IN PURSUIT OF THE PERFECT PLANT

A Business and Technical Guide

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Chapter Six

Strategy, Coordination, and Planning

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Peter Moulton, Joan Bonhoffer, and Krishna Balasubramaniam all sat around the conference room table, swapping travel horror stories over the last few crumbs of donuts. John Mulcahy stood by the whiteboard and cleared his throat for their attention.

"Welcome back, everyone. I know you've been busy traveling to plants, interviewing managers and executives, and reading everything you can get your hands on, in order to help us understand what constitutes the perfect plant," Mulcahy said. "We'll start by stepping back and looking at the big picture—beginning with strategy, coordination, and planning. After all, the plant is just one cog in the wheel of a bigger corporation—or at least it should be if it's going to be successful. Peter is going to fill us in on what he's learned."

Peter stepped up to the front of the room and took the pen from Mulcahy. "Strategy, coordination, and planning are primarily concerned with two big factors. First, the right things must happen at corporate to deliver instructions that the plant can execute. Second, the right information has to come from

the plant floor so that long-term plans can be flexible and adaptable to abrupt changes in condition.

"Manufacturing companies tend to get bogged down when there is poor communication between the operating units and sales and operations. Bala and Joan, you'll probably bring up that same theme in your reports. Strategy has a lot to do with long-term goals being articulated in a boiled-down, Reader's Digest series of directives that the plant can use to clearly see those goals.

"Similarly, a plant often views itself as a singular entity. As a result, the plant becomes isolated from the company's overall goals, just as the strategic planners can be isolated from the factory's issues and constraints. This separation is the fundamental condition we have to break through in order to achieve the Perfect Plant at the Strategy and Planning level. To do this, we need to make sure there is a feedback loop throughout the hierarchy—a closed loop—through which up-to-date information is always flowing.

"It's important that we're clear about our terminology. 'Strategy' is the big picture being set at the corporate level—the budget, financial goals, levels of customer satisfaction, and thresholds for product quality. Strategic goals are articulated in terms of quarters and years. 'Planning,' on the other hand, is the scheduling of production runs. Its goals are expressed in months, weeks, days, and hours."

Sales and Operations Planning

"This next concept is the 'secret sauce' of strategy." Moulton turned to the whiteboard and wrote:

S&OP: SALES AND OPERATIONS PLANNING

"At the simplest level, S&OP is about balancing supply and demand. In an ideal plant, which would produce the entirety of a single product, that's a

fairly easy proposition. In the real world, however, that's not what we have. Multiple corporations support multiple business lines. Huge portions of manufacturing capability are 'virtualized,' outsourced, or spread across multiple plants and products. And your business units may even be competing for some of the same assets and resources." Moulton sketched a diagram on the whiteboard. "Here's how S&OP fits in with the whole production scheme."

"As you can see," Moulton continued, "there are three segments coming together. In one circle, you have sales and marketing. In another, you have manufacturing operations. In the last is your supply chain. S&OP sits at the point where they all intersect."

"Couldn't you say that the supply chain really drives S&OP, since it runs the network design optimization?" Bonhoffer asked.

"The supply chain," Moulton said, "should be getting feedback from sales and marketing that says, 'We want to explore either changing this product or customer mix, or we want to explore a new market. Run us some models that show the effect on distribution costs.' Manufacturing operations balances things out by providing a clear sense of what's happening at the factory level, and communicates plans to the people there that take all three parts into consideration."

"Maybe we could think of sales and operations planning as the link between strategy and execution," Bala said.

"Exactly," Moulton said. "The various units of the plant—picture them as 'mini-plants'—often compete for resources. S&OP determines the best way to allocate those resources. But it gets complicated, because although some of these plants are measured against the same metrics and KPIs, others use different measurements.

"When a plant is part of a business unit and reports up into that unit, S&OP is a straightforward proposition. If so, the plant is measured for its productivity, but not necessarily for its profit. It may be measured on throughput or operating efficiency."

"In which case," Mulcahy said, "you simply want to run the plant to the limit of its capacity and safety, and throw as much material through the line as possible."

"A 'Rough-Cut' view of S&OP says, 'Show me all the supply capacity that I have, and show me all the demand requirements,'" Moulton said. "When the answer arrives, the 'Rough Cut' asks, 'Do I have the capacity, in aggregate, to provide all this, and if not, where is the shortfall?' Your initial view, on the other hand, says, 'This is all the demand that sales is telling me for all of the products for all of the markets. Here is all the production I have available to produce all the products that are available.'

"In markets where you have multiple sites and scheduled maintenance windows to deal with, the sales and operations process has to be well organized. You project forward, looking very tightly at the next 90 days even as you try to provide a rolling forecast for the next 18 months that includes all of your planned maintenance, outages, or any other promotions that might come in."

"People are looking at the targets," Bonhoffer said. "They're saying, 'Yes, we're planning this promotion campaign from a sales standpoint, and we're predicting this sort of uptick.'"

