

Supply-Chain Synchronization: Lessons from Hyundai Motor Company

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One of the challenges of supply-chain management is developing ways to effectively integrate activities across organizations on the supply chain. Hyundai Motor Company developed mechanisms to coordinate production planning and scheduling activities among supply-chain members. Hyundai Motor's production-and-sales-control (P/SC) department uses regularly scheduled cross-functional meetings and scheduling policies to coordinate supply-chain activities. When implementing this process, the P/SC department overcame structural, environmental, and behavioral problems. Although Hyundai management concedes that the process is not perfect, communication among supply-chain members has improved, and the P/SC group has successfully promoted mutual understanding and respect among functional areas. The primary benefit, ultimately, is improved customer satisfaction through better integration of functional activities.

During the last decade, many firms dramatically improved their internal operations, their product quality, their responsiveness, and their efficiency, and reduced their costs by following the pre-

cepts of such philosophies as total quality management, process reengineering, and just-in-time production. However, managers still face increasing competitive pressures to continuously improve. Orga-

nizations seek to enhance their competitiveness by exploring the concept of supply-chain management (SCM).

The supply chain typically includes many organizations, starting from raw-materials suppliers and including component suppliers, subassemblers, final assembler, the distribution channel, and ending with the consumers [Billington 1994; Davis 1993; Ellram 1991; Hammel and Kopczak 1993; Jones and Riley 1985; Lee and Billington 1993]. SCM focuses on managing the flow of materials and information within the supply chain to make it more responsive to customer needs while lowering its total costs. Supply-chain managers try to coordinate and integrate the diverse activities of supply-chain members to synchronize these flows.

Although achieving synchronization is important, attaining it within the supply chain is an arduous task. In fact, many managers find it difficult to synchronize the activities of the functional groups within their own organizations [Rho, Hahm, and Yu 1994; Souder 1981]. Synchronization across organizational boundaries is likely to be even more difficult. For example, Fraser [1997, p. 76] stated that "what we see in our work shows that synchronization is almost non-existent in supply chains, and quite rare even within single companies."

Although practicing managers and researchers accept supply-chain management as an increasingly important concept, few have presented empirical evidence of how companies actually organize their processes to manage their supply chains. We focus on one aspect of SCM at Hyundai Motor Company: syn-

chronizing supply-chain activities in planning production. While not the only approach available for achieving integration within the supply chain, the approach Hyundai selected involves a centralized coordinating group.

Supply-Chain Management

Because SCM is an emerging concept, the definition of what supply-chain management encompasses is still fluid [Ross 1996]. In discussing SCM, some authors focus on materials management, the control of material flows and inventory levels across the supply chain [Billington 1994; Davis 1993; Jones and Riley 1985; Lee and Billington 1993]. Others focus on purchasing, the activities needed to design, build, and maintain a network of capable suppliers [Hines 1994]. Still others concentrate on logistics, exploring such issues as carrier relationships and transportation [Carter and Ferrin 1995].

Although their emphasis may differ, most researchers agree that SCM concerns diverse activities that were formerly considered the realms of separate functional groups, such as marketing, engineering, production, purchasing, distribution, and logistics (Figure 1). With SCM, the perspective must shift from functional specialization to horizontal integration of all functional activities across organizations in the supply chain.

With functional specialization, each function is expected to perform specific value-adding activities required to achieve organizational goals. However, such specialization leads to differences in goals and in interpersonal relationships [Lawrence and Lorsch 1967]. Such differences can create barriers to the coordina-

