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Cross-Functional Alignment in Supply Chain Planning: A Case Study of Sales and Operations Planning

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Working Paper

07-001

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Abstract

In most organizations, supply chain planning is a cross-functional effort. Functional areas such as sales, marketing, finance, and operations traditionally specialize in portions of the planning activities, which results in conflicts over expectations, preferences, and priorities. We report findings from a detailed case analysis of a successful supply chain planning process. In contrast to traditional research on this area, which focuses on incentives, responsibilities, and structures, we adopt a *process* perspective and find that integration was achieved *despite* an incentive landscape that did not support it. By drawing a distinction between the incentive landscape and the planning process, we identify process as an additional mediator beyond the incentive landscape that can affect organizational outcomes. Thus, organizations may be capable of integration while different functions retain different incentives to maintain focus on their stakeholders' needs. Through iterative coding, we identified the requisite attributes of the planning process that drive planning performance—informational, procedural, and alignment quality— but hypothesize that achieving alignment in the execution of plans can be more important than informational and procedural quality. In addition to process attributes, we also identify social elements that influenced the performance of the planning process and place the information processing attributes within a broader social and organizational context.

Keywords: Operations interface, sales and operations planning, supply chain planning, case study.

1. Introduction

In most organizations, supply chain planning—the administration of supply-facing and demand-facing activities to minimize mismatches and thus create and capture value—is a cross-functional effort. In most cases, this means that each functional area, such as sales, marketing, finance, and operations, tends to specialize in its own portion of the planning activities. Such specialization is notorious for generating conflicts over differing expectations, preferences, and priorities with respect to how the matching of demand and supply should be accomplished (Shapiro, 1977). The reconciliation of these conflicts is generally referred to as *coordination*. Coordination in the operations management literatures generally assumes some agreement in the assessment of the firm's environment and on the options available for an organizational response: the challenge centers on the details of the organizational response. But supply chain planning requires something more: cross-functional collaboration to assess the state of the supply chain and the needs of the organization and then to determine an approach for creating and sustaining value based on that collaborative assessment. In other words, beyond coordination, organizations must define the problem, ascertain the options available for dealing with the problem, and create an agreeable solution with collaboration across differentiated functions. Such an approach usually involves detailed evaluations, planning, and execution at the strategic, operational, and tactical levels (Anthony, 1965). Both the operations management and organizational behavior literatures refer to this type of collaboration as *integration* (Barratt, 2004; Ellinger, 2000; Griffin and Hauser, 1996; Kahn, 1996; Kahn and Mentzer, 1998; Lawrence and Lorsch, 1986). With increased competition and globalization creating new opportunities and challenges for supply chain planning (Raman and Watson, 2004) and fostering further differentiation within the organization, it is clear that firms will struggle even more with supply chain integration as they attempt to manage and respond to the increasing complexity of markets, suppliers, and investors.

We expect this type of integration in supply chain planning in a highly differentiated organization to require quite a broad and explicit cross-functional reach. Although particular cross-functional interfaces have been developed—e.g., marketing and logistics (Ellinger, 2000; Stank, Daugherty, and Ellinger, 1999), and purchasing and manufacturing (Fawcett and Magnan, 2002)—very few organizations have achieved the

broader-reaching integration that consistently develops multi-functional plans that are executed in a coordinated fashion (Barratt, 2004; Fawcett and Magnan, 2002). While researchers have partially addressed the roles and infrastructure required for integration, most of their proposals result from attempts to address coordination (e.g., Celikbas, Shanthikumar, and Swaminathan, 1999; Chen, 2005; Porteus and Whang, 1991) or from organizational-level analysis across firms (e.g., Lawrence and Lorsch, 1986; O'Leary-Kelly and Flores, 2002). Furthermore, very little empirical research has been done on functioning integration approaches (Malhotra and Sharma, 2002) and a detailed understanding of interdepartmental integration based on micro-level data has yet to be established (Griffin and Hauser, 1996; Kahn, 1996; Kahn and Mentzer, 1998). Therefore, a comprehensive understanding of cross-functional integration is lacking in the literature (Pagell, 2004). Given the lack of detailed frameworks for cross-functional integration, we decided to use case-based research to explore how a functionally-differentiated organization could achieve such integration for supply chain planning.

We identified a highly differentiated organization with a successful supply chain planning process and used grounded theory development to identify the key drivers of successful cross-functional integration. As we mapped the incentive landscape, we found a typical collection of different incentives and orientations motivating the different functional groups. What was interesting about our case study site is that such an incentive landscape would typically generate misalignment in planning and execution—and so it had, until the firm implemented a new supply chain planning process. That process resulted in significantly improved performance *despite little change in the organizational incentive landscape*.

Since the locus of the intervention to improve planning performance in our research site was the creation of a new planning process, we adopted a *process* perspective—focusing on the sequence of activities that encodes an operational logic creating value within the organization—to make sense of our data. Through iterative coding, we identified the attributes of the planning process that drive planning performance. The constructs resulting from this analysis—informational, procedural, and alignment quality— share some characteristics with distinctions made in decision making and information-processing theories (Daft and Lengel, 1986; Galbraith, 1973; MacKenzie, 1984; Simon and Newell, 1972). In addition to process

attributes, we also identify social elements that influenced the performance of the planning process and place the information-processing attributes within a broader social and organizational context.

The rest of the paper is structured as follows: In Section 2, we review the relevant literature and provide motivation for our research. In Section 3, we describe our research site and methodology. In Section 4, we describe the supply chain planning process that was implemented at our research site, the organizational and structural changes that accompanied its implementation, and summarize the performance improvement resulting from the implementation. The analysis of the implemented process is presented in two stages. First, in Section 5, we identify the drivers of integration by exploring the process attributed that supported effective integration. Then, in Section 6, we locate the quality of the planning process within other behavioral dynamics that contribute to overall performance. We conclude (§7), by discussing the implications of our findings for practitioners and researchers interested in supply chain integration.

2. Literature Review

Most operations management research on coordination across supply chains and within organizations takes its cue from the economics literature, which explores coordination in terms of how incentives, information flows, and hierarchy affect the allocation of resources (see for example Cachon, 2003; Lariviere, 1999). This approach assumes target or optimal system objectives to which allocation decisions should be aligned. Lack of coordination occurs when decentralized decision makers have incomplete information or conflicting incentives. Much research concerns how actors should be compensated, given the informational and hierarchical structure (see Eliashberg and Steinberg, 1993; Sahin and Robinson, 2002; Whang, 1995, for surveys). Coordination mechanisms for internal alignment include accounting-based cost schemes (Celikbas et al., 1999; Porteus, 2000; Watson and Zheng, 2005), improved contract design (Chen, 2005; Gonik, 1978; Li and Atkins, 2002), decision making hierarchies such as first-movers (Kraiselburd and Watson, 2007; Li and Atkins, 2002), and internal markets (Kouvelis and Lariviere, 2000).

Many researchers, however, observe that only in theory would an incentive-compatible scheme or an information scheme induce the actors to implement system-wide optimal behavior (Chen, 1999; Porteus, 2000; Watson and Zheng, 2005). In practice, operations managers are limited by their decision making

capabilities and may commit errors in their replenishment decisions (see Croson, Donohue, Katok, and Sterman, 2005; Sterman, 1989, for evidence of poor replenishment decision-making performance even under conditions of reduced complexity). To address these limitations, the recommended coordination mechanisms are broadened to include better information-sharing among functional decision makers (Dougherty, 1992; Shapiro, 1977; Van Dierdonck and Miller, 1980), such as the use of enterprise information systems (Al-Mashari, Al-Mudimigh, and Zairi, 2003); assessment of the cognitive burden imposed by the evaluation and incentive systems (Kouvelis and Lariviere, 2000; Porteus, 2000; Watson and Zheng, 2005); support for complex decision making, whether from quantitative models (Yano and Gilbert, 2003) or decision-support systems (Crittenden, Gardiner, and Stam, 1993); and outsourcing planning to competent third parties (Troyer, Smith, Marshall, Yaniv, Tayur, Barkman, Kaya, and Liu, 2005).

Within the operations management literature, we find little attention paid to the process for coordination. Even when the above recommendations are considered to have some implications for the process dimension, they are usually only directionally suggestive, rather than appropriately prescriptive, with respect to process. So, while researchers have addressed some potential requirements for integration, most of their proposals result from attempts to address coordination. Furthermore, with very little empirical research done on functioning organizational or supply chain planning integration approaches (Malhotra and Sharma, 2002), a detailed understanding of interdepartmental integration based on micro-level data has yet to be established (Griffin and Hauser, 1996; Kahn, 1996; Kahn and Mentzer, 1998).

Within the organizational behavior literature, the focus on general integration within firms has a longer and better-established tradition, which more explicitly incorporates the behavioral dynamics of the key actors. Classic research suggests that the effort required to achieve integration increases with the level of differentiation in the organizational environment (Galbraith, 1977; Lawrence and Lorsch, 1986; Lorsch and Allen, 1973; Thompson, 1967), differentiation being defined as "differences in the cognitive and emotional orientation of managers in different functional departments" (Lawrence and Lorsch, 1986, p. 11). Differences amongst various functions' cognitive and emotional orientations—not only their goals and incentives but also their perspectives on time and relationships—create short-term conflicts and deemphasize long-term

organizational goals.

