

OPRE 6366: Quiz 2 on 12/12/12

This is an open written/printed-material exam (any book, notes, lecture slides can be used). You **cannot** use a device with wired/wireless communication capability, so no laptops or phones are allowed during this exam. You may use a calculator although leaving quantities as fractions, additions or products is perfectly acceptable and preferable. **Do not forget** to define any variables you introduce. Good luck ...

NAME (please print): _____

Question	Out of	Points
1	20	
2	39	
3	22	
4	24	
Total	105	
Bonus	5	

1. Put **T** before a statement if you think that statement is true. Otherwise put **X**.
1. () Adding a supplier with a unique, flexible and valuable capability to the supply base unnecessarily enlarges the supply base and complicates the relations with the suppliers. **X**
- Others questions are removed.

2. Multiple Choice Questions:

1. A cell phone retailer has a flexible quantity contract to meet its demand D by ordering Q with parameters ($\alpha = 0.5$, $\beta = 0.5$). The retailer thinks that its weekly demand can be met by ordering $q = 200$ in every week. However, its demand turns out to be 75 in the first week and 175 in the second week. What are the orders the retailer can place according to the contract?
 - (a) Week 1: 75; Week 2: 175;
 - (b) Week 1: 100; Week 2: 175;
 - (c) Week 1: 75; Week 2: 300;
 - (d) Orders cannot be determined with the given information

Answer: b. Lower limit is $200(1-0.5)=100$, upper limit is $200(1+0.5)=300$. The retailer can place order only in the range of (100,300). 175 is already in the region but 75 is not.

2. When an anonymous Ford executives told this summer that the company would be switching out the steel body of its iconic F-150 pickup for an all-aluminum one beginning in 2014, many brand loyalists at the Ford Truck Enthusiasts forum were somewhat skeptical. Price was a concern, given that aluminum can cost as much as four times as much as steel. Others noted that aluminum is harder to repair, given that fewer body shops equipped to work with the metal: "It's not like you can just have a dent service repair it when you get a door ding or worse." And then there was the toughness factor, with many complaining that aluminum just doesn't evoke that same masculine/cowboy aesthetic: "I like my old steel pickup, I like the feeling of having heavy protection rather than feeling like a soda can on wheels." Ford would later call the executives' prediction "premature". Still, it prompted the question: Why would America's most popular pickup risk alienating its base? Because as the Ford execs noted, an aluminum body would shave 320 kilograms off of the truck's total weight-and the less weight the engine has to move, the less gas it will have to use. "Weight reduction", Ford's global chief of product development told, "is going to be a big part of our strategy". Which one of the following is exemplified by this forthcoming Ford policy?
 - (a) Environmentally responsible internal operations
 - (b) Environmentally friendly product design
 - (c) Environmentally friendly sourcing
 - (d) All of the above

Answer: b.

Others questions are removed.

3. **[Refurbished Game Consoles]** A game console company (**C**)¹ sells consoles to a market. The company buys new consoles from a supplier (**S**) to sell them in a market composed of users (**U**) and non-users (**N**). Non-users do not have consoles and they become users upon purchasing a console. Users have consoles and they become non-users upon returning/leaving their consoles for refurbishing at the company or throwing it to a dumpsite (**D**). When users return their consoles to the company, used consoles are refurbished to make them as good as new consoles. Users do not buy consoles before getting rid of their current consoles. When users get rid of their consoles, they become non-users and can buy a console but they cannot distinguish a refurbished console from others. This supply chain has S (supplier), C (company), U (users) and N (non-users) in the market and D (dumpsite).

[5P] a) Draw the console flows (such as new, used-but-refurbished and used-and-dumped) in the SCUND supply chain composed of nodes $\{S, C, U, N, D\}$.

ANSWER: In your figure you should have 5 nodes. The arcs and flows are as follows. $S \rightarrow C$: newFlow, $C \rightarrow N$: salesFlow, $U \rightarrow C$: refurbishedFlow, $U \rightarrow N$: dumpFlow. Note that there is no flow between U and N .