"Or they're saying, 'Here's the seasonality of this market for this product in this particular sector,'" Bala said.

"Or, 'there will be a major outage, or we need to rebuild in this plant at this point in time,'" Mulcahy said.

"Exactly," Moulton said. "All of these points should be on that 18-month calendar. And if anything changes, it should be adjusted. Ideally, by the third week of every month, you have locked down your production schedule for the next month."

"Does the plan typically stay locked throughout the month?" Bonhoffer asked.

"It does," Moulton said. "However, since supply and demand never stays locked, S&OP's plan needs to reflect the locked-down targets, which consider all of their commitments and accountabilities. It also needs to reflect each target's activities. If the world never changed, you'd only need sales, marketing, and manufacturing. You'd simply balance them once and run the model forever. But that's not the reality in a competitive marketplace. To stay on top, you've got to engage a constant process of monitoring and adjusting. You have to watch distribution costs, market share, foreign exchange rates, and so forth. If the data says you should do something different in a week or a month, you have to be flexible enough to make the required changes."

"It sounds to me," Bala said, "as if a well-organized operation will have tight 90-day and 18-month cycles in which planned maintenance, outages, seasonal

market changes, and other promotions are coming in. That way, targets can be set and goals met."

"Meanwhile," Moulton said, "sales and operations look at the balance of supply and demand each week and make the needed adjustments."

"Who makes sure this happens?" Bonhoffer asked. "How do meetings run? What's the hierarchy?"

"It's not the same everywhere," Moulton said. "But, generally, on the third week of each month, the chairman, CEO, and business unit leaders come together and set the plan for the next month. At the same time, they look forward three months. That meeting enables the planning department to execute against the sales and operations plan that is aligned to corporate strategy."

"Even if the biggest head honchos in the organization are not at the meeting each month," Mulcahy said, "they always want to know what happened and what was decided. That raises the bar of accountability and guarantees the information will be collected and shared."

"Who are the specific people that would attend this meeting?" Bala asked.

"The CEO, the CFO, the executive VP of manufacturing operations, and the head of sales," Moulton said. "If the company is divided by business units, the heads of each will be there as well.

"In addition, with the last meeting held two or three days ahead of the executive-level meeting, there is another meeting every week, where the S&OP director meets with the production planners and delegates from the business units or authoritative functions."

"These are the meetings," Mulcahy said, "where corporate sets out its financial goals for the plant. Depending on the goals, the managers might fight back to make them realistic and reachable."

"I imagine it can be a bit of a struggle," Bonhoffer said, "between corporate's idealistic dreams of profitability, and operations doling out heavy doses of reality regarding plant capacity."

"Somewhere between these two points of view," Moulton said, "live the real possibilities for what can be achieved. Once they figure it out, the production planners disperse the results to the plant managers. The individual plant production plans must then be aligned with the sales and operations plan so that the sum of the parts equals the whole, asset by asset. Usually, the plant manager reports up one level to an executive who has been part of the weekly sales and operations meeting.

"The S&OP planner's main concern is to balance operations so that the corporation makes the most profit. That means you don't plan more sales than you have production capability, unless there is inventory that must be sold."

"So the monthly executive meeting," Bonhoffer said, "is basically a 'management-by-exception' affair to get a synopsis of the prior month and ensure that everything is on track for the next three-month period, right? And the weekly meeting is where more fine-grain adjustments are made, brokering the relationship between the realities at the plant level and the long-range planning at the executive level."

"You've got it," Moulton said. "This mid-tier S&OP group is also responsible for making sure all customers are informed about changes in product flow. Remember, as well, that since the plan sets the expectation for production volume by product and asset, it also is a predictor of what raw materials will be required for each location. This is why S&OP is a valuable tool for the upstream supply chain partners, the vendors, and the suppliers, too."

