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# Sales and operations planning: an exploratory study and framework

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## Abstract

**Purpose** – The paper seeks to develop a framework for sales and operations planning (S&OP) that is based on previous literature and company interviews. It is designed to help managers understand how effective their S&OP processes are and how to progress to advanced stages.

**Design/methodology/approach** – The S&OP literature, is reviewed and the results of a number of company interviews are presented. These lead to a new framework, with descriptions of each stage, and to implementation insights for managers.

**Findings** – After highlighting key dimensions for establishing a firm's S&OP maturity on a five-stage framework and, with the use of this framework, exploring in a preliminary way the relationship between firm size or process type (job shop, batch flow, continuous flow, etc.) and its degree of S&OP plan integration, little apparent relationship was found. However, the data suggest that business processes are enablers of S&OP plan integration, but that information technology is not clearly so.

**Research limitations/implications** – The results are based on a thorough review of the literature and on 15 in-depth company interviews. Because the sample size is small, the results should be considered to provide only preliminary insights.

**Practical implications** – Managers can use the framework to assess their S&OP process maturity. To advance to higher S&OP integration, managers should focus on leadership of business processes that can enable effective S&OP plan integration. These processes include organizational structure, meetings and collaboration across functional areas, and performance measurements. Information technology tools may also be enablers, but they do not appear to be the primary drivers.

**Originality/value** – The framework separates business processes from information processes. It is quite extensive and therefore provides managers with an indication of the maturity of their S&OP processes. Also presented are insights into an intuitive, albeit challenging, process for advancing through the stages of maturity. Finally, a perspective on the future of S&OP integration is suggested that is focused on optimizing profits rather than myopically maximizing revenues or minimizing costs.

**Keywords** Sales management, Operations management, Profit maximization

**Paper type** Research paper

## Introduction

In recent years, many companies have made remarkable progress with operational excellence and supply chain integration. Managers have implemented lean manufacturing principles within their organizations, while achieving significant cost and service benefits from supply chain integration initiatives such as eProcurement and vendor-managed inventory. Sales and marketing managers have concurrently begun to exploit increasingly deep knowledge of consumer preferences and their

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responses to promotions and dynamic pricing. The internet has provided unprecedented ability to gather this information, while other innovations, such as electronic shelf labeling systems, are creating opportunities for employing dynamic pricing in traditional stores. The goal is substantial revenue growth.

Although there remain opportunities for continued cost reduction in operations and for revenue growth in sales, it seems to us that it is the linkage between the two that may present the most exciting possibilities. The explicit goal of this linkage is profit optimization[1], and for years it has eluded managers, academic researchers and software developers. When operations managers make inventory or capacity decisions, they constrain the pricing flexibility for sales managers; and when sales managers make pricing decisions, they may create vexing ripple effects in operations. Even though there is a dearth of realistic, usable models for profit optimization, leading firms at least engage a conversation among sales, operations and finance managers. This conversation often takes place in the context of a sales and operations planning (S&OP) meeting, whose purpose is to develop and refine production and sales targets.

These thoughts raise questions about S&OP. What has been written on this topic? What distinguishes effective from ineffective S&OP processes? Are there certain characteristics that help define mature processes? Can we glean insights from these companies about how to implement and improve S&OP processes? For instance, is it necessary to purchase new software, or are there other steps that are more important? What does the future of S&OP and profit optimization look like? This paper attempts to answer these questions.

We begin by defining the S&OP process and reviewing the S&OP literature, both academic and managerial. Then, in the next section, we describe our industry interviews. Followed by a section in which we introduce a framework for S&OP integration that we developed from the literature and from our interviews. This framework is designed to help managers evaluate their current S&OP process, and it explicitly points to profit optimization as a future state, primarily to provide a vision for what can be accomplished. Next, we qualitatively test conjectures about S&OP implementation. In the final section, we provide a summary and concluding comments.

The contributions of this paper are therefore threefold. We provide:

(1) a thorough review of the S&OP literature;

(2) an extensive new framework for S&OP integration that separates business processes from information processes and that specifies a goal of profit optimization; and

(3) insights into advancing S&OP maturity.

## Literature review

S&OP is a business process that links the corporate strategic plan to daily operations plans and enables companies to balance demand and supply for their products (Gregory, 1999; Dwyer, 2000; Wight, 1999). Many view S&OP as a process to build a consensus-based operations plan to meet the forecast demand, while others suggest that it be used as a real-time technique to adjust quickly to changing market and operating situations (Smith, 2004; Dwyer, 2000; Wight, 1999; Olhager *et al.*, 2001). In either case, because S&OP generally creates plans for the next 1-18 months, it is often applied to product families rather than to individual stock keeping units (SKUs)

(IOMA, 2003; Lapide, 2002; Dwyer, 2000). However, we have seen recent examples of companies addressing the SKU level in their S&OP discussions. For example, De Kok *et al.* (2005) describe a collaborative-planning process at Philips Electronics that operates at the SKU level.

S&OP in principle, if not in name, has existed for at least 25 years, although little had been published about it until recently (Kruse, 2004; Smith, 2004; Sheldon, 2006). Some say that interest is growing (Kruse, 2004), while others suggest that many companies have tried S&OP, but have not seen the expected results and are moving away from it (Lapide, 2005b; Radjou *et al.*, 2003; Wight, 1999). In general, S&OP is easy to understand but can be very difficult to implement, which may explain the patterns of varying popularity over the years.

As information technology has improved, there have been attempts to impose technological solutions without addressing business processes, leading to almost certain failure (Radjou *et al.*, 2003). In fact, Lapide (IOMA, 2004b) states that traditional S&OP is "internally focused and technologically challenged." His proposition is that companies need to apply the S&OP culture across all functions and levels as well as with their suppliers and customers in order to be "best in class." His view is backed by anecdotal evidence of the importance of S&OP in business success (Lapide, 2002).

## The S&OP process

S&OP typically follows a five-step process (IOMA, 2003, 2004b, 2005; Kruse, 2004; Rooney and Bangert, 2001; Lapide, 2004b, 2005a; Mark, 2004; Dwyer, 2000; Gregory, 1999; Wallace, 2004). First, personnel from sales gather in formal, or informal, pre-meetings to build a baseline demand forecast that is unconstrained in that it captures not what the company can produce, but what could be sold to customers. The forecast is adjusted by anticipated responses to marketing plans, such as advertising, trade shows, and promotions. Furthermore, it includes information about new product introductions and product obsolescence. The result is a consensus-based, unconstrained demand forecast.

A key decision for the forecasting process is the planning horizon. Planning horizons typically range from 6 months to over 3 years, but the most common horizon seems to be 6-18 months[2]. However, the horizon varies by industry, by product seasonality, and by the time of year that S&OP planning occurs. Industries that have long production lead times or high seasonality (apparel, pharmaceuticals, automotive products) will tend towards longer horizons, whereas short horizons will be more common in those with short lead times and low seasonality (commodity items). For seasonal products such as winter clothing, the horizon is often 12 months when the plan is created in December, say, but 18 months if it is created in July, so that the firm can accommodate a full-marketing cycle. Annual S&OP plans are developed to coincide with the company's fiscal year budgeting process. Some use a rolling horizon and update their plans and forecasts at their formal S&OP meetings.

The second step involves pre-meetings with the operations team. While the sales team is developing its forecasts, the operations team gathers information about inventory strategy (build-up or draw-down), supply chain capacity, and internal capacity. Modules of manufacturing resources planning (MRP) may be used in this process to create a time-phased picture of future plans and requirements. Next, but still in the pre-meeting phase, the operations team uses the consensus demand forecast to

create an initial supply plan, often called a rough cut capacity plan, that is designed to meet the forecasted requirements.