[4P] b) You can name some of the flows as newFlow, refurbishedFlow, salesFlow, dumpFlow and use other flows as necessary. Suppose that flows are computed daily so that we can express the console inventory at the company as:

$$\text{Inventory Today} = \text{Inventory Yesterday} + \text{newFlow Today} + \text{refurbishedFlow Today} - \text{salesFlow Today}.$$

Write similar expressions for the number of users and non-users, fill in the blanks below.

$$\text{UsersToday} = \text{UserYesterday}$$

$$\text{NonUsersToday} = \text{NonUsersYesterday}$$

ANSWER:

$$\text{UsersToday} = \text{UserYesterday} - \text{refurbishedFlow} - \text{dumpFlow} + \text{salesFlow}$$

$$\text{NonUsersToday} = \text{NonUsersYesterday} + \text{refurbishedFlow} + \text{dumpFlow} - \text{salesFlow}$$

[4P] c) What condition among flows is necessary to keep the number of users constant from yesterday to today? What condition among flows is necessary to keep the number of non-users constant from yesterday to today? What condition is necessary to keep the number of customers (users + non-users) constant from yesterday to today? Express these conditions as formulas by using some or all of =, +, -, *, /.

ANSWER: refurbishedFlow + dumpFlow = salesFlow maintains the number of users same. The same condition maintains the number of non-users same. Number of customers remain the same no matter what, so no condition is needed.

¹This question is inspired by Gamestop practices. Gamestop has \$9-10 Billion revenue and is headquartered in Grapevine, TX.

[3P] d) Reading the online product forums, the company customers started to be concerned about the quality of refurbished consoles. They have learnt to distinguish between new and used consoles by looking at the product serial numbers. Some customers buy refurbished consoles, while others buy new consoles. Modify the console flows in the supply chain.

ANSWER: In your figure you should have 6 nodes: $\{S, Cr, Cn, U, N, D\}$. Cr is the company inventory of the Refurbished consoles. Cn is the inventory of New consoles. The arcs and flows are as follows. $S \rightarrow Cn$: newFlow, $Cn \rightarrow N$: newsalesFlow, $Cr \rightarrow N$: refurbishedsalesFlow, $U \rightarrow Cr$: refurbishedFlow, $U \rightarrow N$: dumpFlow. Note that there is no flow between U and N .

[3P] e) The company empirically finds out that, among 400,000 users, 2% returned used consoles in each of the previous months without a financial incentive. Without a financial incentive, why would a non-user spend time and effort to return consoles to a company store rather than simply dumping them? Estimates also indicate 1,800,000 non-users in the market. To motivate more users to return consoles, the company starts to offer a company credit of \$40 for every returned console. This credit can be used to purchase new/refurbished consoles or other products from the company. As a result of company credit, 3% of users return a used console every month. What is the number of returned consoles in a month after the introduction of company credit?

ANSWER: Some consumers are conscious of the environment and they are willing to spend effort to return products because they recognize that returns reduce the consumption of virgin raw materials. $400,000 \times 0.03 = 12,000$ consoles are returned every month.

[3P] f) Suppose that 30,000 consoles are returned every month and refurbished to be sold to 1,800,000 non-users. But only 1% of non-users want to buy refurbished products. The company feels that a larger percentage than 1% should buy refurbished products to avoid excessive accumulation of refurbished console inventory at its stores. What should this percentage can be? Suggest a mechanism/policy to increase the percentage.

ANSWER: Percentage should be $1.667\% = 30,000/1,800,000$. To increase the percentage, the company can reduce the price of refurbished products or increase the warranty coverage of the refurbished products.

