LEVERAGING RISK MANAGEMENT IN THE SALES AND OPERATIONS PLANNING PROCESS

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Abstract

The objective of this thesis project is to analyze how companies can utilize risk management techniques in their sales and operations planning process (S&OP). S&OP is a strategy used to integrate planning and processes across functional groups within a company, such as sales, operations, and finance. A large body of academic and industry literature already exists, proving that S&OP can integrate people, processes, and technology leading to improved operational performance for a business. However, little research has been done in the area of applying risk management techniques to the S&OP process. When companies use S&OP in order to align their demand, supply, capacity, and production, based on various factors such as history, pricing, promotions, competition, and technology, they rarely factor in uncertainty and risk into the S&OP process. Furthermore, for those companies that do implement risk management in the

2
S&OP process, there is no consensus in the business community about how to do this accurately and effectively.

Our basic approach to understanding risk management and its place in the S&OP process will be four-fold. First, we conducted a literature review in order to gain basic S&OP process understanding and current risk management strategies. Next, we conducted thirteen hour-long phone interviews with practitioners and thought leaders in the field of sales and operations planning in order to gain insight into how companies currently discuss, assess, and act upon uncertainty within the S&OP process. Third, we conducted an online survey of various companies and consultants working in the field of S&OP to see how they currently discuss and incorporate uncertainty into their S&OP work. Lastly, we visited SemiCo, a leading global supplier of high performance semiconductor products, to gain first-hand insight into the S&OP process of a large multinational company and complete a brief case study about how risk management is currently being utilized within this company’s S&OP process. Finally, we synthesized these four sources of information in order to develop a common framework and recommendations that companies can use for understanding the best practices for incorporating risk management into the S&OP process.
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# Table of Contents

Chapter One: Introduction ......................................................................................... 7  
Chapter Two: Literature Review ............................................................................. 10  
  2.1 S&OP Background .............................................................................................. 10  
  2.2 Risk Management ............................................................................................... 13  
    2.2.1 Risk Management Process ............................................................................ 14  
    2.2.2 Risk Management Strategies ....................................................................... 18  
  2.3 Case Studies .......................................................................................................... 20  
    2.3.1 Sport Obermeyer ............................................................................................ 20  
    2.3.2 Hewlett-Packard ........................................................................................... 22  
Chapter Three: Expert Interviews ............................................................................ 26  
  3.1 Dupont, Peter Murray, Supply Chain Competency and Development Leader ...... 26  
  3.2 Honeywell, Seema Phull, VP of Aerospace SIOP ............................................. 28  
  3.3 Tredegar, Richard Herrin, Global Sales Operations and Inventory Manager .... 29  
  3.4 ABC Inc., Large Consumer Goods Manufacturer, Director of Demand Planning 31  
  3.5 Johnsonville, Brian Harlin, Director of Demand & Fulfillment ....................... 33  
  3.6 MNO Inc., Global Process owner of Demand Planning ................................... 34  
  3.7 Cordis, Wayne Krampel, former Vice President of Supply Chain Management ... 35  
  3.8 Cisco, Colin Chummers, Global Director of S&OP ......................................... 37  
  3.9, AstraZeneca, Martin Joseph ............................................................................. 39  
  3.10 XYZ Inc., Large Networking Equipment Manufacturer, VP of Supply Chain ... 42  
  3.11 Harvard University, Kim M. Thompson .......................................................... 43  
  3.12 ON Semiconductor, Ravi Vancheeswaran, Head of Global Customer Services 44  
  3.13 Stanford University, Blake Johnson .................................................................. 46  
Chapter Four: Company Visit - SemiCo .................................................................. 48  
Chapter Five: Survey Findings ................................................................................. 54  
Chapter Six: Risk Management Framework ................................................................. 57  
  6.1 Risk Management Step One: Developing Business Importance Scorecards .... 57  
  6.2 Risk Management Step Two: Segmenting For Tactical Decision Making ....... 60  
Thesis Summary ......................................................................................................... 69  
Reference List ............................................................................................................. 71  
Appendix A: Survey Questionnaire ................................................................ .......... 73  
Appendix B: Survey Results ....................................................................................... 78
List of Figures

Figure 1: The Monthly Sale and Operations Planning Process ........................................... 11
Figure 2: Supply Chain Risks and Their Drivers .................................................................. 15
Figure 3: Ericsson's approach to supply chain risk management ........................................ 16
Figure 4: Ericsson's Risk Management Evaluation Tool ..................................................... 18
Figure 5: Products by Importance and Variability .................................................................. 30
Figure 6: Forecast Quality Dashboard .................................................................................. 40
Figure 7: Use of Process Behavior Charts ............................................................................ 41
Figure 8: Summary of Risk Management Techniques Identified ........................................ 57
Figure 9: Product and Customer Business Importance Scorecards ...................................... 59
Figure 10: Risk Management Matrix - Product .................................................................... 61
Figure 11: Risk Management Matrix - Customer ................................................................. 63
Figure 12: Risk Management Matrix - Procurement ............................................................. 64
Figure 13: Range Forecasting ............................................................................................... 65
Figure 14: Demand Risk Influence on Procurement Contracts ........................................... 66
Figure 15: Risk Management Framework ............................................................................. 67
Figure 16: Risk Management Framework in S&OP Process ................................................ 68
Chapter One: Introduction

Sales and Operations Planning (S&OP) is a process companies use to align their supply and demand on a continual basis. The goal is to increase communication between the sales/marketing team, the operations team, and the finance team so that future sales estimates are properly in line with production schedules and overall company financial goals. The S&OP process allows top management to arrive at a single number forecast that can be used company wide and also allows the executive team to get a handle on business operations and integrate its long-term strategy into short-term business operations. The S&OP process has been widely used over the last twenty years to open lines of communication and align a company’s supply and demand, however, the use of risk management techniques to mitigate uncertainties in supply and demand have not been widely implemented in the S&OP process. This thesis will explore how companies can incorporate uncertainty into their S&OP process.

In order to fully explore how companies can discuss, assess, and act to mitigate uncertainty in their S&OP process, we utilized a four-fold research approach. First, we conducted a literature review to understand basic S&OP process as well as risk management techniques. Next, we conducted thirteen interviews with practitioners and thought leaders in the field of sales and operations planning who can speak to best practices and suggest how risk management could be fully incorporated into the S&OP process. Third, we conducted an online survey of numerous companies and consultants working in S&OP in order to discover how they incorporate uncertainty within their own company’s process, if at all. Fourth, we visited SemiCo, a large global semiconductor
manufacturing company, and interviewed their S&OP team in order to understand first hand how the company operates their S&OP process and how they integrate risk management techniques into that process. Finally, we synthesized the information garnered from the literature review, interviews, survey, review and company visit in order to develop a framework for considering possible implementations of risk management techniques in the S&OP process.

Research Methodology
Sales and Operations Planning (S&OP) is a known and widely used technique for aligning demand and supply in the business world. In addition, risk management techniques are well ingrained in the world of finance and insurance. However, there is little to no use of risk management techniques within the S&OP process. To examine this, we researched the applicability of theories of risk management to S&OP by administering an online industry survey, literature review, performing fieldwork observation, and interviewing thirteen S&OP industry experts. The goal of this research approach is to make S&OP practitioners aware of risk and how to apply risk management techniques to S&OP for their specific industries.

Through the generation and administration of an online survey, research knowledge was gathered from 120 company executives that participate in S&OP within their company. Ten questions were formulated to understand current S&OP and risk management practices. The goal of survey was to gather information concerning how companies identify and discuss uncertainty within the S&OP process, how that uncertainty is
assessed and measured, and finally, how companies mitigate that uncertainty through risk management, if at all.

In addition, we utilized fieldwork observation as a methodology for our thesis research. We conducted a half-day onsite case study at a large electronics manufacturer to observe first-hand a current S&OP process in action. Through meetings, executive interviews, and S&OP meeting observations, we examined the company’s ability to identify, assess, and mitigate uncertainties within their S&OP process.

