1

Chaos in Manufacturing

Don't mistake activity for accomplishment.

A TYPICAL SITUATION IN TODAY'S MANUFACTURING WORLD

The Place: A typical world-wide manufacturing company
The Time: 10:00 a.m.
The Date: Friday, the last day of the month

What had been a quiet and sporadically busy area three weeks ago has turned into a three-ring circus. Lift trucks careen through the stockrooms at full tilt, barely avoiding head-on collisions. Every inch of the shipping department is piled with partially completed products waiting for missing materials and components. Normally neat and orderly work areas now resemble obstacle courses as excess materials clog the aisles.

Outside the supervisor's office, an angry manager berates an expediter, demanding to know why the night shift had run the wrong size product. The expediter shifts his weight from foot to foot as he explains that the required product had been at the top of the hot list—and maybe, just maybe, the night supervisor did not get that revision of this week's list (of which there had already been three).

Over in one of the assembly areas, a worker complains that she has gone as far as she can without the next skid from the processing department. A supervisor moves from

worker to worker, asking people to sign up for weekend overtime. A chart on the wall shows that 30 percent of the month's shipments still need to be made.

The cost variance reports that were the burning issue of the manufacturing meetings just two short weeks ago are now buried under a stack of quality control reject reports. Management has temporarily waived the rejects so that needed materials and components can be used to meet this month's numbers.

Off in a corner by the coffee machine, a gray-haired foreman shakes his head and mumbles: *"So this is the manufacturing of the future that the folks in corporate promised. It looks like the manufacturing of the past to me."*

This scene continues to play itself out in many manufacturing companies today. Worse, like a recurring nightmare, it returns to haunt companies month after month after month. It happens, in part, because many companies still operate in a reactive mode, in which all decisions, priorities, and schedules are driven by the day-to-day fluctuations of the marketplace, momentary changes in the plant, and the performance of individual suppliers. It is a cycle of action and reaction, and until companies break the cycle, they will never rid themselves of the end-of-the-month crunch and nightmare.

Breaking the cycle entails four steps:

1. Admitting that problems, some serious, exist, and that the current situation is not healthy for the company or the people who work in it;
2. Identifying the specific problems—not just the symptoms;
3. Determining the cause of the problems;
4. Creating and acting on efficient and effective solutions.

Problems in Manufacturing

Consider again the scenario depicted above, this time through the eyes of the managing director, supply manager, and/or plant manager, who sees that although everyone is

attempting to do a conscientious job, the efforts are often misdirected. The use of hot lists to establish and direct production priorities in getting products out the door causes major disruptions and confusion in manufacturing. Schedule changes prompted by these hot lists satisfy some short-term requirements but throw a monkey wrench into others. Shipment dates are missed, the customers complain to the sales force, and the sales manager vents his anger onto the production manager.

Although there appears to be much work in process, the reality is that most of the work is sitting in queues. In addition, a staggering amount of unplanned overtime and quality problems are mounting. After inventorying the problems, the plant manager begins to look for their underlying causes. The hot lists, he finds, are used because of frequent material and/or part shortages, some of which result from late deliveries from engineering (specifications) and suppliers (materials), late ordering by the company (poor planning), and nonconforming quality of materials actually delivered by manufacturing (inside supplier) or outside suppliers in general. Other material and part shortages result from inaccurate bills-of-material (missing items or duplicate items, wrong quantities per, incorrect unit of measure) and inventory record inaccuracies showing materials in stock when they are not.

Schedule change problems often stem from the lack of a priority mechanism, or from following the wrong priorities—such as keeping a machine busy rather than satisfying a customer. *(It is not unusual for a company that has just purchased a new piece of expensive equipment to believe that its first priority is to keep the machine running, even if there are no customer orders for the machine's output.)*

Missed shipment dates may result from material and part shortages or problems with capacity (undefined or incorrectly defined as well as overloaded and/or underloaded conditions). Some companies are not ever sure what their capacity is, nor do they have a process in place to measure it. In other companies, measuring processes may be available, but capacity plans are not trusted due to suspected accuracy issues.

Additionally, incomplete product builds and materials can sit in queues on the manufacturing floor because of material and/or part shortages, because of the capacity issues just described, or because plant priorities and work flows are driven by an overly-optimistic demand or sales forecast that is used to communicate priorities to people on the manufacturing floor *(driving manufacturing priorities and material purchases with a demand or sales forecast was identified as a bad idea 45 years ago)*.

Why do so many manufacturing companies today insist on driving their supply chain planning (and execution) with a certain to be inaccurate and constantly changing demand

or sales forecast? These forecasts (*if the company lets them*) can and do instruct the plant to build either too much or too little.

Unplanned schedule changes, missed shipments, material shortages, past-due supply orders, and so on might not highlight the real problem or problems. These shortcomings might only be the symptoms of the real problems. Figure 1.1 lists a key dozen-plus symptoms that might cause problems in master planning and scheduling as well as in a company's entire supply chain management function.

Symptoms of Master Planning and Scheduling Problems	
Uncontrollable costs	Hot lists
Disruptions on the shop floor	Frequent schedule changes
Late deliveries to customers	Many full-time expediters
Late deliveries from suppliers	Customer complaints
Unplanned overtime/off-loading	Many "past due" orders and plans
High work-in-process	Long queues
Mismatched inventories	End-of-month crunch
Over/underutilized resources	Finger pointing/low morale

Figure 1.1 Symptoms of Master Planning and Scheduling Problems

Does solving the symptoms of a problem or problems solve the problem or problems? In most cases, probably *not*! However, people in supply chain management and master planning and scheduling try every day to do just that—solve the symptom and expect the problem to go away. This entire book is directed at identifying and providing solutions to problems, not solutions to symptoms of problems. There are a few cases within the pages of this book (e.g., safety stocking) where the authors do suggest techniques used to deal with problem symptoms while the company works on solving the real problem or problems.

THE INACCURATE FORECAST

It seems to happen all the time. Marketing forecasts customer demand at one level, while actual demand turns out to be something different—sometimes more, sometimes less.

The difficulty of planning and scheduling production in the face of forecast inaccuracies should be obvious: Materials and capacities are planned for one level of demand, but the demand that actually finds its way to the production facility is something different. Consider the simple case in Figure 1.2. This company's quarterly forecast was off the mark by 25 units (about 8 percent). Not bad, you say! However, its forecast for individual monthly periods was greatly off target. This is typical, as forecasting aggregate demand (such as quarterly) is always easier and tends to be more accurate than forecasting more detailed demand (such as monthly or weekly) or even shorter time periods.