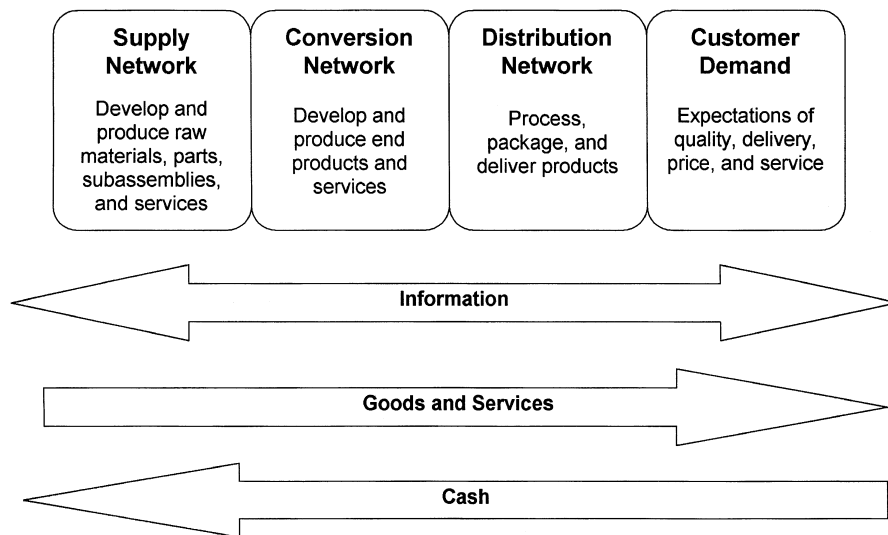


Figure 1: The supply chain encompasses all the activities that are needed to meet the customer demand, from raw-materials acquisition in the supply network, to production in the conversion network, to packaging and delivery by the distribution network.

tion of activities among functional areas [St. John and Hall 1991; Shapiro 1977].

SCM extends functional integration beyond organizational boundaries to include such external organizations as distributors and suppliers. The competitive strength of a product in the marketplace is determined by the combined capabilities of all members of the supply-chain team rather than by the manufacturing company's capabilities alone. Their activities must be synchronized to achieve the maximum benefits.

Synchronization requires close coordination and timing among the different members of the supply chain, and that is a major problem for many companies [Fraser 1997; Gumaer 1997; Lee and Khumawala 1996]. In case studies of five companies, Lee and Khumawala [1996] found synchronization to be a problem and found five common causes of misalignment: (1) functional organizations are managed in-

dependently; (2) functional objectives often conflict; (3) information systems do not provide effective supply-chain information; (4) customer focus is lacking in the interior of the supply chain; and (5) the different needs of customers are not recognized within the supply chain.

Effective communication and coordination among all elements of the supply chain are essential. Fraser [1997] stated that four major factors characterize synchronized operations: (1) a consistent set of shared data; (2) a systemwide perspective; (3) rapid communication to all relevant parties; and (4) proactive response to events, changes, or exceptions. The elements of the supply chain should function as a unified competitive entity focused on responding quickly and efficiently to the changing requirements of the marketplace.

Although synchronization is an issue in all organizations, few industries offer as many challenges or opportunities for

supply-chain synchronization as the automotive industry. A typical supply chain in the automobile industry is made up of thousands of companies engaged in raw materials supply, parts manufacturing, subassembly, final assembly, and distribution. The automobile industry in the worldwide market is a highly competitive mature industry, and automobiles are mass-produced commodities manufactured with widely available standard technology. In this situation, traditional production and inventory theories recommend a make-to-stock production system that relies on a high level of finished-goods inventory for fast delivery.

However, the automobile industry has traditionally allowed customers to choose from different models, colors, and other options. This means that it must accommodate a large number of variations in vehicle specifications. The automobile industry's problem of simultaneously combining a large-volume-production requirement with a large variety of small-lot make-to-order requirements involving thousands of suppliers and dealers can be viewed as a massive supply-chain-synchronization problem.

In the automotive industry, differing functional objectives and an extremely complex supply chain impede synchronization. For instance, generally sales departments want to make many option packages available with short delivery times and competitive prices. Manufacturing frequently counters that increasing product variety means decreasing efficiency and quality and delivery performance. To further complicate the problem, automobile manufacturers often purchase

over 10,000 parts and subassemblies from outside suppliers. This means that they must coordinate information and activities among a huge number of domestic and foreign parts suppliers. In addition, many final manufacturers do not know the depth or configuration of the supply chain beyond the first- and second-tier linkages [Miyashyita and Russel 1994].

Hyundai Motor Company

Hyundai Motor Company was established in December 1967 as a part of the Hyundai Group, one of the largest business groups in Korea. Hyundai started its passenger-car production in 1968 by assembling imported knockdowns (parts and subassemblies) from Ford Motor Company. By 1975, Hyundai became the first Korean auto maker with integrated manufacturing facilities, and Korea became the 16th country in the world to produce its own model of automobile. Hyundai Motor now has production facilities in Korea and in 13 other countries with a total capacity of over 1.8 million cars annually, and it plans to open other manufacturing facilities in Korea and in other countries. The company produced around 1.3 million units per year for the last three years, making it one of the top 10 automobile companies in the world in terms of volume.