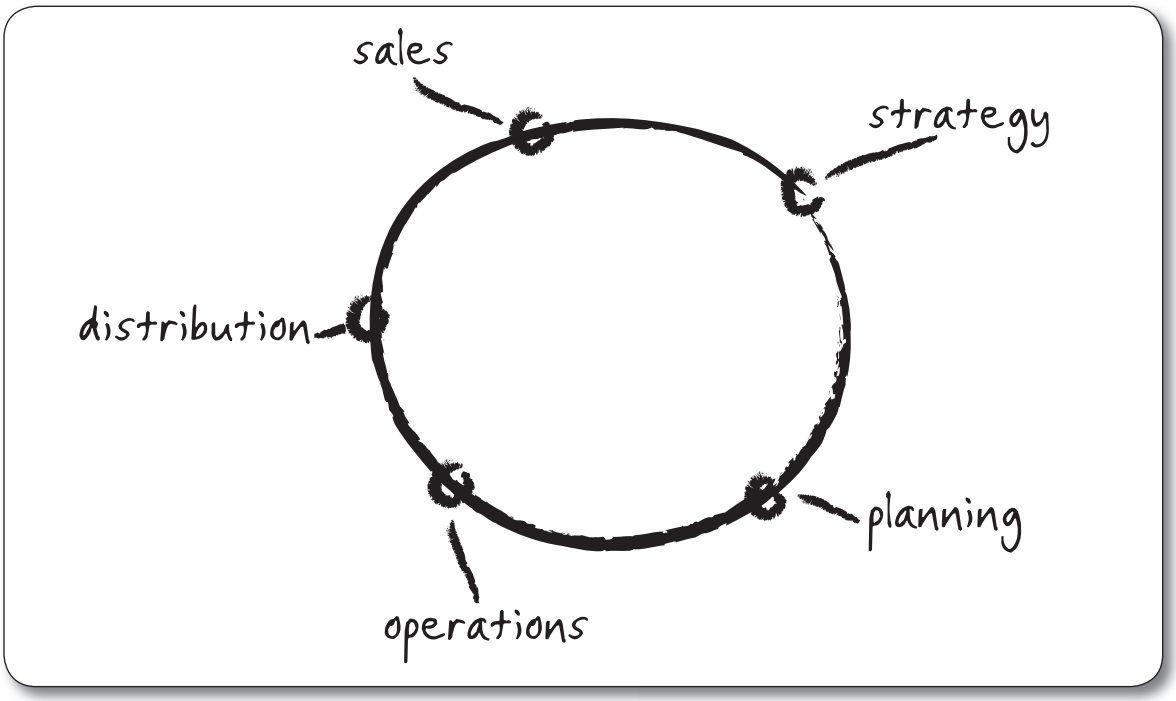
"What if a decision can't wait until the executive meeting?" Bala asked.

"The director of the S&OP meeting may need to inform his superior of the events that have taken place, and the subsequent recommendations. The director will then request that a decision be made immediately with the promise that a report will be ready at the next meeting. That way, he won't lose any time. We call this the 'closed loop.' The S&OP meeting is the lynchpin that holds that loop together."

The Closed Loop

"The closed loop," Moulton said, "is about connecting the dots—and in this case, connecting them frequently. In its simplest form, the loop describes

the relationship between supply and demand. You only need to add a few points to it—sales, strategy, planning, operations, and distribution—to see the interdependence of these elements."



"When the loop is tracked weekly," Bonhoffer said, "people don't have to wait for financials at month's end to see whether their department or business unit is on track."

"And if they're not getting the information in real time," Moulton said, "they're getting a close approximation. This is important for several reasons. Speed and agility builds accountability. No one has an excuse for failing to stay on task. At the very least, they know they're missing goals. Plus, because the closed-loop assesses capacity at every level—upgrades, outages, and availability of raw materials—it also shortens the timeframe in which any shortfalls may be detected and rectified. The supply-demand loop is expected to be closed immediately. That way, no one can wait until the end of the quarter to say, 'I didn't realize we were missing the mark. I didn't have the data until last week.'"

"Based on some of the plants I've run," Mulcahy said, "that sounds borderline revolutionary."

"The closed loop model," Moulton said, "is a real culture-changer. It starts at the level of the CEO, who can see evidence that there is movement underway to meet expectations—whether that is efficiency, throughput, meeting demand, or utilizing supply. Moreover, managers across the enterprise can see how close they are to meeting goals.

"The closed loop seals previous holes in the planning, strategy, and execution processes, even as it takes care of those between the corporate, supply chain, and operations relationships. It's a very important and powerful step toward smoothly integrating disjointed departments and functions. For example, if production skews low, then sales will get on the phone and communicate with customers. Likewise, if production is skewing high, sales can adjust their efforts and promotions."

"Sounds ideal," Bonhoffer said. "Happens all the time, right?"

"Not really," Moulton said. "The S&OP concept has been around for more than 20 years. The statistics I've come across, however, say that despite this, only 65% of companies actually have a working S&OP process. Among those that do, virtually all of them have been doing it for less than five years."

The Fast Loop and the Slow Loop

"In addition to the closed loop," Moulton said, "there is a slow loop and a fast loop. The slow loop, which is separate and seemingly disconnected from the fast loop, entails corporate's long-term planning vision for revenue or cost projections. This loop typically forecasts events 6, 12, or 18 months out. The fast loop involves the day-to-day execution of those plans—the functions of operations, maintenance, supply sources, and labor issues, plus external factors like supply of raw materials and interference by government or community agencies. The big players here are the operations and maintenance managers."

"The slow loop," Bonhoffer said, "sounds like a vision of perfection, while the fast loop gives us a daily dose of reality—where you deal with the issues and problems that can develop as a result of your processes."

"Yes, and as you can imagine," Moulton said, "tension arises where they overlap. Plant operations are in a constant struggle to assess and meet the needs of the targets handed down from corporate. The struggle itself is a

function of matters that affect capacity and output, such as maintenance issues, raw material supply changes, and unexpected emergencies."