4. [**Sony Electronics**²] Sony was founded in 1946 by Masaru Ibuka and Akio Morita³. In the 1950s post-war Japan, Ibuka and Morita created Sony's first hardware device, the "G-Type" tape player/recorder, which relied on paper tape with hand-applied magnetic material. Throughout its history, Sony has demonstrated an ability to capture the imagination and enhance people's lives through technologically innovative products, including the transistor radio in 1955; the world's first color video-cassette recorder in 1971; the Walkman personal stereo in 1979; the first 8mm camcorder in 1985; and some organic light emitting diodes in the last decade. Today, Sony remains a global consumer entertainment company built around a vision of combining hardware, software, content, and services to provide the best customer experience in the new broadband network era.

The past decade has been a time of upheaval in the consumer electronics market. New technologies, new competitors, the recent global financial crisis, and the bankruptcy of the major U.S. retailer Circuit City are just some of the developments that continue to reshape the market. **To survive and succeed in this new environment, manufacturers need to focus on supply chain excellence and more effective collaboration with key retailer partners. That's the strategy Sony Electronics (SEL), the U.S. sales and distribution subsidiary of Japan's Sony Corporation, adopted in 2009.** As part of its response to changing market conditions, the electronics group has strengthened its planning and forecasting by implementing a sales and operations planning (S&OP) process⁴. S&OP involves sharing a "one number" plan among sales, finance, and supply chain organizations; holding regular meetings to align operations and strategy; and tracking agreed-upon key performance indicators. Implementing these principles, however, can be surprisingly difficult in the real world. It requires making cultural and organizational changes that cannot be accomplished overnight. Instead, successfully implementing S&OP is a "transformation" or "journey" that may easily span months or even years.

For Sony Electronics, the journey involved grafting S&OP principles onto its existing collaborative planning, forecasting, and replenishment (CPFR) process. By marrying the two, Sony hoped to achieve results that go beyond the traditional, short-term benefits typically realized from each process on its own. Here's how Sony accomplished this integration and improved its supply chain planning process to meet the new realities of the consumer electronics marketplace.

Shifts in the competitive landscape: Sony Corporation, with its **history of innovation**, has long held a leading position in the consumer electronics market worldwide. In mid-2009, **however, the company had to address shifts in the competitive landscape** in order to maintain its market position.

In the previous five years, the television industry had been revolutionized by flat-panel LCD (liquid crystal display) technology, a development that **opened the way for new competitors that specialized in execution, speed, and cost control rather than product innovation and quality**. Next, the "Lehman shock" in late 2008 caused a worldwide contraction of trade and credit that led manufacturers and retailers alike to intensively focus on cash flow and inventory. Then, the second-largest consumer electronics retailer in the United States, Circuit City, ceased its retail operations – an event that not only demanded Sony's immediate, tactical attention but also mandated a significant adjustment to its channel strategy. In this challenging environment, it was becoming clear to Sony executives that better supply chain management would be critical for maintaining the company's competitive edge in the future.

Sony reacted quickly to its most pressing supply chain issues at the global level. Executive Deputy President Yutaka Nakagawa reduced the number of parts and materials suppliers by more than 50 percent and targeted purchasing cost reductions of 20 percent in fiscal year 2010 through process improvements and rationalization of payment terms. Sony also divested manufacturing assets through alliances with contract manufacturers. However, these cost reduction initiatives were just the first step; the company also needed to find ways to collaborate more effectively with its key retail partners. It was at this point that Sony Electronics stepped to the forefront to lead the company on its journey to optimized supply chain performance.

²This question is based on "Sony Electronics' S&OP Journey" by Y. Kato, CSCMP's Supply Chain Quarterly, 2011 Quarter 1 issue. Y. Kato is in global supply chain operations for Sony Electronics.

³After Morita's first visit to the United States, he suggested to Ibuka that the company name be changed from Tokyo Tsushin Kogyo to one that was easier to pronounce and more recognizable. The new name, "Sony," was inspired by two words: sonus – the Latin root of words like "sound" and "sonic," and sonny, a word that had been adopted from English into Japanese in the 1950s to refer to sharp and energetic young men.