The organizational behavior research on integration has concentrated on the responsibilities and structures supporting integration. Here, "responsibilities" refers to the distribution of decision rights among participants in the collaborative effort. Lawrence and Lorsch (1986), for example, recommend for highly-differentiated settings the role of integrators for coordinating functional efforts. These integrators act as translators, mediators, and integrative goal-setters, helping guide the various functions, which have differing cognitive and emotional perspectives, into collective efforts (Brown and Duguid, 1991; Hargadon and Sutton, 1997; Orlikowski, Yates, Okamura, and Fujimoto, 1995; Yanow, 2000). "Structures," in this literature, refers to the accompanying formal (and social) systematic arrangements, relationships, and infrastructure that regulate the interaction among the participants in the collaboration effort. Examples of structural recommendations include the formation of work groups (Galbraith, 1977) and the use of boundary objects (Carlile, 2002; Star, 1989). This literature, however, also pays little attention to the process perspective. Even in the case of work groups or groups whose identities are conceivably based on what they do and how they interact, more attention is focused on the fact *that* they act and interact than on *how* they act and interact (Brown and Duguid, 2001).

In both the operations management and the organizational behavior literatures, therefore, process is one of the lesser-understood components of integration. For the organizational behavior literature, with its broad organizational overview, the lack of focus on this context- and operations-specific dimension is expected. Although processes are a touchstone of the operations management community, recommendations for coordination have favored quantitative modeling—the discipline's dominant research approach—with very little empirical research done on functioning supply chain planning integration approaches (Holweg and Pil, 2008; Malhotra and Sharma, 2002; Pagell, 2004).

2.1. A Process Perspective on Integration

By *process*, we mean a sequence and interdependency of activities designed to achieve a goal. Processes systematize and standardize certain organizational learning at the micro-level of particular decisions and actions—and reap the benefits of that learning—in ways that are not easily matched by approaches based on

responsibilities and structure or by contracting or market-based interventions (Cyert and March, 1963; Nelson and Winter, 1982). Thus, a process perspective could complement the macro-level focus of the approaches from the organizational behavior and operations management literatures. This complementarity could materialize in scenarios where all approaches, including the process approach, are directly supportive of integration. However, given process's potential intermediate position between, on one hand, the macro-level interventions explanations and, on the other, organizational performance, it could also act as a modifier of the effects of these macro-level interventions on performance.

Therefore, we expect that the process perspective can shed some much-needed light on the challenges of functional integration in supply chain planning and, in so doing, extend the focus in supply chain management from coordination to integration, which for many practitioners more closely represents the challenges they face. Our expectations have their precedent in the operations management literature and we are not the first to affirm a process perspective in this way. It is arguable that a focus on the effect of process on the integration of R&D and manufacturing in the new product development literature has revolutionized both the academic field and practice (Wheelwright and Clark, 1992). A focus on processes and their implications for organizational design has already been recommended in the information technology literature. Malone and Crowston (1994; 1999) emphasize the management of interdependencies among resources and activities and seek to develop a coordination theory by characterizing various kinds of interdependencies and identifying the mechanisms that can be used to manage them. That perspective does not, however, capture the traditional focus on the actors and their natural differentiation seen in the work of organizational theorists (e.g., Lawrence and Lorsch, 1986; Thompson, 1967).

The collaborative planning processes we examine in our case study are referred to in the practitioner literature as sales and operations planning (S&OP) processes (Bower, 2005; Lapide, 2004; 2005). Among the primary roles of S&OP processes is to facilitate master planning, demand planning, and the flow of information between them. Master planning is primarily concerned with the coordination of the supply side of the organization and seeks the most efficient way to fulfill demand forecasts over the medium term (Stadtler, 2005), facilitating finer levels of planning such as purchasing and materials requirements,

production, and distribution planning. Demand planning is concerned with the customer-facing side of the organization, predicting future demand from scheduled customer orders or extrapolating demand from prevailing market conditions or from the demand-influencing activities (e.g., promotions and new product launches) of the organization or its competitors. A basic S&OP process facilitates the transfer of information from demand planning to master planning. Practitioners and academics alike argue that this transfer process can move beyond the superficial synchronization of master and demand planning to sophisticated joint planning (Chen, Chen, and Leu, 2006; Lapide, 2005; Van Landeghem and Vanmaele, 2002).

The fact that little empirical micro-level data exists for supporting the development of a process perspective on supply chain planning sets the expectation that, at least initially, such a perspective should be based on empirical studies such as ours. Furthermore, processes such as the S&OP process, which are the objects of ongoing research speculation on their potential integrative capabilities but are also practitioner-inspired, make good candidates for empirical observation and analysis. Finally, given that the organizational behavior literature possesses a richer and longer tradition of focus on integration than does the operations management literature, there is also an expectation that the process perspective may need to draw on theory from both disciplines.

3. Research Methodology

Our research site, Leitax (the firm's real name has been disguised), is a consumer electronics firm with headquarters in northern California and with a global sales presence. Leitax sells primarily through retailers such as Best Buy and Target and has distribution centers in North America, Europe, and the Far East. Production is handled by contract manufacturers with plants in Asia and Latin America. Leitax maintains seven to nine models in its product portfolio, each of which has multiple SKUs. Product life ranges from fifteen to nine months and is getting shorter.

Three different reasons make this site interesting from a research perspective. Prior to the implementation of the S&OP process, Leitax faced challenges in cross-functional integration which seem quite common to supply chain planning across a wide range of industries with an active sales force driving demand (Shapiro, 1977). In addition, the S&OP process is an increasingly common approach for managing

supply chain planning (Chen *et al*., 2006; Lapide, 2005; Van Landeghem and Vanmaele, 2002). These two reasons make our research site a suitably *representative* case for a single case study (Yin, 1984). Finally, because Leitax implemented its S&OP process without changing its seemingly unsupportive incentive landscape, it provides an opportunity for unusual revelation about how process can foster integration given a seemingly hostile context; it is therefore a *critical* case, which also justifies the singe case study approach (Yin, 1984).

Our primary tool was intensive case study research (Eisenhardt, 1989; Yin, 1984). The research was retrospective; the primary initiative at Leitax, although still evolving, was already fully operational. Data were collected through 25 semi-structured, 45- to 90-minute interviews with leaders and participants from all the functional areas involved in the S&OP process, as well as with heads of other divisions affected by the process and with analysts. The intent of each interview was to understand the interviewee's role in the S&OP process and his or her perception of the process and to explore the orientations of the different actors and functional areas. To assess these orientations, we explicitly asked interviewees about their incentives, goals, internal work processes, and relationships to other actors and functional areas. We conducted most of the interviews in Leitax's northern California facility, but some follow-up interviews were conducted by telephone. Given the nature of the research, interviewees were not required to stay within the standard questions; an interviewee who seemed to be exploring a fruitful avenue was permitted to continue in that direction. All interviews were recorded. Several participants were subsequently contacted and asked to elaborate on issues they had raised or to clarify their comments. We triangulated each interviewee's responses with answers from other actors and used follow-up interviews to clarify differences. The interviews were supplemented with extensive reviews of archival data—such as worksheets and presentation slides that formed the bulk of the information shared between departments and the supply chain, financial performance data, annual reports, and written communications among the participants of the forecasting and planning process—and with direct observation of two planning and forecasting meetings.

In analyzing the data, we controlled for the effects of our a priori beliefs regarding integration in a variety of ways. Prior to categorizing or coding, we summarized our field notes in the form of a detailed case

study that relates the story of the initiative and its current challenges (**citation omitted**). This narrative was primarily detailed from one researcher's field notes; the other interviewer's notes were used for corroboration. The recorded interviews were used to help reconcile discrepancies. Finally, the company participants were asked to review the entire case, not only their own quotations, for accuracy.

We generated multiple hypotheses to explain the dramatic improvements brought about by the planning and forecasting process at Leitax. As a first approach, we focused on the elements driving the improvement of forecast accuracy. We found that a forecasting process, together with the supporting mechanisms for information exchange and elicitation of assumptions, was capable of managing the organizational conflict and the informational and procedural shortcomings that emerge from the biases of the functional areas (**citation omitted**). That analysis, however, did not make clear whether performance and forecast accuracy improved solely because the forecasting methodology had become more accurate or also because the whole organization was being more effectively managed through a coordinated integration effort. At that point, we went back to our data to explore the impact of the planning process. We first explored the role of information processing in the planning process, then broadened our perspective to include decision making, while maintaining a focus on the social and political dimension of the problem.

The purpose of our investigation was to try to explain why the implementation of the S&OP process provided benefits despite the maintenance of a seemingly unsupportive incentive landscape. We decided to compare the organization's planning dynamics before and after the implementation. First, we identified the factors influencing supply chain planning performance before and after. Then we determined the specific relationships between key constructs and supply chain planning performance.