Periods	April	May	June	Quarterly Total
Forecast	100	100	100	300
Actual Demand	140	65	120	325
Variance	+40	–35	+20	+25

Figure 1.2 Case Example of Forecast Accuracy

Unfortunately, most production is scheduled in these shortened (or even smaller) time periods, where grousing about inaccurate forecasts is commonplace but does little to alter the fact that forecasting the future will never have the precision of rocket science. Demand forecasts may be improved, but never guaranteed. Besides, any forecaster who could really see the future clearly would be in the next limousine headed toward Wall Street or Las Vegas or Monaco, where rewards for accurate forecasting are mind-boggling!

Management Issues

People in the day-to-day business of manufacturing must learn to live with the variances between anticipated (forecasted) and actual customer demand, and with the problems they create. For company leaders and managers, forecast inaccuracies create a number

of important issues. First among these is the fact that when someone creates a forecast, real things happen: Materials and components are ordered or canceled. If current capacity isn't up to the forecast, people start thinking about increasing it with new equipment and new personnel. If current capacity is greater than the forecasted requirements, people start thinking about decreasing it by shutting down production centers, laying off employees, or even closing entire manufacturing operations. In other words, forecasting demand is not an intellectual exercise done for its own sake, but an activity that triggers a number of other costly actions within the company.

Unfortunately, forecasts are not always taken seriously. Salespeople may be tempted to overstate the demand forecast as insurance against possible stock-outs. The demand forecast itself is generally uncritical of the estimates submitted by each salesperson and contains no rewards and penalties for accuracy. The task of management is getting all parties involved in the forecasting process to work together and take accountability for its accuracy. Production and finance need to understand the concern of sales personnel about stock-outs and lost commissions. Sales and marketing need to understand the cost of excess inventory to the profitability and survival of the company.

There is now a large body of knowledge and experience indicating the heights of customer satisfaction and profitability that result when teamwork replaces hostility among research, design, engineering, marketing, sales, production, procurement/purchasing, receiving, shipping, quality, and financial personnel. Management can and should act as the catalyst in team-building efforts.

While building a cohesive and energized team may be the greatest contribution of the executive team, other issues merit executive and leadership concern:

- *What about inventory?* If a plant is scheduled to build 100 units and orders for 140 appear, is there enough inventory to satisfy the unexpected demand? In the reverse case, when demand fails to appear, should the plant keep running and building inventory?
- *What alternatives exist on the manufacturing floor?* When forecasted orders fail to appear, equipment and trained people are idled—unless alternative work is found. Moving up an order might keep some hands busy that day; maintenance or training might occupy others. When demand exceeds scheduled supply, can more supply be created through overtime or outsourcing of part of the workload?
- *What are some of the real costs of forecast inaccuracy?* An overloaded schedule creates overtime expenses. The production floor and its personnel are stressed and, perhaps, made less productive. Over-forecasted demand creates idle hands and capacity, and inventories of unused materials.

- *How are customers affected?* When actual demand is underestimated, management becomes a traffic cop, directing the company's limited output to certain customers and withholding it from others. This is known in industry to be placing the customer on allocation (such a nasty word). If allocation of product is necessary (the company will not have enough product to satisfy all its customer demand), how should the product be allocated to customers when there simply isn't enough to go around? Which customers get product and when do they get it? *Remember, all customers are equal; it's just that some are more equal than others*.

It should also be noted here that placing a customer on allocation is done when the company does not or will not have enough product to satisfy its demand. This is different from identifying a customer's priority or which customers get their product first, second, third, and so on when product is available.

As management ponders these issues, the fallout of forecast inaccuracies has other minds working. Marketing observes the discrepancies between its forecasts and actual demand and wonders if these mark a trend. If the forecast is usually on the high side, manufacturing thinks about discounting the forecast as a matter of policy. The corporate controller jokes about just tossing the manufacturing budget out the window. Out in the field, the individual salesperson grows apprehensive about guaranteeing delivery on firm orders; when push comes to shove, another sales representative's customer may have priority.

Knowing that forecasts will never match actual demand, except on rare occasions, experienced master planners and schedulers understand that they must be flexible in shifting capacity and materials from one time period to another. They must know whom to call about splitting a customer's delivery over two or more time periods. And they must have the courage to look beyond the forecasted numbers as they plan production. Indeed, many top managers would be stunned to know that the solution to many of their production headaches is in the hands of the master supply planner and/or master scheduler, who either solves them with skill and ingenuity or allows them to fester out of inexperience or indifference. So, what can be done?

And the Solutions

The search for solutions to these problems should begin with a fundamental question: *Why is this company in business? The answer should be: To satisfy customers while safely making money and a profit*. This answer entails ensuring an adequate product supply to

meet the demand for the company's products. If a product is not in inventory to satisfy demand, the company must have the material, labor, equipment, capital, and time to produce it. This is where master planning and scheduling (MPS), enterprise resource planning (ERP), supply chain management (SCM), and integrated tactical planning (ITP) play such a critical role in the purpose of the business.

Integrated tactical planning, supply chain management, enterprise resource planning, and master planning and scheduling processes are integrated as well as being demand-driven supply planning processes. This demand can consist of a demand forecast, booked customer orders (which may or may not be part of that forecast), customer contracts or long-term agreements, engineering prototypes, branch warehouse requirements (i.e., replenishing a distribution center), or orders from another division within the company if the product in question is, in turn, a component of that division's products. Demand can also originate in the need for specials (industry shows, samples), service parts or spares, increase in safety stock requirements, or lot sizes.

To satisfy these demands, the master planner and/or master scheduler needs to consider the availability of materials and capacity resources. These materials include those being produced internally as well as those being procured from outside sources. Besides the item itself, quantities, dates, and lead times must be taken into account. Capacity can involve people, equipment, floor space, supplier capability, and so on—all of one's own company and of its multiple suppliers. Time, storage areas, and money are also important considerations.

As mentioned in the Introduction, the challenge the master planner and/or master scheduler faces is to effectively balance product supply with product demand. One way to envision the situation is to imagine a seesaw like the one shown in Figure 1.3 on page 9. In a perfect world, the seesaw is parallel with the ground; supply is always an equal counterweight to demand. When demand changes, supply instantly adjusts in a way that keeps the system in perfect balance. In the real world, however, demand rises or falls in unpredictable ways, and imbalances occur. These occasions require a master planner and/or master scheduler to make adjustments to the system in order to get the demand and supply back into balance.

