

The Business Planning Process

The Business Planning Process incorporates all processes that help companies make their strategic and business plans a reality — from the first step of Strategic Business Planning, through making or buying the product/service, to satisfying the customer. Coordinating mechanisms between functional areas including Marketing, Accounting, Finance, and Engineering, ensures all areas are working towards the goals and objectives of the company. The Business Planning Process (as shown in Figure 1) facilitates that coordination. The purpose, level of detail, time frames covered, decisions, and degrees of risk vary for each level and will be discussed in detail in the following sections.

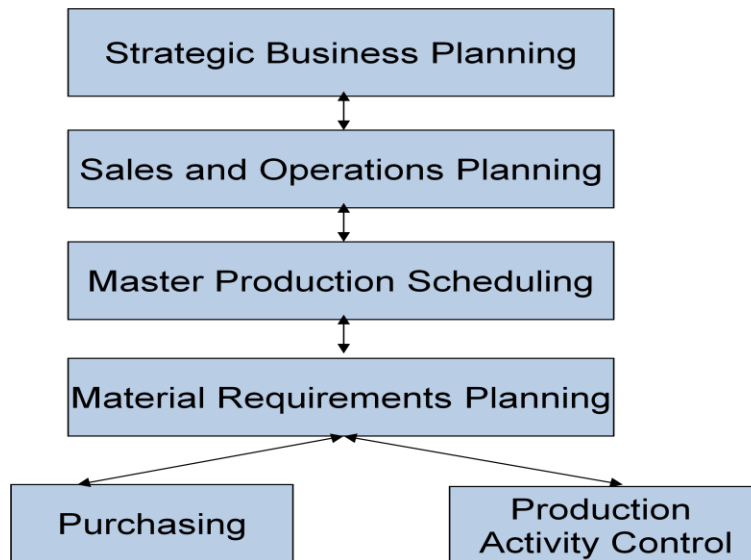


Figure 1 Business Planning Process

Strategic Business Planning

The Strategic Business Planning element outlines the broad direction of the business and what new markets, new products, major process, choices and major capital investments the company plans to participate in during the next 2-10 years. It incorporates the mission, vision, and strategy of the company. It is created by senior management and includes input from all functional areas involved in the business including marketing, finance, operations, and engineering. Each of these functional areas develops goals and objectives which support the firm's Strategic Business Plan.

An example of Strategic Business Planning is a Six Sigma Consulting company deciding it wants to capture new customers in China, a new market penetration for it. An example of a new product and market is that Research in Motion (RIM) strategically decided to diversify beyond offering the BlackBerry for the business market only. They began offering the BlackBerry to the everyday consumer for personal use and created a product that now competes with the iPhone. An example of a major process change is when a dollar store in Waterloo, Ontario installed a new computer system to keep track of inventory. Instead of the cashier counting the number of items sold for a \$1, each item is barcode scanned when sold and is reduced from inventory. Look at your receipt; is the part number and description on it? If so, then inventory is probably being tracked. Another example of a major process change is that an automotive assembly plant installed robots to weld instead of having operators weld parts.

Major capital investment would include “bricks and mortar” decisions such as building a new distribution centre or plant, or investing in new technology. An example of a major capital investment is that a number of years ago, Canadian banks invested in online banking software for consumers to use. A few large retailers have implemented self-serve checkouts, which are also considered capital investment.

Financial projections by product family on revenue, cost, and profit are included in the Strategic Business Plan. Typically financial statements include budgets, a balance sheet, an income statement, and a projected cash flow statement. These are completed with few details for this high level plan in the organization.

Plans developed at this level have the highest level of risk because decisions made here are to be implemented by the organization. Commitments to new markets, new products, new processes, and capital investment are hard to change once they have been made. These decisions can make or break a company.

Flexibility is the highest at this level as there is discussion about “what if” and “what might happen.” But at this stage, the organization is talking about strategic direction and what it wants to accomplish. In the subsequent processes, these plans get implemented. So the farther down in the Business Planning Process, the harder it is to change direction, and therefore, flexibility declines.

Sales and Operations Planning

Oliver Wight Americas, Inc. describes Sales and Operations Planning (S&OP) as a process lead by senior management that, on a monthly basis, evaluates revised, time-phased projections for supply, demand, and the resulting financials. “It’s a decision making process that ensures that tactical plans in all business functions are aligned in support of the business plan. The objective of S&OP is to reach a consensus on a single operating plan that allocates the critical resources of people, capacity, materials, time and money to most effectively meet the marketplace in a profitable way.”¹ (Wight n.d., p.5)

The S&OP element is where management is responsible for balancing supply and demand in an organization at the product family level. A product family or group includes products similar in the processes to make them, in marketing characteristics, and/or in specifications that can be summarized or aggregated for planning purposes. Examples of three product families for McDonalds include burgers, drinks, and salads.

The S&OP review happens monthly when cross-functional representation from Marketing/Sales, Finance/Accounting, Operations, Engineering, Purchasing, and suppliers are involved in developing a plan by product family or group in both dollars and units. Suppliers are encouraged to be involved or Purchasing communicates on their behalf. In these meetings, capabilities from each functional area are discussed, and if there are any constraints, they are communicated and resolved. The outcome of the meeting is a plan that supports the organization’s strategic direction, and all areas involved support and sign off on the plan. Usually several levels of a company are involved including senior management, middle management, and possibly front line staff. It is important that senior management is involved to

communicate to the organization the importance of the S&OP process. When dealing with a constraint of a functional area, a senior manager has more influence to resolve issues.

One benefit that a company realizes from the S&OP process is the collaboration among functional areas. Thomas Wallace, an author and S&OP consultant, says, "S&OP is as much about institutionalizing communications throughout the organization as it is about anything else. (Wallace 2007)" The following is an example of what can happen when an effective S&OP process is not used. Since Marketing/Sales are responsible for understanding and communicating customer demand, in a traditional functional organization, these departments create a forecast that goes to Operations. Operations reviews how it will meet the forecasted demand requirements. Given this new or revised forecast, Operations may have issues with capacity or supplier material availability, or even capacity of a logistics provider. Its logistics provider may also be having issues with the new forecast, such as getting containers of supplier product from overseas during the pre-holiday season in November/December. If these constraints are not communicated back to Marketing, customer orders are not completed on time. When that occurs, conflict can arise between departments. Because Operations did not communicate with Marketing on the potential conflicts or because Marketing did not follow up with Operations that they were able to meet their forecast. The customer is now unhappy and each functional area blames the other. When this happens, the S&OP is not supporting the organization's strategic direction. Budgets are not met: costs rise, cash flow drops, and profit targets are missed. In a publicly traded company, shareholders soon begin selling their shares, and share price drops. Overall this is a situation which cannot go on for long. Have you ever experienced a communications issue? Perhaps you borrowed the family car and were to pick up your sibling or parent at a specific time and you did not communicate that you had to stay late to meet with your group? Communications issues can wreak havoc on our plans and cause conflict.