Third, the S&OP team formally meets to develop the final operating plan for the next period. Key decisions for these meetings include the personnel involved and the meeting frequency. We comment on each of these decisions before addressing the final two steps in the process.

The S&OP team must be cross functional and should include representatives from sales and marketing (demand management, forecasting, etc.), operations (purchasing, inventory management, supply chain operations, master production scheduling, etc.), and finance (see Dwyer (2000) and also Hahn *et al.* (2000) who note that Hyundai's S&OP meetings involve up to 30 people). S&OP effectiveness is greatly enhanced by an S&OP champion. Ideally, senior executives participate in the formal meetings where they review and approve the work from the functional pre-meetings and grant authority to the S&OP team to implement planning decisions (IOMA, 2003, 2005; Kruse, 2004; Rooney and Bangert, 2001). Note that some companies are developing skill sets for key S&OP positions and are either training their own people or hiring to meet these requirements (Slone, 2004).

Meeting frequency varies across companies. While much of the literature recommends monthly meetings, recent papers and our interviews indicate that many companies are moving toward a more frequent schedule (IOMA, 2005; Kruse, 2004; Lapide, 2002; Slone, 2004). For example, executives from HealthPlan Services meet daily, even if for only 15 minutes, to discuss major contracts that may be signed in the near future. Interestingly, some authors oppose daily S&OP meetings because they feel these will create instability in the production process (IOMA, 2004b; Kapp, 2000; Radjou *et al.*, 2003). Common practice is to meet at regularly scheduled intervals, but leading companies are striving for an "event-driven" S&OP process whereby management meets on an as-needed basis to deal with exceptions, such as competitor actions (promotions, pricing) or operations problems (yield rates, supply chain disruptions) (Hahn *et al.*, 2000; Rooney and Bangert, 2001; Lapide, 2004a).

The fourth step is to distribute and implement the plan. The primary recipients are the operations and sales teams, although in almost every case we have observed, the operations team carries the burden of meeting the required production targets, while the sales team is rarely required to adjust sales plans. We will discuss this further when we introduce our framework.

The fifth and final step is to measure the results and the effectiveness of the S&OP process. Measurement is essential, both for implementation and for continuous improvement. The literature suggests that the chosen measures should vary by industry, process, and product line. Examples of commonly used measures for operations include line fill, inventory on hand, obsolete inventory, expediting frequency, stockouts, variance to standard cost, quality, and capacity utilization. When new product introduction is important, measures include development cost, time to market, ramp-up time, and number of successful introductions. Measures for the sales team include top line sales growth, market share, forecast accuracy and variance to baseline forecast. Finance is most interested in business measures such as market share, sales dollars, stock price and return on invested capital (IOMA, 2005, 2004b; Wing and Perry, 2001; Sheldon, 2006). Measures for S&OP effectiveness are very rare in our experience. We will comment more on this in the discussion of the framework.

These five steps capture the common S&OP process, although it is evident from the stages of S&OP maturity in our framework that company experience varies widely.

*Implementation*

Much attention in the literature is focused on S&OP implementation, implying that it is not as well established as some surveys suggest (IOMA, 2004b; Kruse, 2004; Radjou *et al.*, 2003; Wight, 1999). Part of the difficulty is explained by the fact that S&OP requires corporations to change not only a business process, but also company culture as well. In particular, longstanding functional silos must be broken down, and managers with very different incentives must work toward a common goal. This often requires fundamental changes to incentive schemes, a task that requires a major change management effort (Lapide, 2005b; Slone, 2004; Smith, 2004). Studies suggest that it is important to implement in stages starting with a pilot product family (IOMA, 2005, 2004a; Radjou *et al.*, 2003). The family should be of relatively low complexity, but also important to the business, so that senior management can appreciate the effect of S&OP on strategic plans and financial performance.

Enabling technology (software) may be required, but not too early in the implementation process. It is more important to have a well understood S&OP business process than it is to have elegant software (IOMA, 2004a; Lapide, 2005b). In fact, simple spreadsheets can be used in the pilot stages so that the team can focus attention on establishing the proper process. Enabling technology can be introduced once the scope of S&OP outgrows the spreadsheet approach. We will comment further on this when we analyze our results.

*Profit optimization*

One area that has generated significant managerial and academic interest in recent years is profit optimization. Profit optimization accounts for the effects of sales efforts on operations and vice versa, with the goal of maximizing profitability. For example, when sales runs a promotion that generates a demand spike, this spike can amplify throughout manufacturing and the supply chain. This amplification, known as the bullwhip effect, can lead to costly supply chain dysfunctions by overtaxing production and distribution capacities (Macé and Neslin, 2004; Lee *et al.*, 1997). Profit optimization attempts to maximize total profit due to, say, a proposed promotion, by including operations and supply chain costs as well as the beneficial revenue effects. It is likely that explicitly capturing these costs will persuade the sales team to modify their promotion plans, perhaps significantly reducing the depth of the discount, so that overall profit is increased. On the other hand, if operations exhibit economies of scale that would benefit from a surge in demand, the optimal promotion may be even steeper (Fleischmann *et al.*, 2007). With the development of adequate optimization models for manufacturing, full dynamic pricing may someday be possible, such as is used in the airline and hospitality industries, although competition, reference price issues, and customer relationships may dictate stable prices. See Fleischmann *et al.* (2004) and Chan *et al.* (2004) for a review of the literature in this field.

It is our contention that the next level of S&OP integration should be intentional not only about communicating and coordinating plans among sales, operations and finance, but also about revising those plans to optimize profits. It seems to us that software development, managerial practice, and the academic literature are not

sufficiently advanced to realize this vision. We are engaged in ongoing research to help address this need, as are a number of other researchers and software firms.

*Models and frameworks*

There exist a number of S&OP frameworks based on information flows, technology, and how consensus is reached. Some are quite simple (Mentzer and Moon, 2004), while others are somewhat more elaborate. For instance, Wing and Perry (2001) provide a three-stage framework focused on information integration, both internally and with supply chain partners. Two frameworks, in particular, have influenced our research.

The Aberdeen Group's S&OP competitive framework ranks an organization against current industry standards (Elbaum, 2004; IOMA, 2004a). This framework uses six categories and classifies a company in each category as laggard, industry average, or best-in-class. The categories are process, organization, resource effectiveness, IT architecture, decision making, and collaboration. As an example, laggard firms have no S&OP team, attempt only to balance capacity to demand and do so with silos of decision making and collaboration. Best-in-class firms, on the other hand, attempt to optimize profit using an integrated core team that includes multiple functions and supply chain partners. Of note for our framework and recommendations, the Aberdeen framework approaches profit optimization as a dimension of information technology.

Lapide (2005b) proposes a "Four-Stage S&OP Process Maturity Model." The intent of this framework is to aid companies in diagnosing their current status and to identify steps that will help them move to their optimum level. Lapide's model employs four levels of S&OP processes – marginal, rudimentary, classic and ideal – and three categories – meetings, processes and technology. A marginal S&OP process involves sporadic meetings and disjointed supply and demand plans using disparate spreadsheets. Ideal processes engage meetings in response to unusual events and have aligned supply and demand plans that are developed with an S&OP workbench.

We relied on these two frameworks as a starting point for this research. The categories and the descriptions of various stages provided an excellent base from which to build our more extensive framework. Our framework incorporates five categories that include both business and information processes, and it is explicit that the goal is profit optimization through the integration of sales, operations and finance plans. Furthermore, we expanded to five the number of stages of maturity for two reasons. First, we found that with fewer stages, a number of managers had difficulty accurately assessing their S&OP processes. The descriptors were just too general. Second, we believe that profit optimization holds great potential, and we wanted to highlight it as a goal for the future. In our consulting and executive education experience after developing this framework, we have found it to serve well the purpose of helping managers to gauge their S&OP processes and to develop plans for improvement. Furthermore, we have been pleased by the eager reception we have received of the potential of profit optimization. Finally, our framework fills out previous models by capturing our experience from company interviews. Analysis of the interview results provides preliminary recommendations for implementing an effective S&OP process.