Finally, we conducted thirteen interviews with experts in the practice of S&OP, ranging from supply chain executives at Fortune 500 companies, to S&OP consultants, to thought leaders in risk management. The interviews provided a general understanding of current S&OP practices and the types of risk management strategies that would be applicable to S&OP. The interviews identified best practices in managing uncertainty in demand and supply across various industries and also provided a backdrop for framing our online survey questions.
Chapter Two: Literature Review

In order to understand how risk management techniques can be applied to sales and operations planning, we examined three areas of literature, including general Sales and Operations Planning background, Risk Management structure, as well as industry case studies detailing two companies that currently use risk management in their sales and operations planning process.

2.1 S&OP Background
Sales and Operations Planning: The Executive’s Guide and Sales and Operations Planning: The How-To Handbook, two books by one of the foremost authorities on the subject of S&OP, Thomas Wallace, provided a broad overview of the whole S&OP process as well as the benefits to a company from utilizing S&OP. The benefits range from increased communication between organizational silos, to providing the executive team with better information on day-to-day operations of their business, as well as decreasing inventory costs and increasing service levels. The two books outline the general five-step S&OP process that companies can implement to reap the benefits from sales and operations planning as shown below in Figure 1.
The five-step S&OP process described by Thomas Wallace in these two books is considered a gold standard in business and is normally utilized on a monthly basis. In general, the five-step S&OP process begins with a data gathering step in which sales, production, and inventory data from last month are pooled along with marketing and sales input. Step-two consists of demand planning, where the information gathered in step one is used by the marketing and sales organization to establish an unconstrained demand forecast. Then, in step three, the operations team analyzes the unconstrained demand plan from step two and makes any restrictions or adjustments to that plan based on production capacity and constraints.
Step-four, the pre-executive meeting, provides an opportunity for middle-managers to iron out issues and problems in matching the demand plan and supply plan from steps two and three, as well as to condense and summarize all unresolved issues so that the executive meeting is productive and makes good use of upper management’s valuable time. Finally in step-five, the executive meeting, the heads of operations, marketing, sales, finance, logistics, and hopefully the CEO, meet to discuss the recommendations established during step four as well as to make final decisions on any unresolved issues from step four in terms of matching supply and demand. By studying the standard S&OP process and the various versions utilized by companies, we hope to discover ways in which to incorporate risk management in the S&OP process.

Thomas Wallace’s two books provided a comprehensive overview of the basic S&OP process, but two articles in particular that we read provided insightful knowledge into how S&OP is actually used in specific companies and the benefits it bestows. “Balanced S&OP” by Harpal Singh discusses the establishment and success of the S&OP process at Sunsweet Growers, a California dried fruit producer. The main obstacle to implementing S&OP was creating buy-in from employees and management to change the way they operate. Prior to implementation, there was little communication between the sales and operations sides of the company. By establishing one set of forecast numbers, via the S&OP process, management was able to create a meaningful and actionable monthly operations plan that was based on cross-functional insight. With S&OP in place, Sunsweet Growers was able to balance supply and demand and keep it in balance going forward. The increase in communication due to the monthly S&OP process allowed the
management team to have an earlier warning detection process of problems in demand or supply and thus be able to minimize or eliminate disruptions.

"Islands of Automation" by Stephanie Neil discusses the communication and information benefits of S&OP at Shaw Industries, a carpet manufacturer. The people in marketing tend to think in terms of generating revenue whereas the people in operations tend to think about minimizing costs. Consequently, if you do not have an S&OP process in place where these two groups of people can come together and collaborate, a company's supply and demand will be out of alignment. S&OP provides the means for a company to establish one baseline set of demand numbers (during stage two of Thomas Wallace's generic S&OP process model) that is then passed through both the sales and operations organizations to flush out and refine. This vetting process increases buy-in from these two organizations and increases communication as the two groups work with each other to agree on a demand and supply plan going forward. The article also describes the need to establish a "champion" for taking ownership of the S&OP process. When most companies start a new organizational process, an executive level person is needed to spearhead the implementation so that the process does not die out after a few months.

2.2 Risk Management
Risk Management can be defined as the process of identifying, measuring and assessing risks, then forming strategies to eliminate or reduce the risk. Risks are introduced when there is uncertainty or variability within the supply chain. According to Science and Judgment in Risk Assessment from the National Research Council, uncertainty requires
decision makers to judge how probable it is that risks will be overestimated or underestimated. Whereas variability is coping with the certainty that risks are both above and below a chosen reference point. In a Sales and Operations Planning process, how a company is able to balance the odds of demand and the reliability of supply is becoming increasingly important as companies expand globally and issues such as long lead times, cost, capacity constraints or supply reliability emerge.

2.2.1 Risk Management Process
Many authors have developed a three-step risk management process which include risk identification, risk assessment, and risk treatment. The first step is risk analysis or identification. This is the process of understanding the risks that are present or could potentially occur.

To understand how to identify the risk, first there must be a clear understanding of the types of risks and the areas one can influence within Sales and Operations Planning.

In an article entitled, *Managing Risk to Avoid Supply-Chain Breakdown* by Sunil Chopra and ManMohan S. Sodhi, risks are categorized along with key drivers. The main categories of risk are disruptions, delays, systems, forecast, intellectual property, procurement, receivables, inventory and capacity. These nine types of risks are defined below in Figure 2 with examples of each.
Figure 2: Supply Chain Risks and Their Drivers

<table>
<thead>
<tr>
<th>Disruption Type</th>
<th>Definition</th>
<th>Cause</th>
</tr>
</thead>
</table>
| Delay           | A delay is the postponement is tardiness of something meeting a designated goal or appointment. For example: A product is scheduled to launch on Jan 1st but because it did not pass quality inspection it was released on Jan 15th. This is a delay caused by quality issues. | 1. Inflexible response to demand  
2. Quality issues  
3. Border delays/customs issues – handling at high levels |
| Disruption      | A disruption is something unplanned that impacts the normal flow of the supply chain. For example: Hurricane Katrina disrupted the flow of products into the ports in Louisiana. | 1. Labor strikes  
2. Natural Disasters  
3. Terrorism |
| Systems         | A system is a disruption in the IT processes or infrastructure of your supply chain or network breakdown. | 1. IT  
2. Automation  
3. E-commerce |
| Forecast        | A forecast is risk that occurs when there is a discrepancy between supply and expected demand. | 1. Seasonality  
2. Lead-time issues  
3. Distorted information |
| Intellectual Property | Intellectual Property has many companies are concerned with the loss of product design or leverage with other companies stealing or leveraging their ideas. | 1. Vertical Integration  
2. Outsourcing |
| Procurement     | Procurement deals with risk associated with buying parts and affect its change | 1. exchange rates  
2. single sourcing  
3. contract issues  
4. storage or capacity constraints |
| Receivables     | Receivables is the financial inability to collect payment on products rendered | 1. way in which sale is transacted (system)  
2. credit worthiness of customer  
3. cash flow impact |
| Inventory       | Inventory risks are concerned with the fluctuation of inventory, too much, not enough inventory. | 1. Costs  
2. Forecast Issues  
3. Product lifecycles |
| Capacity        | Capacity risks are associated with the ability to ramp up or have excess capacity. | 1. Flexibility of Supply Chain warehousing or facilities  
2. Cost Implications |

Source: “Managing Risk to Avoid Supply-Chain Breakdown” by Sunil Chopra and ManMohan S. Sodhi

These nine risks can have dramatic affects on a company but their impact can be assessed within the Sales and Operations Planning Process. Not only must a company understand what types of risk there are but also the source of the risk. The risk could be internal or external to the supply chain. This leads to the second stage of Risk Management which is risk assessment. In her presentation “Life in the supply chain: Managing risk and the value of information” Kimberly Thompson, ScD, defines the risk assessment step as the use of mathematical models to characterize information in order to answer the questions
of what can possibly happen, how likely will it happen and if it happens what are the consequences? Many companies have attacked Risk Management assessment through scorecards or business impacts which will be discussed further in the Interview sections.