As is typical in the auto industry, the upstream portion of Hyundai's supply chain is very complex. Hyundai has approximately 400 first-tier suppliers, 2,500 second-tier suppliers, and an unknown number of third- or higher-tier suppliers. Although domestic sources in Korea account for the vast majority of the suppliers, Hyundai also relies on foreign sup-

pliers for some materials and parts.

The structure of the sales and distribution portion of the supply chain is different for Hyundai than for companies in the

Hyundai has approximately 400 first-tier suppliers, 2,500 second-tier suppliers, and an unknown number of third- or higher-tier suppliers.

US automotive industry. Hyundai's domestic distribution is handled by 700 sales offices owned by Hyundai Motor and by 200 independent dealers. These sales offices and dealers have demonstration models but carry no other inventory. Thus, customer orders in Korea are filled by delivery from inventory held at the plant or distribution centers, or by scheduled production. By holding limited finished-goods inventory at the plants or distribution centers, instead of at specific sales offices, Hyundai maintains the greatest flexibility to respond quickly to specific customer demands with low overall costs. Hyundai tries to make deliveries in seven days or less for domestic orders if the ordered model is in a popular color and has frequently ordered options. If the color and options requested are not frequently ordered ones, Hyundai promises delivery within 15 days.

The company also exports its automobiles to over 80 countries throughout the world. Hyundai's export market accounts for approximately 45 percent of total sales. The export items are shipped to destinations through regularly scheduled shipping lines. For export vehicles, the deliv-

ery lead time is 45 days.

One goal of Hyundai's sales and distribution system is to minimize finished goods inventory while maintaining competitive delivery lead times. Hyundai tries to keep no more than seven days worth of finished vehicles on hand. This inventory goal is very aggressive even compared to Japanese automotive companies. Typically, Hyundai tries to minimize its finished-goods inventory by delivering vehicles directly to customers as soon as they are completed. Hence, it must carefully coordinate and monitor customer-order promises, production schedules, and supplier deliveries.

Supply-Chain Coordination Issues at Hyundai Motor

All automotive companies must develop production schedules. Managing the conflicting goals of increasing product variety, reducing delivery lead times, and reducing costs is difficult. To address this problem, about 15 years ago, Hyundai Motor organized its production-and-sales-control (P/SC) department to mediate conflicts between manufacturing, the domestic and export sales departments, and the domestic and foreign purchasing departments. Hyundai decided to use a centralized approach to achieving coordination because most of its manufacturing facilities and related functional areas were located at Ulsan, Korea. This centralized location made it fairly easy for the new department to coordinate its efforts. This group faced five key issues: (1) synchronizing sales and plant capacity, (2) balancing requests from the domestic and export sales departments, (3) dealing with shortages and excesses of inventory due to schedule

changes, (4) coordinating new product introductions or part changes, and (5) synchronizing order-launching and delivery activities.

Synchronizing sales requirements and plant capacity is an important issue because production capacity and sales requirements do not match perfectly. For each model, production capacity tends to be fixed in the short run, yet sales fluctuate. The sales function wants to meet customer demands quickly and thus wants scheduling flexibility until the last possible moment. However, to increase efficiency and reduce costs, manufacturing, inventory control, purchasing, and suppliers typically prefer a smooth, stable production schedule.

Another issue faced by the P/SC department was balancing requests from the domestic and export sales departments. Frequently, domestic and export sales compete for the limited production capacity. One problem in accommodating requests is that domestic and export sales have different patterns of aggregate demand. Although the demand for specific models varies, the domestic aggregate demand for vehicles tends to be quite stable. The export demand tends to be lumpy because of shipping schedules. Meeting these different demands with limited production capacity in a cost-effective manner is difficult.

A third issue was shortages and excesses of inventory due to schedule changes. Changing a production schedule can cause shortages and excesses of inventory. In addition, schedule changes can cause a ripple effect upstream in the supply chain. For example, when planners schedule pro-

duction of more cars of a certain model than initially planned, the plant may run short of parts for those models, while carrying excess inventory of affected parts for the models whose schedules were reduced. The suppliers may also experience a shortage or excess of materials or parts because of the change. Therefore, supplying accurate information promptly is critical.