## Industry interviews

Our literature search indicates that the bulk of S&OP development has occurred in industry rather than academia[3]. Therefore, we determined it prudent to interview and

assess manufacturing companies across a range of industries[4]. The goals were twofold: to understand the degree of S&OP sophistication at each company, and to identify best practices and find common themes in these practices. The results of this analysis are a framework for S&OP integration, and a set of recommendations for improvement in S&OP integration.

We began by drafting a preliminary framework and template of questions based on our previous experience and the literature. We then interviewed four companies to get feedback on the draft framework and the questions. After refining the framework and questions, we went back to the same four companies for any follow-up questions that arose due to the refinements, and we interviewed the other 11 companies in the sample. Throughout the research process, we made minor modifications to the framework based on the conversations with managers, and therefore occasionally we returned to some of the companies for further information. Several interviews were with one decision maker, primarily because that person was responsible for all relevant functions. However, most interviews involved three to five people across several functional areas. We used conference calls and individual conversations, as appropriate.

As is often the case in interviews, we provided the respondents with many opportunities to provide additional details and insights. Hence, we were able to get responses to all our basic questions as well as gain a much deeper understanding into their S&OP processes and implementation challenges. For this reason, the interview template listed in the Appendix should be viewed as the starting point, rather than an exhaustive list of questions.

Each interview began by obtaining basic information on the product line and manufacturing process, to assess the degree of complexity and scope of their operations. Next, we delved into their S&OP processes to understand the details and integration of demand forecasting, production planning and supply planning. Detailed S&OP questions focused on meeting processes, organizational structure, performance measurements, plan integration, information systems, and supply chain collaboration. We always asked if the supply and demand systems were linked, in the IT and plan integration sections. This was a prompt for the respondents to discuss profit optimization, although not one company had made any progress on this dimension. In fact, in most cases managers had not even considered the possibility.

We identified 15 manufacturing companies that represent a cross-section of size and industry. Revenues range from $50 million to 5 billion, and from a single plant with a narrow product line to a large global enterprise with multiple product families. Furthermore, we made an effort to capture multiple manufacturing process types (job shop, batch flow, worker- and machine-paced line flow, and continuous flow) so that our sample spanned the well known product-process matrix (Hayes and Wheelwright, 1979a, b). See Figure 1 for the location of the firms on the product-process matrix. Relative company size, in terms of revenue, is indicated by the bubble size.

The final outcome of the interviews was an S&OP framework that can be used to evaluate a company's current level of S&OP integration. Additionally, we discovered that the framework is useful for recommending a process for advancing to higher levels of integration. In the next section, we introduce our S&OP integration framework and the subsequent section provides some conjectures regarding advancement.

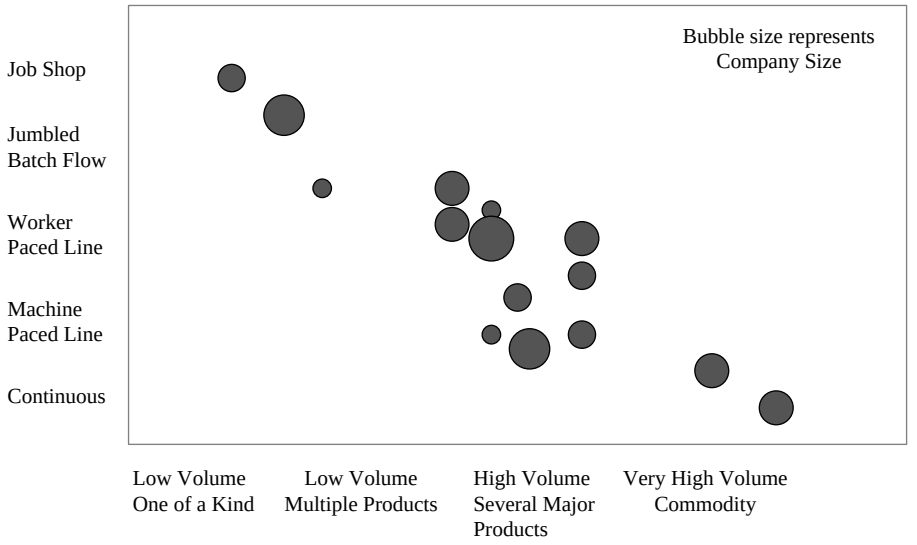


**Figure 1.**
Product-process matrix with company size

## S&OP integration framework

Our proposed S&OP integration framework uses a one to five ranking across five dimensions. Three of the dimensions: meetings and collaboration, organization, and measurements are primarily business processes. Information technology is, of course, an information process, as is S&OP plan integration. Details on each of these dimensions follow. The framework is presented in tabular form as Figure 2. The ultimate goal, of course, is not an additional meeting or an organizational change, and it is certainly not a new information system. Rather, the goal is profit optimization through S&OP plan integration. The business processes and information technologies are a means to that end.

The ranking starts with a company that has no S&OP practices whatsoever and hence would be classified as Stage 1. We designate the top rating of Stage 5 as proactive, and is in our opinion the ultimate a company can achieve in the foreseeable future. We found no companies that are currently at Stage 5 for reasons that will become evident. The remaining levels are described as reactive (Stage 2), standard (Stage 3) and advanced (Stage 4).

### *Meetings and collaboration*

Meetings and collaboration, the first of the business processes, evaluates the effectiveness of the human component in S&OP. In Stage 1, there are no planning meetings and virtually no collaboration between sales and operations departments. Sales personnel work independently from operations, interacting only when customers are complaining about late deliveries or poor quality. For their part, operations personnel take whatever forecast information is available and do their best (maybe) to meet demand.

Sales personnel often develop very poor demand forecasts that may be inflated to overcome frequent late deliveries from operations. Operations personnel then "adjust"

**Figure 2.**
S&OP integration framework

| | Stage 1<br>No S&OP Processes | Stage 2<br>Reactive | Stage 3<br>Standard | Stage 4<br>Advanced | Stage 5<br>Proactive |
|---|---|---|---|---|---|
| Meetings & Collaboration | • Silo Culture<br>• No meetings<br>• No collaboration | • Discussed at top level management meetings<br>• Focus on financial goals | • Staff Pre-Meetings<br>• Executive S&OP Meetings<br>• Some supplier / customer data | • Supplier & customer data incorporated<br>• Suppliers & customers participate in parts of meetings | • Event driven meetings supersede scheduled meetings<br>• Real-time access to external data |
| Organization | • No S&OP organization | • No formal S&OP function<br>• Components of S&OP are in other positions | • S&OP function is part of other position: Product Manager, Supply Chain Manager | • Formal S&OP team<br>• Executive participation | • Throughout the organization, S&OP is understood as a tool for optimizing company profit. |
| Measurements | • No measurements | • Measure how well Operations meets the sales plan | • Stage 2 plus:<br>• Sales measured on forecast accuracy | • Stage3 plus:<br>• New Product Introduction<br>• S&OP effectiveness | • Stage 4 plus:<br>• Company profitability |
| Information Technology | • Individual managers keep own spreadsheets<br>• No consolidation of information | • Many spreadsheets<br>• Some consolidation, but done manually | • Centralized information<br>• Revenue or operations planning software | • Batch process<br>• Revenue & operations optimization software – link to ERP but not jointly optimized<br>• S&OP workbench | • Integrated S&OP optimization software<br>• Full interface with ERP, accounting, forecasting<br>• Real-time solver |
| S&OP Plan Integration | • No formal planning<br>• Operations attempts to meet incoming orders | • Sales plan drives Operations<br>• Top-down process<br>• Capacity utilization dynamics ignored | • Some plan integration<br>• Sequential process in one direction only<br>• Bottom up plans - tempered by business goals | • Plans highly integrated<br>• Concurrent & collaborative process<br>• Constraints applied in both directions | • Seamless integration of plans<br>• Process focuses on profit optimization for whole company |

these forecasts because they know that sales regularly inflates the numbers. Both departments may have to change the numbers entirely to meet goals set by the finance group – goals that are developed without a clear understanding of the market or of production capacity or inventory positions. The result is a set of numbers that no one believes because they are often completely inaccurate. Company M is a perfect example of a Stage 1 company on this dimension.