Contrast the above scenario with an organization using an effective S&OP process, where Sales/Marketing, Accounting, Operations, Engineering, Purchasing, and Suppliers sit down once a month and talk about demand forecasting and supply and how to satisfy the customer. If there are constraints, they are identified through this process and resolved through communicating delivery date to the customer, by getting more resources, or by reallocating resources to meet the customer forecasted demand. Resolution comes from adjusting demand, adjusting supply, or both, and then communicating the agreed-to plan through the S&OP process.

Communicating the S&OP plan to supply chain partners to incorporate in their planning processes is really important. The S&OP plan is the coordinating mechanism internally between departments within a company and externally to its supply chain partners. When plans are not effectively communicated, partners have to forecast or guess at requirements, and they are usually wrong. Communicating the plan to the supply chain partners results in better planning, improved performance, and improved competitive position of the entire supply chain.

Detailed budgets are developed based on the S&OP against which execution of the plan is measured each month. S&OP typically is developed by product family, product group, or division lines. The S&OP plan is generally 1 to 2 years in length. The level of risk is high, but not as high as the Strategic Business Plan. Flexibility is fairly high, but is limited by the Strategic Business Plan's goals and objectives.

Aggregate capacity decisions made at this level include changes to workforce levels, aggregate inventory level adjustments, subcontracting, and logistics provider decisions.

Roles of Functional Areas in S&OP

It is important to get an idea of what each functional area in an organization brings to the S&OP process. The next sections will provide some details.



Marketing/Sales

Marketing/Sales provide the projected customer demand or forecast. In developing the forecast Marketing/Sales identify current customer requirements, new customer requirements or opportunities, new product information, information about the competition, and upcoming promotions.

Marketing and Sales own the forecast and are accountable for its accuracy. Having an accurate forecast is a cornerstone of S&OP. If it is too high, there can be excess inventory. If it is too low, there is a risk of not satisfying the customer. In a service organization where it is not possible to build up inventory, if the forecast is high we will not have work for all our staff which could cost the company money and eventually put it into bankruptcy. On the other hand, if the forecast is low and we are not meeting the requirements of our customer, we can get a reputation of being unreliable and lose customers. Have you ever been in a restaurant when there were few customers and staff was standing around? That is an example of the forecast projection being too high. How about when there was not enough staff, did you go back? Granted there are other variables like weather that are out of the forecasters control, but the Sales and Marketing people have to continually refine their forecasting techniques to provide as accurate a forecast as possible. This forecast drives the whole process.

One approach to S&OP forecasting that proves successful for organizations involves the development of an upside or optimistic forecast, a downside or worst-case scenario, and a forecast that was really what they thought would happen. With this approach, a company can then cost out the differences and look at the potential of each forecast. It can then develop contingency plans for each scenario, such as plans to handle an unexpected increased or decreased demand. For example, if demand increases, Purchasing will have worked on setting up subcontractors to build products. If demand decreases, plans to reassign people can be developed.

It is important that the strategic business plan is considered here. Marketing/Sales need to develop a demand forecast that supports the Strategic Business Plan (SBP). For example, if the SBP has a sales projection of \$10 million dollars and the sales forecast is \$9 million dollars, Marketing/Sales has to find a way to increase demand to meet the SBP.

Marketing/Sales is responsible for the demand side of S&OP.

Accounting and Finance

Accounting and Finance prepare cost information required for the detailed budgeting and cash flow analysis using the new S&OP plan and both the Demand and Supply plans, to project revenue, cost, and profit. Specifically they cost out the production plan, as well as create a projected balance sheet, income statements, and cash flow analysis. Finance staff has the responsibility to ensure the financial viability of the firm. From a cash flow perspective, they may need to acquire more cash, possibly a line of credit if required. They may also recommend that the S&OP be modified if they are unable to attain the credit required to support the plan as stated. For capital purchases, Finance will prepare a capital request which includes a return on investment and payback analysis for various alternatives. For example, a Spa company may evaluate purchasing new pedicure chairs. They could consider a basic comfortable chair with a basin or a fully massaging chair with a basin. What is the cost and payback period for each option? Could they charge more for a pedicure that gives a massage at the same time? In each scenario, how long would it take to pay back the investment and start making money on this capital investment? Do they have the funds available to make the purchase? Based on input from Finance, a decision is made for what type of equipment to buy.

Operations

Operations use the sales forecast and develop supply plans to meet projected customer demand. This includes plans that balance cost, customer service, inventory investment, manpower, and asset utilization. Operations know the resources they currently have and develop plans to utilize those resources to satisfy demand and ultimately the customer. Resources include people/manpower, machines/equipment, materials, and money. Operations are responsible for the internal supply and capacity side of the S&OP process. This process is called production planning and will be covered in more detail below.

Purchasing

Purchasing provides information about suppliers' capabilities, possible new suppliers, and improvements to supplier processes or materials. In a sense, suppliers are considered part of the organization's capacity in satisfying customer demand. Purchasing must continually be monitoring what

is happening on the external supply side. Are there new sources of supply to consider, for price, quality, or speed of delivery? Perhaps there is new technology available that will improve quality, reliability or cost. Are there constraints coming from external suppliers? Marketing also aids in this process as they are the eyes and ears of the marketplace. They, too, can advise if new technology or products are coming out in the marketplace. There must be constant and unrestricted communication between operations and suppliers to operate efficiently and keep costs down while satisfying demand.

Engineering

Engineering designs products to meet changing customer requirements and looks at changes in processes and improvement in product serviceability. A company that is organized to engineer-to-order and makes unique products may be required to have an S&OP process for an engineer's time. In this case, the forecast would be for the expected time required for an engineer to complete a design and the capacity would be all of the engineer's available time. Improvements in processes can reduce the time or the amount of material required to complete a product or service. Improvements in product serviceability could make repairing products in the field easier and less costly.

Summary

All functional areas' plans must be reconciled to the Strategic Business Plan. If the plan were to introduce a new product, then Engineering's S&OP plan should include the details of when the product and possibly new processes will be available. Marketing/Sales plan should include the new sales forecast, and Operations' plans must include planned production levels, manpower, and all resources required to meet the plan.

The Production Planning Process

As stated previously the objective of S&OP is to balance supply with demand. Marketing has looked after the demand side of this, now Operations needs to look at the supply side. In order to ensure that companies have the capacity at critical resources, a production plan is created. The forecast needs to be converted into planning units for Operations and Purchasing to look at capacity required to meet the demand plan.

Figure 2 displays the links between the planning side and checking on the capacity or resource side. As with the other processes, the higher up in the Business Planning Process it is, the less detail is required. At the production planning process, capacity is verified using resource requirements planning.