⁴S&OP is a process that provides management the ability to strategically direct its businesses to achieve competitive advantage on a continuous basis by integrating customer-focused marketing plans for new and existing products with the management of the supply chain. The process brings together all the plans for the business (sales, marketing, development, manufacturing, sourcing, and financial) into one integrated set of plans. It is performed at least once a month and is reviewed by the management team at an aggregate (product family) level. The process must reconcile all supply, demand, and new product plans at both the detail and aggregate level and tie to the business plan. It is the definitive statement of the company's plans for the near to intermediate term covering a horizon sufficient to plan for resources and to support the annual business planning process. Executed properly, the S&OP process links the strategic plans for the business with its execution, and reviews performance measures for continuous improvement.

Clarified roles and responsibilities: Sony Electronics was well-suited to the initiative because it already had certain characteristics and capabilities in place. For one thing, SEL had a good working relationship with its retailers, built on years of doing business together. For another, the division had established electronic data interchange (EDI) relationships with many of its retail partners and was even receiving store-level point-of-sale (POS) information from several of them. But SEL also had some problems to solve. For example, the division was not taking advantage of all of the data it was collecting. It seemed that no one had the time to sift through the massive files to identify useful information, let alone pass it on to people who might be able to act on that intelligence. Moreover, the supply chain planning and forecasting process, while thorough, tended to be tactical and reactive.

At the time, Sony Electronics was already engaged in CPFR with its major retail customers, but there were significant variations in how different groups executed the CPFR processes. For instance, the headquarters channel management team, a key voice in decisions about allocation of product and quantities for each retailer, did not consistently participate in the CPFR conference calls. Plus, there were no clearly defined rules for what data would be prepared and discussed during the calls. Without a preset agenda, participants might spend more time discussing the previous week's results than looking forward to the next quarter's forecast. Complicating matters was the fact that a large amount of manual work was required for Sony to consolidate the demand signal across all accounts in time to provide an accurate forecast to overseas suppliers. As a result, suppliers were working from a monthly plan instead of adjusting to week-by-week changes, a situation that sometimes created disconnects between supply and demand.

In order to bring consistency to these critical processes, Yuka Yu, vice president of supply chain operations at Sony Electronics, created a dedicated team to look at how to improve planning and forecasting. This cross-functional team included representatives from Sony's sales, business planning, channel management, and supply chain groups. Working together, the team redefined the existing CPFR review as a tightly managed weekly call with standardized metrics, such as weeks of inventory supply by channel and "order-to-commitment" achievement. (The latter compares the quantity Sony commits against customers' demand forecasts to those customers' actual orders.)

Additionally, the team clearly defined and assigned roles and responsibilities for the call, including designating some roles as "speaking" and some as "nonspeaking". This distinction kept the calls on track: The speaking roles were designated for those closest to the data (account sales team, demand planners, and channel managers), while the distraction of well meaning requests for explanation or investigation from less informed listeners was eliminated. (Their questions could be answered outside the meeting as needed.) The team even created and disseminated a standard operating procedure for the call to ensure that the process, roles, and rules of engagement were crystal-clear. Now, the right people were always in the room to hear the information firsthand and to make decisions appropriately there was no waiting for news to filter back to headquarters.

This initial step formalized the CPFR partnership and gave added focus to Sony's discussions with its retailers. **Where previously some categories focused primarily on "sell-in" quantities (the units sold by Sony to the retailer), now the emphasis shifted to "sell-through" quantities (the units sold by the retailer, a better measure of end-customer demand) and channel inventory as measured by weeks of supply based on the sales forecast.** These rules of engagement set clear expectations that both Sony and its customers would meet their respective commitments.

One plan, one number: With collaboration firmly established, the foundation for true sales and operations planning was in place. The next step was to extend the CPFR discussions to a deeper level of analysis and partnership. Accordingly, **Sony asked its retailer partners to communicate sell-in and sell-through forecasts for a longer planning horizon; in return, Sony shared future product and promotional plans more openly.**

In addition, the information exchanged during the CPFR call could now be fed into a new, common information platform. Stakeholders across multiple functional areas were now able to view and update the latest sales and forecast information. This **consolidated planning platform allowed Sony and its partners to create a consensus demand plan,** which in turn could feed the consolidated business-unit forecast - ultimately enabling SEL to generate the "one number" plan required for S&OP. SEL then shared this plan each week with the factory suppliers, who used it to develop production and shipment schedules.