Company M manufactures electrical products, virtually all of which are custom made. They sell extensively in the USA, but they also have substantial sales internationally. The factory is a large, complex, process-oriented job shop. Production volumes for orders range from a few hundred units to several hundred thousand units, and because virtually all products are make-to-order, the operations planning process is quite complex. Process steps for a given order range from 10 to 110. They have been in business for several decades and have a reputation for high quality but poor delivery performance.

This company is solidly in Stage 1 on the meetings and collaboration dimension. There are no S&OP meetings; in fact, there are virtually no meetings at all between functions. The only meetings that occur are at the executive level, and S&OP is not on the agenda. Organizationally, sales and production are independent – almost insulated – and communication between departments is minimal. Sales personnel are measured on beating volume or revenue targets, and the operations team is constantly scrambling to fill orders as they arrive. At this company, it is common to see one of the key salesmen walking the production floor, expediting his orders and disrupting other orders to get his to the front of the queue.

In Stage 2, sales and operations issues are discussed at senior management meetings, which may include vice presidents of both functions. However, the discussion is primarily in the context of financial goals, rather than for the purpose of integrating plans. The strong silo mentality persists at this stage with little collaboration among line employees. The danger in Stage 2, like in Stage 1, is that corporate financial goals drive sales efforts, promotional activity, and other pricing decisions, without understanding the true effect on the market or operations. Therefore, even though senior managers from both functional areas are in regular conversation, their plans may be far from optimal.

Company B is a $50 million firm in the corrugated cardboard industry that produces a niche product line. S&OP at this company is run in a centralized manner by the assistant to the president. Decisions are made by this person with input from operations and sales leaders, but with very limited discussion among parties. Because this person is responsible for financial results, there is a strong temptation to let short-term financial goals be the sole driver of the S&OP decisions.

S&OP processes become formalized in Stage 3. Sales and operations personnel hold pre-meetings within function, prior to formal S&OP meetings, and they may share information from their separate plans. The formal, executive S&OP meetings focus specifically on integrated S&OP. Unresolved conflicts are addressed at this time. Some supplier and customer data for key accounts may be used in both sets of meetings.

Company L is a $100 million firm that produces equipment for high-speed assembly lines. The sales cycle at this company can take months and may involve extensive negotiations on price. As this cycle unfolds, the sales team brings updated information on the likelihood of closing a major sale to the S&OP meeting. Demand forecasts and

operations plans are then updated. In a similar vein, in Stage 3 companies, if operations identifies, say, a shortage of a critical component, the pre- and formal-meetings would address the potential fallout and possible remedies. Firms at Stage 3 meet weekly or perhaps monthly, but they are unlikely to have extensive discussions between meetings.

Stage 4 is an extension of Stage 3 where top customers and suppliers actively participate in the meetings. They may physically attend the meetings, but more likely they will participate by phone or video-conference as needed. In Stage 3, only major supplier and customer data is included in the S&OP process. In Stage 4, data from a broader set of supply chain partners is incorporated. We all know of cases where a plant was temporarily shut down, not because of an expensive or "critical" component, but because of a relatively inexpensive part. Stage 4 companies recognize this, and invite – even require – more suppliers and customers to engage in the S&OP discussions. Several companies where we conducted interviews approached Stage 4, although none had extensively involved both suppliers and customers.

In Stage 5, firms employ all the processes of Stage 4, plus event-driven meetings that supersede the scheduled ones. Rather than waiting until the regularly scheduled S&OP meeting to address a shortage of a critical component, the S&OP team will meet immediately. Stage 5 companies provide internal personnel and supply chain partners with real-time access to internal and external data. The advantage of moving to Stage 5 is that sales and operations managers get early warning signals about impending disruptions and can take appropriate actions. None of the companies we interviewed would be classified as Stage 5, although event-driven meetings are not unheard of today (Hahn *et al.*, 2000).

*Organization*

The Organization dimension focuses on the corporate S&OP structure. In Stage 1, there is no S&OP function in the company, even as part of another job function. Company M is again an example of a Stage 1 company. In fact, no one had ever heard of S&OP.

In Stage 2, there is again no formal S&OP function, but some of the tasks are fulfilled by others. The assistant to the president in Company B, for instance, has no formal S&OP position, although he serves this role as he reconciles sales and operations plans with financial goals in mind. As a result, we classified Company B at just above Stage 2 on this dimension.

In Stage 3, the S&OP function is the responsibility of another position, such as a product manager or supply chain manager. There may be no formal S&OP team, but a formal team may exist. In Stage 4, there is a formal S&OP team that has executive level participation. Job descriptions for all members of the team clearly specify S&OP responsibilities. In Company J, for instance, the S&OP meetings and process are handled by the supply chain manager. This manager previously ran a reasonably effective but informal process (Stage 3) until S&OP was formalized as part of his job with an established S&OP team (Stage 4). Because there is still no executive participation, Company J would be considered between Stages 3 and 4 on this dimension.

The Stage 5 organization has a formal team with executive level participation, like Stage 4. Furthermore, S&OP is understood and respected by others in the organization. They know that the negotiations that take place in these meetings lead to a more

profitable outcome for the company. The idea that a salesmen would appear on the shop floor disrupting production (Company M) would be absurd at a Stage 5 company. This is similar to how six sigma or TQM is currently deployed in many companies. Not everyone is a black belt nor is everyone involved directly in product quality, but they understand the role that these initiatives play in company success.

*Measurements*

As mentioned in the literature review, measurements apply to both company performance as well as the effectiveness of the S&OP process. Stage 1 companies have virtually no measurements beyond standard financial accounting systems. Company M (electrical products) and Company E (a small, but high-end furniture company run by the founder/designer) are in Stage 1 on this dimension. Our interviews gave no indication that sales or operations were measured in a rigorous manner. Some managers even pointed out the difficulty in making decisions that should be straightforward, because of the lack of operational and other information.

In Stage 2, a company assesses how well the operations department meets the sales plan, usually on a quarterly or monthly basis. The issue here is that sales managers are not held accountable for their plans. Company N is a large multi-facility firm that produces bedding products, entirely made-to-order with a ten-day lead time. The firm is growing rapidly, and in spite of improvements in the supply chain and operations, the emphasis is clearly on sales growth. Operations is driven by sales orders, with limited opportunity for feedback or adjustment to sales plans based on capacity or other operational issues.

In Stage 3, firms not only measure the responsiveness of operations, but they also measure sales on forecast accuracy. Firm H moved to Stage 3 in the past few years when they realized that the sales team did not have an incentive to forecast accurately. Firm H's profitability is driven in large part by utilization of expensive production capacity. They are aware of a "sweet spot" of capacity utilization where it is not too low, thereby incurring high-fixed costs per unit, or too high, where lead times and customer service degrade. Planning production with this in mind requires good communication and accurate forecasts. Senior managers now hold sales managers accountable for their forecasts, a development that has allowed operations to improve planning and efficiency.