The final step of risk management is the risk treatment stage. This stage involves evaluation of different options to deal with the risk and weighing the implications of these options. The company will determine what can be done about the risk and given the assessment of the risk what is the best option for mitigation. This stage requires strategic planning for options and their business impact to the company. In his article, Ericsson’s Proactive Supply Chain Risk Management Approach After a Serious Sub-Supplier Accident, Andreas Norman defines the risk management or treatment stage as “the process whereby decisions are made to accept a known or assessed risk and/or the implementation of actions to reduce the consequence or probability of occurrence”. Here in the final step of treatment is explained through a risk management process that Ericsson implemented as seen in Figure 3.

Figure 3: Ericsson’s approach to supply chain risk management
The importance of risk management can not be stressed enough as Ericsson found out in March of 2000. During this time, Ericsson, a mobile phone manufacturer experienced a disruption in supply from Phillips Electronics. A lightening strike caused a Phillip plant in New Mexico to catch fire destroying millions of micro-chips. Ericsson’s production was disrupted costing the company $400 million in sales because Phillips was the sole supplier of micro-chips to Ericsson. However, Ericsson’s competitor, Nokia, had a multi-source supplier strategy and immediately ramped production of micro-chips from another supplier removing the supplier risk and the loss of sales that impacted Ericsson.

Immediately afterwards, Ericsson implemented a risk management process which included the identification, assessment, treatment, and monitoring of risks to their supply chain for the future. Ericsson created a corporate function called corporate risk management which consists of a council of members in supply and sourcing as well as members in each business area. The concept is that many different players are responsible for implementing and maintaining risk management responsibilities within the company.

Ericsson created a Risk Management Evaluation Tool (ERMET) as shown in Figure 4, which looks into all areas of the supply chain (internal and external) along with contingency planning to analyze risk exposure.
2.2.2 Risk Management Strategies
Currently there are a few well known supply chain strategies that companies use in order to add flexibility to either the demand side of the business or to the supply side. These strategies include: inventory buffers, postponement, hedging, multi-sourcing or scenario planning. The strategies are described below:

Inventory buffers are a traditional risk management tool that companies have used for years to reduce the probability of stocking out of a particular product by keeping enough stock of product in every level of the supply chain. Inventory buffers can also be considered a company's safety stock where companies will build sufficient stock ahead
of time so that any demand fluctuations are absorbed within the inventory. While maintaining inventory can be expensive for the company due to carrying costs it can prevent impacts on customer service levels or potential imbalance between demand and supply. While pushes for an efficient supply chain move to optimizing inventory levels, for some products with unstable demand or inefficient supply require inventory buffers as the most common risk mitigation method.

Postponement is the act of delaying decisions until the last possible moment until a decision based on more accurate information, can be made, which reduces the risk. A company well known for a postponement strategy as a risk mitigation tool is Benetton. Benetton uses un-dyed yarn to make wool sweaters and waits until a clearer demand picture is known to dye the sweaters at the last step in the process. This use of postponement allows them to create a forecast based on aggregate demand of total sweaters and then dye later once seasonal or trendy colors are more clearly uncovered.

Another type of risk strategy is hedging. Hedging allows companies to mitigate cost risks through assurance of supply for more stable demand while creating flexibility in ramp time for more varied demand. In the AMR article, *Supply Chain Risk Management Strategies II*, Mark Hillman states that “the recent spike in prices for energy, copper, metals, sugar and other core raw materials has made companies more aware of risks caused by rising raw material costs.” Because of this rise in the price of commodities, companies such as Southwest hedged oil contracts in the midst of rising prices to mitigate
risk. Because of this they were successfully able to gain market share in a turbulent time for the airline industry.

Multi-sourcing is another example of risk management in the supply base. Multi-sourcing is the use of multiple suppliers for a single component part. When the reliability of one supplier is unstable or they can not meet specific demand for a component, many companies will contract two suppliers for the single component to remove the risk of stocking out of the component, such as Nokia did in the example provided.

Scenario-planning is another example of risk management in the supply chain. Scenario planning involves analyzing possible risks that could occur. For each risk identified a corresponding action to mitigate or eliminate the risk can be taken. From the most feasible option the company makes an actionable decision.

2.3 Case Studies
Several authors have identified many risk management strategies which will be discussed in further detail. This thesis will seek to apply many of these strategies in a systematic format to the Sales and Operations Planning process. Sport Obermeyer and Hewlett Packard are two companies that have applied risk strategies to their supply chain process.

2.3.1 Sport Obermeyer
Many companies face the problem of growing stock-outs and markdowns. One such company, Obermeyer, found itself in this predicament. Sport Obermeyer is the leading
supplier in the U.S. fashion Ski apparel market and has been in existence since 1947. Since then, the company has been committed to making performance winter clothing. When Obermeyer was faced with the common problem of missed sales opportunities it took action, creating a process to minimize the uncertainty in demand called “accurate response”.

Accurate response is the process of determining what forecasters can and can not predict well. Then accurate response requires developing the supply chain to become both fast and flexible so that managers are able to delay decisions about the most unpredictable products until there are clearer market signals. Accurate response requires two changes in the forecasting process. First it requires that a company be resourceful in using a type of demand indicator to improve forecast. Secondly, there must be a system in place that tracks forecasting errors.

Sport Obermeyer put the process of accurate response into place and saw dramatic results. First to address the forecasting inaccuracy, an in-house buying committee was assembled. Each member of the buying committee then made an independent forecast for each style and color. It was found that when the buying committee had similar forecasts they were more accurate with the forecast and that the variance among the individual forecasts was a predictor of the forecast accuracy.

During this process they noticed that different garment style costs affected their risk. The more costly styles carried the greater financial risks. Next, they used a mathematical
model that optimized production (taking into account predictions only) with optimal production levels and factored this into early demand information. Lastly, they compared data with historical data to estimate costs of stock outs and mark downs. As a result Sport Obermeyer produced 30 percent of the volume reactively (reaction to market demand); which provided half of the potential cost reduction for the company.

Moreover, with a better system in place to determine forecast accuracy, Obermeyer was able to take operational actions such as securing more capacity for peak seasons by buying raw materials in advance without releasing final production schedules. The creation of an S&OP department through the merger of the design and production departments was also formed. The results from the S&OP group were a reduction in the number of zipper types and encouraging designers to use similar raw materials in designs.

The Accurate Response program is one way of mitigating risk in the Sales and Operations Planning that proved to be successful for Sport Obermeyer. From this case it can be seen that assessing the cost of stock-outs and markdowns can help determine if accurate response will be a technique that will benefit the company.

2.3.2 Hewlett-Packard

Another example of a company successfully implementing risk management techniques into their Sales and Operations planning process is Hewlett-Packard (HP). HP has used operations risk management techniques in the past, notably during the early 1990’s by using postponement during the production of printers, so that final region-specific
assembly could be done at distribution centers around the world, rather than at one production plant. However, by the late 1990's, HP had exhausted all of the gains from low-hanging supply chain fruit by improving their operations (i.e. printers and postponement) so the company started to explore less directly controlled improvement possibilities.

Postponement of printers was an example of improving processes that were directly under control of their operations, but now HP was starting to explore ways to mitigate risks not directly under their control, such as uncertainty in demand, component availability, and spot market price fluctuations for components. In order to tackle these uncertainties, HP developed a Procurement Risk Management (PRM) program, which utilized a portfolio management approach common in the world of investing. Essentially, holding a portfolio of stocks minimizes the risk from any one stock crashing and this technique can be applied to S&OP as a way to minimize risk and uncertainty in supply.

HP tries to focus on high probability day-to-day risks that you can control, such as supplier failure or market risks, rather than low probability events, such as natural disasters. HP’s PRM program tries to address three questions: how much to buy, what price to pay, and for how long. The first step in PRM’s process is determining the probability of the demand forecasts and the costs to procure supply to meet that demand. PRM then determines high, low, and base scenarios for the demand forecasts and the probability of each scenario. Based on these demand probability assessments, HP will structure their contract arrangements with suppliers. HP will use a three tiered contract
based on the demand scenarios. For the low scenario demand plan, HP will use a fixed contract with a supplier and guarantee to purchase a certain amount at a certain low price. For the differential demand between the base scenario and the low scenario, HP will agree to a flexible “ramp-up” quantity contract, which allows them to secure additional supply at a slightly higher per unit cost if demand should actually turn out to be higher than the low scenario. Finally, for the high demand scenario, HP does not contract supply to meet that demand scenario because of the low probability. If demand should actually turn out to be in the high scenario range, then HP uses spot markets to purchase the additional needed supply.