When a company has more demand for its products than it has supply, it has three options for returning to a balanced condition:

1. Increase the supply of product—get more material and resources.
2. Decrease the demand—turn away or reschedule some demand orders.
3. Some combination of the above.

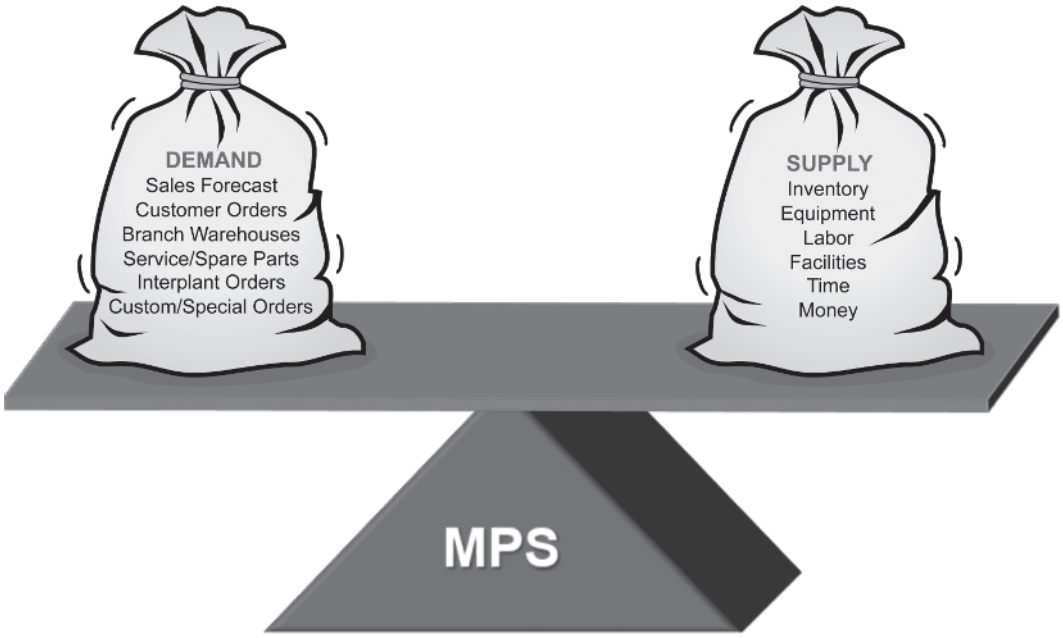

Figure 1.3 Balancing Supply and Demand

The situation in which there is more supply of the product than demand also suggests three choices:

1. Increase demand—energize the sales force, run a promotion, discount the price, and so on.
2. Decrease the supply of the product or the material/capacity needed to produce it—cut back on production, people, and equipment.
3. Again, some combination of the above.

Even though these situations can be solved only by one of the choices described or, as stated, some combination of the noted choices, some companies nevertheless believe that if they ignore the situation, it will just go away—an approach to problem solving called *ostrich management*.

The periodic imbalances between demand and supply are represented in Figure 1.4 on page 10, which shows inventory's constant fluctuations over time between high, medium, and low demand as well as high, medium, and low supply, resulting in a *sawtooth curve*.

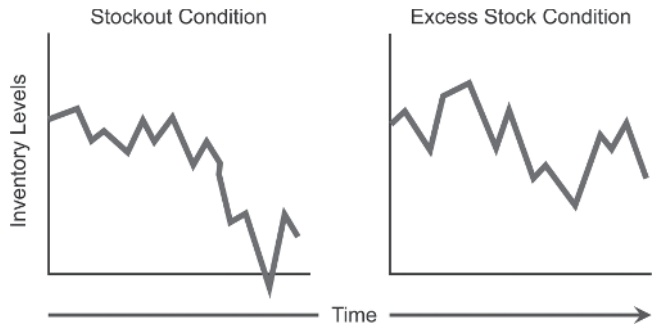

Figure 1.4 The Sawtooth Curves

In profitable manufacturing companies, the goal is generally to stabilize production by level-loading the plant while smoothing out the demand. The situation shown—stock-outs as well as excess inventory—is certainly not the objective; the objective is to have just enough inventory to satisfy demand, thereby satisfying customers and safely making money and a profit.

In the presence of sawtooth demand, manufacturing will be a seesaw in constant motion, with all the stock-outs, hot lists, and confusion that characterize the company profiled at the beginning of this chapter. If the company is not experiencing stock-outs, it is experiencing excess inventories. What is known for sure about this environment is that it continually goes back and forth. Companies that try to smooth out sawtooth demand through artificial contrivances usually fail. Tactics like schedule freezes and placing limits on the volume of orders salespeople can take cause more problems than they solve. Telling a sales force to limit its sales for a particular time period (due to poor planning of the supply constraints), for example, is a sure way to torpedo the important relationship that must exist between the demand organization (sales and marketing) and the supply organization (manufacturing and procurement) if a company is to grow and prosper.

Using these types of approaches is like installing welded struts onto the bottom of the seesaw: nothing moves. A better approach may be to install "shock absorbers" under the seesaw, to dampen expected fluctuations in demand and supply (see Figure 1.5).

Inventory in the form of finished goods, for example, is one traditional type of shock absorber. Inventory helps the company to accommodate changes in both demand and supply. Another type of shock absorber is flexibility in the supply chain, which allows the company to alter the activity rate on the production floor in order to satisfy demand fluctuations without severe disruption. Flexibility can also be extended to sales and