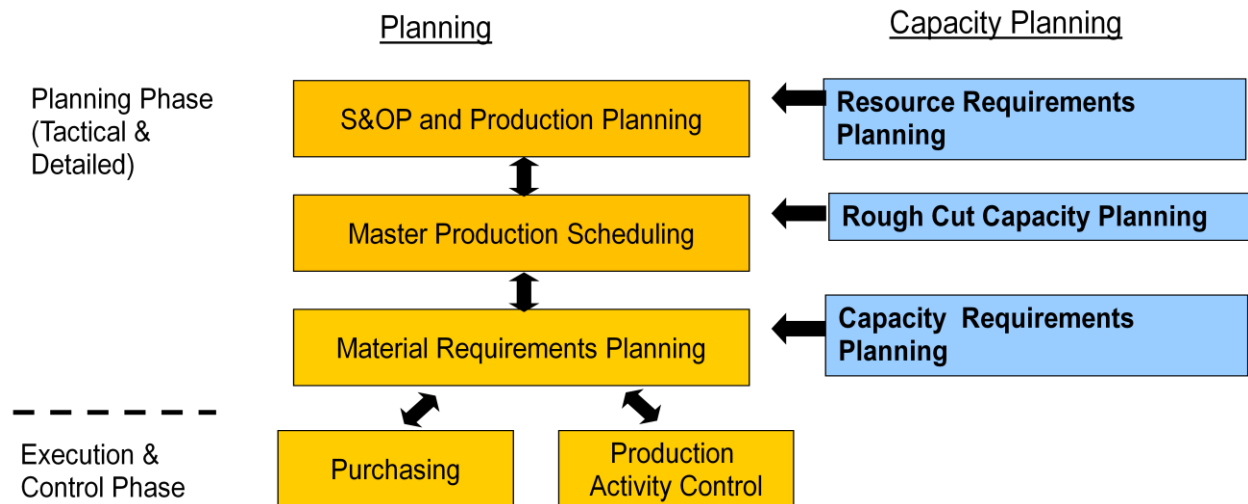


Figure 2 Linkages between Production Planning and Capacity Planning

The APICS dictionary defines a resource as “anything that adds value to a product or service in its creation, production and delivery.”² (APICS, APICS Dictionary Twelfth Edition 2008). A resource can be a person, machine, building, computer program, money, space, etc. At the production planning level, we are evaluating resources that take a long time to get: buildings, capital equipment, and people. In this phase, planning factors based on a bill of resources are used to convert product/service requirements to capacity information. This is done at a very high level in the organization with not a lot of detail and compared to capacity available.

To create a production planning spreadsheet, you need the forecast from marketing (demand management), planning factors to convert the forecast into required resource capacity information, and identification of the current capacity constraints. A spreadsheet best displays this information.

Company’s generally follow one of three production planning strategies: level, chase, or mixed.

Level

This planning strategy tries to level the amount of production built over the year. Figure 3 shows this concept graphically. Production is held constant while sales fluctuate.

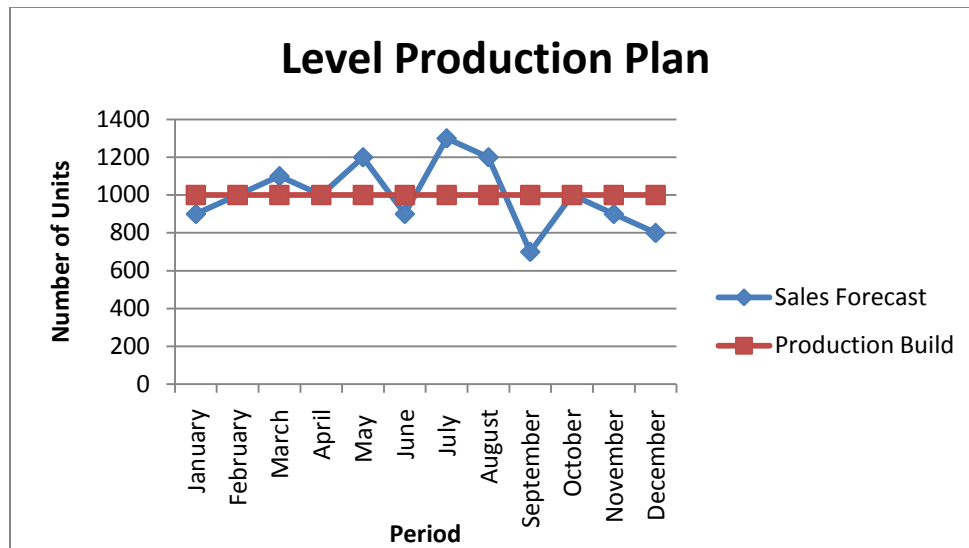


Figure 3 Level Production Planning

The advantage of a level strategy is that the resources - labor, machines, etc. - are kept at a constant rate, and when demand fluctuates, inventory is built or consumed. This method is used if you have a highly skilled work force or expensive machines or equipment that needs to be run continuously. In the case of a skilled workforce, when demand drops you do not want to lay off these people. With skilled labor, typically jobs available at other companies, and it will be difficult to hire them back when you need them. The time and money invested in training them is also lost. With skilled employees, there is a longer learning curve, so you want to protect these employees. There are disadvantages with this method. When demand drops, inventory can be built up but it costs money to store inventory. Inventory carrying costs include the cost of borrowing money to finance inventory, the cost of the storage area where the inventory is held, and risk costs, for example the chance of it going bad or obsolete. When demand rises, you may very well stock out of product. There are penalties (costs) associated with not having product when your customer wants it.

When employing a level strategy, a company may try to influence demand to try to level it out. Methods used to influence demand include offering promotions or discounts during slower times. An example of using level production planning follows in Figure 4.

Level Production Planning Strategy

Planning Factors

Opening Inventory	500
Hours per part	12
Worker hours per month	160
Worker Hourly rate	\$20
Inventory cost per part per month	\$2
Backorder Costs per part per month	\$5
Hiring Costs	\$1,000
Firing Costs	\$750

Level Production Planning Strategy

Month	Sales Forecast	Production Build	Inventory	Required Workers
January	900	1000	600	75
February	1000	1000	600	75
March	1100	1000	500	75
April	1000	1000	500	75
May	1200	1000	300	75
June	900	1000	400	75
July	1300	1000	100	75
August	1200	1000	-100	75
September	700	1000	200	75
October	1000	1000	200	75
November	900	1000	300	75
December	800	1000	500	75

12000

Cost Calculations

Regular Labor costs	\$ 2,880,000
Inventory holding Costs	\$ 8,400
Backorder Costs	\$ 500
Hiring Costs	\$ -
Firing Costs	\$ -
Total Cost Level Production Plan	<u>\$ 2,888,900</u>