Coordinating new product introductions or part changes was another issue faced by the group. Coordinating engineering changes and new model introductions are

Sales offices and dealers have demonstration models but carry no other inventory.

two of the most difficult challenges a supply-chain manager may face. Product-design changes affect the entire supply chain. Downstream, sales and distribution must phase out the inventory of the existing model and switch over to selling the new models when new models are introduced. Upstream, suppliers must change their production processes and carefully coordinate the phase out of parts and sub-assemblies while preparing to produce new parts and subassemblies required by design changes.

Synchronizing order-launching and delivery activities was the fifth key issue. Hyundai, like other automobile companies, uses an order-launching and delivery-sequencing system to improve its production and inventory efficiency [Hahn, Watts, and Kim 1991]. About 28 percent of the purchased items are delivered by suppliers on at least a daily fre-

quency and in the sequence required for daily production. To accomplish this, supply-chain managers must coordinate their order-launching and delivery decisions with the production schedules to ensure that suppliers maintain the correct sequence. This approach requires good communication, rapid information flow, and stable production schedules.

Supply-Chain Synchronization During the Production-Planning Process

Hyundai's production-and-sales-control department synchronizes production-planning activities across facilities and functional areas. The P/SC department has final responsibility for the production schedules for all of Hyundai's domestic manufacturing facilities: the master production schedule (six-month production plan), daily production schedules for each month, and weekly production schedules. The interface among purchasing, production, and sales is especially critical during short-term planning. Thus, this process provides one illustration of the supply-chain management perspective at Hyundai Motor.

Hyundai's domestic sales offices carry no inventory of finished automobiles other than the display models. A typical customer visits one of these sales offices to buy an automobile. When a customer decides on a particular model, the salesperson uses a computerized information system that includes data on the available inventory at the plants and distribution centers to determine whether Hyundai can meet the order from finished-goods inventory. If the required model is available, the sales person gives the customer the delivery date for the vehicle. The vehicle is de-

livered to the distribution center (total of 15 centers) nearest the customer's home. The customer has the option of picking up the vehicle at the distribution center or having it delivered to his home for an extra charge. If the requested vehicle is not available from inventory, the salesperson checks the current production schedule to provide the customer with a delivery date, entering the customer-order information

Export demand tends to be lumpy because of shipping schedules.

into the computer system and transmitting it to the sales headquarters for data consolidation and analysis in real time. Hyundai tries to make deliveries in seven days or less for domestic orders if the ordered vehicle is in a popular color and has frequently ordered options. Otherwise, Hyundai promises delivery within 15 days.

Based on the accumulated customer orders and sales forecasts, the domestic sales department provides its requirements to the P/SC department. Similarly, the export sales department consolidates all export requests supported by letters of credit and transmits the consolidated export requirements to the P/SC department. The production-planning-and-control departments at the manufacturing plants provide the P/SC department with current information about available plant capacity by time period. The capacity situation changes because of such factors as maintenance schedules and planned overtime. Based on sales and capacity data, the P/SC department develops preliminary

plans to be reviewed by involved departments.

When the purchasing/materials department receives these preliminary production plans, it checks their feasibility in terms of parts and materials availability from suppliers. The purchasing/materials department works with suppliers to ensure that they can deliver the specified quantity of parts and materials on time. Earlier the department had given the suppliers estimates of its parts and materials requirements for the next several months. It then provides the suppliers with the final production plans for confirmation two weeks prior to actual production. All the suppliers are connected to Hyundai's value-added network, and communication about scheduling takes place through this electronic data interchange (EDI) system. If changes are necessary, the suppliers transmit the information to Hyundai for possible actions.

Based on the requirements provided by the domestic and export sales departments and available plant capacity information, the P/SC department develops all production schedules. The first production schedule developed by the department is the master production schedule. Many functional groups must exchange information and coordinate their efforts to come up with an acceptable master production schedule. The P/SC department's primary role in this process is to coordinate the various functions in the supply chain (Figure 2).

The master production schedule is developed in monthly time buckets on a six-month rolling horizon basis. The six-month planning horizon gives the

purchasing department and suppliers enough lead time to acquire necessary imported raw materials, parts, and knock-downs (subassemblies). Suppliers that need imported materials or parts get confirmed orders four to six months prior to the actual production date plus another two to three months of forecasted schedules. For parts manufactured domestically, suppliers get a one-month confirmed schedule plus one to three months of forecasted schedules.