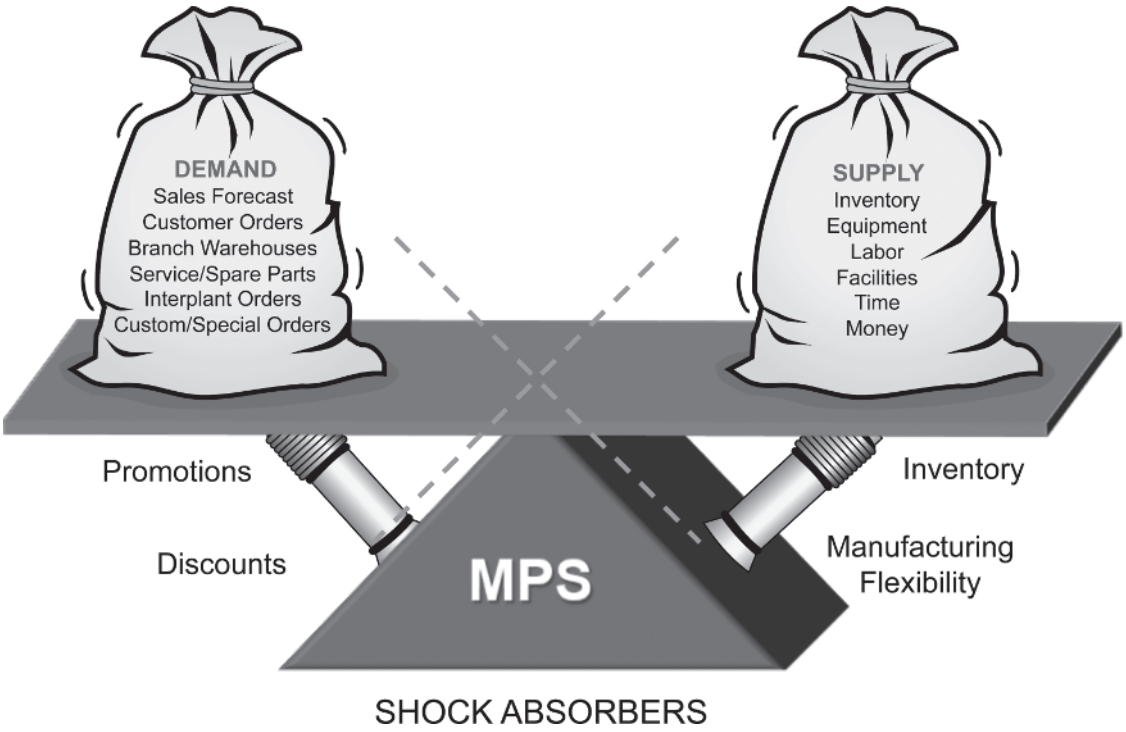

Figure 1.5 Dampening Supply and Demand Fluctuations

marketing. If the customer orders a red item, will a blue one work? If the customer requests the product for a next month or week delivery, would that delivery better suit the customer's business purpose if it arrives in this month or week or in two months or weeks? If the customer cannot be so swayed, discounts or other sales inducements may give the customer reasons to assist you with your demand and supply balancing problem.

The point is, don't be afraid to ask. In any case, the company should identify whether it wants its greater flexibility in demand (sales and marketing) or supply (manufacturing and procurement or possibly engineering). It should decide whether it wants to "sell the products manufacturing makes" or "build the products that sales sells." (Further discussion regarding these choices is done in Chapter 4, "Managing the Supply Chain with Master Planning and Scheduling.") Once that determination is made, the company can move on to the task of balancing product supply with market demand. This effort takes place in

integrated business planning (IBP) and/or sales and operations planning (S&OP), product management (PM), demand management (DM), supply management (SM), and master planning and scheduling (MPS).

It's this effort to balance demand and supply that drives a company to improve its master planning and scheduling process and capability. The job ahead certainly is not an easy one. However, Class A (a term used by some companies when describing industry best practices) and world-class companies face uncertain demand and supply in a controlled and managed way. The next chapter addresses the issue of why companies whose personnel wish to formally establish Class A Integrated Planning and Control processes elect to tackle the master planning and scheduling function right from the start. Most Class A and world-class companies believe it's never too early to start to improve their master planning and scheduling processes. However, before we move on, consider the following situation, which is all too typical of today's manufacturers.

THE CASE OF THE OVERLOADED MASTER PLAN AND/OR MASTER SCHEDULE

Some companies are always behind schedule on production and shipment. If Friday afternoons are a hellish race to whittle down the mountain of late manufacturing orders, Monday mornings are even worse. On Monday morning, the manufacturing manager and master scheduler face the dismal prospect of starting the new week under a load of past-due orders. It is tough enough to run a smooth operation when each week begins with a clean slate, but when you are faced with the normal scheduled orders *plus* all the work that failed to get done the previous week, the outlook is far from rosy. Yet, this is how many companies operate today—many on a continuing basis. Like a football or soccer team that starts the second half three touchdowns or goals behind its opponent, the manufacturer that carries past-due orders into the next time period plays a desperate game of "catch up."

Let's look at a typical scenario (see Figure 1.6 on page 13). Spectrumatic Paint Company, which has a weekly capacity of 300 units, begins the current week with 500 units to produce—the result of inept planning and scheduling as well as arm-twisting by salespeople to accept orders, and so forth. To compound its current problem, Spectrumatic ended the previous week sitting on 200 units of past-due orders.

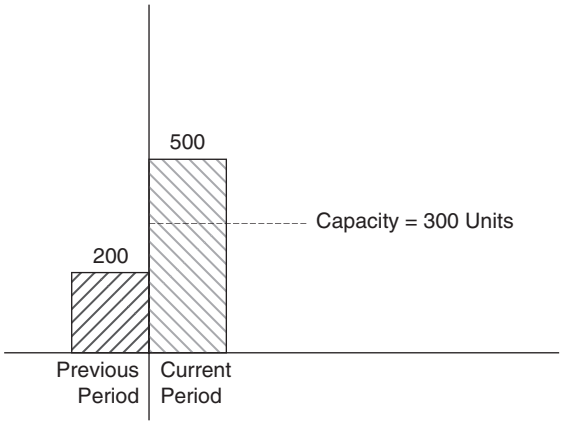

Figure 1.6 The Overloaded Master Plan and/or Master Schedule with Past-Due Orders

There is one unfortunate principle about past time periods and it is *inalterable*: Time that passes is gone forever! Once a current production time period expires, there is no retrieving it, and any orders left undone must either be done in a future period or dropped entirely. Many companies simply move them into the current period. In the case of Spectrumatic Paint Company, its inexperienced scheduler simply piled the 200 past-due units on top of the 500 units currently scheduled, resulting in a total burden of 700 units in a period with 300 units of capacity. As Figure 1.7 shows, this is what the company was faced with on Monday morning.