Figure 4 Example of Level Production Planning

Figure 4 is an example of a production planning spreadsheet including cost information. The Sales Forecast, Production Build and Inventory numbers are in units. Some companies will calculate hours in addition to units. At the top of the chart are the Planning Factors. Planning factors are part of a bill of resources which identifies the key resources required to make a part. At this level the planning factors are average times or dollars based on the product family and the usual product mix. Opening inventory is the amount of inventory available to satisfy the customer at the start of the planning period. Hours

per part are the time it takes to make one part. Worker hours per month are the standard number of hours an employee works in a day, week, or month. These standard number of hours worked by an employee varies from industry to industry, company to company, department to department, and even shift to shift. In Fig. 4 we are assuming a simple 8 hour work day, 5 days per week, and 4 weeks per month. Worker hourly rate is the cost per hour for each employee including their hourly rate and benefits. Inventory cost per part per month is calculated based on the cost of the part and the inventory carrying cost. It is the cost to hold one unit in inventory for one month. Accounting is responsible for assigning these costs. Inventory carrying costs will be covered in more detail in the inventory chapter. Backorder costs per part per month are the cost if the company has a customer order and is unable to fulfill it. Backorder costs include the possibility of premium costs incurred to expedite product to meet customer requirements. They can also include the cost of a lost sale, and/or a lost customer. Backorder costs are usually more expensive than inventory carrying costs, but really depend on the product/service bundle and the customer expectations.

Hiring and Firing costs recognize that layoff and/or firing an employee costs the company money. With a layoff or firing, there are severance pay issues, government regulations to follow, possible legal fees, relocation support for the employee, legislated paperwork, etc. With respect to hiring, costs can include recruitment costs, costs during the selection process, and costs associated with the learning curve of a new employee, in this example our production build has been leveled at 1000 parts per month, therefore our work force is stabilized and we do not use the hiring and firing costs in our calculations. You can see from the example how inventory levels vary from month to month as demand varies yet production remains constant. Overall for the year, there is no change in inventory level. Opening inventory is 500 and it is the same for closing inventory. This is due to the fact that total annual demand is 12,000 units, the exact same amount as total annual production. At this point the costs of this plan would be calculated using the cost planning factors. Other costs like overtime or machine capacity constraints may also be included. For this course you will not need to know how to do the cost calculations. That will come in later courses. Having said that, see if you can calculate the inventory costs, labour costs, and backorder costs associated with this plan.

Chase- This planning strategy chases or matches production levels to the sales forecast. Sometimes there is minimal inventory carried, but often there is not. Figure 5 demonstrates this graphically where sales and production are matched.

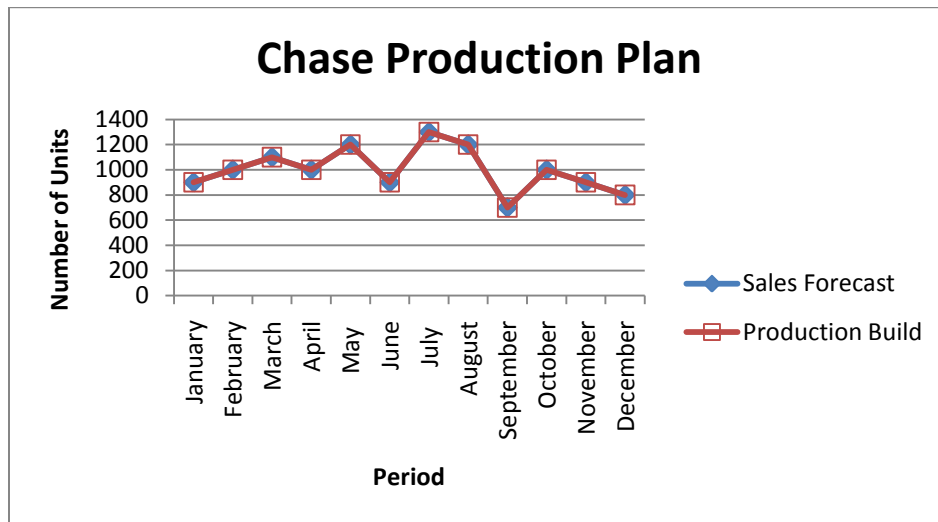


Figure 5 Chase Production Planning

The advantage of this strategy is that little or no inventory is built up; you make what you need when you need it. This is the strategy that most services are forced to use because they cannot build inventory. There are ways to influence demand and capacity which will be covered in the S&OP for services section.

The disadvantage is you may be hiring people one month, then laying off people and not utilizing equipment in the next month. In fact you would need equipment available to meet peaks in the demand. This method works best if your work force is not skilled, is easily replaced (large labour pool) and/or training is minimal.

The post office does not level out delivering mail but needs to process it as it comes. I would hate to get my Christmas cards in January if they chose to use a leveling strategy! Highly perishable products like fruits and vegetables are planned using the chase strategy.

Chase Production Planning Strategy

Planning Factors

Opening Inventory	500
Opening Workers	75
Hours per part	12
Worker hours per month	160
Worker Hourly rate	\$20
Inventory cost per part per month	\$2
Backorder Costs per part per month	\$5
Hiring Costs	\$1,000
Firing Costs	\$750

Chase Production Planning Strategy

Month	Sales Forecast	Production Build	Inventory	Required Workers	Hire/Fire Workers
January	900	900	500	68	-7
February	1000	1000	500	75	7
March	1100	1100	500	83	8
April	1000	1000	500	75	-8
May	1200	1200	500	90	15
June	900	900	500	68	-22
July	1300	1300	500	98	30
August	1200	1200	500	90	-8
September	700	700	500	53	-37
October	1000	1000	500	75	22
November	900	900	500	68	-7
December	800	800	500	60	-8

12000

Cost Calculations

Regular Labor costs	\$ 2,889,600
Inventory holding Costs	\$ 12,000
Backorder Costs	\$ -
Hiring Costs	\$ 82,000
Firing Costs	\$ 72,750
Total Cost Level Production Plan	<u>\$ 2,901,600</u>

Figure 6 Chase Production Planning

Figure 6 is an example of a Chase Production Plan using the same sales forecast as we used earlier in the Level Production Plan example. Most of the information is the same as the level production planning example except the production build is matching sales. In this case an adjustment to the workforce is required monthly. In January, seven workers need to be laid off, in February seven workers hired, March an additional eight workers hired, etc. The company needs to have the ability to make these adjustments in workforce to use a chase strategy. Some companies have a core workforce and use contract workers or part time workers for these types of adjustments. There are no backorder costs since all demand is met. The inventory is level at 500 units per month, and carrying costs are

correspondingly level. Management could decide to reduce the amount of inventory carried at the end of the plan, which would reduce the total cost of this or possibly any plan developed for that matter.

The costs of this chase production plan are \$12,700 higher than the level production plan.

Mixed- Is probably used most often in business and combines both level and chase strategies. Figure 7 shows this concept graphically. Production is leveled from January to April and then stepped up from May until August, perhaps with the use of summer college students, then stepped down and leveled from September to December.