Two key metrics are added in Stage 4: new product introduction and S&OP effectiveness, which go beyond standard operational and financial systems. The reason for including new product introduction in Stage 4 is that most other operational measures are best applied to products that have some demand history and have been part of sales and operations plans for months or even years. The dynamics introduced when new products enter production can be very challenging, and Stage 4 companies are intentional about measuring the efficiency and effectiveness of their development activities. As mentioned in the literature review, measures include development cost, time to market, ramp-up time, and the number of successful introductions.

S&OP effectiveness is rarely measured in our experience. Measures should include 360-degree feedback, in which team members are provided detailed information from their peers, supervisors and subordinates – specifically on their participation in the S&OP process. In addition, suppliers and customers should be asked to evaluate the process, probably using a short numerical questionnaire. Functional measurements

can also serve as an evaluation of the effectiveness of S&OP. For instance, an effective S&OP process should lead to improvements in forecast accuracy over time. Likewise, on-time deliveries should improve as the teams coordinate plans.

Stage 5 adds profitability to the Stage 4 measures that are tied to the S&OP process. Now, tracking profitability is common in industry, but functional managers are typically accountable only for their functional targets. Stage 5 companies report profitability to the S&OP team and hold the team partially accountable for it. Operations managers are not only accountable for meeting sales plans, and sales managers are not only accountable for forecast accuracy. Rather, both functions are accountable for setting prices and adjusting inventories and production plans to jointly achieve more profitable outcomes. Currently, this is a challenge because profit optimization models are not yet sophisticated enough to support these decisions, but in the future such models will be available, and mangers should be encouraged to employ them.

*Information technology*

Information technology focuses on an information process rather than a business process. In Stage 1, a company has a few spreadsheets owned (but not shared) by individual managers, and there is no consolidation of information. Company E (furniture) is an example of Stage 1 on this dimension. It is a very low-tech operation, at least in information technology, leading to great frustration by the few managers who have experience in other more sophisticated IT environments.

In Stage 2, spreadsheets and data are separately owned and updated, but there is some manual consolidation. Company B (corrugated products) was in Stage 2 on this dimension as the assistant to the president gathered and consolidated the various reports and made decisions. Recently, this company began a move to Stage 3 with the implementation of a fairly elaborate production-planning system.

Stage 3 companies centralize information in an automated way, and they employ revenue or operations planning software. Company L (equipment for high-speed assembly lines) uses MRP for production planning and control, and rudimentary revenue planning software for updating bid status. Information is shared, but not in an efficient, automated way. Hence, we classified Company L as 2.75 on the IT dimension.

In Stage 4, the company has revenue and operations optimization software, although the plans are optimized sequentially or separately rather than jointly. Revenue optimization software analyzes past data on, say, promotions to determine the optimal discount. Operations optimization software, such as finite scheduling, analyzes multiple production sequences and chooses the optimal sequence to achieve the desired performance objectives. Additionally, Stage 4 firms employ an S&OP workbench that is accessible throughout the organization. An S&OP workbench is simply an automated tool for sharing information about sales and operations plans among the team members. Most of these processes are done on a batch basis, due to the size and complexity of solutions and the limitations of current hardware technology.

Company A manufactures non-pharmaceutical medical products for a global market. Their annual sales exceed $1 billion, and they employ close to 4,000 people. Sales volumes range from quite low to very high, and they employ a combination of worker paced and machine paced line flows in production. This firm uses revenue and operations planning software, but has not yet implemented software that optimizes

sales or operations. It does however employ an S&OP workbench via the company's intranet. Hence, we classified them as Stage 3.5 on the IT dimension.

Stage 5 IT is not achievable currently, but we submit that it is the next stage of S&OP information technology sophistication. Stage 5 firms will employ real-time, integrated solutions that jointly optimize sales decisions, such as pricing, with operations decisions, such as production schedules. This profit optimization approach will allow firms to achieve Stage 5 of S&OP plan integration by reacting quickly to changes in market conditions, without overtaxing operations or the supply chain, and yet not leaving potential revenue on the table. Although full dynamic pricing will be feasible in Stage 5, as mentioned above, the optimization may indicate the stable prices are more profitable in the long run. The software will be linked to enterprise resource planning (ERP) systems, as well as to accounting and forecasting packages, and so that information is shared seamlessly across the enterprise.

*S&OP plan integration*

S&OP plan integration measures how effectively a company builds its sales plans and operations plans, and how well the plans interface. Such integration is the goal of the meetings, measurements, organizational changes and information technology.

Stage 1 companies, as implied earlier, have no S&OP planning, and operations attempts to meet incoming orders with no advance information on sales forecasts. Again, Companies M (electrical products) and E (furniture) are clearly in Stage 1 on plan integration.

In Stage 2, the sales plan drives the operations plan, and it is purely a one-way process; no operations information is used to refine or adjust the sales plan, and capacity utilization dynamics are ignored. Recall from the description of Company H that performance can degrade if utilization is too low or too high. Many companies do not understand this dynamic, and hence managers ignore capacity utilization in planning. Company H, in fact, was much more attuned to low utilization than to high utilization, leading them to occasionally reprimand a plant manager for poor lead time performance in spite of the fact that it was caused by a surge in orders.

A Stage 3 company still employs a sequential process where sales plans primarily drive operations plans. However, some operational information may be used, and plans may be adjusted in response. Furthermore, rather than plans being created in a top-down process, Stage 3 companies develop forecasts bottom-up. The plans are then tempered by business and financial goals. The result is a more integrated and realistic plan.

The fact that Company H did consider capacity utilization at some level in their planning process, and that plans were prepared in a bottom-up way, led us to classify this company as 2.75 on this dimension. Company L (assembly line equipment) is at Stage 3 on plan integration because field sales personnel are responsible for forecasts, and as mentioned above, sales and operations plans are adjusted based on updates to the likelihood of a major sale. However, sales plans are rarely, if ever, adjusted based on capacity constraints or other operational considerations.

Stage 4 represents the current state of the art for plan integration. The process to develop sales and operations plans is collaborative rather than solely driven by sales. Capacity constraints are considered by both marketing and operations. Most importantly, the planning process in Stage 4 is concurrent rather than sequential.

At Company A (medical products) the supply chain manager develops sales and operations plans concurrently, with extensive input from all the relevant personnel in both functions, as well as finance. However, sales plans are the primary driver. In fact, when production faces a capacity constraint, this information is communicated to all parties but is not incorporated in the sales plan – it is expected that Operations will satisfy the required demand. In order to move to Stage 4, Company A will need to incorporate production constraints in their sales plans and pricing decisions.

A company in Stage 5 has a seamless planning process that is optimized concurrently for demand and supply to maximize not just sales revenue or operational efficiency, but profitability. Constraints on pricing, competitive actions, capacity constraints, and inventory and supply chain constraints are all explicitly considered. Managers can move toward Stage 5 processes by ensuring that issues raised by all team members are heard and responded to, with the goal of profit optimization. One would expect that senior management involvement will be necessary, at least during the transition to Stage 5, because incentives most likely will need to be changed. In the future, when Stage 5 optimization tools are available, much of this process can be automated, although we doubt that the tools will ever eliminate the need for human judgment.

## Analysis and conjectures

We applied our framework to 15 manufacturing firms and graded them on the five characteristics. The mean position on our S&OP framework ranged from 1.05 to 3.55 with standard deviations ranging from 0.112 to 0.512 (Figure 3).

As our research progressed, we considered various conjectures regarding factors that influence a company's S&OP maturity. Because the sample size was small, we graphically investigated each conjecture to see if it warrants further study. The results of that analysis are presented here.