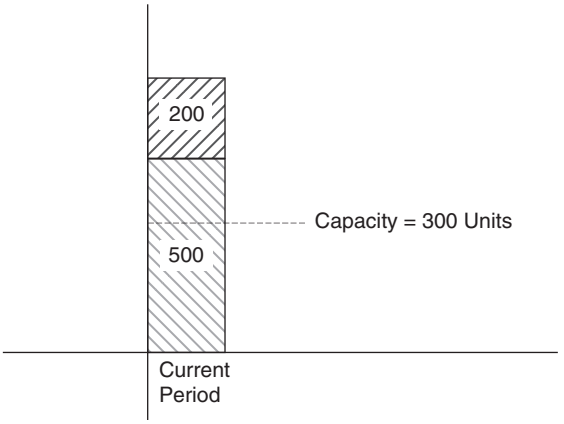

Figure 1.7 The Overloaded Master Plan and/or Master Schedule with Orders Rolled into Current Period

This is like packing your van or sport utility vehicle (SUV) to the rain gutters for a summer vacation, only to find that—*oops*—you forgot the bicycles, fishing gear, and canoe. Chances are that with all this new stuff loading down the van or SUV, you and your passengers are destined for an uncomfortable ride. Therefore, this scenario suggests an ironclad law for master planners as well as master schedulers to obey: *Items on the master plan and/or master schedule cannot be past due*. In fact, some people who believe and live MPS best practices think that having supply items on the master (supply) plan and/or master (supply) schedule is a violation of the law!

Issues for Management

Past-due master plan and/or master schedule supply orders and overscheduling current work periods are two major sources of overloaded master plans and/or master schedules that plague so many companies. And these overloaded plans and/or schedules create a host of *internal* problems for management.

- *Production efficiency decreases*. "Drop what you're doing and start order 247. We have to get this customer taken care of or we'll lose their whole account!" Poorly timed line changeovers, downtime due to material shortages, and stress take a toll on the effectiveness and efficiency within the manufacturing facility. Production supervisors and cell leaders also get mixed signals as to real priorities.
- *Products do not get shipped*. An overloaded master plan and/or master schedule can result in material stock-outs; partially built products are taken offline, where they sit as work-in-process until missing materials are received. Products built, but not shipped, increase inventories while reducing current revenues, thereby creating financing problems for the entire company.
- *Costs go up or out of control*. As production effectiveness and efficiency decrease, financial managers see costs rising. Dependence on overtime, expedited material purchases, air freight charges on late orders, concessions to irate customers, and other compensations drive up unit costs and cause havoc with cost planning and budgets.
- *Widespread confusion makes it difficult for management to identify the real problems*. Why are products not being shipped? Is there a lack of coordination of materials and production scheduling? Could there be capacity problems? How about credit holds? What, engineering specifications are not available?
- *Product quality suffers*. Production is pressured to work faster and faster to complete work in less than planned lead time, possibly causing quality to drop.

Given all of these negatives, the authors have to ask: Why would anyone allow the master plan and/or the master schedule to be overloaded? *Very often, the answer comes down to some basic human behaviors in situations where trust and confidence are absent*.

Consider the sales representative who must ensure delivery of 100 units of Model 5B3 refrigerators to an appliance distributor on the 15th of October. If the company's history is such that production is *always* late, or *always* short, or the stockroom *never* has enough components to complete an order, this sales representative has every incentive to inflate the size of the order and to ask that the order be available earlier in the schedule. "One hundred twenty units delivered to the customer on the first of October" becomes his or her entry to the order book. Discounting production's capabilities is a natural response to past lack of performance, and deliberately overloading the schedule is seen as a way of ensuring that enough materials will be on hand and that enough units will be built. Naturally, production schedulers also learn to play this game and begin discounting orders as they appear. In no time at all, no one can trust anyone else's numbers.

The unfortunate part of this dysfunctional charade is that all the players are motivated to do the right thing: for the sales representative, to fill the customer order with the right quantity at the right time; for the purchasing department, to have just enough materials on hand; for the production facility, to meet *real* demand in an efficient and timely manner.

The net result of all these fine intentions in an atmosphere of distrust, however, is an overloaded master plan and/or master schedule and profit- and energy-sapping people problems, the deadliest being the *blame game*. Sales blames manufacturing for lost orders due to shipment delays. Manufacturing points the finger at the sales representatives, who promise anything to get an order. Everything is a crisis! Finance yells that costs are out of control because of overtime charges as well as air freight expenses. In this atmosphere, the refusal to recognize the seriousness of the problem naturally becomes a survival trait. Why admit that there *is* a problem? You can only be blamed for it and, maybe, fired ("If you can't get the job done, we'll find someone who can!"). Avoidance or denial of the problem becomes the course of least resistance. Sweep it under the rug. Park it at someone else's door.

Ultimately, all the people problems come to rest at the doorstep of the management team. Management must create an environment in which all concerned can be honest about their numbers. Sales and production must be motivated to be frank with one another and to operate in a mutually beneficial partnership. Very often, the key to developing this environment of cooperation is, as W. Edwards Deming noted, to "drive out fear."[1]

[1] From W. Edward Deming's "Fourteen Points," in *Out of Crisis* (Cambridge: Massachusetts Institute of Technology/Center for Advanced Engineering Study, 1982), p. 23.

Management must end the blame game and create a climate in which people can admit to problems and past mistakes without fear of blame or retribution. Lacking this climate, problems will simply continue being swept under the carpet.

With fear driven from the workplace, the next step toward dealing with an overloaded master plan and/or master schedule is a top-down analysis that:

- Lists sales and production priorities;
- Seeks practical remedies to production constraints;
- Prioritizes and allocates production to customer demands;
- Establishes a strategy to get out of—and stay out of—the overscheduled condition;
- Implements and communicates the chosen strategy; and
- Monitors and measures the strategy's success.

The ultimate goal of this analysis, of course, is to give leadership and management the knowledge and the tools to shake off the oppressive burden of the overloaded master plan and/or master schedule and to reschedule production with completion dates that are both realistic and that satisfy customer needs to the company's best ability.