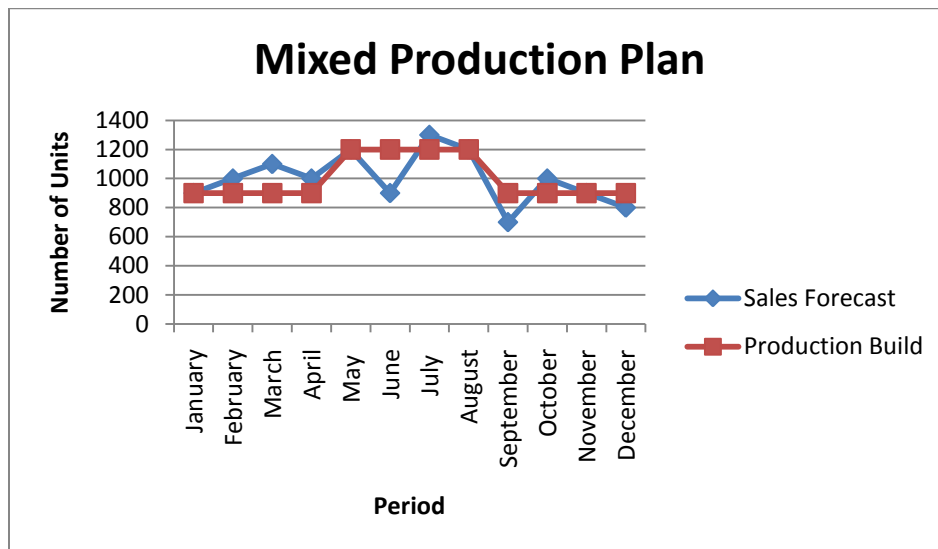


Figure 7 Mixed Production Planning

Another example would be a hot dog manufacturer like Maple Leaf Foods. In the summer months when demand rises, they may run a second shift of hot dog production. Conversely, they may only run one shift or less of hotdogs in the winter months when demand is lower. There may be times when workers can be shifted around to accommodate for changes in demand , rather than layoffs or firings. Changes in manpower levels typically corresponds to a significant change in demand.

In developing the mixed plan, management is responsible to develop a plan that achieves the best possible compromise for all involved; employees, managers, customers and shareholders of the company.

The advantage of the mixed production planning approach is that it combines the best of both the level and chase approaches and usually produces the lowest cost plan.

Mixed Production Planning Strategy

Planning Factors

Opening Inventory	500
Opening Workers	75
Hours per part	12
Worker hours per month	160
Worker Hourly rate	\$20
Summer Student Hourly rate	\$12
Inventory cost per part per month	\$2
Backorder Costs per part per month	\$5
Hiring Costs	\$1,000
Firing Costs	\$750

Mixed Production Planning Strategy

Month	Sales Forecast	Production Build	Inventory	Required Workers	Hire/Fire Workers
January	900	900	500	68	-7
February	1000	900	400	68	0
March	1100	900	200	68	0
April	1000	900	100	68	0
May	1200	1200	100	90	22
June	900	1200	400	90	0
July	1300	1200	300	90	0
August	1200	1200	300	90	0
September	700	900	500	68	-22
October	1000	900	400	68	0
November	900	900	400	68	0
December	800	900	500	68	0
12000					

Cost Calculations

Regular Labor costs	\$ 2,611,200
Summer Student Wages	\$ 168,960
Inventory holding Costs	\$ 8,200
Backorder Costs	\$ -
Hiring Costs	\$ 22,000
Firing Costs	\$ 21,750
Total Cost Level Production Plan	<u>\$ 2,788,360</u>

Figure 8 Mixed Production Planning

Figure 8 Mixed Production planning total cost is the lowest of the three plans developed to this point, at \$2,804,610 which is \$84,290 less than the level planning alternative. In the mixed model example, the

use of summer students has reduced the labor costs from \$20 an hour to \$14 per hour. Hiring costs are less for summer students as they are more temporary employees and firing costs are eliminated because they are hired on contract with a beginning and end date. This is one solution management may use to try to balance resources and costs. Do you see any potential problems with this solution? How do you think the seven employees who were laid off in January are going to react to being replaced by a summer students in May? How will the other 68 employees react? If the company was unionized would this be more of a problem? Does management need to be concerned with employee reactions? How could this impact productivity and/or quality? Cost is a large factor, but impacts on productivity, quality and morale also need to be considered in making a good decision.

Sales and Operations Planning for Services

Balancing supply and demand for services is even tougher as you typically cannot build up inventory. When a customer wants a service, you need to provide it. Sometimes customers are willing to wait for the service until the provider is available, such as with a doctor. In other service organizations, customers may decide to go elsewhere rather than wait, such as with a one hour wait to be seated at a restaurant.

Balancing supply and demand is tougher but not impossible to do for services. There are really two main strategies companies use to accomplish this, influencing sales to match available capacity or changing capacity to match sales.

- 1) **Influencing sales to match available capacity.** Companies look for ways to influence sales or demand to match available capacity. Promotions in the off season are one way to accomplish this. Replacement windows are generally less expensive if installed in the winter season when sales are lower. Veterinarians offer discounts for dental work on animals during February which is a slower period for them. When you schedule a doctor's appointment, you are told when the next available appointment is, this is influencing sales.

Yield Management is used by the service industry for products such as airline seats or hotels. With this approach, prices are adjusted to maximize total profit based on available capacity. When demand for a hotel is low, the hotel has many rooms available; the price is adjusted downward to attract customers. When demand for a hotel is high and there are few rooms left, price is adjusted up and a premium price is charged for the limited number of rooms that are available.

- 2) **Changing capacity to match sales.** There are a number of ways to adjust capacity; cross train employees, overtime, the use of part time, temporary or seasonal workers, shifting part of the work to customers.
 - a. Cross trained employees are able to do several tasks. When demand is high on a task , capacity is adjusted when another employee steps in and helps out for a period of time when needed. At supermarkets or drug stores when the line to cash out gets long, another employee who is stocking shelves may be called to operate another cash register until the line or demand is reduced. This is a good use of resources for the store as they do not need to have extra cashiers that are idle and waiting for customers. Cross training allows for an employee to be shifted to other work thereby adjusting capacity up in periods when the demand is higher, and correspondingly adjusted down when shifted to perform other tasks when demand decreases.

- b. During busy periods overtime may be used to increase capacity. The premium costs in extra wages paid to employees, as well as potential costs due to loss of productivity and /or quality do not make the use of overtime attractive in the longer term.
- c. Hiring part time, temporary or seasonal workers is an effective way to increase capacity for shorter periods of time. Retail stores hire Christmas staff for the sales period leading up to Christmas. Gardening and landscaping companies hire seasonal workers for spring to fall period.
- d. Shifting work to the customer is being used more often. Self serve checkouts at retail stores have reduced staffing needs and tend to have smaller line ups. Only one cashier is required for multiple self serve checkouts. The banking industry has shifted financial transactions from tellers to banking machines, to telephone banking to internet based banking. Many customers do their own banking online where they can do most of the transactions themselves. Only when a transaction is not available online, do the customers go into the bank and have the teller perform them. A reduction in the amount of bank cashiers has been the result and the customer is performing most of the work traditionally done by the banking cashiers. Another example, there once were separate employees responsible for clearing tables at fast food restaurants. Now this job is handled by servers or sometimes even the customer.