"This presents a difficult situation," Mulcahy said. "The two loops are separate but not disconnected, as it seems at first. The space between them is at times quite blurry, more of a continuum of planning and execution."

"Is there a way, then," Bala asked, "to clear the air between these loops, between planning and execution?"

"Tools, such as software programs like those we discussed, do help both loops resolve their difficulties," Moulton said. "What they require in order to operate at peak performance, however, is a single, standardized platform. Each loop needs to see what the other is doing. Each needs to know what pressures and issues the other is responding to. And both need to know which goals are being met and why. Fast loop and slow loop, operations and corporate, as John just said, are not really discrete functions. In fact, a well-oiled plant, if you will, has the infrastructure to ensure that doesn't happen.

"For example, in a perfect plant, all operations in the fast loop will be recorded in a log that is sent to the slow loop for examination every three or six months. This accomplishes two purposes. The first concerns the annual planning process—information from the operational log is used by corporate to create forthcoming quarterly or annual schedules and goals. Secondly, data from the log also enables corporate to adjust the planning parameters—production rates or yields as capital projects, for example, can be activated. The same goes for production and maintenance scheduling. I would also point out that in this instance, operations— the fast loop—drives corporate—the slow loop.

"That must generate further tension in the fast loop," Bonhoffer said. "How is it negotiated?"

"Production is highly dependent on maintenance," Moulton said. "When production goals come down from corporate, operations must determine what capacity rate is needed to meet those goals. This involves collaborating with maintenance to guarantee the equipment is fit. To do this, planners

and managers generate Microsoft Excel or Project spreadsheets to create the schedule of updates, repairs, and maintenance that is needed for production to meet its goals."

"Of course these are all merely preventative measures," Bonhoffer said. "An infinite number of maintenance issues are sure to arise."

"How is it possible to plan for unexpected breakdowns," Bala asked, "or, God forbid, a power outage?"

"Unfortunately," Moulton said, "there isn't a great answer. Ordinarily, there's a balance between the level of risk at which you operate and the average yearly production. Production doesn't want to turn their equipment over to maintenance because they've got targets to meet. And maintenance complains that they can't get access to perform the work to keep everything in order. Both sides have a somewhat myopic view of these concerns. Maintenance bases its decisions and schedules primarily on reliability levels. Production focuses strictly on output. Optimal solutions typically factor in both drivers simultaneously. The chief obstacle to success resides in the inability of each side to access the other's performance index on demand."

The Broken Loop

"Now I'd like to talk about a problem," Moulton said, "that is both the most common and the most unfortunate—the broken loop. In many companies, planners are off in a corner doing what they do best, planning. In some cases, they are so isolated that they don't even show the plan to the people running the plants."

"What?" said Bala.

"They're afraid it won't be accepted," Moulton said. "In this worst-case scenario, there isn't any real feedback from the plant itself to help the planners do a better job. In other cases, it's a little better—a third-party group analyzes the plant's performance and then reports to the planners. The problem here is that they do so a month later, when it's frequently too late to do anything with their data."

"That's absurd," Bonhoffer said. "How could anyone on the floor possibly understand what they're supposed to do?"

"Although operations is given specifications," Moulton said, "it's usually in a highly condensed form, a mere synopsis of the big-picture goals."

"In other words," Bala said, "operations doesn't understand because the information they're given is both incomplete and inaccurate."

"Yes," Moulton said, "and the people on the floor know it. Sometimes the plan's modeling is so bad that operations simply refuses to follow it."

"That's what happens," Mulcahy said, "when you're handed an order that says, 'We need a million widgets by Wednesday,' but have no idea why, or what is needed to make it happen."

"This is the broken loop," Moulton said. "Someone from strategy academically calculates how much raw material is needed to manufacture a given quantity of product. They send it to operations, expecting them to find a way to make it happen."

"At that point, operations is shooting in the dark, using tribal knowledge," Bonhoffer said.

"This is terrible," Bala said. "Tell me there is a software solution buried in there somewhere!"

Process Control and Planning Software

"Not to worry, Bala," Moulton said. "There is a solution. But it's not an instant fix, nor is it limited to software. Two core pieces of the latter are needed to create the ideal closed loop—the process information and planning systems—and each must be tightly integrated with the other.

"Immediate issues on the plant floor make it tough to change the planning system unless the two are linked in real-time. When something breaks on the floor, you must be able to quickly recalibrate the plan to accommodate the new level of production capacity. Problems like this can't wait until the next weekly

or monthly meeting. Without immediate attention, serious money will be lost. The way to create this real-time link is to connect the planning system to a process information system such as Pi."

"Once you do that, how do you reach a stage where your process control information and responsive planning tool are optimally integrated?" Bonhoffer asked.

"It isn't easy," Moulton said. "A lot of advanced process control software requires more real-time data inputs than most plants can muster. A lot, too, depends on the quality of your models. To build them, you've got to see the patterns that your instruments produce and then make sense of them historically. Success often depends on trial and error. Over time, you'll find the right level of instrumentation you need to tune your model."