For an initial coding, we used broad categories such as process, differentiation, infrastructure, roles/responsibilities, and integrative behavior. Given the exploratory nature of the research, initial constructs from the literature did not provide complete guidance. Our categorization therefore required multiple iterations as we attempted to be both parsimonious and complete. To minimize researcher bias, researchers alternated during data analysis between independently coding data based on categorizations and then jointly assessing the fit of the current categorization scheme and making refinements to the scheme. Within our

analysis of the planning process, three constructs related to process attributes—information quality, procedural quality, and alignment quality—emerged from our coding. We found not only that each of these attributes was the result of designed process characteristics, but also that the way participants engaged in the process played a significant role in the outcomes. In Section 6 we expand the scope of our inquiry to account for the drivers of this social engagement, using causal loop diagrams to structure our findings (Sterman, 2000).

4. Planning at Leitax

The following description of the planning process at Leitax was summarized from our interviews with participants in the process. The description first highlights the integration challenges prior to the implementation of the S&OP process. Complementing this description, we map the incentives or orientations that exist across different groups within the organization, which we refer to as the incentive landscape, and, given the tensions within this landscape, confirm the resulting potential for misalignment in planning and execution. We then describe the implemented process and contrast its alignment success with the incentive misalignment. The section concludes by reporting on the performance and social outcomes of the implemented process.

4.1. Background

Before 2001, the demand planning and master planning processes at Leitax were ill-defined. For new product introductions and midlife product replenishment, the sales group made forecasts that were informally disseminated to the operations and finance groups, sometimes via discussions in the hallways. These shared forecasts were to be used by the operations group to guide the supply chain and by the finance group to guide financial planning and monitoring. Traditionally, Leitax's sales directors forecasted *sell-in* sales, the expected sales from distribution centers to resellers. But sell-in sales tended to be a distorted signal of demand because the sales force had an incentive to influence sell-in in the short term and retailers had time-varying appetites for inventory. Not surprisingly, then, these sales forecasts were often mistrusted or second-guessed when they crossed into other functional areas. For example, the operations group often generated its own forecasts in order to minimize the risk of inventory shortages, its primary responsibility. Similarly, marketing would devise its own forecasts when that group suspected that the sales forecast had been

distorted by promotions. Sales, for its part, believed that finance exerted too much pressure on the forecasts; for example, by urging sales to increase forecasts that did not meet the company's financial goals. A manager in operations described the range of orientations as follows:

> From finance forecasting to financial plans that met their expectations "start with a revenue number and then lets see what kind of products can build to the number," passing through the sales and product planning forecasts, each with its own biases, to our own operations forecast that ignored any market information and just looked at past builds as the most stable and desirable forecast.

Leitax's demand planning process fell short in still other ways. It was not unusual for sales to arrange deals to extend the production of products for which an end-of-life decision had already been approved and the supply chain had been depleted. Data relevant to forecasting were usually inaccurate, incomplete, or unavailable and the lack of objectives and monitoring mechanisms for the demand planning process meant that process improvement could not be managed. Support for supply management was equally ill-defined, as master production schedules were sporadic and unreliable and suppliers had learned to mistrust them.

This inefficiency and lack of coordination, previously hidden by booming growth in the consumer electronics sector, caught up with Leitax in 2001 when poor planning and execution resulted in an inventory charge of roughly 15% of revenue for FY 2001-2002. The inventory write-offs were followed by major changes during the fall of 2001, including the appointment of a new CEO and new vice-presidents for product development, product management, marketing, sales, and operations.

In December 2001, the new senior vice-president for global operations recruited a manager to head the newly created demand management organization (DMO) and charged him with improving the supply chain planning process. In April 2002, the DMO launched Project Redesign, with the goal of improving the accuracy of planning information and the speed with which information from one part of the organization was disseminated to other parts of the organization and to the supply chain. The DMO's initial idea, based on its leader's prior experience, was to solve Leitax's planning inefficiencies with sophisticated statistical forecasting techniques. However, the head of the DMO soon reassessed the situation at Leitax as follows:

> The truth was that the root of the problem was not a "classic" forecasting issue in that it was not about getting another perfect data stream; it really didn't matter. We already had a number of forecasts that functional areas were utilizing. … [the problem was that] there was no tie, no formal sales and operations planning process. There was no getting together to discuss "what are you guys building vs. what do you want vs. what is the financial target."

Instead, he expressed a guiding belief that the "buy-in" of different functional groups was critical to the improvement of demand planning; this gave rise to the planning process that was implemented.

In soliciting functional support for the proposed new forecasting/planning process, the DMO assured the different groups that their voices and perspectives would be *continually* heard. Although there already was general agreement that the forecasting process needed to be changed, the DMO took the time to acquaint each group with Leitax's forecast and inventory performance to date, emphasizing that the problem was not localized in a particular group. By the summer of 2003, a stable planning system was in place and Leitax had already enjoyed dramatic improvements in forecast accuracy and operational performance.

4.2. Incentive Landscape

The incentive landscape at Leitax prior to the implementation of the sales and operations planning process can be mapped by considering the cross-functional differences in objectives and orientation: short-term direct monetary incentives, long-term goals that naturally define functional purpose, and functional preferences for planning horizons and the handling of relationships (Lawrence and Lorsch, 1986).

The differences in functional objectives at Leitax are the traditional ones (Shapiro, 1977) and therefore support the generalizability of our findings. For example, sales people's commissions were based on sell-in, an incentive that biased the sales organization in favor of maintaining sufficient inventory to avoid stockouts. The operations group, accountable for avoiding shortages or excess inventory and for managing relationships with suppliers, wanted more measured, stable inventory levels. The operations group therefore preferred smoothed extrapolations from historical orders and was wary of what seemed to be enthusiastic sales projections. Similarly, differences in orientation with respect to time were the expected ones. Sales emphasized current sales opportunities while operations focused on medium- to long-term inventory and capacity planning requirements. Finally, differentiation in formality of structure was observed in terms of reporting relationships, criteria for rewards, and control procedures. Operations, for example, needed more established routines and specific details in order to communicate manufacturing requests to its contract manufacturers than sales needed in order to manage its sales accounts.

The initial situation at Leitax supports a distinction between the tensions identified in the incentive

landscape and the mediating effect of a particular planning process on how those tensions impact planning and execution. In particular, we argue that, before Project Redesign, the difficulties in integration resulting from different functional incentives were exacerbated by the weaknesses of Leitax's former planning process. For example, having the sales force provide forecasts to the other functional groups was inherently ineffective because it was a one-way transfer of information with little formal procedure for reconciliation. But its ineffectiveness was exacerbated by the fact that forecasts communicated by the sales group were sometimes inaccurate or at least mistrusted, not only because of the known biasing effect of sales' incentives, but also because of insufficient motivation to generate more accurate forecasts, a faulty forecasting process, and haphazard changes to end-of-life and product introduction schedules. A history of poor demand and supply planning fostered complacency in the preparation of the sales force's forecasts; it often didn't seem worth the extra effort to try to be more accurate. Faulty forecast process features included (a) forecasting capacity shortages instead of unconstrained demand and (b) little mitigation of subjective and quantitative biases. Beyond forecasting, planning requests to contract manufacturers were infrequent, which limited the forecasts' utility as long-term guides for capacity planning/positioning. In short, the incentive landscape naturally encouraged misalignment, but various features of the planning process amplified that negative effect.

From a conceptual perspective, Leitax had two options for addressing the integration problems that plagued it: Either reduce the level of incentive misalignment between the functions sufficiently to enable integration to be achieved through the existing planning process or else develop a new planning process that could effect better integration among the functions despite their functional misalignment. As mentioned above, much of the literature in supply chain planning focuses on reducing differentiation among organizational units through incentive alignment. But this approach has its limits. For managers, functional differentiation is a natural response to a limited span of surveillance that forces them to focus on only a portion of their total environment or the needs of only certain stakeholders. Losing this focus on legitimate stakeholders' needs could be detrimental to organizational performance. This partly justifies Leitax's decision to retain functional orientations—despite their inherent misalignment—and try to improve

integration by implementing changes in process, organizational structure, and reporting mechanisms.

4.3. Planning Process

In this section, we document the planning process introduced at Leitax, as well as the responsibilities and structures created to support it. We use a representation based on the construct of validation of plans that arose from our refinement of the categorization of the process features. This validation-based representation characterizes the cross-functional planning at Leitax as the simultaneous validation of an initial organizational plan by multiple functions and stakeholders, spurring its revision until it reaches a certain level of acceptance.

Each month, a forecasting group that included the sales directors and the VPs of marketing, product strategy, finance, and product management generated a consensus sales forecast that was used to drive all supply management, demand management, and related financial planning decisions. Ownership of the forecasting and planning process was assigned to the demand management organization (DMO), which was responsible for synthesizing the necessary data, managing the planning process, resolving conflicts, and creating and disseminating demand projections to keep pace with worldwide operations.