*Conjecture 1: S&OP maturity is linked to the firm's position on the product-process matrix*

The first conjecture we proposed was a link between a company's position on the product-process matrix Hayes and Wheelwright (1979a, b) and its S&OP maturity. We surmised that firms in the lower right hand region (high-volume machine-paced line flow or continuous process) would tend to be at higher stages while the upper left region firms (low-volume job shop or batch flow) would be at lower stages.

| Company | Mean | Standard Deviation | Meetings & Collaboration | Organization | Measurements | Information Technology | Plan Integration |
|---|---|---|---|---|---|---|---|
| A | 3.55 | 0.112 | 3.75 | 3.50 | 3.50 | 3.50 | 3.50 |
| B | 2.40 | 0.335 | 2.25 | 2.25 | 2.00 | 2.75 | 2.75 |
| C | 2.95 | 0.512 | 3.75 | 3.00 | 3.00 | 2.50 | 2.50 |
| D | 2.70 | 0.209 | 2.50 | 3.00 | 2.75 | 2.50 | 2.75 |
| E | 1.05 | 0.112 | 1.25 | 1.00 | 1.00 | 1.00 | 1.00 |
| F | 2.75 | 0.354 | 2.50 | 3.00 | 3.00 | 3.00 | 2.25 |
| G | 3.15 | 0.137 | 3.25 | 3.00 | 3.00 | 3.25 | 3.25 |
| H | 2.80 | 0.209 | 2.75 | 2.50 | 3.00 | 3.00 | 2.75 |
| I | 2.55 | 0.411 | 2.25 | 2.50 | 2.50 | 3.25 | 2.25 |
| J | 3.35 | 0.224 | 3.50 | 3.50 | 3.50 | 3.00 | 3.25 |
| K | 3.20 | 0.274 | 3.50 | 3.50 | 3.00 | 3.00 | 3.00 |
| L | 2.90 | 0.137 | 3.00 | 3.00 | 2.75 | 2.75 | 3.00 |
| M | 1.15 | 0.137 | 1.00 | 1.25 | 1.25 | 1.25 | 1.00 |
| N | 1.50 | 0.306 | 1.25 | 1.50 | 2.00 | 1.50 | 1.25 |
| O | 2.95 | 0.447 | 3.25 | 2.50 | 3.50 | 3.00 | 2.50 |

**Figure 3.**
S&OP integration results

Our rationale was that firms in the lower right region tend to be larger and compete on rapid delivery and low cost, and therefore would have the resources and motivation to coordinate sales and operations plans. Firms in the upper left, on the other hand, are often small job shops and may not have the resources to pursue sophisticated S&OP processes. Furthermore, because these factories often produce in a make-to-order fashion, they may not be able to plan ahead with any clarity. S&OP integration might be impossible.

Figure 4 is a plot of the companies on the product-process matrix, where the placement of a bubble represents the company's position on the matrix, and the size of the bubble correlates to the company's S&OP stage. A pattern of small bubbles in the upper left gradually increasing in size to large bubbles in the lower right would indicate that our conjecture is likely true. In fact, our conjecture proved to be false; we could not discern any relationship between S&OP integration and position on the product-process matrix. It is clear from the chart, and from the numerical data, that the firms in our sample simply did not exhibit enough dispersion on S&OP maturity to discern a relationship with the product-process matrix. However, the chart suggests that a larger sample size is not likely to change the conclusion.

*Conjecture 2: S&OP maturity is linked with firm size*

Prior to our company interviews, we surmised that the size of a company (revenue, employees, etc.) would be positively correlated with S&OP maturity. This conjecture is similar to Conjecture 1, but it focuses entirely on size, without confounding it with process type. Once again, our results suggest that if there is such a correlation, it is quite weak (Figure 5). In Figure 5, we grouped companies by size and ranked them on a scale of 1-5. Note that there are no companies in the lower right region of the graph, which suggests that large companies tend to be somewhat more sophisticated with S&OP. Furthermore, there appears to be a slight upward slope on the graph. But the data clearly do not support a strong relationship between company size and S&OP maturity. We found that several

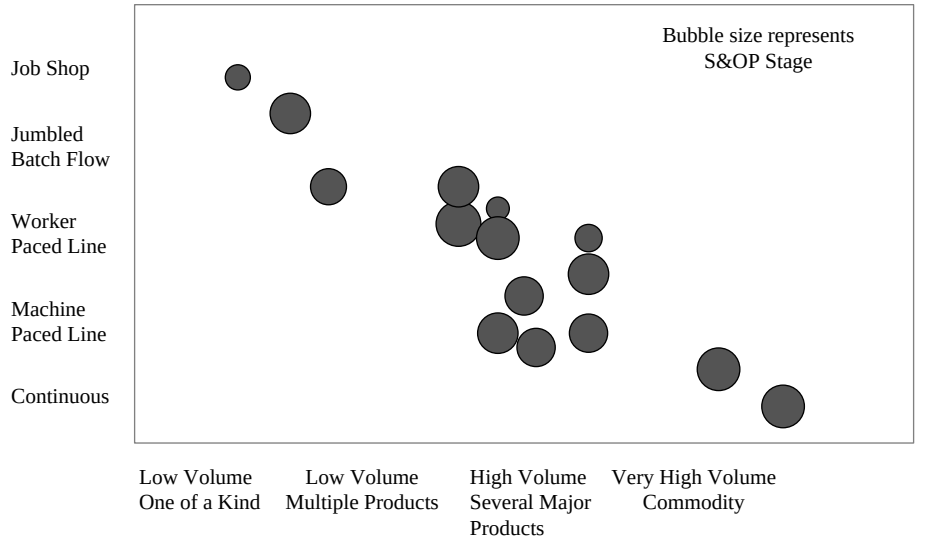


**Figure 4.**
S&OP stage on product-process matrix

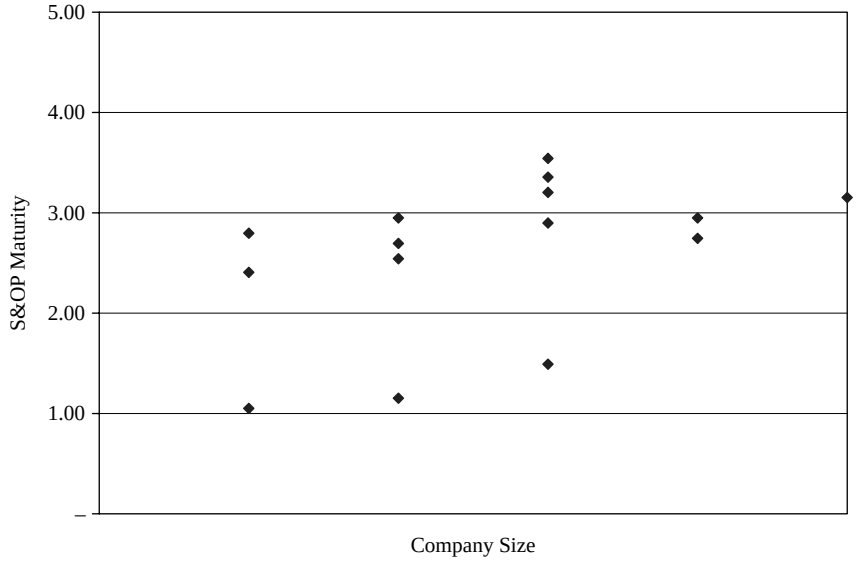


**Figure 5.**
S&OP maturity vs company size

smaller companies were more advanced in their S&OP process than larger companies, but the range was so large that strong conclusions are impossible. Nevertheless, these results should be an encouragement to managers of smaller companies.