Representatives from the sales, production planning, and materials departments typically hold a meeting between the 20th and 25th day of each month to develop the monthly master production schedules. The manager of the P/SC department chairs the meeting. Ten days prior to this meeting, the P/SC department asks the domestic and export sales departments to submit expected sales data. Based on this data, information on production capacity, and parts and materials availability information, the P/SC department develops a preliminary production schedule for discussion at the meeting, which it distributes in advance.

The day before the main meeting, the P/SC department holds a preliminary meeting to resolve the differences among departments by soliciting suggestions from all participants. Attending the meeting are 25 to 30 people—section managers of the involved functional areas or their staff members who develop the schedules or both. Any issues not resolved during the preliminary meeting are handled during the main meeting attended by senior executives from each functional area.

During this process, the participants

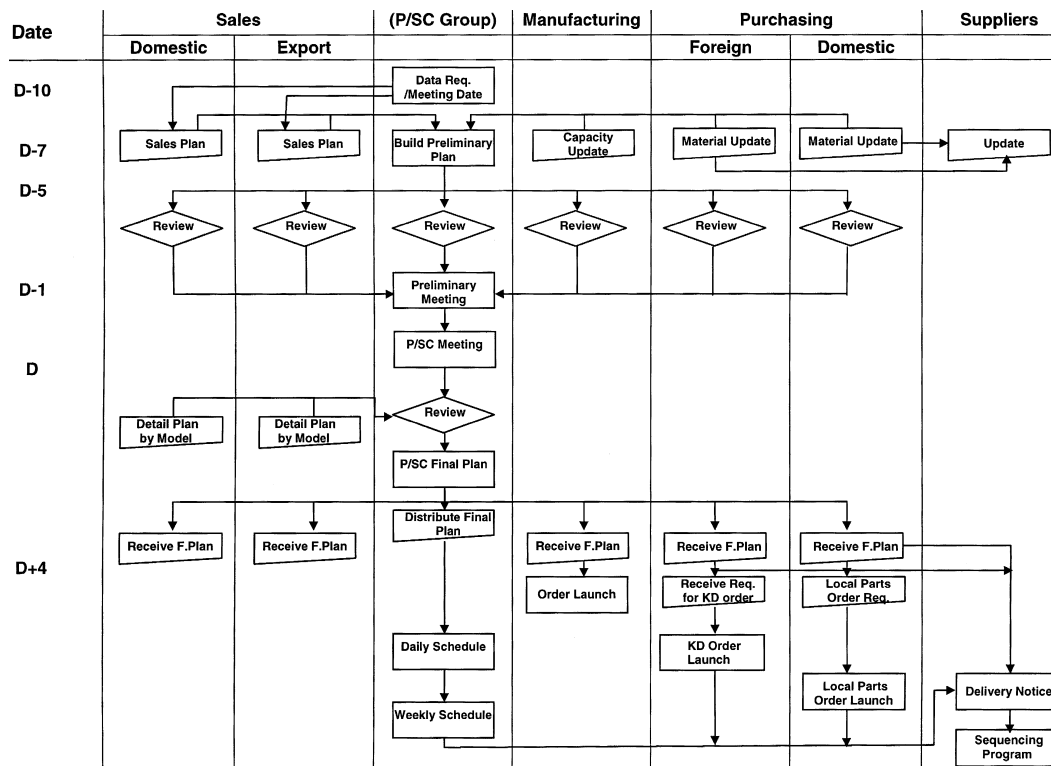


Figure 2: The P/SC group coordinates the efforts of sales, manufacturing, purchasing, and suppliers to develop an acceptable master production schedule. We summarize the activities of the various functional units and the complete process in this flow chart indicating the timing of activities in the date column, where D refers to the date of the production-and-sales-control meeting. For example, 10 days prior to the P/SC meeting (D-10), the P/SC department sends out an announcement of the meeting and requests sales data from the domestic and export sales departments.

confirm the next month's ($M - 1$) schedule and develop the following month's (M) schedule. For example, the March schedules are developed and agreed upon in January. Once the next production schedule (M month) is agreed upon, the P/SC department asks the sales areas to prepare a detailed breakdown of the monthly plan by model and trim level. Once this detailed plan has been accepted by the parties involved, the production schedule is finalized, and within five days, the P/SC department distributes it to all relevant parties for appropriate action.