Now that Sony had a consolidated business forecast that incorporated the latest customer demand and retail sales trends, the product groups could use it to make more strategic decisions about supply planning and allocation of products to sales channels. For example, if a particular series of television sets was selling well in the club store (Costco or Sam's Club) channel but not as well in the regional stores channel, the product group could request that the factory manufacture more of the club-specific models.

Providing a validated, **consensus demand plan** was also an important cornerstone of Sony's global efforts **to manage worldwide supply and demand in the highly competitive LCD panel market.** LCD panels, which are used in flat-panel televisions and laptop computers, typically are **constrained and price-sensitive components and therefore must be closely managed.** Establishing better demand plans across all regions allowed Sony's main sourcing factories in Asia

to effectively plan their component procurement and production.

The shared database also helped Sony to establish key performance indicators that could be used both to track execution and to drive collaboration. Previously, compiling and reporting the data was a largely manual, labor-intensive task requiring data to be pulled from several disconnected systems. With a common database, it was now possible to automatically calculate metrics and report back to the business on a much more timely basis. These metrics included sell-in and sell-through forecast accuracy, channel weeks of supply, order-to-commitment achievement, and customer in-stock percentage.

To ensure that the system had good data, Sony worked with its retail partners to improve the data coverage and quality of the point-of-sale information received via EDI. For example, SEL installed data quality management (DQM) software that could identify and correct common mapping errors, such as an almost but not-quite-correct model name.

Retailers benefit from data analysis: Sony Electronics next approached its key retail partners with a low-risk offer: Would they be willing, on a trial basis, to expand the CPFR agenda to include a store-level data analysis in addition to the aggregate sell-through quantity information they were already providing? The new level of detail would include feedback on such concerns as whether inventory at the retailer's distribution center was aligned to store-level demand and whether certain stores were consistently over- or under-performing compared to average sell through levels. The proposed pilot program, which encompassed the television product category, would have a fixed duration of four to six weeks; after that the retailer could opt out if it saw no benefit to having the additional information, or it could continue.

To process this information, Sony teamed up with JDA Software to set up a team in India that would analyze the store-level data during U.S. evening hours. This meant that fresh insights would be available in time for the morning CPFR calls. The Indian team parsed the sell-through and inventory quantity data by product model and store to identify actionable trends for the CPFR team back in the States. For example, if the analysis showed that the sell-in order quantities for a retailer's distribution center were not in line with the associated store-level sell-through quantities, then the Indian team would identify this mismatch. That information would then be highlighted during the CPFR call, giving the retailer's buyer or planner time to adjust future order splits accordingly. Another example: If sell-through of a particular model-store combination showed an anomalous drop, Sony would alert the retailer, which could then check whether the model was correctly displayed, priced, and available for sale at that store.

Having this type of analysis available in a timely fashion quickly produced results. In-stock levels at stores increased by up to 18 percent with the same or lower aggregate channel inventory levels. Forecast accuracy improved by up to 40 percent. The retailers, of course, were delighted. During the review sessions held at the end of the pilot program in late 2009, their demand planning managers expressed excitement that Sony had been able to focus the CPFR discussions and make useful suggestions for improving store level execution. There was universal agreement to continue the program beyond the pilot phase, and the retailers asked when and how the program could be extended to include more categories, more recommendations, and more information sharing.

Capping off this success story, Wal-Mart Stores Inc. recognized Sony Electronics as its 2009 Supplier of the Year. The award criteria included financial growth versus the prior year, market-share gains, ability to provide new technology and innovative design, marketing collaborations, and support of Walmart's online business. As these criteria suggest, the award served to validate the very point that had been used to initially justify the S&OP program: that supply chain improvements and better collaboration with retailers can provide competitive advantage and benefits to the bottom line.