This three-pronged procurement contract strategy helps HP share the risk with their suppliers, which builds trust in the relationship and allows HP to become the customer of choice if supply of a certain component should ever become tight. By guaranteeing to purchase the low demand scenario supply needs at a certain price, HP helps the suppliers more accurately gauge their own production needs, while at the same time allowing HP to avoid spot market price fluctuations. Prices of energy and commodities can rise and fall sporadically and dramatically, so it is in HP’s interest to lock in a price for their highly certain low demand scenario to avoid price fluctuations. In addition, by only locking in supply contracts for the low demand scenario, HP does not get stuck with excess inventory for demand that never materializes (the base and high scenarios and only very rarely the low level scenario). HP will also utilize a multiple supplier procurement strategy (redundancy), so that they are not tied to any one particular supplier that may go out of business or increase their price without notice.
HP's PRM portfolio approach has been successful in lowering costs for direct materials as well as indirect materials such as energy and advertising. HP also used a portfolio approach to align supply and demand of labor by moving from solely full time exempt (FTE) employees before the 1990's to a mix of FTE, part-time contractors, consultants, and temps. This increased flexibility in their labor supply and, in addition, reduced their labor cost because they were not carrying excess labor capacity. The flexible labor force allowed them to quickly increase or decrease labor capacity depending on the situation. Hewlett-Packard’s unique approach to incorporating financial portfolio risk management techniques into their demand and supply planning provides a valuable case study into how other companies might be able to decrease uncertainty within their sales and operations planning process.
Chapter Three: Expert Interviews

In order to gain an understanding of the role risk management currently plays in sales and operations planning, we interviewed thirteen experts in the field of S&OP and risk management. Eleven of the interviewees were current executives involved in the S&OP process at companies in various industries, from information technology, consulting, and consumer packaged goods, all the way to manufacturing. In addition, we received insight on risk management from two highly respected professors, Kim Thompson from Harvard University and Blake Johnson from Stanford University. The various backgrounds of the individuals we spoke with provided a large cross-section of perspectives on how risk management is currently being discussed and assessed in the sales and operations planning process and how the benefits of risk management could be further leveraged in the S&OP process.

3.1 Dupont, Peter Murray, Supply Chain Competency and Development Leader
Currently, DuPont is in the second year of implementing an S&OP process, which they term Integrated Business Management. Their S&OP process consists of five steps, which are performed separately for each of the forty business units within DuPont. The first step is a product review of current and new offerings to make sure all are aligned with the strategic drivers of the business unit. The second step consists of the marketing and sales team generating a demand plan that is then analyzed against capacity and supply constraints in step three. The fourth step consists of an integrated reconciliation where the results of the third step are compared to financial goals to assure there are no gaps.
All discrepancies in the fourth step are forwarded to the executive review in step five for a consensus decision. Mr. Murray stressed that within each step of this process, the team working on the step assesses the uncertainty of forward plans not meeting the financial budget for the business unit.

One way DuPont tries to assure accurate analysis during the S&OP process is to hold the business units accountable for producing a “50/50 plan” that is backed up by both quantitative and qualitative measures. The “50/50 plan” requires that the business unit’s plans be at least 50% likely to succeed. Currently, each business unit produces only one set of numbers rather than different scenarios of high/low/medium demand. However, the businesses do use a dashboard tool to track how accurate current plans are to older plans and to provide awareness of where exceptions between the plans may be found. Formerly, business units would commit to producing what marketing and sales were able to sell, but now through the S&OP process, they discuss the risks and drawbacks required to meet sales increases before committing to new requirements.

In terms of setting safety stock levels, DuPont is just starting to evaluate them on a business wide basis in order to meet customer service levels and lead time goals after taking into account forecast accuracy. In addition, during the S&OP process, DuPont does utilize supplier scorecards that look at delivery reliability and level of quality, so that they are able to assess the condition of the supply base for their business units’ material needs. Two areas of improvement that Mr. Murray hopes to see implemented at DuPont in terms of risk management in their S&OP process are the use of hedging.
strategies to combat fluctuating commodity prices that many of their businesses face, as well as having the ability to produce multiple realistic and actionable scenarios for each business unit.

3.2 Honeywell, Seema Phull, VP of Aerospace SIOP
Honeywell currently operates under a five step S&OP process termed Sales, Inventory, and Operations Planning, or SIOP. The first step involves demand planning and generating a demand forecast that is then passed on to the second step, aerospace demand review, where a consensus forecast is settled on. During the third step, capacity review, the supply side constraints such as production capacity are discussed to understand whether the demand plan is feasible. Then, in the fourth step, the compare stage, the unconstrained demand forecast generated during the first two steps is constrained based on information generated during step three. During the fifth and final step, the consensus constrained demand plan finalized in step four is fed into the materials resource planning system which plans out the production necessary to meet the agreed upon demand.

Although, Honeywell does not currently use a scorecard system to track risks during their S&OP process, they do discuss certain risks during the first four steps. Due to the fact that their average production lead times are roughly 12 to 24 months, because of the highly technical nature of their aerospace products, forecast error rates and assuring that expected demand turns into firm demand are two topics that are discussed in great detail during steps one and two of their S&OP. During the capacity review stage, Honeywell tries to identify key constraints that would negatively affect their ability to meet the
demand that is coming at them. Honeywell also uses leading indicators, such as oil prices, airline ticket price trends, and major customers’ build plans to determine if their supply and production are in a good position to meet upcoming demand. In addition, Honeywell tracks the delivery reliability of key suppliers during step three, so that they are aware of any threats to steady supply of key components.

Seema Phull mentioned a few risk management functionalities that she hopes to bring into Honeywell’s S&OP process in the future. The ability to generate what-if scenarios for high/low/average demand situations, the use of more collaborative forecasting with suppliers and customers to share demand risk and minimize demand uncertainty, and the use of postponement in production of assemble-to-order products are all risk strategies Seema Phull is working on developing within Honeywell’s S&OP process.

3.3 Tredegar, Richard Herrin, Global Sales Operations and Inventory Manager
Tredegar Film Products does not currently have an S&OP process. Mr. Herrin recently joined Tredegar and is in the process of implementing a standard five step S&OP process like that of General Mills, his former employer. However, Mr. Herrin discussed the risk management aspects he will address in formulating the S&OP process at Tredegar. The main tool he will install within the S&OP process to address risk is a two-by-two matrix, as seen in Figure 5, to segment products on the basis of business importance and forecastability. The business importance will be based on certain attributes set by management such as volume, net margin, and strategic importance, and then all of the products will be ranked on these attributes and normalized from 0 to 100. Products will
then be placed within one of four quadrants, low forecastability and low business importance; high forecastability and low business importance, high forecastability and high business importance; and low forecastability and high business importance.

**Figure 5: Products by Importance and Variability**

![Diagram](image)


The S&OP process will develop strategies for how to handle products within each of these quadrants. Low forecastability products will require more flexibility in the supply chain so that they can quickly ratchet up production, whereas with high forecastability products, they will carry more inventory because of the higher confidence in forecasted demand. The S&OP process at Tredegar will analyze products each month based on strategies set for each of these quadrants. Instead of using one demand and supply strategy across the company for all products, Tredegar will instead use four strategies.
based on the business importance and variability dynamic. Measuring based on business importance helps minimize working capital targets while meeting customer service target levels and efficiently utilizing production assets.

3.4 ABC Inc., Large Consumer Goods Manufacturer, Director of Demand Planning
In our first interview, we spoke with the Director of Demand Planning at ABC, Inc., which is one of the largest consumer goods manufacturers in the world. ABC currently operates a five-step S&OP process on a monthly basis. Step one involves gathering information on demand and supply for products, which is then used in the second step in which members of the marketing, finance, and supply chain groups develop an unconstrained demand forecast. In step three, this forecast is constrained based on feasibility of supply. In step four, middle management reviews all risks associated with meeting business plan goals and they then summarize this information for review during step five, which is the executive level S&OP meeting. In order to qualify the risks reviewed during step four, the Director of Demand Management’s team generates a one-page scorecard for each business unit, which details risks that will keep the business unit from reaching its business plan for the month.