*Conjecture 3: business and information processes are enablers for plan integration*

Our interviews and analysis led us to believe that the business and information processes that we considered – meetings, organization, measurements, and information technology – could be enablers for S&OP plan integration. The plots shown in Figures 6-9 generally support this conjecture. On these graphs, the horizontal axes are the stage of the business or information processes, and the vertical axis is stage of plan integration. If a firm's stage on the Organization business process, say, is higher than its plan integration, it will show up below the 45-degree line, implying that the business process precedes S&OP plan integration. We might argue that it not only precedes integration, but also that, it is an enabler of it. On the other hand, if a point lies above the 45-degree line, it suggests that plan integration is more advanced that the business or information process, and hence that process is not necessary to plan integration. Hereafter, we use the term "enabler," recognizing that our results do not prove causality.

Figure 6 shows that a suitable S&OP organization in general precedes plan integration. However, at three of the 15 firms, this was not the case. Two of these firms were quite small and had no formal S&OP function; yet they were reasonably advanced in integrating plans. Subsequent review of these firms, including follow-up interviews, revealed that the S&OP role was performed by a single manager. Thus, no formal S&OP organization was necessary because the entire process was effectively driven by one person. The other firm was larger, but it had spread the S&OP functions across several other positions, and hence had no formal S&OP roles. These firms suggest that it is possible to integrate sales and operations plans without an S&OP organization. However, it is not clear whether it is possible to advance to Stage 5

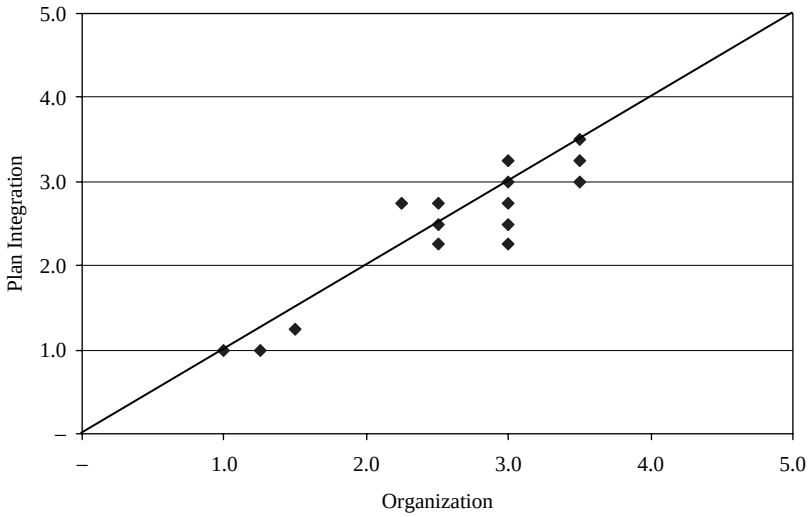


**Figure 6.**
Plan integration vs organization

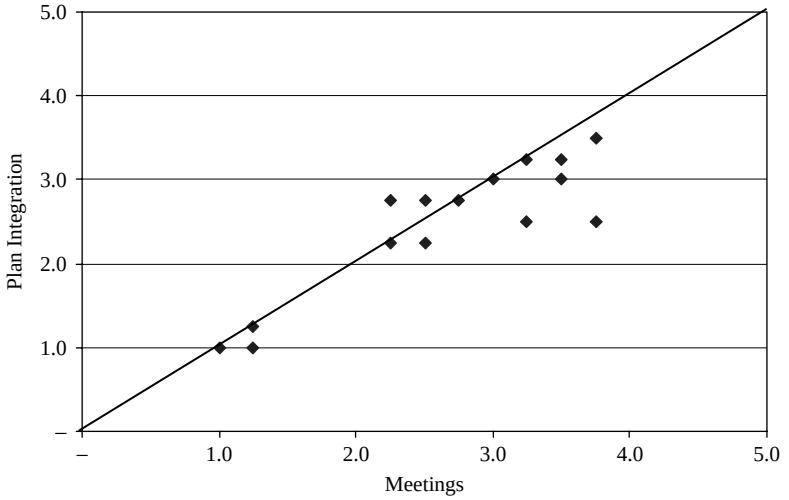


**Figure 7.**
Plan integration vs meetings

without one. In general, we can conclude that a suitable organizational structure appears to be an enabler for plan integration.

The relationship between S&OP meetings and plan integration seems stronger. In fact, such meetings appear to be enablers at all but two companies (Figure 7). These two outliers, like in the previous case, were small firms or divisions where the S&OP role was performed by a single manager. Again, no executive S&OP meetings were necessary. Nevertheless, the stronger evidence supports the role of these meetings in plan integration. Trying to achieve S&OP integration at a larger firm without such meetings in place would be very difficult because of the large number of the product lines and the number of people affected by the plans. In fact, we strongly recommend

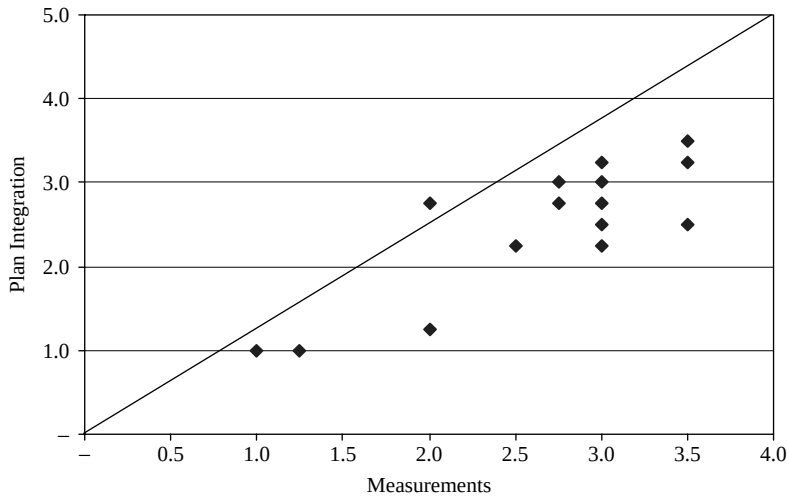


**Figure 8.**
Plan integration vs measurements

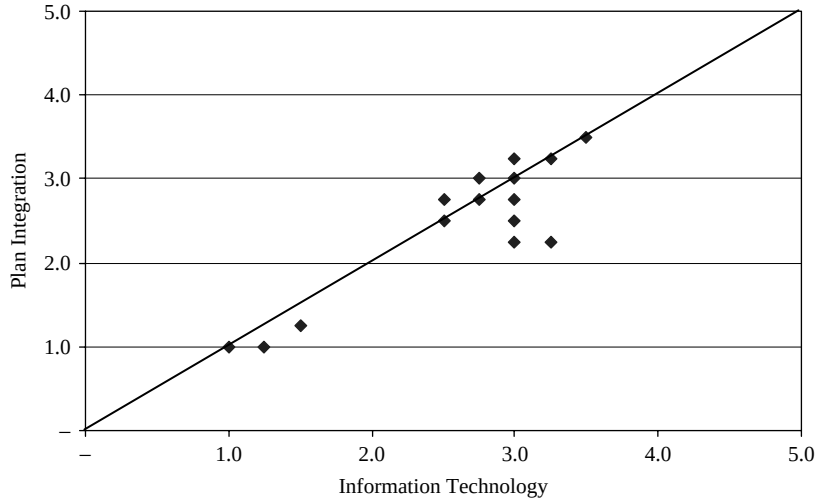


**Figure 9.**
Plan integration vs information technology

that smaller firms, which are successfully relying on a single person to integrate plans, put in place S&OP meetings as they grow. Otherwise, the process will certainly become overwhelming and will break down.

Use of measurements, as shown in Figure 8, likewise appears to be a very strong enabler of plan integration, as would be expected. Recall that these measurements include those specific to finance, sales and operations, as well as those related to the effectiveness of the S&OP process. Clearly, if a company does not know how it is performing in sales, operations and in the S&OP process, then it cannot achieve a high level of plan integration. In general, measures must be specific, clear and assigned to a person who will be accountable for the results. Measuring S&OP effectiveness will

require an S&OP owner, which has implications for the level of maturity on the organization process.