The future of the "trusted chain": As Sony's journey along the road to S&OP continues, collaboration with its key retail partners has expanded. In addition to the weekly CPFR calls with the customer's buyer or demand planner, Sony Electronics now also conducts quarterly reviews at the manager/director level and holds biannual executive level summits. This focus on collaboration is why Vice President of Supply Chain Operations Yuka Yu advocates using the term "trusted chain" instead of simply "supply chain". According to Yu, this term emphasizes that the strong relationships between Sony and its partners depends on mutual trust and communication.

What's next for Sony's trusted chain? According to Yu, the next level of S&OP sophistication is "profitability-aware decision making". In other words, decisions about sales and operations should support Sony's overall objective of maximizing gross margin return on investment for retailers as well as revenue and profitability for Sony.

Rather than merely discussing tactical, execution oriented metrics (such as the number of units ordered, shipped, and sold) the conversation will extend to such topics as which assortments are most profitable and strategic for the retailers based on customer demographics, or what pricing actions make the most sense from a mix and margin perspective. In this way – collaborating with retailers not just on order flow but also on business plans, customer-segmentation strategies, and long-term vision – Sony will ensure a continued strong presence in the consumer electronics space for the foreseeable future.

[3P] a) Before flat-screen LCD, TVs used to have cathode ray tubes (CRTs). Sony led the improvement of CRTs by innovating some new associated technology. Did the invention of LCDs help Sony to strengthen its competitive position or not, explain. Would you call Sony more or less innovative with respect to ten years ago?

ANSWER: LCDs weakened Sony's competitive position. Sony is now less innovative.

[3P] b) Explain why "sell-in" quantities are worse measures than "sell-through" quantities.

ANSWER: Sell-through quantities are sales to end customers and they indicate supply chain revenues. Sell-in quantities are transfers within the supply chain so they have no relation with the demand or supply chain revenues.

[3P] c) Did Sony implement CPFR with its suppliers or retailers? If you say suppliers, what is a supplier's benefit from participation in CPFR. If you say retailers, what is a retailer's benefit from participation in CPFR.

ANSWER: CPFR is implemented with retailers. Sony shared future product and promotional plans with retailers.

[3P] d) In CPFR, what is the benefit of "one plan and one number"? Can a retailer and supplier still collaborate even if they do not agree on "one number"? If you say no, explain why. If you say yes, describe or point out an example of a flexible collaboration mechanism.

ANSWER: One plan brings in consistency across the chain. Such consistency allows for closely managing constrained and price-sensitive components, such as LCDs. Collaboration can happen without a single plan. For example, quantity flexible contract does not requires a single plan. As a matter of fact, this contract inherently allows for some flexibility.

[3P] e) In some collaboration cases, one of the partners may not immediately see the benefits of collaboration. Or this partner may not trust the other partner enough to implement a collaborative scheme. How did Sony overcome these issues with its own partners?

ANSWER: Sony suggested a pilot program to establish trust and prove benefits. the pilot program lasted 4-6 weeks and limited to TV category.

[3P] f) How does Sony use overseas analysts to expedite the processing of the store-level data?

ANSWER: Indian analysts start their work when the working day ends in the USA. They finish the analysis and report fresh results before the morning meetings in the USA. Sony uses time difference among these countries to continuously run the analysis of the data.

[3P] g) By using store-level data, Sony can decrease retailer inventory levels while increasing the in-stock levels. But, inventory levels are generally traded off against service measures. How is it possible for Sony to improve both inventory levels and service measures at the same time?

ANSWER: By improving forecast accuracy by 40%.

[3P] h) What is Sony's objective in "profitability-aware decision making", state it as given in the text above? What kind of challenge(s) will Sony face in achieving this objective?

ANSWER: Sony's overall objective is "maximizing gross margin return on investment for retailers as well as revenue and profitability for Sony". These are two different objectives. There can be conflicts between Sony and its retailers.