"What about the payoff?" Mulcahy asked. "Is it worth all that work?"

"Here's an example," Moulton said. "Chevron runs a system that is so responsive and reliable that within a matter of hours after its crude oil has been delivered, all of the recipes to refine it have been adjusted. About 40% of the time these adjustments are immediate and automatic."

"The whole corporation must have signed on without much fuss," Bala said, "if the system helps to generate major profits."

"In the future," Moulton said, "we'll see data collected in real time, with goals and targets adjusted automatically. This is called 'responsive planning.' On a larger scale, responsive planning links the financial output of the plant with expectations for prices and profits against costs. These metrics are then measured against strategy."

"That closes the loop in a very meaningful way," Mulcahy said.

"Just remember," said Moulton, "that all of this is very unlikely to be effective without strong S&OP. It's the go-between that responds to and understands the plant's realities and needs as much as it understands the strategy and vision of corporate."

Strategy and Execution in Process Industries

"It's worth spending some time discussing how strategy and planning are executed in process industries," Moulton said. "They tend to be much more unpredictable than discrete industries, whose raw materials are essentially components made by other manufacturers. In discrete industries, your primary concern lies in making sure that your supply chain provides you with the material you need at the rate you need it. Your variability changes with the supply. In process industries, on the other hand, uncertainty arises in both the quantity and quality of your supply, since you usually need it in several varieties.

"Take the example of a large refiner. Typically, it works with 15 to 20 different crudes per month, none of whose supply levels are consistent. You can't just say, 'We'll do what we did last month,' because each month is different. Success depends upon the individual process operation. With a refinery, you can ramp production down so that it won't exceed any maximums on furnace temperatures or run too close to safety limits. Doing this, though, lowers profitability. That's why the most profitable plants run their equipment to the limits."

"They have to drive everything like a sports car in commercials," Bala said. "You know, with a professional driver on a closed course. To negotiate traffic like most people, wasting fuel switching lanes, accelerating, and braking, is to lose the race."

"And to run at peak performance," said Moulton, "all your instrumentation has to be very accurate. The feedback loop has to be tight, too, otherwise, you're always in danger of an accident or seriously underperforming. But sophisticated technology isn't the only factor for success. You need an expert driver, as well. In our case, that driver is the collective group consciousness that acts in a prudently aggressive way based on information derived from its technology.

"For instance, Chevron closed the loop for their gasoline refineries by examining the octane levels of each batch's finished product. They controlled the levels throughout the batch with a real-time process control system that feeds into their planning model and allows them to calculate 'biases,' or the deviation

from the model, very quickly. The model is flexible enough to adjust for each successive batch.

"Planning in a process-type plant requires a model that consumes raw data. It must also understand transformations at the chemical or mixture level well enough to predict and evaluate what emerges from the process. On top of that, you need a way to close the loop so that the economic models are reconciled with it."

"This is very different," Mulcahy said, "from the discrete industries. They reconcile a bunch of separate parts with the final product through the funnel of an economic model that says, 'If I reduce the number of times I bolt the wheel on this car from eight to six, I can save X amount of dollars.'"

"It's not as simple to use the supply-chain model for an industry that relies on commodities," said Moulton. "Their typical economics are expressed by the corporate management as, 'Our optimum is to run this raw material and produce these products. And with that we're going to make a certain gross margin, and, after expenses, a certain cash margin.' Maybe the supply guys on the raw materials side say, 'We can't do that. It'll cost us $0.50 a barrel or a penny a gallon.' Oftentimes, corporate looks at those two optimums and says, 'Which is the sum of the two? If you're going to lose $0.50, but I'm going to make a buck, then let manufacturing do it. The supply or distribution guys will just have to suck it up.'

"This scenario occurs at many oil companies in a centralized planning and economics group, with relatively senior people, who are often called supply chain pilots. They look at those economics continuously to ensure that the different parts of the chain are using the same information."

Strategy KPIs and Responsible Parties

"So how does all of this play out in terms of the KPIs?" Mulcahy asked.

"I look at it from the perspective of the EVP of manufacturing," Moulton said, "His first responsibility is to operational safety. Environmentally safe storage is second. Reliability is third. Then comes profitability, and then product quality.

"As for KPIs," Moulton said, and began to write on the whiteboard, "the most important one in the context of coordinating strategy in the plant is return on capital employed, or ROCE. It's calculated like this."

$$\text{ROCE} = \frac{\text{Pretax operating profit}}{\text{Capital employed}} = \frac{\text{EBIT}}{\text{Total assets} - \text{Current liabilities}}$$

"Other than ROCE, there's your gross margin—that's revenues minus raw materials. Gross margin is a big one in refineries. Because of the way crude oils vary, there is a 10:1 ratio between the impact of cutting raw material costs versus other cost-cutting moves. This is why raw material inputs are analyzed by whole teams of people. Watching the commodities markets, for instance, is huge in this area. Analysts will reach conclusions like, 'We'll buy the crude at $1.00 a barrel less than we paid last quarter, and although we can produce $0.25 less of a certain quality gasoline, which will incur $0.25 more operating cost, we should still do so—at the end of the day, we save $0.50 per barrel.'"