The company uses a three-color flagging system, with green and yellow colored scorecards meaning the business unit will meet its business plan, while a red colored scorecard indicates that a business unit is at risk to not meet its plan for the month. The red cards are forwarded on to the executive level S&OP meeting for a decision on how to proceed to correct a business unit’s problem. One area for improvement needed in this
process, that the Director of Demand Management mentioned, is distinguishing between two red scorecards on the basis of the financial impacts to the company. Currently, business units are assigned red cards solely on the likelihood of the unit not meeting its monthly plan without thought given to the revenue or profit impact of a certain business unit being short. If the executives were able to receive the red cards in some sort of financial importance order, this might make for a smoother and more effective step five meeting. The Director mentioned that he typically deals in terms of cases of product or customer service levels, but the executives tend to focus only on the financial numbers.

Other uses of risk management techniques applied by ABC are operating below capacity at their manufacturing plants, using fixed supplier contracts for minimum amounts with the flexibility to increase the supply amount, pre-build inventory of seasonal products to utilize manufacturing capacity during non-peak times, and scenario planning for high, medium, and low demand scenario for products. The Director did mention that this last strategy for dealing with uncertainty, using scenario planning, is still quite a manual process and they are currently looking for an IT product that could significantly upgrade their capability to do multiple scenarios on product demand. Overall, ABC is characterizing uncertainty in supply and demand during step four of their S&OP process, but they have room to improve in terms of assessing uncertainty and what to do with uncertainty they have identified.
3.5 Johnsonville, Brian Harlin, Director of Demand & Fulfillment

Johnsonville has approximately $500M in sales a year. The S&OP process is broken up by two channels, retail and food service. The S&OP process is a normal five-step process consisting of monthly pre-S&OP meetings attended by business units and marketing groups who focus on forecast projections by product level details, new products and customers. This segmentation allows visibility from 3 to 12 months down the road. In the food service industry the cycle times to turn products are as quick as 3 days due to perish rates. Monthly, executive meetings attended by company VPs review business synopsis and performance metrics.

The S&OP process allows for normal forecast variation. To offset the variation Johnsonville uses flexibility in capacity through manufacturing to minimize risk. Flexible production schedules allow for quick response in demand patterns. Capacity flexibility helps mitigate risk, but Johnsonville also eliminates significant swings in variation by planning customer forecasts per Distribution Centers (DC). Johnsonville allows the forecast error to be monitored by each DC and determine at the DC level what actions should be taken to deal with uncertainty. The forecast is segmented by product category level which ties back to capacity flexibility.

As a form of utilizing range forecasts, Johnsonville segments by product category and looks at historical statistics from the last six months. The low and high points of error are located to obtain an average forecast within a 5-10% variation range. If the variation is close, then future capacity options are considered. These options can include subcontractors and co-packers, who can be flexible by producing partial or entire products.
These sub contractors will have fixed contracts with variable up-side. Johnsonville's ability to source to these co-packers helps mitigate risk of stock-outs with increased demand.

Assessing the forecast error and eliminating major assumptions in the data helps Johnsonville identify risks and opportunities from a qualitative perspective. Using a chart that summarizes business impacts to the company from month to month helps give a demand snapshot of the next steps the company should take.

3.6 MNO Inc., Global Process owner of Demand Planning

MNO Inc. is an $80 billion dollar large consumer goods company that utilizes the standard five step S&OP process, which builds on Oliver Wight’s original Sales and Operations process. The process utilizes consistent documented work processes, standard software tools and assessment tools that mold excellence in S&OP. Due to the scale of the company, these processes are separated by business units, which are defined by product and geography and the S&OP process is duplicated over 100 different business units. Scaling up the S&OP process is the next stage of S&OP for this large consumer goods company.

In demand planning, demand variability is accessed through considering the uncertainty of new business or new products, variability within the market, and looking at the historical forecast accuracy. Forecast accuracy is assessed through different size buckets and time buckets. MNO Inc. also focuses on removing the bias in forecast accuracy by
eliminating the tendency to be overly optimistic or pessimistic. Through this assessment process, expectations are clearly communicated and progress of the error is tracked. The accuracy is also used on the supply side to calculate safety stock levels, for rough-cut capacity and supplier plans, and to understand supply capabilities. Finance also uses it to understand cash flow and costs.

MNO Inc. looks to sales and marketing to clearly understand their customers, consumers and the competition. This knowledge helps to plainly understand price sensitivity patterns and how promotions or new product introductions will affect the demand. To respond to variation within the demand, MNO Inc. also has a flexible supply chain to account for the variability. However, the main focus is to understand their customers in order to reduce this variability.

Within S&OP meetings it is important in the final executive meetings to get real data on the table so that senior leaders can better understand the decisions that are being made and how those decisions affect the entire supply chain. Visibility to issues helps clearly consider all risks when making the decisions.

3.7 Cordis, Wayne Krampel, former Vice President of Supply Chain Management
Cordis is a lead supplier of medical devices with a standard Sales and Operations planning process. The S&OP process is divided between business units across different regions. The executive meetings in the S&OP process tackle the impact on the business plans. The business needs such as whether to invest in capacity are assessed based on a
cost of goods measure and the impact to the company. The meeting addresses concerns such as promotion runs and the ability to spot short inventory in specific markets are discussed to proactively manage inventory. Measures include moving or redistributing inventory allocation. Every month’s S&OP meeting addresses the previous month’s performance to understand what went wrong or right with the forecast, and what were the circumstances surrounding events to help understand if there was a specific reoccurrence happening.

Cordis also focuses on customer segmentation as a means of risk mitigation. Products are segmented by both customer and product demand. This division allows forecast errors to be utilized to manage demand. On the supply side, the forecast was done at a product family level which consisted of 20 different products. By forecasting at a higher aggregated level the swings in variability are avoided removing noise from the forecast accuracy. Consistent follow-up to see if the segmentation of A level products are behaving as expected and if C level segmented products were behaving as predicted helps monitor variability swings.

Another risk mitigation tactic is to create manufacturing flexibility as to not rely on the forecast accuracy. Utilizing a demand pool planning system, the error is absorbed in the inventory carrying. This switch from Master planning to a demand pool planning system helps absorb the error through inventory buffering. Inventories were set at appropriate levels to mitigate the inaccuracy. Cordis also utilizes sensitivity analysis as form of
scenario planning to understand how sensitive the demand forecast is and what actions must be taken in any case.

There is also a push for Sales and Marketing to really understand customers in order to better understand demand. As well as a desire for reconciling the financial plans for the business, is a critical part of the Sales and Operations process. In the future risk management must become more quantitative. By looking at the number and understanding how the risks are flagged you are able to categorize decisions based on solid numbers and impact.

3.8 Cisco, Colin Chummers, Global Director of S&OP
Cisco Systems, Inc is one of the leading Internet solutions companies in the world providing hardware, software and services to help companies get and stay connected. Due to the nature of the business Cisco does not use the traditional five step S&OP process. Instead, the Sales and Operations Planning Process at Cisco is centered around a collaborative planning process with key customers where customers commit to the demand in advance and Cisco delivers the business service and product. This collaborative planning works well. Cisco has identified 20 key customers with whom they work closely to understand the demand needs and expectations. These 20 key customers conduct co-planning with Cisco.

The process begins with a consensus demand planning process which is the use of a statistical historical forecast that is reviewed month-over-month of current activity on the
product. Within the consensus demand planning meeting, marketing and demand planners work together with a forecast segmented by the Product ID level. Exceptions are discussed once consistent problems occur in forecasting. The planning process relies on the historical accuracy for determining the forecast while taking into account production transitions, seasonality or trends that cause any deviation from the process. The review allows a forum that determined historical information to customer current plans to assess relevance and accuracy. The consensus demand planning process with key customers helps mitigate risks.