Most organizations will use a combination of approaches to successfully balance supply and demand. For example, Financial Planners have to look ahead to RRSP season and find ways to ensure they can meet with all current and potential new clients to maximize RRSP contributions prior to the deadline. Calling customers ahead of time and trying to schedule appointments before the deadline, or having clients make monthly contributions to their RRSP is how the astute Financial Planner tries to influence demand. Additionally, during the first few months of the year Financial Planners usually extend their working hours to be able to meet with all clients during this busy time. This is an example of them adjusting their capacity.

It is really important that S&OP planning is done for services to ensure that supply and demand are in balance. Many service companies are implementing S&OP to aid them in this process.

The next few sections to be covered will focus on making parts and the processes required to make them. Service organizations do not follow these processes exactly but they do have to go through the process of scheduling people and materials to meet their customer orders. As you go through the material you will get an appreciation of what each process is doing and its importance. At the end of each section we will discuss how these processes can be adapted for services.

Master Production Scheduling

Master Production Scheduling is the process of creating a build plan for individual end items otherwise known as finished goods. It is the anticipated build schedule for independent demand items which are usually shipped to the customer. Examples include finished goods and service parts. Service parts are replacement parts. When we buy a car and the windshield wipers wear out, we buy replacement windshield wipers. This is an example of a service (independent demand) requirement in the master schedule.

When we create the Master Production Schedule (MPS) we start from today and plan our build for each end item out into the future, typically in weekly amounts or time buckets. The length time into the future the MPS created for is called the Planning Horizon. The length of the minimum Planning Horizon is determined by the longest cumulative lead time of the part which includes both purchasing and manufacturing lead time, plus one additional planning period and time bucket. The longest cumulative lead time includes the total lead time of all the parts and processes to make a product or service. This longest cumulative lead time varies from product to product based on the product itself and the nature or complexity of the processes involved. You can well imagine that the longest cumulative lead time to manufacture a Popsicle is considerably shorter than that of a manufactured home. Whatever the product, we calculate its longest cumulative lead time, typically measured in weeks (the MPS time bucket). A manufactured home may have the longest cumulative lead time of 26 weeks from the time the order is placed until the home is completed and handed over to the home owners. In another example, if we were to make chocolate chip cookies, we would need to purchase ingredients such as flour, sugar, butter, salt, baking powder, and chocolate chips. Assuming we have no inventory in our pantry, we would go to the grocery store to purchase these ingredients, which would take us one hour. This is our purchasing lead time. As we follow our recipe and start creaming the butter, mixing in the sugar and the other ingredients, the cookie dough may be considered a sub-assembly. This takes 15 minutes (manufacturing lead time). At this point we would separate the dough into cookie size pieces on a baking sheet. We then bake and cool the cookies, which takes one hour (manufacturing lead time). Total manufacturing lead time including mixing, baking, and cooling, is 1.25 hours. We add the 1 hour of purchasing lead time to the 1.25 hours of manufacturing lead time to arrive at a total cumulative lead time of 2.25 hours.

The MPS must support the S&OP and the Production Plan. Remember that at the S&OP/Production Plan level the forecast and production was determined to meet our customer requirements and effectively utilize our resources at a minimum cost. If we start making changes at the MPS level without regard to the S&OP/Production Plan, we may not satisfy the customer or it could cost more to produce the product/service bundle than we originally planned for in the S&OP/Production Plan. The Master Scheduler must consider the availability of material and capacity as well as management's policies and goals contained in the budget, which was derived at the S&OP/Production Planning level. Management goals on customer service, inventory levels, overtime policies and scheduling policies are all captured in the budget and support the strategic plans of the organization. Therefore, the MPS must also support the S&OP/Production Plans, thereby supporting the financial and strategic plans of the organization.

The Master Production Schedule (MPS) disaggregates the S&OP. What this means is that the MPS breaks down the S&OP into greater detail. Figure 9 demonstrates this concept. The approved production plan

from S&OP for the month of January is to produce 2000 cases of the burger product family. The S&OP time frame is planned by month whereas the MPS is usually weekly. At the MPS level the 2000 cases of burgers per month is divided into weekly time buckets within each month. In this example we'll assume 500 cases per week. The burger product family has three finished goods; hamburger, cheeseburger and bacon cheeseburger. As a result, the 500 cases of burgers each week is further broken down into an amount to be produced for each different type of burger in the burger family. For example, the weekly breakdown could be 200 Hamburgers, 200 Cheeseburgers and 100 Bacon Cheeseburgers, or whatever combination to add up to 500 per week. The exact combination or number of each end item in the MPS is determined by incoming customer orders and/or detailed forecasts out into the future.

Approved Production Plan from S&OP

	January	February	March	April
Burger Product Family	2000	2000	2000	2000

January Master Production Schedule

Finished Goods	Week 1	Week 2	Week 3	Week 4
Hamburgers	200	200	200	200
Cheeseburgers	200	200	200	200
Bacon Cheeseburgers	100	100	100	100
Total	500	500	500	500

Figure 9 Disaggregating the S&OP to MPS

At the S&OP and Production Plan level, the primary demand inputs were forecasts provided by Sales and Marketing. At the MPS level we now introduce actual customer orders for finished products. The MPS is the primary interface between Operations (supply) and Marketing (demand) and is used to provide delivery commitments based on actual customer orders and when the orders will be filled. Within the MPS, Available To Promise is a tool used to identify what production is committed to actual customer orders on the books and what is still available to commit to new customer orders as they arrive. It's an important tool used by both Operations and Sales and is a critical interface between supply and demand for the organization.

The MPS process is said to coordinate the forecast, actual customer orders and production activities. Going back to Figure 9, how did we know how much of each finished good to produce? Why did we schedule 200 hamburgers, 200 cheeseburgers and 100 bacon cheeseburgers? We need to look at customer orders, forecast and inventory available.

Figure 10 below is an example of a MPS Planning chart for the hamburger. There would be a chart for each finished good; hamburger, cheeseburger and bacon cheeseburger. The first line is forecasted demand by finished good. The second line is the actual customer orders. The third line is the calculation of the projected available inventory. When calculating the projected available inventory you start with the opening inventory of 25 cases. Then, from Week 1 you add your MPS (200) (supply) and subtract the higher of forecasted demand (200) or customer orders (212) (demand). The result is a projected

available inventory ($25 + 200 - 212$) of 13 cases in Week 1. The 4th line is available to promise which is what marketing will use to book new customer orders. Let's say a customer calls in and wants to order 25 cases of hamburgers with delivery ASAP. The salesperson can go to this grid and see that they could commit to providing the full 25 cases in week 3 as there are 47 in ATP. If the customer needs before that time, 13 could be committed in week 1, 3 in week 2 and the balance in week 3. This is a powerful tool in helping satisfy the customer.