"And how frequently does that happen?" Bonhoffer asked.

"Depending on the supply chain," Moulton said, "and how your raw material is delivered, it can happen as frequently as every two to four weeks. If the refinery's information is up-to-the-minute, and it has multiple manufacturing and distribution channels through which to redirect the raw materials, it can optimize hour by hour. The very best companies are constantly evaluating gross versus net margin. Most, however, don't have the ability to access real-time data."

"Are there any other KPIs we need to know about?" Mulcahy asked.

"Beyond gross margin and ROCE," Moulton said, "it's tough to generalize across all process industries. There is, however, one more capability to consider regarding general profitability, and that's 'percent of optimum captured.' It describes the variance between your real numbers and idealized goals."

"And your ideal," Bonhoffer said, "is to have all raw materials on hand while running at full capacity with no outages or safety concerns. That way, you can know the exact amount and quality of product you will produce."

"Once you've established that ideal," Moulton said, "you can weigh it against your actual constraints, such as a major supplier's lack of a certain variety of crude or the cost of maintaining or replacing a piece of aging equipment."

"A minute ago," Bala said, "you noted that the EVP of manufacturing's first concern was to operational safety. What are the KPIs there?"

"There are both leading and lagging safety KPIs," Moulton said. "The lagging statistics concern the frequency and severity of accidents. Frequency is measured by number of incidences of each cut or bruise, for instance, and severity covers whether someone got a bandage or an amputation. These are reported to OSHA at the end of each month.

"A leading KPI is behavioral safety, which pertains to monitoring processes as a means of identifying unsafe practices. The goal is greater accident prevention. It takes a bit more manpower, but it beats a poor safety record and OSHA citations. The plant assigns people to report the number of safe and unsafe acts they find. When they locate breaches in protocol, the details are entered in a safety log and the offenders are brought in for training."

"What about the manufacturing EVPs themselves?" Bonhoffer asked. "They give all the orders, but how are they evaluated?"

"Over the year," Moulton said, "they are judged mainly on deltas, which are changes in statistics or ratios. These include improvement of profitability, accident rates, environmental footprint, and the like."

'Rolling Down' and 'Rolling Up': The Tug-of-War between Corporate and Operations

"KPIs," Moulton said, "create serious tension between corporate and operations. Obviously, a lot rides on the two finding peaceful solutions to their differences. For example, each side has its own idea of planned versus

unplanned maintenance. If a top manager says something like, 'You can expect some shutdowns, but the rest is totally unpredictable,' there is a problem. He should tell you that the plant tracks the usage, historic maintenance schedules, and breakdowns and slowdowns of each piece of equipment. More, he should know how those histories dictate what the plant as a whole expects from its equipment. There should be precise, data-based predictions about the overall health of operations for the coming months, and everyone from the plant to the top of corporate should clearly understand them."

"No doubt the goal is to keep production steady," Bonhoffer said, "in spite of any planned or unplanned maintenance activities."

"Many factors determine whether that happens," Moulton said. "Other important KPIs include financials, human resources, and transportation. Do you have enough maintenance technicians to sufficiently handle a breakdown? If not, do you have sufficient financial resources to hire more people? If maintenance interrupts production, can you adjust transportation or inventory to accommodate the ensuing production changes? Maintenance issues influence every level of the company. The relevant negotiations are far from trivial."

"What kind of information does the plant manager need to provide the EVP?" asked Mulcahy.

"The EVP," Moulton said, "requests information from the plant manager through a 'roll-down.' The plant manager 'rolls up' by writing a monthly report that covers each of the company's major KPIs.

"Roll-downs also go from the plant manager to his employees on the floor," Moulton said. "The technical, operations, maintenance, and health and environmental safety managers all send him roll-ups that include the relevant KPIs."

"Am I correct to assume," Bonhoffer asked, "that both absolute and trend numbers are used in these reports?"

"You are," Moulton said. "After all, one month does not make a year."

"What about future directions?" Bala asked. "With all of the instrumentation and integration that we're encouraging, the EVP of manufacturing could be sitting in his office and watching KPIs without having to wait for the roll-up. Is it possible that this becomes a daily or real-time event?"

"No one has been able to make an economic justification for real-time KPI reporting yet," Moulton said. "But that time will probably come, because there are situations where a quick decision can save costly waste. These situations can often test a plant's organizational mettle by showing how significant the human factor really is."