Information Technology helps the collaboration process where key customers input demand into a software tool that Cisco uses to identify the demand stream from its critical customers. Cisco will then reserve supply in the inventory to meet the demand. Scenario planning is another tool that Cisco utilizes especially for new products or new platforms. In high demand case scenarios Cisco uses the mean demand then identifies the long lead time components to plan accordingly. The risk is assessed from a component basis especially with single source components. Scenarios are created for an upside in demand and a reorder point is calculated. The reorder point process consists of commit dates including concept commit and engineering commit and a date to release or go live once the business unit has approved the product. This process is similarly used for transitions for end-of-life products.

Cisco also implements other risk mitigation tools such as multiple sourcing for a majority of components. Suppliers are given a base line forecast and can negotiate the price,
keeping contracts flexible before commitment and utilizing aggregate demand patterns. Due to the close supplier relationship, scorecards are not apart of the S&OP process at Cisco. Understanding the realistic forecast number and creating scenarios for the uncertainty around the percentage of accuracy will help mitigate risk tremendously in the S&OP process. The delta between the forecast and the production plans and determining if the difference is high will always determine how to mitigate the risk.

3.9, AstraZeneca, Martin Joseph
AstraZeneca is a pharmaceuticals company specializing in discovering medicines that will improve health and welfare of life. As a well defined mature business, AstraZeneca understands that as the business demands grow higher a well define S&OP process is critical, hence the use of a standard 5 step process. Moreover, a critical component is upper management’s support to help enforce change. The political environment in which companies exist also plays a factor in the support of the Monthly S&OP process.

In the pharmaceutical world the culture is to naturally become risk adverse. At AstraZeneca, the customers are considered Marketing and Sales that consist of over 400 worldwide affiliates to service. AstraZeneca is decentralized so that local affiliate information can be disseminated within the supply process. They allow the principles of the S&OP process to be applied locally in a decentralized format to serve the needs of the affiliates.
The vertical integration of AstraZeneca allows most of the manufacturing to be done internally as well as contributes to the very well defined supply chain. Government regulations for pharmaceuticals also demand that the process be risk adverse. Within the S&OP process, AstraZeneca brings the financial aspects and different functional areas together from the beginning. When the budget is produced it takes into account the plans for the company and how S&OP will fit into the budget being set as well as risks that the business is willing to allow. The Supply Chain Planning process is a monthly process and is considerably disciplined. Forecast accuracy is always fed back into the monthly S&OP meeting which uses a 3 month rolling forecast coupled with commercial intelligence added to forecasts for better accuracy. AstraZeneca uses an in-house developed tool for the forecasting.

Figure 6: Forecast Quality Dashboard

<table>
<thead>
<tr>
<th>Governance</th>
<th>Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>On time; Completeness etc</td>
<td>Accuracy; Bias, Value-add etc.</td>
</tr>
<tr>
<td>This Month</td>
<td>This Month</td>
</tr>
<tr>
<td>Last month</td>
<td>Last month</td>
</tr>
<tr>
<td>Previous month</td>
<td>Previous month</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Behaviour</th>
<th>Scorecard Trend</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base line adoption, tampering etc.</td>
<td></td>
</tr>
<tr>
<td>This Month</td>
<td>This Month</td>
</tr>
<tr>
<td>Last month</td>
<td>Last month</td>
</tr>
<tr>
<td>Previous month</td>
<td>Previous month</td>
</tr>
</tbody>
</table>

Source: Institute of Business Forecasting Conference Sept. 2007 by Martin Joseph
AstraZeneca utilizes a Forecast Quality Dashboard chart which is used to look at forecast accuracy and understand exactly how accurate they could be and how to understand behavior as seen in Figure 6. The charts provide signals to understand risks associated and anticipate the change through commercial intelligence and produce a new scenario to plan. X charts as seen in Figure 7 allow spotting unexpected change in the demand patterns. The concept is to try to look at the 20% that were unstable and understand their implications in the supply chain. They relied on the 20% to segment. The statistical tool and detailed look at forecast quality network supported by marketing for non-linear products is coupled with commercial intelligence.

Figure 7: Use of Process Behavior Charts

Use of Process Behaviour Charts

Source: Institute of Business Forecasting Conference Sept. 2007 by Martin Joseph
3.10 XYZ, Inc., Large Networking Equipment Manufacturer, VP of Supply Chain

XYZ, Inc. supplies major telecommunications carriers such as Bellsouth with equipment and services and they provide switches and network devices to end users. Recently, XYZ has undergone a reengineering of its supply chain process now called the Program Management Process (PMP). Before PMP’s implementation, forecast accuracy was only 40%. Currently through a traditional S&OP process, a monthly meeting accessing what carriers want and their demand patterns, forecast accuracy has increased. The software tools that XYZ implemented has allowed customers to upload information through the demand planning tool, their orders and expected demand. The tool through historical algorithms helps XYZ look at the actual demand versus the forecast for the last year. With the S&OP process the forecast meetings have become more than manufacturing meetings and include production control, sales and operations, in more of the preliminary S&OP.

The S&OP process also allows a forum to speak to top products that were impacted by misses and the impact to the company’s bottom line and P&L. For XYZ, a key component to utilizing forecast errors is understanding the root causal analysis as to weather the forecast measured up against the inputs into the demand planning tools. Finding the reason why and digging deeper to understand what the accuracy means is the focus. The software is extremely important and used to set safety stock levels for the company. Since the tool’s implementation the accuracy improved from 40% to 60% accuracy.
XYZ addresses risk management in several ways. XYZ maintains flexibility within its manufacturing through a 20% temporary workforce to ramp up or down production. Hedging on materials for key components is also done. XYZ maintains flexibility and securing capacity with amnesty clauses with all supplier contracts as well as benefits from volume discounts and price breaks. A key component to new product launches and end of life inventory impacts is the inclusion of New Product Managers. This allows transitions that will affect inventory to be openly discussed especially since revisions of products occur every 6 months. XYZ also maintains flexibility by using multi sourced suppliers.

XYZ depends greatly on the Sales & Marketing teams to ensure they understand the changes that their customers are undergoing. This knowledge helps understand demand patterns and changes in the pipeline. This emphasis guards against up and down swings as a risk. The key to understanding uncertainties in S&OP is to understand customer motivations and their directions. Being able to understand how to get the communication from the customer is essential to risk mitigation.

3.11 Harvard University, Kim M. Thompson
As an academic of Risk Management in Public Health circles, Kim Thompson has extensive experience in consulting with companies on risk mitigation. With the awareness that risk is truly undervalued by many companies, Kim is usually contacted once companies are in fire fighting mode. Kim begins by emphasizing that information flow is key to addressing risk management through four essential steps. The first step is
dismantling the perceptions. Many companies don’t know what to worry about and brand perception by the public is always a concern. Kim takes the time to assess true consequences and perceptions from the media, company executives and customers. Once the company understands what to worry about they can began to move to the assessment phase which is determining the probability that the risk will actually occur. Assessment can be done through scenario planning or range forecasting. One tool that Kim utilizes in the risk assessment phase is the use of decision tree analysis. These decision trees are tools that help assess different paths needed to manage risk. Step three entails the management of the assessed risk. Companies can decide to take no action if the risk is low or create dual sourcing or extra capacity for examples as a management tool if risk is high. Lastly, companies must communicate risks from executive levels even to the suppliers and customers. Increased communication in the supply chain helps eliminate bull-whip effects and ensures companies are aligned.