Before describing the S&OP process in detail, we provide an overview (see Figure 1). The first step was the cross-functional preparation and dissemination of a planning-related information package known as the business assumptions package (BAP). The BAP contained the core details of the product offering and promotions plan: decisions on product offerings, launch and end-of-life dates for each product line, price offerings, promotions, and details of business deals with customers. The BAP was followed by careful validation of the product offering and promotions plan via (1) functional forecasts; (2) a consensus forecast, which determined the potential demand based on the product offering and promotion decisions in the BAP; (3) financial validation, which revealed the financial attractiveness of the plan; and (4) operations (supply chain) validation, which revealed whether there was sufficient capacity to accommodate the demand. If there were capacity or financial concerns, the product offering and promotion decisions in the BAP were changed and the process of validation repeated. Additional planning, feedback, and learning were facilitated by deliberate interaction within the consensus forecasting meeting. We now describe each of these activities in

detail.

Information Collection and Product Offering Planning: The Business Assumptions Package

The BAP integrated (1) the plan for product offerings (price plans, new product introduction dates, and end-of-life dates) and promotions and (2) information reflecting the market environment, such as marketing strategies and intelligence about market trends and competitors' products. Each month, the entire BAP was updated, discussed, and agreed upon by the forecasting group. The product planning and strategy (PPS), marketing, and DMO groups used the market information to assess the market's impact on future business performance and entered their recommendations (explicitly labeled as such) into the BAP.

Validation: Functional Forecasts

Once the BAP was agreed upon, it was used as a starting point to elaborate three different forecasts at the product-family level with a focus on *sell-through* (the quantities sold by resellers). These three forecasts were the work of separate functional areas:

Product planning and strategy (PPS). This three-person group supported all aspects of the product life cycle from launch to end-of-life, assessed competitive products and the effects of price changes on demand, and prepared a *top-down* forecast of anticipated global demand for Leitax products. The PPS forecast derived product- and region-specific forecasts from the worldwide estimate of Leitax's product demand and from historical and current trends in market share.

Sales directors (SDs). Leitax's five SDs used a *bottom-up* approach to generate their forecast, aggregating their account managers' knowledge about channel holdings, current sales, and expected promotions with their own knowledge. Their forecast was first stated as a sell-in forecast, then translated into a sell-through forecast by maintaining a maximum level of channel inventory (inventory at downstream DCs and resellers) for each SKU.

Demand management organization. The DMO prepared a forecast of sell-through by region, entirely on the basis of *statistical inferences* from past sales. This was primarily intended to provide a reference point for the other two forecasts. If either of these forecasts deviated significantly from the DMO's statistical forecast, the responsible group was called upon to investigate and justify its assumptions.

These three functional forecasts ignored capacity constraints since it was common at Leitax at this time

for forecasts to be affected by perceptions of present and future supply chain capacity and thus to become self-fulfilling prophecies. For example, even if more manufacturing capacity were to become available in the future, deflated forecasts might have positioned insufficient quantities of raw materials and components.

Validation: Consensus Forecasts

The three groups' forecasts were submitted on Excel templates and merged into a proposed consensus forecast using a formulaic approach, devised by the DMO, which gave more weight to the SDs' bottom-up forecast in the short term and increased the weight of the PPS's top-down forecast as the consensus forecast went out to the future. Each month, the forecasting group evaluated the proposed consensus forecast and the three independent forecasts.

Whereas the early consensus meetings had sometimes consumed an entire day and had been characterized by heated discussions, by the fall of 2003 the meetings were lasting between two and four hours and conversations were cordial. The reasons and assumptions underlying diverging forecasts would be identified and discussed and the proposed consensus forecast revised by open conversation. When justified on the basis of the SDs' intimate knowledge of upcoming sales deals or prospects, bottom-up sales forecasts that were slightly higher than the PPS's or DMO's forecasts were often accepted. The finance group, although it did not submit a forecast, voiced opinions and concerns based on its understanding of the revenue potentials at stake. With little functional stake in the outcomes of the meetings, the PPS group tended to be vocal, objective, and unemotional about the forecasts and demand planning.

Validation: Financial and Operational Assessments

The final consensus forecast was sent to the finance department where, in conjunction with pricing and promotion information from the BAP, the forecast in units was converted into its revenue equivalent. Forecasted revenues were compared with the company's financial targets. If gaps were identified, the finance group would first ensure that the sales group was not underestimating a product's market potential. If revisions made at this point still did not result in satisfactory financial performance, the forecasting group would return to the BAP and, together with the marketing department, revise the pricing and promotion strategies to meet financial goals and analyst expectations. These gap-filling exercises, as they were called, usually occurred at the end of each quarter and could result in significant changes to the forecasts. The

approved forecast was released and used to generate the master production schedule (MPS).

Operations validation of the final consensus forecast was an ongoing affair. Over time, suppliers responded to the increasingly consistent and reliable MPSs by providing Leitax with more accurate information about the status of the supply chain and their commitments to produce orders. In addition, more reliable MPSs made the suppliers better prepared to meet expected demand. Capacity issues were also discussed in the consensus meetings. In essence, the operations feedback to the planning group synchronized the demand and supply plans and ensured compatibility between them.

Other Roles of the Consensus Meetings: Tactical Planning and Learning

Consensus forecasting meetings were also planning meetings. The forecasting group considered new product introductions and determined initial inventory for product launches. As a launch date drew near, the consensus forecasting meeting was used to report the expected inventory status at launch, revise regional requests, and seek consensus on regional allocations, taking into consideration any expected shortfalls.

Products to be discontinued in the current quarter were also discussed during the consensus forecasting meetings. Proposed drop dates were presented together with sales to date, predicted sales for the rest of the product's life cycle, and available inventory. Consensus was sought on how a product's end-of-life should be managed.

For ongoing products, sell-in and sell-through rates and channel inventory were analyzed and compared to expected sales. Finance aggregated channel inventory and sales data from resellers' weekly electronic data interchange (EDI) reports. Discrepancies between reported inventories and inventories calculated from sell-in and sell-through data were resolved and consensus sales forecasts were updated according to the latest information. Promotion and price-change decisions were also revised in light of these data.

Finally, the consensus forecasting meeting was a source of feedback on forecasting performance, particularly on biases exhibited by previous functional forecasts. The DMO, being responsible for forecast accuracy, continuously monitored the accuracy of all the forecast streams and used this information to improve its algorithms and heuristics and to help functional areas improve their forecasting processes. At one point, for example, the DMO presented evidence that sales forecasts tended to overestimate near-term sales

and underestimate long-term sales; the forecasting group used this information to better interpret and weight the sales forecasts and the SDs used this information to improve their forecasting processes.

4.4. Operating and Social Performance

By the fall of 2003, Leitax had attained dramatic improvements in forecasting accuracy. Three-months-ahead forecast accuracy (ABS[sales-forecast]/forecast) for sell-through (sell-in) had improved from 58% (49%) in the summer of 2002 to 88% (84%). (See **citation omitted** for a description of Leitax's efforts to improve forecast accuracy.) Better forecasts translated into greater operational effectiveness: Inventory turns increased from 12 the previous year to 26 in Q4 '03, average on-hand inventory decreased from $55 million to $23 million (see Figure 2), and on-time delivery improved from 35% of orders to 75% (see Figure 3). Excess and obsolescence costs decreased from an average of $3 million for fiscal years 2000-2002 to practically zero in fiscal year 2003.

We observed that all of the functions were actively engaged in each step of the process: information collection, validation, and general consensus meetings. In such a collaborative process, any function that takes a passive stance could see its goals overridden by the more active or vocal participants—a constant criticism of consensus approaches (Armstrong, 2001). In Leitax, however, we observed genuine *constructive engagement*—active involvement by all the participants in collecting, validating, and processing information and in voicing and defending their interpretations. Our observations of current meetings and the recollections shared during our interviews revealed that the "heat" and length of the early meetings was a valid measure of the active participation. Furthermore, the contrast between the orderliness of the meetings we observed and the "heat" and length of the early meetings described by our interviewees was generally attributed to an increase in trust in the process and not to any increase in apathy.

A final noteworthy result of this process was the level of agreement reached by the forecasting group and, through the members of the group, by all the functional areas involved in the process. Because of their involvement in and understanding of the process, participants reported a higher level of commitment and compliance to the resulting plans. In fact, during our analysis of the forecasting process, we found it difficult to determine whether the improvement in forecast accuracy was the result of better forecasting processes or

of better adherence to the agreed plans. While this question remains open, process participants and observers consistently reported that the implemented process had raised support for organizational plans to levels not previously seen at Leitax.

5. Analysis: Quality of the Planning Process

In this section, we present the results of our first analysis of the intervention at Leitax. Since the locus of the intervention to improve planning performance was the creation of a new planning process situated within a largely unchanged incentive landscape, this analysis focuses on the planning process. To explain the functionality of the planning process, we identify three constructs—informational quality, procedural quality, and alignment quality—and interpret them as attributes of the process. We provide evidence for our constructs by elucidating the process mechanisms that facilitated each feature. Observing the process through the lens of these constructs allowed us to explain the functionality of the planning process in general and, more specifically, how each function's engagement with the process had an impact on the effectiveness of the planning.