When the Rubber Hits the Road: Decision-Making Based on Strategic Models

"Suppose you have to decide to shut down a line or defer maintenance 30 days," Moulton continued. "The less time it takes for corporate to make a decision, the better off the person making the call in the plant will be. Often, these are seat-of-the-pants, intuitive decisions. For instance, say a pump goes down on New Year's Eve. The plant foreman calls a maintenance guy, who looks at the spare pump's record. If it looks good, he makes an instant decision not to call out a crew that he knows will cost triple time. If he can't make that decision, it rolls up one level, and it keeps on rolling up until someone finds the economics that will enable a good decision. Absent the data, the plant manager will go to the floor and say, 'Damn it, you keep this place running, whatever it costs.' He knows what his risk-reward is. He's going to get an 'Atta boy' if he gets the thing fixed that night, regardless if it costs him $10,000 to call out guys from the party. He also knows that if it stays broken, he's going to get canned."

"But there's got to be an alternate approach, one that's a bit more sane," Bala said.

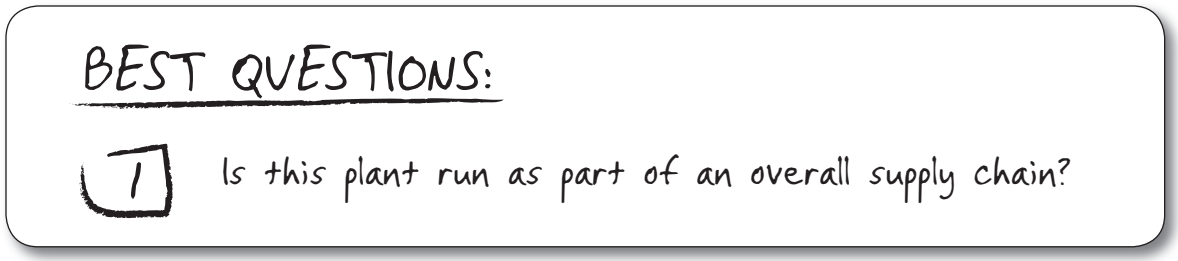
"The alternative is arming yourself with more facts and figures," Moulton said. "The shift foreman needs to know, for instance, that every time he loses capacity because of an ailing pump, it's going to cost $10.00 a barrel. Therefore, he always needs to know the condition of his spare pump. If he's not willing to risk that $10-a-barrel shutdown, he also needs to know it's only going to cost $3,000 to call out the repair crew to make things right. In a more

sophisticated plant, better data enables you to reach the same decision with greater confidence. You know that your mean-time-between-failure for this kind of pump is three years. This pump is only a year old, so there's no reason to panic."

Best Questions

"Let's now take a look at our best questions," Moulton said. "Assuming you have an hour to walk into a plant and fire away at anyone, here's a list of questions to ask to get a good sense of how well their strategy and planning are coordinated with the realities of the plant. The answers provided by managers and executives at a plant should indicate how well the strategy, coordination, and planning are working together."

Moulton wrote on the board:



"Do you make what you sell," Moulton said, "or do you sell what you make? Are you the original manufacturer, like an auto-maker, or are you reconstituting a commodity, with a market on either side of the plant? Refining would be a good example of the latter. Generally, this would be a question to ask senior management before you went down to the floor. It helps determine whether you're looking at a discrete factory or a process factory."

BEST QUESTIONS:

1. Is this plant run as part of an overall supply chain?
2. Are production planning and maintenance planning done together?
3. When you make scheduling decisions, do you know the impact on the other guy's KPI?
4. Do you implement any mechanism to systematically and comprehensively address these issues and make decisions?
5. Does top management understand the risk or degree of control of a planned or unplanned shutdown?
6. If there is an unscheduled breakdown or shutdown, can you opportunistically schedule other maintenance, or are you just coping? To what degree are you able to look at that as being 'in control' or 'out of control?'
7. How reliable are your metrics for managing the plant?

"I have a question about number six," Mulcahy said. "What sort of answer might suggest that you need to contend with certain risks in the way you run the plant?"

"The worst answer is a blank stare," Moulton said. "The best answer would be that they'd established an acceptable level of risk and know exactly what the plant can tolerate—say, an 8% risk of breakdown. For example, they might have spreadsheets and hard data and some concrete information on which

they can base an estimate. That's definitely better than nothing. If they've been running a production environment and gathering data about how long things will run for before they need to be shut down and repaired—a.k.a. preventative maintenance—they'll be able to provide an estimate of the failure-free interval and an assessment of a guaranteed failure point. Somewhere between the guaranteed failure point and the failure-free interval there's a curve that starts to change. As you cruise through the failure-free interval, your risk starts to increase.

"In other words, if you had 24 hours between the failure-free interval and the guaranteed failure point, then when you're at 12 hours over the failure-free interval is your risk of a breakdown now at 50%? Maybe, maybe not. It depends on the piece of equipment. But if you can assess the amount of risk in that little interval, and then add up the risk over all the pieces of equipment, you can get an assessment of the overall risk in the plant."