3.12 ON Semiconductor, Ravi Vancheeswaran, Head of Global Customer Services
ON Semiconductor conducts their sales and operations planning process on a quarterly basis and it consists of two major parts: revenue management, and supply and demand management. The revenue management piece takes input from sales and marketing in order to figure out the appropriate revenue goals for each of ON Semiconductor’s twenty-three business units over a two quarter horizon. The supply and demand management portion of ON Semiconductor’s S&OP process is structured around the scenario planning functionality available in their i2 Technologies Corporate Planner tool. This tool allows ON Semiconductor the ability to allocate strategic capacity at the SKU level by running
numerous automated demand scenarios. Running demand scenarios allows ON Semiconductor to be prepared for an industry upturn. In addition, the company uses the scenario planning tool on a weekly basis to monitor the presence of gaps between demand and supply. Any deltas they locate that are greater than 10% are discussed in an ad-hoc mini S&OP meeting in order to analyze the situation and decide if investment in inventory or additional production is necessary to reduce the gap. Another innovative risk management tactic ON Semiconductor employs is the use of multiple forecast confidence levels, as opposed to one single "point" forecast. The forecasting team provides management with a 10%, 50%, and 90% confidence forecast which can then be run in the scenario planner tool and used by management to decide which scenario they want to actively pursue.

Supplier risk management is not a large concern for ON Semiconductor as their major raw material is sand, for the use in wafer production, and this commodity is not a highly constrained product. However, ON Semiconductor does use a supplier scorecard rating system for all of its suppliers and they do tend to dual source to assure supply. With new product introductions, the company is very thorough in vetting new product ideas. By using a comprehensive four-stage gate review process, ON Semiconductor ensures that the new product is designed properly and most importantly, that there is market and a customer base for the new product. Since ON Semiconductor is normally two steps removed from end consumers in their supply chain, the company actively investigates end-user demand patterns to minimize the dreaded "bullwhip effect." Finally, Mr. Vancheeswaran emphasized the need for companies to forge strategic partnerships in
order to mitigate risk in supply chain. By forming strategic supplier and customer relationships, a company can minimize contract “gaming” and reduce second-guessing of your customers and suppliers.

3.13 Stanford University, Blake Johnson
Professor Blake Johnson’s webcast on Steelwedge.com provided significant insight into how range forecasts can be used to plan production within a sales and operations planning process. He suggests that by forecasting high, low, and base demand scenarios from the outset and then revising these scenarios further at a later date as more information is accumulated allows a company to be better prepared to align supply and demand. Professor Johnson suggests a three-step planning process. First, develop a range forecast that encompasses a range of the most likely demand scenarios. Then, develop a range plan whereby a company evaluates the demand scenarios developed in step one and then decides which of those scenarios they want to commit to that best matches management’s goals. In addition, a company must evaluate their “commit window,” the period of time that they can delay final production commitments in order to receive updated demand information to revise their demand forecast accuracy. The longer a company can wait to make firm production plans, the more accurate demand information they can incorporate into their supply planning; and thus the more aligned their supply and demand will be. The third step of Professor Johnson’s framework is accountability for performance. In order to create buy-in to this planning process, employees and managers must be answerable and incentivized to be accurate in planning.
for potential demand outcomes. Blake Johnson’s scenario planning framework provides management a way to proactively plan for uncertainty in demand within the sales and operations planning process.
Chapter Four: Company Visit - SemiCo

In order to observe first hand the processes and information technology tools that are used by a company with an established sales and operations planning process, we visited SemiCo, a leading global supplier of high performance semiconductor products. We met with the head of S&OP at SemiCo for an afternoon in order to get a detailed look at the company’s current S&OP process and how it incorporates risk management into the process. SemiCo has a well-established S&OP procedure, with advanced online training manuals, a detailed process calendar, and advanced information technology planning tools.

The company uses a five-step S&OP process. Step one is a data gathering stage where the company generates a base-line forecast. In step-two, a formal demand review takes place where the sales and marketing teams synchronize all sales information into a single accurate, realistic, and sensible demand plan. Then, in step three, the supply chain team takes the single view of demand generated in step two and determines the constraints to executing that plan. Any gaps identified in step three between what the demand plan calls for and what the supply plan can actually deliver are discussed in step four, the reconciliation meeting. Step four provides an opportunity for middle managers to reconcile gaps and filter the top priorities and critical items that need to be decided by top management in step five, the executive review. This final stage of SemiCo’s monthly S&OP process provides the executive team with an opportunity to review the state of the business and resolve any critical gap issues so that the executives are able make sure the organization as a whole is aligned and on track with the overall strategic plan.
In terms of risk management utilization within their S&OP process, SemiCo is quite advanced. The company has invested in a corporate planning information technology tool that allows them to run demand scenarios to more accurately plan capacity needs. The corporate planner can aggregate demand forecasts with backlog demand figures and run scenarios to allow management visibility into potential gaps between supply and demand that may occur. However, SemiCo has just begun the process of harnessing the full power of the tool’s scenario planning functionality and the company is currently just running the unconstrained demand scenario in order to determine total capacity needs. The head of S&OP said that the company hopes to be running additional scenarios by the end of 2008.

From a procurement risk management standpoint, SemiCo is in an enviable position. The majority of their raw materials are bulk supplies, such as sand for semiconductor wafer production, that are not constrained commodities and can be stored for long periods of time with minimal spoilage. However, the company does utilize demand forecasts when making supply purchases to ensure they are not over procuring raw materials.

One area of risk mitigation where SemiCo is especially innovative is in product segmentation. The company has just rolled out a “Supply Chain Design” initiative where all of their products are scored on a matrix of business importance characteristics, such as revenue and margin contribution, stage in the product lifecycle, growth potential, lead-time, and key customer importance. All of the products are measured on this point scale
and the top “A” level products, those with the highest business importance according to their score in the matrix characteristics, are given top priority in the demand and supply planning phases of the S&OP process. This approach allows the company to reserve capacity in their production cycles for these top tier “A” level products so that all demand fulfillment is efficient and smooth. In addition, this product segmentation allows the company more insight into how much flexibility to put into their “available to promise” commitments they make to customers. By segmenting their products on business importance, SemiCo is able to know which products to focus their production on so that they are getting them to customers as soon as possible and which products they can widen their delivery promise dates. Furthermore, product segmentation allows the company to prioritize which “gaps” in demand and supply to focus on resolving first. High priority products, with the most impact to the bottom and top lines of the company’s finances, are given the highest priority in the sales and operations planning process.

Finally, SemiCo uses a unique approach when there are capacity constraints in their supply chain that cannot be remedied immediately. The company utilizes various “demand shaping” techniques to minimize the impact to their operations and their customer service levels. For example, if SemiCo is having difficulty locating production capacity to meet demand levels for a certain semiconductor product X, the company will either raise the price of product X to lower its demand and ease the production capacity constraint or they will lower the price of a similar product Y. Lowering the price of product Y will increase its desirability and will lower the demand for constrained product X and alleviate product X’s production capacity constraint. SemiCo discusses these
types of demand and supply “gap filler” techniques during the reconciliation stage in step four of their sales and operations planning process.

Overall, SemiCo is quite advanced in the implementation of risk management techniques in their sales and operations planning process. Many companies that we interviewed are just in the rudimentary stages of a basic S&OP implementation, whereas SemiCo has an established process in place and is now moving into advanced S&OP topics such as product segmentation and demand scenario planning. By implementing risk management into all levels of their sales and operations planning process, SemiCo is in an excellent position to minimize disruptions to their supply chain and keep demand and supply in alignment going forward.

Summary of Expert Interviews and SemiCo Visit
Based on the thirteen expert interviews and the company visit, we identified a few reoccurring themes of interest in incorporating risk management into the S&OP process. The first theme was that many companies wanted the ability to be able to plan different scenarios or what-if patterns for different demand patterns. For instance, they wanted to plan for a realistic, optimistic, and pessimistic approach for different demand situations. Scenario planning involves coming up with a plan of action if the actual demand turns out to be different from the forecast.

Another area of importance is understanding the financial impact much earlier in the S&OP process. Many companies wait until the Executive meeting to talk about financial impacts to the business. The CEO is responsible to the commitments that the company
makes to Wall Street, however these commitments must be understood in daily actions and the supply chain’s efficiency within S&OP must be closely tied. If demand planners and forecasters understand the financial impact of product decisions in the S&OP process, they are better equipped to mitigate the risk of deviating from financial commitments to Wall Street.