5.1. Attributes of the Planning Process

Recall that supply chain planning requires cross-functional collaboration to first, assess the state of the supply chain and the needs of the organization, and then determine and execute an approach for creating and sustaining value based on the assessment of the information, The first part of the planning process—assessment of current and desired state—relies on the information-processing capabilities of the organization, while the second part of the process—selection of plan and execution—relies on the decision making capabilities and the synchronization of activities within the organization. Evidence from our case study of Leitax implies that these information processing, decision making, and synchronization requirements in turn require three corresponding process attributes: information quality, planning procedural quality and alignment quality. These constructs are supported by *information processing* theory and *decision making* theory which are traditional approaches in the organizational behavior literature (see MacKenzie, 1984).

In the collaborative setting of supply chain planning, distributed and collective decision making within an organization are typically supported by some cross-functional assessment and sharing of relevant and appropriate information. In particular, cross-functionally communicated information, along with any private

information that a function or group of functions possesses, help to form the organization's assessment of constraints, objectives, and potential solutions (Simon and Newell, 1972), with each function processing or making inferences from this information in order to develop the plans it then executes (Ungson, Braunstein, and Hall, 1981). The coordination and guidance of this decision making across functions forms the core of organizational decision making. The execution of these plans, however, needs to be consistent (a) across functions, with all plans supporting the same organizational goals, and (b) across time, with all plans synchronized for full effectiveness. We now provide more precise definitions and justifications for our three process attributes.

An organization's decision making and information-processing needs are influenced by uncertainty and equivocality. Whereas uncertainty reflects an absence of information (Galbraith, 1973), equivocality reflects an absence of clarity even when there is information (Daft and Lengel, 1986). Many organizational decisions are characterized by noisy data that do not always lend themselves to straightforward interpretation or to application in a decision making process. In such circumstances, especially in the presence of equivocality, the quality of information and the quality of decision making cannot be taken for granted. By *informational quality* we mean the degree to which a process enables the information used for decision making to be appropriate, both in content and in form, for the decision maker and the decision. The quality of the input data, however, is not the only threat to the quality of decision making and of the resulting plans. Inconsistent decision making procedures or procedures subject to the cognitive and social limitations, influences, and idiosyncrasies of individuals and groups also pose a threat to the quality of decision making and of the resulting plans (e.g., Bowman, 1963; Sterman, 1989). By *procedural quality* we mean the degree to which a process continuously ensures that the rules of inference used to assess and validate information—and to make decisions within and across functions—are sound (March and Simon, 1993; Simon and Newell, 1972). Finally, the cross-functional nature of planning and execution implies that functional decisions and actions need to support organizational goals and synchronization through time, which we refer to as alignment (Daft and Lengel, 1986). By *alignment quality* we refer to the degree to which a process ensures that organizational and functional goas and supported and that resulting actions are synchronized (Bendoly and Jacobs, 2004;

Sahin and Robinson, 2002).

The constructs of informational quality and procedural quality lead us to recognize that information must not only be available to the decision maker but must also be appropriate, in both form and content, to the behavioral characteristics of the decision making process, characteristics that are affected by both the decision maker and the task. We recognize, for example, that not all organizational functions require the same information in order to make or be comfortable with a decision and that the same information may need to be presented differently to different functions. Similarly, the construct of alignment quality (a) sheds light on process characteristics that help achieve support for organizational goals and synchronicity and (b) forces a contrast with other dimensions through which alignment could be achieved. For example, at our case site, the incentive landscape was generally unsupportive of the alignment needs. However, process features that still managed to support synchronization in actions towards aggregate goals reveal an additional dimension, beyond the structural, that can be explored in order to broaden our understanding of alignment.

5.2. Ensuring Information Quality at Leitax

The forecasting group's emphasis on the business assumptions package (BAP)—the main instrument for collecting and aggregating data for the planning process—initially pointed us towards process information quality. It is interesting to note that the BAP was not initially part of the planning process and that early consensus meetings proved difficult to manage. Varying assumptions about product price changes and promotion schedules were a significant source of conflict, which strongly suggests that informational inefficiencies or poor informational quality were significant enough to hamper Leitax's integration efforts. It is also likely that these inefficiencies affected the quality (or the perception of the quality) of the functional forecasts and plans. Realizing that transparent business assumptions were crucial to the overall process, the DMO devoted considerable attention to developing and refining a package that summarized such information about Leitax's and its competitors' products.

The very contents of the BAP suggest that informational inefficiencies must have been a problem before Project Redesign. Functions were not always fully acquainted with the product offering and promotion plans they were expected to support or with competitors' actions and general market conditions; the BAP directly

addressed these inefficiencies. Explicit clarification of Leitax's product offerings and promotions plans was particularly important; without such information, the various functions had been like members of an orchestra unaware of which piece they were about to play. The BAP provided not only a common set of data, but also a common *interpretation* of the data (for example, the PPS's assessments of the threats posed by competitors' products), which helped create a common problem space for the functions.

The manner in which the BAP was generated also had a positive effect on integration efforts. Retaining functional orientations and incentives while requiring the functions to participate in a collaborative effort in which no particular function could keep relevant information to itself motivated the participants to become fully engaged. As mentioned before, during the BAP meetings we observed *constructive engagement* in that all of the functions were actively involved in developing and assessing the product offering and promotions plan. Constructive engagement, in turn, improved informational quality in two ways. First, constructive engagement led to more thorough information collection. As more functions became engaged in the BAP's development, the document included more of the necessary information that had previously been available only to a particular functional area. Norms discouraging private information and favoring cooperative interpretation of public information were established and reinforced. The second way in which constructive engagement affected informational quality was by compelling the individual functions to make their information not merely available but also accessible. Functional idiosyncrasies in the submission of data that hampered widespread dissemination of information were addressed, as were idiosyncrasies in the receipt and interpretation of the data.

The separate functional forecasts were also an important conduit for functional information that was not fully articulated in the BAP, either because it was too hard to explain or because the functional area was not aware that it was relevant. By using and challenging the functional forecasts, the forecasting group was able to obtain unshared information that previously might have only been visible to the functional area preparing the forecast; that is, the separate functional forecasts provided a second opportunity for this information to surface.

5.3. Ensuring Procedural Quality at Leitax

The quality of the plans is determined not only by the quality of the information used in the planning process, but also by the *procedural* quality of the planning process—the appropriateness of the perspectives and the soundness of the rules of inference and judgment used for developing and validating the plans. Procedural quality can suffer from awareness of different stakeholder needs, since incentives and priorities can bias the assessment of a plan's validity. Recognition of this dynamic leads the forecasting literature to argue, for example, for the separation of decision making from forecasting (Armstrong, 2001). We found that procedural quality was enhanced at Leitax by (a) mechanisms that promote overall soundness of individual inferences, and (b) explicit and extensive validation across the organization.

Leitax's S&OP process included specific mechanisms that promoted the *soundness of the rules of inference and judgment* that would be used to validate the information in the BAP and the resulting forecast. Mechanisms that promoted procedural quality in forecasting included the combination of multiple forecasts in the consensus forecasting process, a focus on sell-through instead of sell-in, forecasting at an aggregate level, and the use of statistical forecasts to spur discussion about the assumptions behind the forecasting. In the forecasting literature, it is well known that combining forecasts, even through simple averaging, can improve accuracy (Lawrence, Edmundson, and Oconnor, 1986). The emphasis on forecasting sell-through provided a reality check for sell-in forecasts and shifted the focus away from sales incentives that could compromise forecast accuracy. Mechanisms for promoting procedural quality in financial validation included using BAP data to convert the forecasts in units into their monetary equivalents. Mechanisms for promoting procedural quality in operations validation included publishing production requests to suppliers more frequently (see **citation omitted** for a full discussion on how the implemented process ensured higher forecast accuracy).

The S&OP process also included explicit and extensive validation *across the organization*, which in turn increased each function's awareness of—and therefore its responsiveness to—the important needs and perspectives of other functions' stakeholders. The separate and explicit validation steps ensured that function-specific concerns were given individualized attention so that they could be collectively planned for rather than being overemphasized by one function or underemphasized by the others. For example, feedback

from operations and finance validations directly prompted changes to the product offering and promotions plan in the BAP and then indirectly prompted changes in the forecasts, rather than inappropriately affecting the forecasts directly.

Constructive engagement in the validation steps of the S&OP process contributed to improvements in procedural quality. In the consensus forecasting meetings, the attending functions were actively engaged in reconciling differences in the forecasts generated by the sales force and the product planning group. By surfacing the private information (or private interpretations of public information) that motivated objections to the proposed consensus forecast, these discussions strengthened the procedural quality of the forecasting step. Open discussion of a particular function's forecasting logic served to filter out poor rules of inference. Constructive engagement, by its very nature, ensured that the concerns of different stakeholders were at least partially addressed.