Hamburger		Week 1	Week 2	Week 3	Week 4
Forecasted Demand		200	200	200	200
Customer orders		212	197	153	79
Proj. Avail. Inv.	25	13	13	13	13
Available to Promise(ATP)		13	3	47	121
MPS		200	200	200	200

Figure 10 Example MPS Planning Chart

After the preliminary MPS of all finished goods in a product family is completed, the capacity of critical resources needs to be verified using rough cut capacity planning. Critical resources could include labor, machine time, or supplier capacity. During the Production Planning process planning factors or averages were used to look at capacity. Now at the MPS level, once we add the detail by finished good part numbers we may need to rebalance and make adjustments to our resources. For example, assume that the planning factor used in Production Planning for the burger product family is 1 hour per case. At the individual end item level, the time that it takes to make a case of hamburgers may be .9 hours, cheeseburgers 1.05 hours, and bacon cheeseburgers 1.10 hours. Depending on the product mix scheduled weekly there may need to be shorter term adjustments in capacity. Adjustments to resources could include changes to workforce, shifts, overtime, subcontracting, and inventory levels and logistics decisions. Once we have adjusted our capacity at critical resources, or changed our MPS quantities, we have a firm MPS.

Flexibility is getting more limited as the Master Scheduler is constrained by the S&OP plan. Risk is fairly low, as decisions are being implemented.

In service industries it is really important to plan to have the service available when the customer needs it. This means having the right number of people and/or equipment available at the time the customer requires the service. At the S&OP level customer forecasts were used. At the Master Scheduling level, actual customer orders or customers arriving in person are used. A bank needs to know how many tellers and bank machines are needed to be available to satisfy customers. In some cases they can bring in cross trained employees who are performing other tasks when the lineups become long, and those people go back to other work when the lineups are shorter. The bank does their own type of master planning.

Material Requirements Planning

At the MPS level we planned finished goods. The next step in the planning process is Material Requirements Planning (MRP). MRP provides more detail in planning for all the purchased and manufactured component parts required to make a finished product. These are called dependent demand items. Dependent demand items are calculated based on a bill of material. Think of MRP as a

huge calculator that processes information, typically by a computer program. MRP is especially useful for manufactured parts where there is a build-up of sub-assemblies and parts to make a finished good. Computers, automobiles, airplanes, or any assembly manufacturing would be a good candidate for MRP.

MRP is the most detailed of the planning phases and the time frame is as long as the MPS offset by lead time in weekly time buckets for all parts. Sometimes in the nearer term the time buckets are daily or by shift. Risk is low and flexibility is also low.

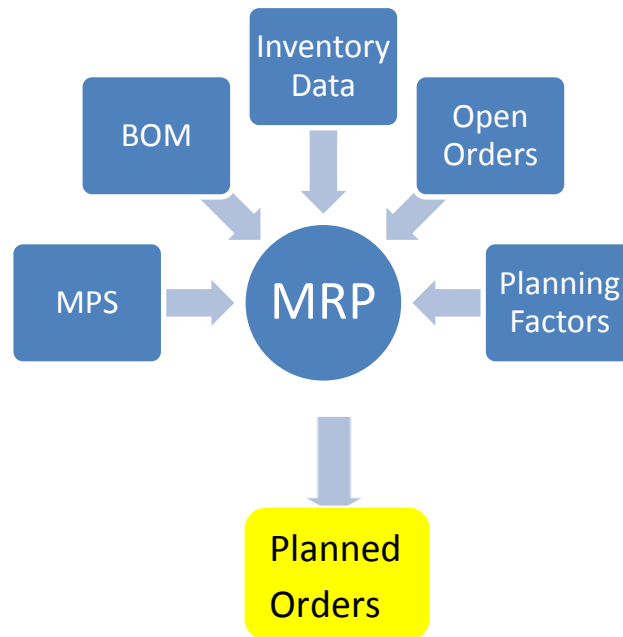


Figure 11 Inputs and Output of MRP

Figure 11 provides the inputs MRP. It is crucial that each of these inputs is accurate for the system output to be useful throughout the supply chain. If any of these inputs are not accurate, it is "garbage in, garbage out". This is where many companies fall down in the use of computerized planning systems. We covered the MPS in the last section, so we'll review each of the other inputs to MRP in more detail.

A Bill of Material (BOM) is a listing of all subassemblies, components and parts required to make a finished good and the quantity required of each. Think of it as a recipe, where the ingredients and quantity of each ingredient is listed. Figure 12 is an example of a chocolate chip cookie dough bill of material displayed as a product structure tree. The advantage of using a product structure tree is that it displays how the product is put together. Anything on the lowest level (without anything items underneath it) is a purchased part. Any items that have parts linked beneath it are subassemblies or finished goods. In Figure 12 there are two subassemblies; the wet ingredients and the dry ingredients. These have to be made first before mixing these two sub assemblies together with the chocolate chips to make the cookie dough, the finished item in this BOM.

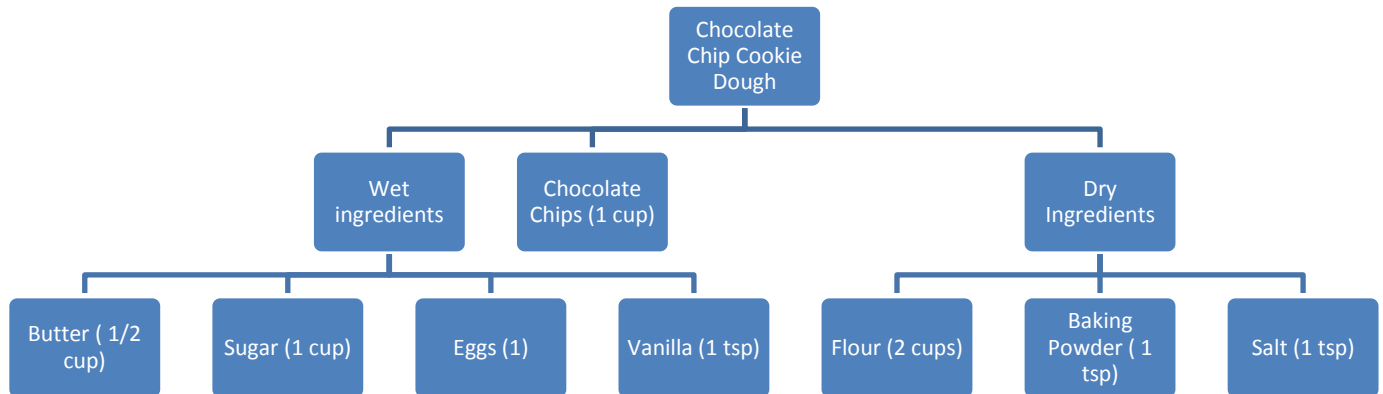


Figure 12 Example of Bill of Material (Product Structure Tree)

Inventory data is the record of perpetual inventory balances. Do you work at a store or a company that keeps track of inventory? Are the inventory records accurate, or do you have to go and check the shelves or in the back before telling the customer you have the part? Inventory record accuracy must be high in order for the calculations and resulting information coming out of MRP to be accurate and useful. Accurate Inventory records for all parts must be maintained in the MRP system for it to be used effectively in meeting the customer orders contained in the MPS. The opening inventory balance, also called On Hand Inventory, appears on the MRP record.