"OK, so the overall risk is the average risk of all the equipment in the whole plant. That is easy," Bala said. "In sum: the more data you have, the better decisions you can make."

"I have more best questions," Moulton said, returning to the board.

MORE BEST QUESTIONS:

8 Does the plant compare its planning program prediction with what's actually happening in the plant?

9 Do you know what S&OP is?

"I want to tell you a story about question number nine," Moulton said. "As you know, I am an advocate of S&OP, which is why I went to a seminar on strategy and vision as preparation for giving this presentation. The presenter asked the room, 'How many of you have heard of S&OP?' Amazingly, only 50% of the participants raised their hands. Then the presenter asked, 'How many of you

have a defined S&OP process?' Guess how many people raised their hands then? Just one! These were sophisticated companies in attendance, too."

Do you have a visible leader of your supply chain?

"This question was one of many from an article I read," Moulton said. "It asked a number of best questions. Its basic proposition was this: if you can't answer these questions as 'yes,' then you probably are the problem. I suggest you all read it."

Is there visible support from the executive level?

"How would you know whether the support was visible?" Mulcahy asked.

"You would ask the question more specifically," Moulton said. "'Do my CFO and CEO have visible knowledge and interest in the outcome of that meeting?' This spawns further questions, such as…"

How well does the meeting reflect reality?

Can you use the meeting to adjust to either market or operational situations?

Are the results understood and incorporated into the perfect plant?

"One way to know that the results are not being used productively," Moulton said, "is to ask the manager if he is continuously juggling calls from multiple sales people, production management, and senior management asking whether they need to change grades or insert a given order. If so, there are people who

don't understand what the manager is being measured against. There isn't a clear distinction of roles."

How many of your maintenance decisions are made with good data, tested data, or quality information, and in how many of them do you let the economics do the talking?

"I think we all know the most likely response to this question," Moulton said.

Perfect Plant Playbook

"To close this afternoon," Moulton said, "I'll take you through some quick pointers on how to get started with optimizing strategy, planning, and coordination at the perfect plant. You can make a real dent in a strategically challenged organization armed with little more than a pencil and spiral notebook.

"Let's start with simple supply-demand balancing. It's amazing how much it can enhance your overall understanding of how to improve things. It just gets people thinking in a more collaborative manner and forces the issue.

"And before you worry too much about software, it's critical to account for your plant's S&OP. If nobody seems to know what it is, then either you don't need it, because operations are so simple, or you need it badly. If your planners are creating 90-day targets but you only get a feedback loop from the plant once a month, you need an intermediary enforcer, or group of enforcers and mediators, to ensure that the information flows between the two camps. Without the intermediary, valuable information is just leaking away.

"Suppose you do want to create a responsive, tactical planning system with real-time updates to the process representations in the model. It may involve the scary but necessary step of ditching your current planning tool. A familiar system that's inadequate now will only limit the performance of the integrated system.

"You also need to examine the structure of your process. Before installing any software, you may need to reorganize your people. In fact, if you don't do this first, the stage may be set for a big software failure. Many plants are run from the top-down, where the plan is imposed on schedule and processes. If processes deviate from the plan, the process supervisors or plant managers have to explain why. This results in poorly defined targets for advanced process control systems when it comes time to automate. If you look at strategy from a bottom-up approach, where the plan is tuned to the process, the processes are still subject to targets and specifications. But you can update and re-run the plan as many times as necessary to balance it with the processes. Once you figure out if that works, then you can think about the software you need.

"I'll leave you with 11 critical success factors," Moulton said, and wrote more on the board, "that I cribbed from a lovely book called *Planning, Scheduling and Control Integration in the Process Industries,* by C. Edward Bodington.

"In order to implement a successful integration of planning, scheduling, and control, you need…"

THE CRITICAL SUCCESS FACTORS

* A realistic and well-documented business process model and material flow diagram of what you want and expect to achieve, the timing, and the activities and ownership identified
.
* A Process Information System for real time data collection and analysis of process operations that is blueprinted and configured to support the expected business process model.

* Data communications networks for easy, standardized transfer of information between elements.

* A central, rationalized database for storage and dissemination of all input and results.

* Model-based data reconciliation both for the overall plant, and for the individual processes.

* Advanced Process Control, including process optimization.
A formal computerized scheduling system to manage process interactions and inventories, to capture and report production and shipments against plan into a form useful to the advanced process control systems.

* A responsive tactical planning system with real time updates to the process representations. A plan redeveloped as often as necessary to maintain coordination between customer requirements and the processes.

* Expert System applications imbedded in all the other elements to interpret data and results and improve the efficiency of data analysis.

* Process models tuned in real time so that planning predictions for current operation agree with actual performance.

* An organizational structure that rewards cooperation and teamwork.

"While this advice was gained from experience in the process industries, it's not hard to generalize these lessons," said Moulton.

"It is clear these points come from experience," said Mulcahy. "This was a fascinating session, Peter. Thanks for your effort."