5.4. Ensuring Alignment Quality at Leitax

Finally, we explore the process characteristics that improved Leitax's level of alignment—that is, support to organizational goals across functions and synchronicity of actions across time. With respect to aligning support towards organizational goals, we argue that, while the collaborative *nature* of Leitax's S&OP process sets the stage for alignment, it is the collaborative *engagement* that enables this alignment to be realized. Constructive engagement in validation required every function to focus on the product offering and promotions plan and stimulated increased alignment with it. Each function's allocation of resources to validate the plan helped create operational momentum for the plan and made the allocation of resources to (possibly disruptive) alternative plans less likely. The involvement of the individual functions in the validation of the product offering and promotions plan also resulted in a greater shared understanding of constraints, which translated into organizational plans that were easier for each function to execute and to align with. Because engagement increased the imprint of each function on the strategic plan, there was more explicit and collective ownership of the plan, which in turn resulted in alignment across functional plans. Finally, engagement encouraged participants to trust that the other participants would adhere to the plans, which promoted alignment.

With respect to synchronicity of actions, consensus meetings performed double duty as tactical planning meetings; participants not only reached a consensus forecast, but also discussed detailed aspects of events such as product introduction and end-of-life. Consensus meetings, beyond validation, ensured the coordination needed for execution, since they allowed for the timely dissemination of coordination signals to ensure the execution of plans for new or end-of-life products or for mid-product-life replenishment. The consensus meetings also gave participants constructive feedback on process performance by relating it to specific process changes or to deviations for which participants had been responsible. This reduced process deviations, either by promoting voluntary conformance or by demonstrating the need for additional constraining mechanisms. For example, feedback to the sales force revealed short- and long-term biases in its forecasting. If the sales force had accepted this feedback but been unable to mitigate its own bias, which was probably due to its short-term orientation, there would have been collective recognition that the process needed to be modified.

6. Analysis: Behavioral Dynamics

We have emphasized a process perspective on integration for supply chain planning, an approach that complements the existing focus on more macro-level interventions such as structure and responsibilities. From this process perspective, the quality of demand and supply planning can be roughly related to the quality of the information used, the quality of the inferences made from available data (e.g., forecasts and plans), and the organization's alignment—its conformance to and support of its own plans. In this section, we locate the quality of the planning process within other organizational behavioral dynamics that contribute to overall performance.

Empirical observations from the Leitax case study suggest that fulfillment of our three process criteria was encouraged despite an incentive landscape which did not seem to support it. To explain these observations, we drew a distinction between the degree of alignment reflected in the incentive landscape and the mediating effect of process characteristics on planning and execution. We found that the creators of Leitax's S&OP process were concerned with ensuring the consistency of information flows, the quality of the decision making, and the ability to transform decisions into actionable plans that all functional areas

would ultimately support because the plans not only satisfied organizational objectives but also, at minimum, respected functional goals and priorities. These characteristics match our three attributes for a successful planning process. By contrast, the planning process before the implementation of the S&OP process lacked many of these characteristics.

We also observed active participation, or *constructive engagement,* in the planning process by all the relevant functions and hypothesized that it supported the three information-processing attributes of the planning process, particularly alignment in the execution of plans. In fact, the benefits of constructive engagement at Leitax were numerous, including more complete and accessible information for the planning process, rules of inference that had been sharpened through debate, more accurate and validated forecasts, efficient and coordinated functional plans, and organizational plans that reflected the interests of the multiple stakeholders in the organization. Constructive engagement also opened the S&OP process itself to objective scrutiny and continuous improvement.

It is a key point that Leitax did not achieve this constructive engagement by reducing differentiation among the functional groups involved in demand and supply planning, but rather by retaining group differentiation and using it to empower the groups' constructive engagement in organizational planning while each group maintained a proper focus on its stakeholders' needs. The S&OP process was open, transparent, and participatory; it not only enabled all participants to influence outcomes, but motivated them to do so in order to have access to all the relevant information and agreed resolutions, and to serve their stakeholders' needs. It therefore explicitly confronted the conflicts between participants, rather than trying to smooth them over.

In addition to these two structural drivers of constructive engagement—misaligned incentives and an open transparent process—much of the reported motivation to engage in the process came from the perceived results of the planning process. As plans became more effective drivers of the firm's activity and achieved broader and more precise integration among functional areas and the firm's customers and suppliers, participants updated their perception of the planning process's quality (better informational, procedural, and alignment quality) and saw more and more reason to engage in it in order to influence organizational plans.

Figure 4 portrays the reinforcing structure of this virtuous cycle in which participant engagement yields better process quality and outcomes, which in turn motivate participants to engage in the process even more. Note that the initial drivers of participants' engagement are the lack of incentive alignment, which makes it more important for the participants to engage, and the openness and transparency of the process. Once the process is given an opportunity to show results, the positive outcomes pull participants into even greater engagement (Keating, Oliva, Repenning, Rockart, and Sterman, 1999; Shiba, Graham, and Walden, 1990)

Since Leitax did not attempt to align incentives, as some companies do, it is ironic that the incentive structure, which certainly did not seem to support integration, *indirectly* encouraged integration when mediated by the social and organizational dimensions of the new S&OP process. Open debate and explicit accommodation of conflicting functional goals moved the S&OP process from a coordination and information-sharing process (Dougherty, 1992) to a highly integrated collaborative process (Pinto, Pinto, and Prescott, 1993).

With respect to deliberate choices concerning design features of the process, both our evidence and feedback from members of the organization suggest an operational distinction between the benefits that would accrue from a logical and efficient information-processing algorithm—i.e., from informational and procedural quality—and the benefits that would accrue from organizational alignment supported by the organization's ability to engage participants. Specifically, it can be argued that a significant fraction of the reported benefits were less the result of informational and procedural quality than of the alignment resulting from an effective planning process. Alignment yielded two important benefits: First, as action plans gain in credibility, the organization's reputation and trustworthiness grows in the eyes of customers, suppliers, employees, and investors, giving it even greater leverage with which to execute its stated plans. Second, the ability to execute stated plans is the key to continuous improvement, because predictable processes are the first requirements for reliably interpreting historical data and making inferences for learning and improvement (Spear and Bowen, 1999). Thus, a lack of alignment can significantly compromise a process graced with informational and procedural quality, while alignment alone—even in pursuit of suboptimal targets—might reduce the level of uncertainty in an organization by virtue of the predictability and increased

potential for coordination it engenders (Daft and Lengel, 1986), Such reduction in uncertainty is particularly beneficial in organizations that exhibit a high degree of interdependence across functional groups.

Given the benefits of alignment and the resulting commitment to the developed plan, an organization might even be willing to sacrifice information accuracy or procedural efficiency in order to retain a process that delivers cross-functional alignment or conformance to plans. In fact, the DMO at Leitax had evidence that, for the second half of 2003, the statistical forecast was more accurate than the consensus forecast approved by the group. Although eliminating the consensus forecasting process would save the cost of the management time consumed in lengthy BAP and consensus forecast meetings, the DMO leadership was reluctant to streamline the process if it meant eliminating opportunities to engage participants through confrontation and validation of the forecast and resulting plan. And without a participatory process, a major forecasting error could subject even the statistical forecasts to the same skepticism to which the sales forecasts had been subject in the "bad old days" before Project Redesign. The value of organizational alignment revealed through this study thus suggests a new dimension in the design of coordinating/integrative planning systems that seek to go beyond simple information-sharing and coordination of action.

7. Discussion and Conclusions

The purpose of this case study is not to argue for a specific solution but rather to develop an explanation for an interesting observed phenomenon which seems to have implications for theory and practice (Yin, 1984). Still, it is fair to ask how much light this (or any) explanation can shed on a given set of problems. By characterizing the supply chain planning context as exhibiting functional differentiation and by characterizing Leitax's initial planning approach as being complicated by functional mistrust and poor inter-temporal coordination, our research potentially addresses a range of planning dysfunctions that may not always show up specifically as they did at Leitax, but may spring from similar causes. We believe—and conversations with management from diverse industries have confirmed—that these unhelpful dynamics are not only prevalent but persistent in industry.

Similarly, when we examine Leitax's S&OP process, we are not trying to generalize a solution, but

rather to generate an explanation of *why that particular process worked*. By drawing a distinction between the incentive landscape and the planning process, we conceptually recognize process as an additional mediator beyond the structural mechanisms and responsibility approaches of the extant supply chain and organizational behavior literatures. Recognizing a specific characteristic of this process approach—namely, constructive engagement and its relationship to the tensions in the incentive landscape—we provide a credible description of the mechanism by which a seemingly unsupportive incentive landscape can nevertheless indirectly support cross-functional integration in planning.