Together, meetings, organization, measurements appear to be enablers of S&OP plan integration. Our data are not sufficient to disentangle whether one is a stronger enabler than the others, or if they are all required. We will comment below on our conjectures in this regard.

Finally, Figure 9 shows that IT could be an enabler of plan integration, although we found it difficult to conclude clearly that it is so. More points of the graph hover on or close to the 45-degree line than in the other figures, which suggests that IT at most develops concurrently with plan integration. This may be good news indeed for managers who are tired of frequent claims that a new IT solution is the answer to all their problems. Of course, if an S&OP team is to make meaningful decisions, it must have good information on which to base them. In particular, in most environments to achieve Stage 5 plan integration, Stage 5 IT optimization tools most likely will be required. Yet, the presence of a particular S&OP workbench, or of other specified software, does not seem to be required for lower stages of S&OP maturity. Having the right business processes appears to be more important.

These results, while preliminary due to the sample size, are quite encouraging. They suggest, for instance, that for a firm to achieve significant gains in S&OP integration, it is not necessary to be large. Furthermore, it seems that integration is not dependent on the type of production process. What is required, however, is leadership. Managers cannot easily change production volumes, number of employees, or process type. But they can create an organization that facilitates integration.

Our results, coupled with experience and intuition, suggest that managers should begin implementation with an S&OP organization – put leaders and teams in place; then set up regular meetings and incentives/measurements associated with the teams. Finally, they should provide resources for information tools that will support the team. Team leaders most often come from the operations or supply chain organizations, although some come from sales. In every case, representatives from sales, operations and finance should be regularly involved. Some effective S&OP teams meet monthly, many meet weekly, and a few meet daily, if only by phone. As noted above, the frequency of the meetings is dependent on how dynamic the market and production environments are. Measurements should be assigned an owner who will be accountable for results. We have found it helpful for managers to list the measures they currently use, and then to consider if any should be added or eliminated, specifically questioning whether the measurements will drive the desired behavior. It is critical to keep the goal in mind – not additional meetings, not new organizational structures or teams, and not new software. Rather, the goal is integration of sales and operations plans, with a growing ability to share information, constraints, and opportunities between finance, sales and operations. Ultimately, the goal is to optimize profit, and the fundamental driver is leadership.

## Conclusions and future research

In the paper we reviewed the literature on S&OP and described the results of a series of interviews with a wide array of companies. As a result of these investigations, we developed a framework for S&OP integration that is based on five key dimensions. These dimensions are composed of business processes – meetings and collaboration, organizational structure and performance measurements, and information processes –

information technology and plan integration. The framework proposes five stages of S&OP maturity, and we rated each of the companies we interviewed according to the framework's stages. Subsequent use of the framework with many managers in our consulting and executive education experiences suggest that this level of detail is very helpful for assessing S&OP maturity. Furthermore, we encountered many managers who were very enthusiastic about the possibilities of profit optimization.

We then developed several conjectures for advancing in S&OP maturity. We discovered that there is no apparent link between S&OP maturity and either firm size or its location on the product-process matrix. Our preliminary results indicate that the business processes are enablers of S&OP plan integration, but that information technology is not clearly so, at least for Stages 1 through 4. It is our hope that this framework will be used by managers to understand the level of S&OP maturity in their companies and to identify specific action steps for moving to a more advanced process. We have provided several recommendations in this regard.

Recent research into profit optimization models, and into the application of sophisticated revenue management tools to manufacturing, suggests that these models have not achieved the level of realism that will allow firms to reach Stage 5 in our framework. Nevertheless, this is an active area for academic research, as well as for software/consulting firms. Progress must move ahead on two fronts. First, firms must develop and deploy excellent leadership capabilities so that S&OP processes are in place and supported. Second, academics and software developers must pursue sophisticated and realistic models that can be employed by firms as they strive for real plan integration and profit optimization.

## Notes

1. "Profit maximization" may be a more appropriate term. However, "profit optimization" is more commonly used, particularly with recent software initiatives such as "Enterprise Profit Optimization (EPO)."
2. The literature on planning horizons is extensive and goes back many years. See for instance, Eppen *et al.* (1969), Hwang and Jaruphongsa (2006), Kunreuther and Morton (1973, 1974), Moon and Yun (1993), Sridharan *et al.* (1987), Blackburn and Kunreuther (1974), Lundin and Morton (1975) and Chapter 6 in Silver *et al.* (1998).
3. The reader will note the scarcity of academic articles on this topic. Most of the literature is found in practitioner journals.
4. S&OP can be found in service companies, but not as commonly. For this reason, we decided to focus on manufacturing companies.

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## Appendix. S&OP interview template

*Product questions*

(1) Please tell me about your products:
- How many product families within each segment?
- What are the typical product families?
- How many SKU's within each family?
- How many SKU's in your process – components, WIP, purchased items?

(2) How many customers do you have?

(3) Does the Pareto Principle apply to your products/customers?

(4) What types of markets:

- B2C, B2B?
- OEM, Tier 1?
- Retail? Wholesale? Both?
- Where would you place your shop on the product-process matrix? (Low, medium, high volume? Job shop, batch flow, assembly, continuous flow?)

*Process questions*

(1) Do you manufacture in house/is some outsourced/what is the split?
(2) How many steps are involved in a typical operation to make your product?
(3) How long is a typical production run?
(4) Do all products follow the same process?
(5) Is there a prescribed flow through the plant?
(6) Is this an assembly line, and if so, is it worker paced or line paced?

*S&OP questions*

(1) Please describe your process to forecast demand:
    - Bottoms up/top down/mixture?
    - Who is involved? What organizational levels?
    - Time frame: 3/6/12/18 month/other?
    - How long does it take to generate a forecast?
    - How often are forecasts generated and updated?
    - What tools do you use – spreadsheets/more sophisticated software?
    - Do you involve your customers?
(2) Please describe your process for supply or operations planning:
    - Who is involved – organization?
    - Are any of your suppliers involved?
    - What inputs do you use from demand forecasts?
    - Who sees the operations plans when complete – sales/marketing?
(3) Please describe how you integrate the demand and supply plans:
    - Do you have meetings with both supply and demand side personnel?
    - If so, how often?
    - Is there pre-work for each meeting?
    - Is there a formal process? Please describe.
    - What time frame does S&OP focus on?
    - 0-3 months
    - 3-6 months
    - 6-18 months
    - Combination of the above?
(4) What IT structure is used for demand, supply, and S&OP planning?
    - Spreadsheets – is there a single one or several? How many?
    - Is there specific software suite that you use (e.g. Manugistics)?

- Are the demand and supply side systems linked?
- ERP system? – SAP, etc.
- I-supply web site?
- Scenario simulation and analysis?

(5) What measurements do you use to evaluate S&OP effectiveness?
- Financial: cash flow, revenue, costs
- Managerial accounting: residual cash flow, IRR
- Operational: inventory turns, obsolescence, delivery performance, capacity utilization
- Marketing: accuracy of forecasts, variance to baseline
- New product introduction frequency & time to market, product churn
- How often are measurements taken?

(6) How do you respond to disruptions to your demand forecast?

(7) How do you respond to disruptions to operations?

(8) Do 6 & 7 lead to event driven S&OP or is it within the regular meetings?

(9) Meetings:
- Collaboration tools – video conference, physical presence, web tools?
- Customers? Suppliers?

(10) Organization:
- SOP coordinator? Full or part time? Who does he/she report to?
- SOP team – how many, full or part time, departments represented?
- Who from senior management is involved and how?

## About the authors

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