Getting Out of the Overloaded Master Plan and/or Master Schedule

One of the primary responsibilities of the master planner and master scheduler is to create a realistic, valid, and doable master plan and master schedule. A valid master plan and/or master schedule is one in which the material due dates equal the material need dates, and the planned capacity equals the required capacity. Look at Figure 1.8 on page 17. As you can see, a master plan and/or master schedule item has gone past due. This MPS item is used to drive the material requirements for all lower-level items as well as the capacity requirements for all manufacturing and engineering resources. If the MPS item is past due, what does that say about all the material that still needs to become part of the scheduled item? All this material is also past due. If we start with a past-due master plan and/or

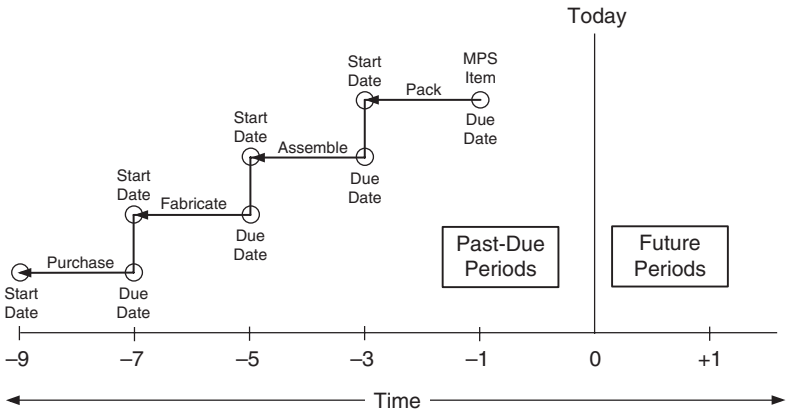

Figure 1.8 Past-Due Master Plan and/or Master Schedule

master schedule due date, all the material and capacity still required, by definition, is past due. And how valid is a past-due date? How do you answer manufacturing, suppliers, or engineering when they ask, "Which past due do you want me to work on today?"

The job of creating a *valid and doable* master plan and/or master schedule is *not* an easy one. It certainly is harder to do than to create an *invalid and unrealistic* plan or schedule. In fact, it is not difficult at all to create an *invalid* plan or schedule! Just about anyone can do that! The real challenge is to create a plan and/or schedule that balances supply of resources and materials with the demand for those resources and materials. So, when in an overloaded condition, how does a master planner and/or master scheduler successfully orchestrate getting out of this inevitable situation?

The first step is to admit that the master plan and/or master schedule is overloaded. With this question answered, an assessment of the situation and identifying the constraints facing the company become necessary. Can overtime be used? Can work be subcontracted? Can more people be hired? Can material be expedited? Can premium air or ground freight be used? Knowing these opportunities and constraints, a rescheduling strategy needs to be identified.

Other approaches to the rescheduling strategy have been tried, most of which have been unsuccessful. Look at the example presented in Figure 1.9 on page 18, which illustrates a situation in which 42 orders have been scheduled over a seven-period (current plus six periods) horizon. As the figure shows, six of these scheduled orders are past due, while five others have been committed over the planned capacity. Clearly, this represents an overloaded master plan and/or master schedule. Over the years, three approaches have been tried to correct this situation. The first approach might be referred to as ostrich

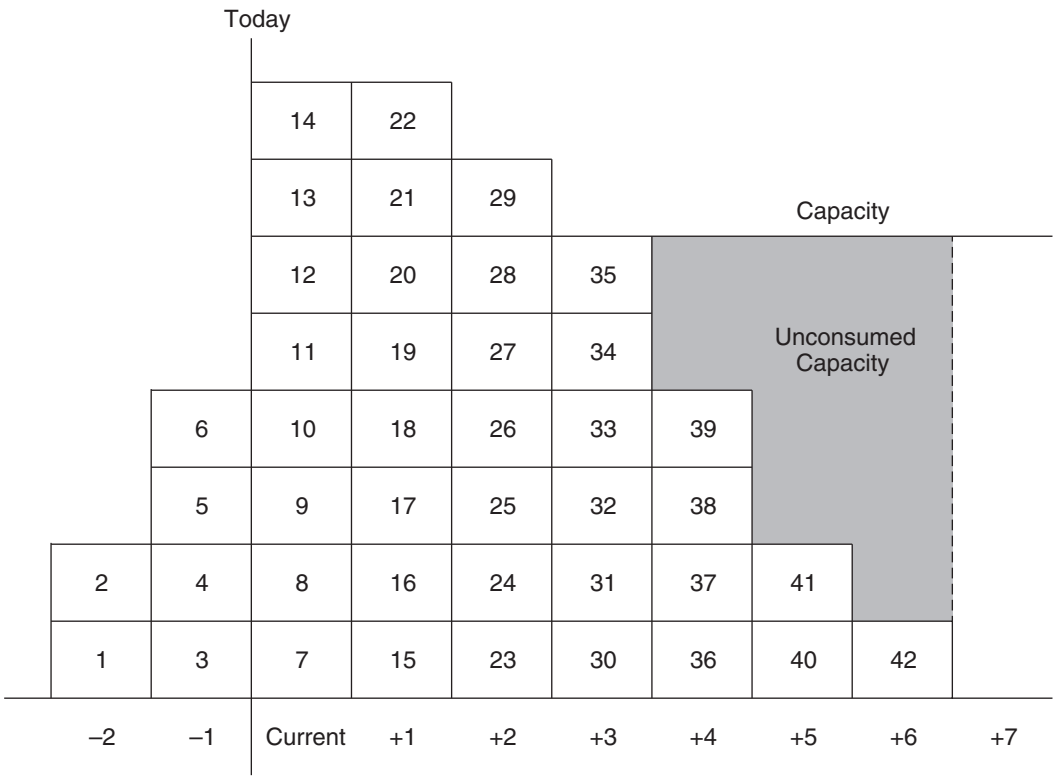

Figure 1.9 Overloaded Master Schedule

management—ignore the situation and it will simply go away. History has shown that this approach has never worked and probably never will.

The second approach is to *freeze the plan and/or schedule*; no more orders are taken until a time period well into the future—this will allow the company to work its way out of the overloaded condition. Refer to Figure 1.10 on page 19 for a visual of this approach. What management or the master planner and/or master scheduler has done in this example is to inform everyone that no orders can be committed for delivery inside of seven periods. By doing this, the master planner and/or master scheduler expects to use the unconsumed capacity in time periods current plus four through time periods current plus six (see Figures 1.9 and 1.10) to work off the overload. In other words, the supply orders keep their same priority and just shift to the right, as seen in Figure 1.10.