Through the synthesis of our observations on these relevant elements of the planning process, observations on Leitax's assimilation of the S&OP process and the priorities that emerged from it, and credible deductions linking the process approach to the success of the planning approach, we provide sufficient evidence for the following propositions concerning the management of cross-functional planning:

> *Proposition I: For organizational supply chain planning, changes in incentives are not the only solution for what appears to be incentive misalignment. In a highly differentiated organizational context, that is, a context susceptible to incentive misalignment, a process that promotes informational, procedural, and alignment quality can be an additional mediator in achieving integration.*
>
> *Proposition II: Constructive engagement can have a direct positive impact on the process attributes—i.e., informational, procedural, and alignment quality—and an indirect positive impact on cross-functional integration.*
>
> *Proposition III: The quality of the attributes and outcomes of a planning process can have a positive impact on participants' collaborative engagement in that process.*
>
> *Proposition IV: The pursuit of alignment in organizational planning can be more important than achieving particular levels of informational or procedural quality.*

Both the empirical and the theoretical grounding of our propositions suggest implications for practitioners and researchers. For practitioners, the Leitax case is, first of all, a proof-of-concept that an S&OP-based process can do more than simply coordinate information flow; it can fulfill both the information-processing requirements and the collaborative-assessment and problem-solving requirements of simultaneous demand and supply management. Furthermore, although the primary site for supply chain planning at Leitax was *within* the company, by retaining functional differentiation and the integrity of representation of stakeholders *external* to the organization—e.g., suppliers, customers and investors—the process can, in principle, support the planning processes that span organizations and have a more diverse

incentive landscape. In addition, a consensus planning system, with all its embedded advantages for buy-in and integration, was shown to be capable of making prompt and responsive planning adjustments in a dynamic and challenging supply chain environment. Finally, the details of Leitax's approach make it clear that it takes more than the implementation of an efficient information-sharing tool to achieve true integration. For supply chain management researchers, the Leitax case renews interest in the dimension of process—a touchstone for classic operations management researchers and a germane concept for organizational behavior researchers—as part of a solution to a problem that had been largely classified as structural. Particularly promising is the fact that process specifications play a mediating role between the incentive and structural choices currently proposed by the literature, and the firm performance. Finally, determining when our propositions hold remains an open research question, beyond the scope of a single case study. Addressing this question calls for a contingent analysis of the effectiveness of process approaches and for an assessment of the significance of the information-processing framework—informational quality, procedural quality, and alignment— and engagement dynamics in explaining organizational integration.

References

Al-Mashari, M., Al-Mudimigh, A., Zairi, M., 2003. Enterprise resource planning: A taxonomy of critical factors. European Journal of Operational Research 146 (2), 352-364.

Anthony, R.N., 1965. Planning and Control System: A Framework for Analysis. Harvard Business School Press, Boston.

Armstrong, J.S. (ed.), 2001. Principles of Forecasting: A Handbook for Researchers and Practitioners. Kluwer Academic Publisher, Boston.

Barratt, M., 2004. Understanding the meaning of collaboration in the supply chain. Supply Chain Management: An International Journal 9 (1), 30-42.

Bendoly, E., Jacobs, F.R., 2004. ERP architectural/operational alignment for order-processing performance. International Journal of Operations & Production Management 24 (1), 99-117.

Bower, P., 2005. 12 most common threats to sales and operations planning process. The Journal of Business Forecasting Methods & Systems 24 (3), 4.

Bowman, E.H., 1963. Consistency and optimality in managerial decision making. Management Science 9 (2), 310-321.

Brown, J.S., Duguid, P., 1991. Organizational learning and communities-of-practice: Toward a unified view of working, learning and innovation. Organization Science 2 (1), 40-57.

Brown, J.S., Duguid, P., 2001. Knowledge and organization: A social-practice perspective. Organization Science 12 (2), 198-213.

Cachon, G.P., 2003. Supply chain coordination with contracts. In: A.G. de Kok and S.C. Graves (Eds), Supply Chain Management: Design, Coordination and Operation. North Holland, Amsterdam, pp. 229-340.

Carlile, P.R., 2002. A pragmatic view of knowledge and boundaries: Boundary objects in new product development. Organization Science 13 (4), 442-455.

Celikbas, M., Shanthikumar, J.G., Swaminathan, J.M., 1999. Coordinating production quantities and demand forecasts through penalty schemes. IIE Transactions 31 (9), 851-864.

Chen, F., 2005. Salesforce incentives, market information and production/inventory planning. Management Science 51 (1), 60-75.

Chen, F.G., 1999. Decentralized supply chains subject to information delays. Management Science 45 (8), 1076-1090.

Chen, J.M., Chen, L.T., Leu, J.D., 2006. Developing optimization models for cross-functional decision-making: Integrating marketing and production planning. OR Spectrum 28 (2), 223-240.

Crittenden, V.L., Gardiner, L.R., Stam, A., 1993. Reducing conflict between marketing and manufacturing. Industrial Marketing Management 22 (4), 299-309.

Croson, R., Donohue, K., Katok, E., Sterman, J.D., 2005. Order stability in supply chains: Coordination risk and the role of coordination stock. Sloan School of Management Working Paper.

Cyert, R.M., March, J.G., 1963. A Behavioral Theory of the Firm. Prentice-Hall, Upper Saddle River, NJ.

Daft, R.L., Lengel, R.H., 1986. Organizational information requirements, media richness and structural design. Management Science 32 (5), 554-571.

Dougherty, D., 1992. Interpretive barriers to successful product innovation in large firms. Organization Science 3 (2), 179-202.

Eisenhardt, K.M., 1989. Building theories from case study research. Academy of Management Review 14 (4), 532-550.

Eliashberg, J., Steinberg, R., 1993. Marketing-production joint decision making. In: J. Eliashberg and G.L. Lilien (Eds), Handbooks in Operations Research and Management Science, 5: Marketing. Elsevier Science, Amsterdam, pp. 827-880.

Ellinger, A.E., 2000. Improving marketing/logistics cross-functional collaboration in the supply chain. Industrial Marketing Management 29 (1), 85-96.

Fawcett, S.E., Magnan, G.M., 2002. The rhetoric and reality of supply chain integration. International Journal of Physical Distribution and Logistics Management 32 (5), 339-361.

Galbraith, J.R., 1973. Designing Complex Organizations. Addison-Wesley, Reading, MA.

Galbraith, J.R., 1977. Organization Design. Addison-Wesley, Reading, MA.

Gonik, J., 1978. Tie salesmen's bonuses to their forecasts. Harvard Business Review 56 (3), 116-123.

Griffin, A., Hauser, J.R., 1996. Integrating R&D and marketing: A review and analysis of the literature. Journal of Product Innovation Management 13 (3), 191-215.

Hargadon, A., Sutton, R., 1997. Technology brokering and innovation in a product development firm. Administrative Science Quarterly 42 (4), 716-749.

Holweg, M., Pil, F.K., 2008. Theoretical perspectives on the coordination of supply chains. Journal of Operations Management 26, 389-406.

Kahn, K.B., 1996. Interdepartmental integration: A definition and implications for product development performance. Journal of Product Innovation Management 13 (2), 137-151.

Kahn, K.B., Mentzer, J.T., 1998. Marketing's integration with other departments. Journal of Business Research 42 (1), 53-62.

Keating, E.K., Oliva, R., Repenning, N., Rockart, S.F., Sterman, J.D., 1999. Overcoming the improvement paradox. European Management Journal 17 (2), 120-134.

Kouvelis, P., Lariviere, M.A., 2000. Decentralizing cross-functional decisions: Coordination through internal markets. Management Science 46 (8), 1049-1058.

Kraiselburd, S., Watson, N. 2007. Alignment in cross-functional and cross-firm supply chain planning: Harvard Business School Working Paper #07-058.

Lapide, L., 2004. Sales and operations planning Part I: The process. The Journal of Business Forecasting Methods & Systems 23 (3), 17-19.

Lapide, L., 2005. An S&OP maturity model. Journal of Business Forecasting 24 (3), 15-20.

Lariviere, M.A., 1999. Supply chain contracting and coorination with stochastic demand. In: S. Tayur, R. Ganeshan, *et al*. (Eds), Quantitative Models for Supply Chain Management. Kluwer Academic Publishers, Boston, pp. 233-268.

Lawrence, M.J., Edmundson, R.H., Oconnor, M.J., 1986. The accuracy of combining judgmental and statistical forecasts. Management Science 32 (12), 1521-1532.

Lawrence, P.R., Lorsch, J.W., 1986. Organization and Environment: Managing Differentiation and Integration. Harvard Business School Press, Boston.

Li, Q., Atkins, D., 2002. Coordinating replenishment and pricing in a firm. Manufacturing & Service Operations Management 4 (4), 241-257.

Lorsch, J.W., Allen, S.I., 1973. Managing Diversity and Interdependence: An Organizational Study of Multidivisional Firms. Harvard Business School Press, Boston.

MacKenzie, K.D., 1984. Organizational structures as the primal information system. In: S.K. Chang (Ed), Management of Office Information Systems. Plenum, New York, pp. 27-46.

Malhotra, M.K., Sharma, S., 2002. Spanning the continuum between marketing and operations. Journal of Operations Management 20 (3), 209-219.

Malone, T.W., Crowston, K., 1994. The interdisciplinary study of coordination. ACM Computing Surveys 26 (1), 87-119.

Malone, T.W., Crowston, K., Lee, J., Pentland, B., Dellarocas, C., Wyner, G., Quimby, J., Osborn, C.S., Bernstein, A., Herman, G., Klein, M., O'Donnell, E., 1999. Tools for inventing organizations: Toward a handbook of organizational processes. Management Science 45 (3), 425-443.

March, J., Simon, H., 1993. Organizations. Blackwell, Cambridge, MA.

Nelson, R., Winter, S., 1982. An Evolutionary Theory of Economic Change. Harvard University Press, Cambridge, MA.

