store

- Historically, participants in the supply chain have used competitive bidding to achieve low prices

- The supply chain is frequently more efficient if participants work collaboratively to:

  - Improve products

  - Reduce paperwork

  - Reduce inventories and costs

  - Increase responsiveness to the customer

Traditional Supply Chains

- In the traditional supply chain, information is passed through the supply chain reactively as participants increase their product orders-as illustrated in Figure 4-24.

  - For example, a *retailer* sees an increase in the sale of FS's bars and order a larger quantity of bars from the *wholesaler*.

  - If a number of *retailers* increase their orders, the *wholesalers* will increase its orders from *Fitter Snacker*.

  - When FS gets larger orders from wholesalers, it must increase production to meet the increase demand.

  - To increase production, *FS* will order more raw material from *suppliers*.

- Because of the time lags inherent in a traditional supply chain, it might take weeks or even months-for information about FS's increased need for raw materials to reach FS's suppliers.

Traditional Supply Chains

- Raw material suppliers may require time to increase their production to meet FS's larger orders, resulting in temporary shortages for the supplier.

- By contrast, if the participants in the supply chain are part of an integrated process, information about the increased customer demand can be passed quickly through the supply chain, so each link in the chain can react quickly to the change.
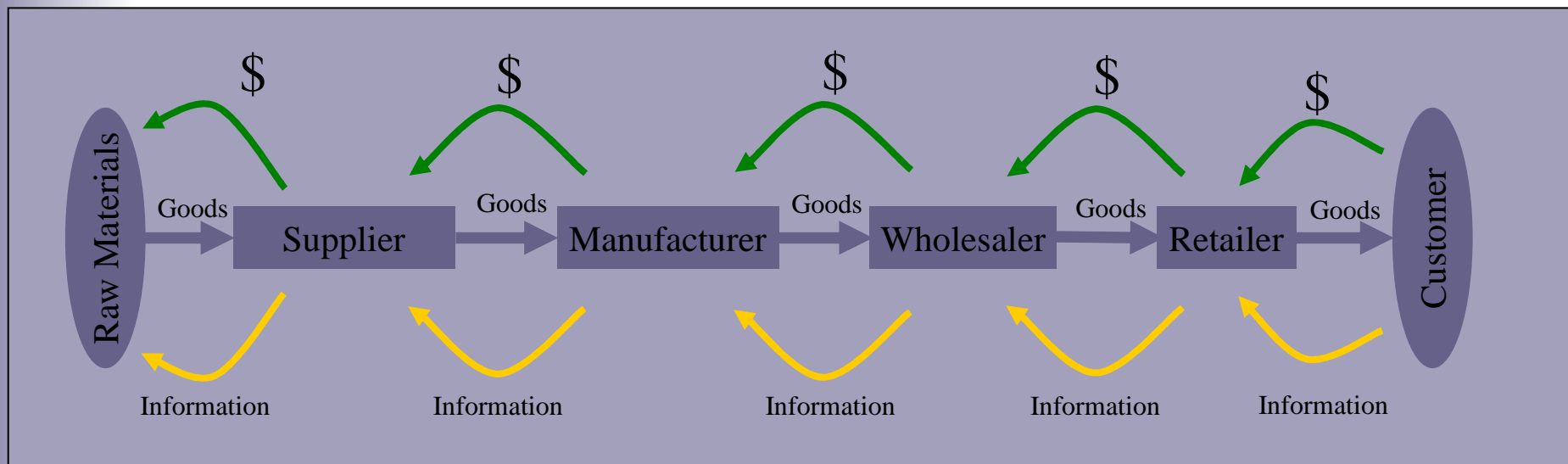
Figure 4.24 Supply-chain management (SCM) from raw materials to consumer

ERP and Supply Chains

- ERP systems can facilitate supply chain efficiency
  - Companies could be linked with customers and suppliers through electronic data interchange (EDI) systems
  - EDI is the computer-to-computer exchange of standard business documents (such as purchase orders) between two companies.
  - Production plans can be shared along the supply chain in real time
  - Using the Internet can make this communication even faster and cheaper than if done by private EDI networks
  - Integration of accounting (described in the next chapter) allows managers to evaluate impact of plans on total supply chain costs

ERP and Supply Chains

- Measures of supply chain performance include:
  - **Cash-to-cash cycle time**: refers to the time between paying for raw materials and collecting cash from the customer
  - **Total SCM costs**: include the cost of buying and handling inventory, processing orders, and information systems support.
  - **Initial fill rate**: is the percentage of the order that the supplier provided in the first shipment.
  - **Initial order lead time**: is the time needed for the supplier agreed to fill the order.
  - **On-time performance**: if the supplier agreed to requested delivery dates, this measurement tracks how often the supplier actually met those dates.

Summary

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

  - Begins with Marketing sharing sales forecast

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

- Production planning can be done without an ERP system, but an ERP system that contains MRP allows Production to be linked to Purchasing and Accounting

  - This data sharing increases a company's overall efficiency.

Summary

- Companies are building on their ERP systems and integrated systems philosophy to practice SCM.

    - In doing this, the company looks at itself as part of a larger process that includes customers and suppliers.

    - By using information more efficiently along the entire chain, significant cost savings can result.