How long do you think this directive will last? Maybe about 17 seconds—or until the next customer order that must be committed within the seven-period freeze zone! Another issue with this approach is to recognize that these orders are not shipping because of

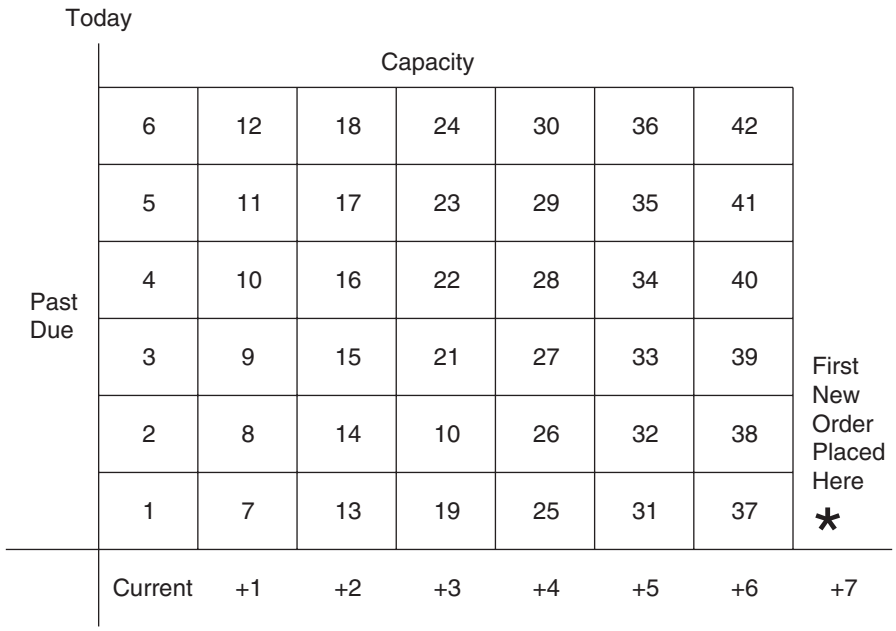

Figure 1.10 A Poor Strategy to Correct the Overloaded Master Plan and/or Master Schedule

some problem (material, capacity, quality, credit hold, missing engineering specification, etc.). This approach somewhat ignores the fact that these problems may exist, and the product cannot be completed as scheduled, or cannot be completed even in the first or second periods, no matter how much pressure is put on the people or the facility. *A better approach, although requiring more work initially, is to reschedule the entire workload into time periods that best satisfy the customer while addressing the supply constraints causing the problem(s) in the first place*.

Rescheduling the Overloaded Master Plan and/or Master Schedule

Using the reschedule strategy requires that the right mix of people—people who have the authority to make decisions—participate in an exercise to put achievable and realistic dates on all orders needing rescheduling. This process may require properly scheduled

products to be moved out (or in some cases moved in) due to another product being rescheduled into its committed time slot. Using Figures 1.9 (page 18) and 1.11 (page 21), let's review how this rescheduling process takes place.

Caution! Before beginning the actual rescheduling process, the company should be sure to identify a more realistic approach to booking customer orders in the future. This is important so that when the rescheduling exercise is complete, the company will not find itself right back in the same overloaded condition. Not only does the company need to identify how it will book orders in the future (using available-to-promise and realistic lead times), it must also implement the changes necessary to ensure that this more realistic approach is followed.

To start the rescheduling effort, a few key people must be available. The first and probably most important players are sales and marketing. In fact, when it comes to determining customer priorities, sales and marketing, working with the facts as known at the time as well as within the identified constraints, should have the final say. Manufacturing and materials management also should be included in the session to answer questions on capacities, capabilities, and materials.

Other requested functions may include finance, quality, engineering, and general management. For obvious reasons the president, general manager, or managing director should speak last: it's called "people empowerment" and getting the people close to the situation to solve the problem. Of course, general management always has the right to make the final call. General management is also responsible for breaking ties when sales, marketing, manufacturing, procurement/purchasing, engineering, quality, and finance cannot agree.

Figure 1.9 on page 18 identifies an overloaded condition. Before starting the exercise, the status of each order (why it is past due or scheduled beyond the capacity limits) needs to be known. Once this information is on the table, the painful process of deciding a realistic and valid promise date begins. Looking at order number 1 and reviewing the problems associated with it, the group determines the new, realistic date. In the example, order numbers 1 and 2 remain as the highest priority. Order number 3 has been rescheduled into the current time period plus four, while order numbers 4 and 5 have been rescheduled for a time period 2 (current plus one) delivery. Order number 6 is designated as the number-three priority and rescheduled into the current period. The rescheduling process continues until all orders have new expected delivery dates.

Now, that looks like a lot of work, and it certainly is that! However, as stated earlier, implementing a rescheduling strategy along with a redefined order promising strategy is one that works and works well! But this is the third decade of the twenty-first century and technology has come a long way since a man first walked on the moon. How can

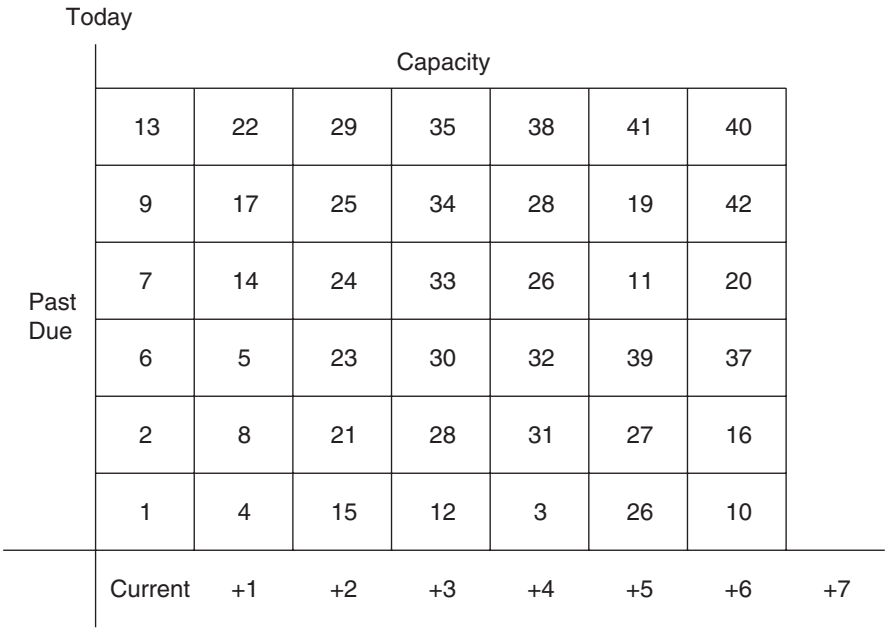

Figure 1.11 An Acceptable Strategy to Correct the Overloaded Master Plan and/or Master Schedule

the required rescheduling process be a joint venture between man and machine? Let's take a look!

Technology Assistance in the Rescheduling Process

Master planning and scheduling has always, and will always, required technology assistance. People's brains have always been, and will always be, required (in some capacity) as well. However, our human brains will be required to process information at a pace not demanded of them today. In addition to working at an acceptable pace, people's brain storage, as well as recall ability, simply needs technology assistance. With that thought in mind, let's turn our attention back to rescheduling the overloaded master plan and/or master schedule.