O'Leary-Kelly, S.W., Flores, B.E., 2002. The integration of manufacturing and marketing/sales decisions: Impact on organizational performance. Journal of Operations Management 20 (3), 221-240.

Orlikowski, W.J., Yates, J., Okamura, K., Fujimoto, M., 1995. Shaping electronic communication: The metastructuring of technology in the context of use. Organization Science 6 (4), 423-444.

Pagell, M., 2004. Understanding the factors that enable and inhibit the inegration of operations, purchasing and logistics. Journal of Operations Management 22 (5), 459-487.

Pinto, M.B., Pinto, J.K., Prescott, J.E., 1993. Antecedents and consequences of project team cross-functional cooperation. Management Science 39 (10), 1281-1297.

Porteus, E.L., 2000. Responsibility tokens in supply chain management. Manufacturing & Service Operations Management 2 (2), 203-219.

Porteus, E.L., Whang, S., 1991. On manufacturing/marketing incentives. Management Science 37 (9), 1166-1181.

Raman, A., Watson, N., 2004. Managing global supply chains. In: J.A. Quelch and R. Deshpandé (Eds), The Global Market: Developing a Strategy to Manage across Borders. Jossey-Bass, San Francisco, CA, pp. 263-287.

Sahin, F., Robinson, E.P., 2002. Flow coordination and information sharing in supply chains: Review, implications, and directions for future research. Decision Sciences 33 (4), 505-536.

Shapiro, B.P., 1977. Can marketing and manufacturing co-exist? Harvard Business Review 55 (5), 104-114.

Shiba, S., Graham, A., Walden, D., 1990. A New American TQM: Four practical Revolutions in Management. Productivity Press, Portland, OR.

Simon, H.A., Newell, A., 1972. Human Problem Solving. Prentice-Hall, Englewood Cliffs, NJ.

Spear, S., Bowen, H.K., 1999. Decoding the DNA of the Toyota Production System. Harvard Business Review 77 (5), 96-106.

Stadtler, H., 2005. Supply chain management and advanced planning—basics, overview and challenges. European Journal of Operational Research 163 (3), 575-588.

Stank, T.P., Daugherty, P.J., Ellinger, A.E., 1999. Marketing/logistics interaction and firm performance. International Journal of Logistics Management 10 (1), 11-24.

Star, S.L., 1989. The structure of ill-structured solutions: Boundary objects and heterogeneous distributed problem solving. In: M.N. Huhn and L. Gasser (Eds), Distributed Artificial Intelligence, Vol. 2. Morgan Kaufman, Menlo Park, CA, pp. 37-54.

Sterman, J.D., 1989. Modeling managerial behavior: Misperception of feedback in a dynamic decision making environment. Management Science 35 (3), 321-339.

Sterman, J.D., 2000. Business Dynamics. Irwin McGraw-Hill, Boston.

Thompson, J.D., 1967. Organizations in Action. McGraw-Hill, New York.

Troyer, L., Smith, J., Marshall, S., Yaniv, E., Tayur, S., Barkman, M., Kaya, A., Liu, Y., 2005. Improving asset management and order fulfillment at Deere & Company's C&CE division. Interfaces 35 (1), 76-87.

Ungson, G.R., Braunstein, D.N., Hall, P.D., 1981. Managerial information processing: A research review. Administrative Science Quarterly 26, 116-134.

Van Dierdonck, R., Miller, J.G., 1980. Designing production planning and control systems. Journal of Operations Management 1 (1), 37-46.

Van Landeghem, H., Vanmaele, H., 2002. Robust planning: A new paradigm for demand chain planning. Journal of Operations Management 20 (6), 769-783.

Watson, N., Zheng, Y.-S., 2005. Decentralized serial supply chains subject to order delays and information distortion: Exploiting real time sales data. Manufacturing & Service Operations Management 7 (2), 152-168.

Whang, S., 1995. Coordination in operations: A taxonomy. Journal of Operations Management 12 (3-4), 413-422.

Wheelwright, S.C., Clark, K.B., 1992. Revolutionizing Product Development. Wiley, New York.

Yano, C.A., Gilbert, S.M., 2003. Coordinated pricing and production/procurement decision: A review. In: A.K. Chakravarty and J. Eliashberg (Eds), Managing Business Interfaces: Marketing, Engineering, and Manufacturing Perspectives. Springer, New York, pp. 65-104.

Yanow, D., 2000. Seeing organizational learning: A "cultural" view. Organization 7 (2), 247-268.

Yin, R., 1984. Case Study Research. Sage, Beverly Hills, CA.

Figure 1. Sales and Operations Planning Process

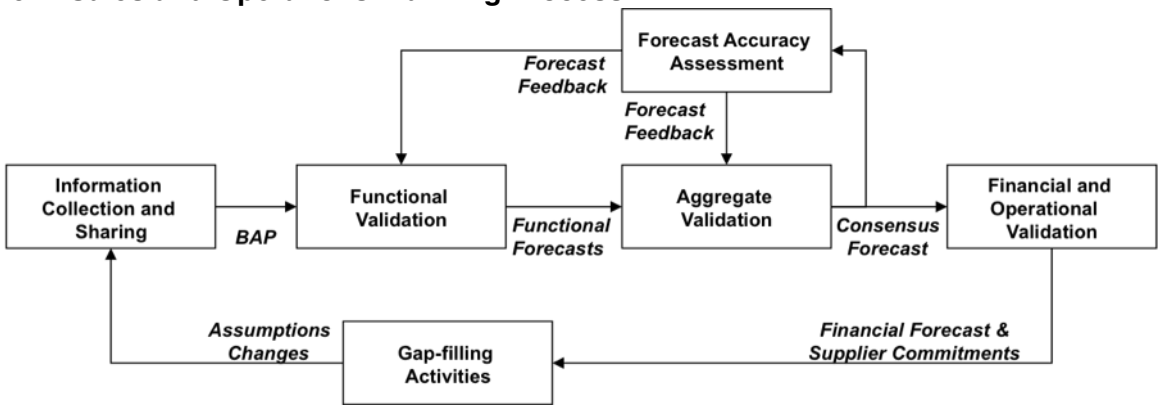

Figure 2. Inventory Turns Performance

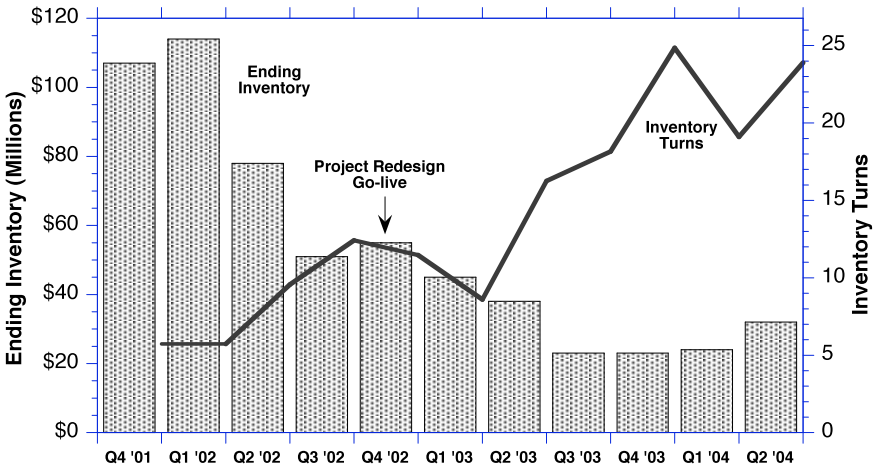

Figure 3. On-time Delivery Performance

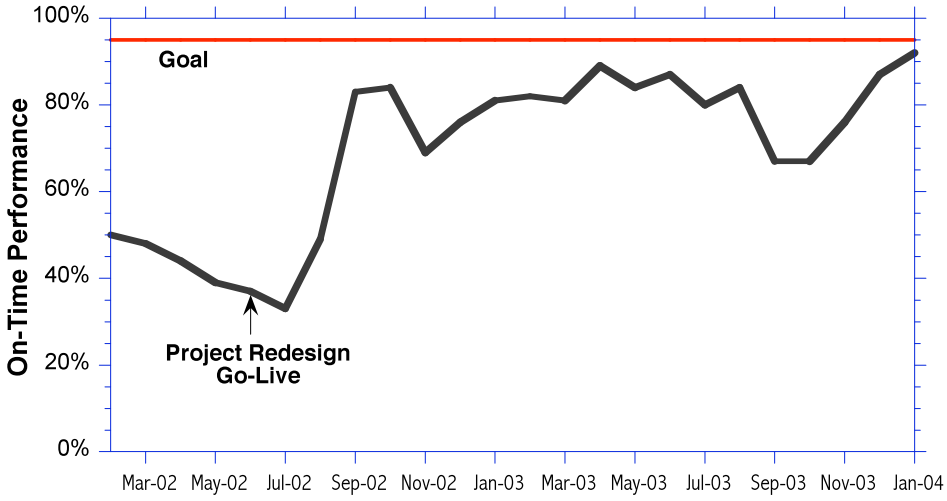

Figure 4. Structural Determinants of Planning Process Quality and Outcomes