Once it has the final master production schedule for period M , the P/SC department breaks it down further into weekly and daily production schedules by plant, model, trim level, engine type, and destination. It develops the weekly production schedules two weeks prior to the first production week. The first two weeks' portion of the schedule are considered firm, and the remaining two weeks are considered to be tentative. The department then drafts daily schedules for the finalized month, distributing them to the manufacturing, domestic-purchasing, and foreign-

materials areas for further comments. Following their review, it calls a monthly meeting to finalize the daily production schedules for the month.

Within two days of the meeting, the P/SC department distributes finalized daily production schedules to all involved departments for their actions. For example, the export-sales department develops its shipping schedule on the basis of the daily schedule, and the data-processing department prepares tables that compare planned performance to actual performance.

Based on the finalized weekly schedule, the data-processing department develops the daily assembly-sequence list, specifying the order of vehicles with exact options to be assembled each day. It also develops the supplier-delivery-notice list that is compatible with the daily-sequence list. For such items as seat assemblies, the sub-assembly lines and supplier-delivery sequences must be totally synchronized with the order of the vehicles on the sequence list so that the workers on the line do not

have to search for the right parts.

Responding to changes and informing all involved parties quickly are important aspects of supply-chain synchronization. The P/SC department updates monthly sales and production schedules (MPSs) at the regularly scheduled meetings or at specially called meetings. It calls special meetings when changes in the sales or manufacturing environment, such as a shift in demand or problems with a supplier, warrant adjustments to the master production schedule.

Any request for revision of the master production schedules must be made according to previously agreed upon policy guidelines (Table 1). The P/SC department considers such requests in light of availability of capacity and of domestic and foreign materials. The extent of possible changes increases for time periods further into the future since the tentative portion of the MPS permits more flexibility. These policy guidelines encourage give and take between marketing, manufacturing, and purchasing, while also recognizing the im-

Timing	Month	Total	Model	Color	Comments
		volume			
P/SC meeting (M - 2) 20-25th day of each month	M - 1	0%	10%	10%	Adjustments made during the regular P/SC meeting
	M	10%	20%	20%	
	M + 1	10%	30%	30%	
	M + 2	15%	30%	30%	
	M + 3	20%	30%	30%	
Thursday of each week (W - 1)	W	0%	0%	0%	Adjustments made during the weekly production schedule meeting
	W + 1	0%	0%	0%	
	W + 2	10%	30%	30%	
	W + 3	10%	30%	30%	

Table 1: Master production scheduling policy guidelines specify the timing and the extent of revisions for the total volume, the mix of models, and the color mix. In this table, M refers to the second month after the production-and-sales-control (P/SC) meeting month and W refers to the next week after the meeting time. Considering the total production volume, the month M is a time fence and M - 1 is a firm portion of the schedule.

part of schedule changes on suppliers.

Evaluation of the Process

The P/SC department ensures that all functions take an integrated-supply-chain perspective during the planning process. Hyundai management believes that the P/SC department has been effective in resolving conflicts and synchronizing activities among the sales, production, and purchasing areas. Also, although suppliers are not directly involved in the production-planning meetings, they are kept informed at various stages of the planning process through the value-added-network EDI system.

The P/SC department encountered structural, environmental, and behavioral problems. When first formed, the P/SC department encountered several structural problems. First, although the P/SC department was to coordinate production planning, authority and responsibility for the planning process were not well defined. Also, the newly formed department had no well-established policies and procedures or historical precedents to guide its actions. Moreover, although the P/SC staff members were expected to encourage cooperation, mediate conflicts, and solve problems, they had no formal training in these areas. These initial problems subsided as the department gained experience and developed formal policies and procedures.

Managing information flows, critical to supply-chain management, was another problem for the P/SC department. As is the case in many companies, Hyundai did not have a common database linking the different functional groups. Thus, initially the department had to manually gather

data from various sources and manually develop the production plans. The P/SC department also had to reconcile data from the different functional groups. Consequently, it allocated most of its staff resources to preparing the master production schedules, leaving very little time to focus on other issues.

Rapidly changing internal and external conditions also created coordination problems. For example, Hyundai's success in the North American market during the late 1980s was far beyond its initial expectation and put a heavy burden on production in terms of volume requirements and the frequency of schedule changes. Another example was an unexpected explosive growth of demand in Korea for a new model called Sonata during the early 1990s. The demand for the new model was so great that the delivery lead time to customers had to be extended to three to five months, a major concern for the sales department. These situations amplified the conflicts among different functional areas in the supply chain and forced the company to emphasize coordinating the entire chain.