First of all, the computer and its related software have most of the pieces needed already as part of the company's enterprise resource planning system. Second, computer hardware and its associated electronic components continue to add new capabilities at lightning speed. Third, and maybe most importantly, is that the technology people will use in the next few decades will integrate directly with people's bodies, from wearable

tech to assimilation directly into people's brains. Perhaps, in the future, a master planner and/or master scheduler will create, validate, and approve the master plan and/or master schedule just by thinking it!

Looking inside the company's enterprise resource planning (ERP) system, we see the master plan and/or master schedule (work orders, firm planned orders, computer planned orders—past dues as well as future builds/purchases) displayed as numbers in a matrix format or as a stacked graph based on a priority driven by due dates. Along with the master plan and/or master schedule is the aligned, synchronized, and integrated rough cut capacity planning data displayed in a matrix format or as a stacked graph based on date (time periods in which the master plan and/or master schedule driven resource requirements fall). Using these two pieces of data (or information), the ERP system can balance the required workload using infinite (supported today by people) and/or finite (supported by computer) scheduling software. Therefore, the ERP system is a big plus to the rescheduling effort.

What additional data might be available in the company's ERP system that can be used during the rescheduling exercise? Well, all booked demand—that is, customer orders (past due as well as future requirements)—are noted by customer, product, unit of measure, quantity, and due date. Additionally, all supplier agreements, supplier schedules, purchase orders, firm planned orders for buy items, and computer planned orders for buy items are stored in the company's ERP system. The ERP system can (and does in a Class A company) use this data to calculate the item's available-to-promise (ATP) that can be used by the demand organization to commit and protect the booking of customer orders. Coupled with this ATP knowledge, many companies (most Class A companies) have the ability to identify, in their ERP system, whether a customer order represents *normal* demand or *abnormal* demand.

Normal demand is orders that were expected and included as anticipated (i.e., forecasted) demand when the demand plan was developed. Abnormal demand is orders that were not expected and therefore were not included in the development of the demand plan. In summary, the company can see current obligations, planned obligations, what is available to sell, and which orders may need special consideration when rescheduling.

So, the reader can see that most of the needed pieces to carry out the rescheduling effort are already in the company's enterprise resource planning system. What's missing are a few parameters, such as customer priorities, acceptable customer delivery policies (full delivery required, partial deliveries accepted, split deliveries accepted), acceptable marketing lead times, maximum inventory levels, maximum capacity levels, and supply order requirements regarding rescheduling dates, splitting supply lots, and so on. This list

does not look overpowering, nor is it unreasonable to expect that securing the data and loading it into the ERP system is out of reach. Of course, if the ERP system has all the data mentioned in the prior paragraph along with the missing scheduling parameters just mentioned, most of the rescheduling effort can be machine based.

Machine and/or technology based? Yes, the master planning and scheduling rescheduling effort that needed to be done mostly manually just one decade ago can now be done almost completely by the technology. The operative word in the previous sentence is *almost*. As we move into the third decade of the twenty-first century, there still are tasks that people can and will do, such as reviewing, analyzing, tweaking, and finalizing the computer's decisions. However, these tasks will decline as people-intensive tasks and will become increasingly machine-intensive tasks.

For now, touchscreen technology that allows the user to drag and drop data from one place to another can be used during the rescheduling process. If the master scheduler wants to move an item from one time period to another time period, he or she just needs to use the curser or fingers on the screen to drag that item, along with its quantity, due date, specification, and so on, to the other time period. And when the item is dropped into its new location, the rough cut capacity planning graphs are instantly updated. If the master planner and/or master scheduler wants to look deeper into the rescheduling situation, he or she can use technology, like zooming in and out of a satellite photo, to assist in reprioritizing supply orders.

Computers have, and will continue to, become increasingly important and increasingly powerful *technology assistants*. To assist the technology assistant in assisting the master planner and/or master scheduler (that's a mouthful!), sales needs to do their homework each time a rescheduling effort takes place within a company. Sales is responsible for reviewing all customer orders and identifying the priority for each customer order (or group of orders), ranking these orders from high to low. Supply must note why supply orders are past due, including material, quality, capacity, and capability reasons. The leadership of the company must establish the priority for demand and supply based on the manufacturing strategy being used for the items under rescheduling analysis. And, the target inventory (maximum, minimum, and range of asset management) and desired backlog position (acceptable marketplace and customer lead time), must not be overlooked during the overloaded master plan and/or master schedule rescheduling effort.

Let's summarize what was just discussed relating to using the computer and its associated hardware and software as a technology assistant in rescheduling the overloaded master plan and/or master schedule. The computer does the initial rescheduling based on parameters set by the demand organization (sales and marketing), the supply organization

(material and production), and the finance organization (financial planning and cost accounting).

Following this initial rescheduling by the computer, the people with the responsibility review, analyze, tweak, and finalize the reschedule draft. Master planned and/or master scheduled orders are moved around in the plan and/or schedule by using the planner's and/or scheduler's fingers on a touchscreen or the curser integrated with the computer. As the master planner and/or master scheduler moves the orders around on the computer screen, the company's rough cut capacity planning charts and graphs are instantly updated. Finally, the revised master plan and/or master schedule is forwarded (with supporting explanations) to management and/or leadership for approval prior to releasing it to the people with a need to know.

What a world master planners and master schedulers live in today. Tomorrow will be even more interesting for the profession of master planning and scheduling!

Implementing the Revised Master Plan and/or Master Schedule

The next step in the process is to secure approval for the new plan from product, demand, supply, and finance general management and leadership. Once this is done, it is time to implement the reschedule and make it happen. This is when the sales and marketing people really earn their money. Someone (with sales and marketing responsibility) must tactfully notify the customer of the anticipated delay and reschedule—generally not a pleasant task. Remember, many of these orders are already late and the customer is now being told that the expected delivery may have been pushed out even further. No, it's not a pleasant task, but someone needs to do it (it's called *open and honest communication*). The challenge now is to ensure that the new delivery dates are met; that means that the company must implement a strict monitoring process. Although implementing a rescheduling strategy may seem difficult (and it is), when coupled with the implementation of the new promising strategy, it works and the benefits are many.

As you can see in the scenario, guarding against an overloaded master schedule is one reason why companies need to pay attention to how they master plan and master schedule. The next chapter discusses the whys of master planning and scheduling and the framework into which this master planning and scheduling process must fit.