Open orders are orders that are in progress. A purchase order is opened when we purchase parts from a supplier. For manufactured parts, a work order or manufactured order is given to production to manufacture parts or sub-assemblies. These open orders are important to MRP (and the planner) as they identify what is already being worked on by your company and/or your suppliers. These open orders are contained in the scheduled receipt field on the MRP record.

Planning Factors are details about the parts; lead time, lot size or order quantity, scrap factors, and safety stock. These are the planning parameters MRP will use to perform calculations. These planning factors are entered into a file called the Item Master in the computer system.

Planned Orders are the **output** of MRP. These are suggestions or recommendations generated by the MRP system advising the planner to create purchase or manufacturing orders to meet customer requirements. MRP uses lead time offsetting to make sure materials and products are scheduled to meet delivery dates.

Let's walk through an example to understand how MRP calculations work. Figure 13 contains two records, the MPS record for the parent part Chocolate Chip Cookie dough and the MRP record for chocolate chips that go into the dough. The first input of MRP is the MPS. In looking at the cookie dough record, we see that in Week 3 we require 100 cookie dough batches need to be completed. Assuming that the lead time to make cookie dough in an industrial setting is 1 week, therefore we must start making the cookie dough in Week 2. Thus we see in the Start Date row a requirement for 100 cookie dough batches in Week 2 to meet the MPS requirement for 100 batches in Week 3. This is called lead time offsetting.

In order to start the 100 cookie dough batches in Week 2, all the ingredients, such as chocolate chips, must to be available at the beginning of week 2 in order to make the dough. At this point we need the second input of MRP, the BOM. Referencing Figure 12 for the BOM, how many chocolate chips does it take to make a batch of cookies? 1 cup is the right answer. MRP takes the 100 batches of cookie dough that we need to start in Week 2 and multiply it by the bill of material quantity of 1 cup for chocolate chips. The result is seen in the chocolate chip MRP record. MRP identifies that 100 cups of chocolate chips are required in Gross Requirements in Week 2. The same calculation (between parent and component items) is used in Week 4 or anywhere there is a Start Date requirement coming from the parent item as identified in the BOM.

Now we can see when we need to order chocolate chips to meet our cookie dough requirements. The opening inventory available is 25. We see this in the first amount shown in the Projected Available Inventory row. That means that there are 25 cups of chocolate chips in the facility. There is a scheduled receipt or open purchase order of 50 cups in Week 2. This means that we can expect to receive 50 cups of chocolate chips from our supplier sometime during Week 2. If we have 25 already and 50 coming that is a total of 75. We need 100 so we are short 25, which is the Net Requirement seen in Week 2. Now we have to apply the only planning factor we have for this item, the lot size or order quantity which is 50. This order quantity means that we have to order chocolate chips from our supplier in multiples of 50 cups (50, 100, 150 ...). The Planned Order Receipt is when we need to receive the product as seen in Week 2. The Planned Order Release is in week 1 because there is a 1 week lead time offset for chocolate chips. If we have 75 cups of chocolate chips expected in Week 2 (25 + 50 coming in) and we order another 50 cups to arrive in Week 2 (Planned Order Receipt), and we require 100 cups, which leaves 25 cups of chocolate chips as Projected Available Inventory at the end of Week 2.

This 50 that shows up in Planned Order Release would be the trigger to a planner to create a purchase order in week 1. That is why the output of MRP is called planned orders. The system plans for an order to be released, but only a planner or another authorize person can actually create an order.

Choc. Chip Cookie Dough	Week		1	2	3	4	5
Lead time = 1 week	MPS due date				100		100
	Start date			100		100	

Choc. Chips	Week		1	2	3	4	5
Lead time = 1 week	Gross Requirements			100		100	
Order Quantity= 50 cups	Scheduled Receipts			50			
	Proj. Available Inventory	25	25	25	25	25	25
	Net Requirements			25		75	
	Planned Order Receipts			50		100	
	Planned Order Releases		50		100		

Figure 13 –Example MRP Chart of Chocolate Chip Cookie Dough and Chocolate Chips

All the other parts in that BOM in Figure 12 should have MRP Charts.

After MRP is run, capacity is verified using Capacity Requirements Planning. Detailed schedules by work center and shift are converted into load hours of work and compared to available capacity. This is the most detailed phase of capacity planning verifying that all resources are available, labor, machines, etc.

Although MRP is typically used in manufacturing companies, the concepts are easily applied to most organizations. All organizations need to do some form of material ordering or planning. They need to know what the requirements will be (MPS), they need to know what materials are required (BOM), what they already have (inventory), what they have on order (scheduled receipts), the time it takes to get an item (Lead Time), and the quantity to order (Lot Size). The college is a service organization but they are required to have products available for students. Textbooks have to be ordered to be available for students to learn. The MPS would be the number of students that are registered for a particular course. The BOM is the textbooks or other learning packages that are assigned for that course. Available inventory is what is in the bookstore. On order are any outstanding purchase orders with the publishers. Planning factors are the lead time and if certain books have to be ordered in any particular lot sizes.

What are some of the materials that need to be ordered in other service organizations? It is easy to apply these concepts to service organizations.

MRP is the last and most detailed of the planning phases in the Business Planning Process.

Production Activity Control

The last two phases in the Business Planning Process are Purchasing and Production Activity Control (PAC). Purchasing has been covered in earlier chapters, so we will focus on PAC. Purchasing and Production Activity Control are responsible for managing the execution of the plans made in all the other planning processes. It is in the PAC phase where parts get scheduled, manufactured, and the processes evaluated for effectiveness throughout the entire production operation. There are many different scheduling techniques that can be employed to make sure parts are completed on time. After scheduling, work orders are generated and monitored to ensure products are completed on time and on schedule. When things don't go according to plan, work around solutions and other activities happen to try to ensure the customer is satisfied. Feedback through the Business Planning Process helps keep departments in communication when customer delivery dates change. Continuous improvement to drive out variation in processes and quality is critical here.

Summary

The Business Planning Process is used to implement the Strategic Business Plan in an organization. Strategic Business Planning, Sales and Operations Planning, Master Production Scheduling, Materials Requirements Planning and Production Activity Control work as coordinating mechanisms between functional areas to work towards the goals and objectives of the company. Each process was outlined in detail in the preceding sections including applications for service organizations.

Notes

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