The P/SC department also had to cope with several behavioral problems that affected the planning process. First, senior managers frequently changed the production plan that had been developed through the coordinated efforts of all involved parties during the preliminary meeting. These changes caused confusion and frustrated and demoralized the many participants in the process. In many cases, the changes were necessary because of rapidly changing environmental conditions or because of corporate-level policy

changes. However, the senior managers failed to communicate the reasons for the changes to the planning group in a timely manner.

Second, various area representatives often differed because of perceived performance expectations for their own areas. As the operating units translated the annual business plan into their own operating plans, they often emphasized different aspects to achieve the annual plan. Frequently, the difference in emphasis resulted in perceived differences in

The final decision was sometimes determined by force of personality.

performance expectations and affected operating-unit behavior. This was a classical example of the sub-optimization problem, and top management needed to address this issue since the P/SC department cannot change the operating plans or performance criteria of the operating units.

A third behavioral problem concerned task responsibility. To be effective, final production plans must be based on accurate planning data, such as sales forecasts, available capacity, and materials plans. The responsibility for developing and providing these data rests with the involved departments. However, as the representatives of the various areas developed the final plan through the process of compromise, some participants tried to make the P/SC meeting or department responsible for developing and providing the best data. This problem probably arose out of the participants' frustration when their best estimates were revised as part of the

compromising process. Closely related to this problem was that of departmental representatives concentrating on supporting their departmental positions. This meant that the final decision was sometimes determined by force of personality instead of logic.

As the number of automobile models offered and the number of plant facilities increase, coordinating many different interests becomes increasingly difficult and time consuming. For example, with 25 to 30 people attending a typical monthly P/SC meeting, coordinating such a large group is difficult. On one hand, broad participation is essential for the success of the planning process. On the other hand, the potential problems of managing a large group with a variety of interests need to be recognized. Thus, the synchronization of various links in the supply chain continues to evolve at Hyundai Motor Company.

Conclusion

Although Hyundai's decision to create a centralized P/SC department was based partially on the fact that most of its manufacturing facilities were located at the Ulsan complex, a centralized coordinating approach does not require geographical closeness of supply-chain members. For example, Magretta [1998] reported on the centralized approach used by Li and Fung, Hong Kong's largest export trading company, to synchronize activities within its geographically diverse supply chain.

The collaborative relationship between purchasing, manufacturing, and sales at Hyundai has evolved and continues to evolve over time. As it gained experience in working with a cross-functional team

effort through the P/SC department, it has refined and improved policies and procedures continuously. In general, Hyundai management has been pleased with the P/SC group's progress. As pointed out by one executive, "This arrangement has not been a perfect solution to the situation. However, the process was able to successfully resolve many of the conflicts among the areas." Moreover, through the planning process, participants have developed many new ideas and future strategies for coping with difficult problems. Thus, Hyundai continues to improve its ability to synchronize supply-chain activities.

Hyundai's experience can provide some general lessons for other organizations. The difficulties that the P/SC group encountered can help other companies to identify potential problems that they may face in managing their supply chains. Likewise, the successes the P/SC department achieved indicate the potential benefits that other companies may reasonably expect to gain. Through better communication and a cross-functional team effort, the P/SC group has successfully promoted mutual understanding and respect among functional areas. The primary benefit, ultimately, is improved customer satisfaction through better integration of functional activities. Thus, although the approach taken to achieve synchronization and the specific benefits and difficulties encountered may differ from situation to situation, Hyundai's experience illustrates how one organization is successfully integrating activities within the supply chain.

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Kwan Ho Ro, President, Hyundai, 140–2, Kye-Dong, Jongro-Ku, Seoul, Korea, writes: "The Hyundai Motor Company initiated the Production/Sales Control Meeting to resolve potential conflicts between Sales and Production functions and to better coordinate efforts to serve customers several years ago. Later, the program included Purchasing, Materials Control, and other impacted groups to synchronize the production planning, purchasing, and sales and distribution decisions. We have been generally happy with the results, and the program is still being used throughout the Hyundai Motor plants in order to come up with production and distribution plans. We have been cooperating with Dr. Hahn's group in terms of data collection and plant visits."