Next, many companies segmented their products or customers. In cases such as Honeywell or SemiCo, Tier 1 customers faced a different demand patterns than Tier 2 products. For Tier 1 customer, SemiCo may reserve capacity for the customer or participate in demand shaping for a Tier 2 customer. Meaning they may raise prices to shift demand patterns for a Tier 2 customer. For Honeywell, their Tier 1 customers work closely with them so that there is a high confidence in the demand pattern which is usually assured demand. Companies also segment products by ABC analysis or lastly companies may segment by channels. In the case of SemiCo, products are sold to OEMs or directly to customers representing two separate distribution channels.

Another reoccurring observation from the expert interviews was the contribution of procurement as a risk mitigation action in the S&OP process. To understand the reliability of the supply base, many companies solely rely on procurement to handle the relationship, while other companies incorporate procurement into the S&OP process. In the S&OP process some companies use supplier scorecards as a means to understand supplier reliability while others let procurement manage the relationship. Moreover, using flexible contracts or hedging products are risk mitigation tactics many companies
use while others omit this information from the S&OP process. Utilizing techniques such as supplier scorecards to monitor reliability, multi sourcing, or using flexible contracts are all ways that risk can be mitigated in the S&OP process but are also usually seen as procurement functions. The role of procurement is therefore essential in the S&OP process to mitigate supply risk
Chapter Five: Survey Findings

The third primary research technique we used to analyze how risk management techniques can be applied in a sales and operations planning process was to conduct an industry survey of supply chain executives and supply chain thought leaders throughout the world. The survey comprised a total of 18 questions, with the last 10 focused on how supply chain executives currently characterize and assess uncertainty within their S&OP process and what tactics they use to mitigate the uncertainties in supply and demand they face in their industry. A copy of the survey can be found in Appendix A and a detailed breakdown of the survey results can be found in Appendix B. The 10 risk-related questions we used in the survey were developed from information about risk management techniques and current S&OP best practices learned from our literature review and the thirteen expert interviews we conducted. The survey was distributed via the polling website www.surveymonkey.com by the Demand Management Solutions Group (DMSG) to which Dr. Lapide is the Research Director. The DMSG is a working group of supply chain executives and thought leaders that provided us with access to 120 knowledgeable and experienced sales and operations planning practitioners who filled out our survey. We conducted the survey over a thirteen-day time-period in April of 2008 and the results provided us with key insights into the current state of risk management within S&OP across various industries.

Survey Results
As with any qualitative survey, precise results are difficult to ascertain. The goal of our survey was not to discover any exact percentages of what current S&OP executives are
currently doing with risk management and thus make recommendations based on those percentages, but rather, we hoped to gain a general sense of how various industry executives deal with uncertainty and risk within their S&OP process. The survey is one piece of our thesis research, which is meant to complement our expert interviews and fieldwork observations to get a holistic view of the sales and operations planning process. Consequently, we are only looking at the survey results to provide us with general takeaways on how risk is currently discussed, assessed, and acted upon within the S&OP process.

The first set of questions were geared to understand how companies access, talk about and define uncertainty within the S&OP process. Of 120 respondents, 79% of respondents discuss uncertainties within the demand planning forecasts while 58% of the respondents carry over uncertainty conversations in the supply base. This indicates that companies are aware of the uncertainty in either forecasting errors or demand variability and place more focus on the demand side than in the supply base when mitigating risk. Moreover when uncertainty is discussed, 63% discuss it in terms of a range forecast or scenario. The survey also revealed that in the standard five-step S&OP process, 48% of respondents discuss uncertainty in all five steps while 28% only discuss uncertainty at the middle-manager level and 14% only discuss risk at the executive level.

The results of the survey yield two key insights that match our findings from our expert interviews: lack of segmentation and supplier performance analysis. One of the key findings we have discovered from our literature review and expert interviews is the need
to segment your products or customers into high business importance and low business importance. This allows a company to focus its effort on what is important to growth and profitability. A company cannot be all things to all people, so it should prioritize its limited planning resources. By focusing on the important products and/or customers, companies can limit the risk of problems arising with their “A” level products because they have spent time looking at issues and resolving them before they turn into disasters.

From the results of survey question 16 (please see Appendix B for the results of each survey question), we see that 54% of respondents do not segment their planning efforts by both customers and products. There is a large capacity for decreasing a company’s risk if they do segment their efforts and spend the most time on the most important products and customers. Another area for minimizing risk is in constantly monitoring your supply base for your “A” level products with formal structured methods. This ensures that no surprises arise each month and that you are minimizing the risk of a supply disruption for your most important products. However, as we see from the results of question 13, only 41.3% of respondents are using formal supplier scorecards in their S&OP process. The results of this survey are clear. Companies have room for improvement in terms of lowering their risk of surprises occurring in the supply and sales of their “A” level products.
Chapter Six: Risk Management Framework

By synthesizing the key information from the expert interviews, the industry survey, and the company visit, we developed a two-step risk mitigation framework that companies can implement into their sales and operations planning process. By incorporating all of the successful risk management techniques we studied during our literature review and interview research (please see Figure 8 below), our two-step framework provides companies with actionable risk mitigation steps that can be integrated in to each of the five steps of the S&OP process.

Figure 8: Summary of Risk Management Techniques Identified

<table>
<thead>
<tr>
<th>Demand Side Risk Management Techniques</th>
<th>Supply Side Risk Management Techniques</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inventory Buffers</td>
<td>Varied Use of Fixed, Variable and Spot Rate Supply Contracts</td>
</tr>
<tr>
<td>Variable Customer Service Level Promising</td>
<td>Dual Sourcing Key Supplies</td>
</tr>
<tr>
<td>Product and Customer Segmentation</td>
<td>Product and Customer Segmentation</td>
</tr>
<tr>
<td>Component Commonality</td>
<td>Varied Use of Centralized and Decentralized Inventory</td>
</tr>
<tr>
<td>Demand Shaping</td>
<td>Maintain Reserve Production Capacity</td>
</tr>
<tr>
<td>Range and Scenario Planning</td>
<td>Range and Scenario Planning</td>
</tr>
<tr>
<td>Postponement of Final Steps in Production</td>
<td>Lock-in Supply of Scare Materials and Components</td>
</tr>
</tbody>
</table>

6.1 Risk Management Step One: Developing Business Importance Scorecards
Based on the data generated from our research, the most important step companies can do to mitigate uncertainty in their supply and demand is to simply segment their products and/or customers on the basis of business importance so that the limited resources of the S&OP process can be spent on the most important elements of a company’s top line and
bottom line performance. Consequently, the first step to incorporate risk management into the Sales and Operations Planning process is to segment a company’s products and/or customers on the basis the most essential business importance characteristics, such as revenue/margin contribution, product lifecycle stage, and length of customer relationship.

Developing a product and customer scorecard is essential for a company to be able to understand which products and customers are the most essential to their survival and growth. In addition, the scorecard is also a means for management to communicate to all company employees, especially sales and marketing teams, which products and customers are the top priorities that employees should focus time and energy. For some industries, such as defense and aerospace, segmenting by customer does not provide a lot of value as there are very few customers and so companies in this industry just need to focus on segmenting out their most important products. In other industries, such as packaged goods, segmenting business importance on both products and customers might make sense as both are found in large numbers in this industry. Based on insight gained from our expert interviews, we recommend five key attributes for which companies can measure products and customers on business importance. Figure 9 shows an example scorecard for both a product and a customer by business importance; however, the most important attributes will vary depending on the industry.
Figure 9: Product and Customer Business Importance Scorecards

Step 1: Business Importance Scorecards

<table>
<thead>
<tr>
<th>Customer Business Importance Scorecard</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Score</strong></td>
</tr>
<tr>
<td><strong>Attribute</strong></td>
</tr>
<tr>
<td>Revenue Contribution</td>
</tr>
<tr>
<td>Length of Relationship</td>
</tr>
<tr>
<td>Strategic Importance</td>
</tr>
<tr>
<td>Potential for Sales Growth</td>
</tr>
<tr>
<td>Portfolio Expansion</td>
</tr>
<tr>
<td><strong>Total</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Product Business Importance Scorecard</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Score</strong></td>
</tr>
<tr>
<td><strong>Attribute</strong></td>
</tr>
<tr>
<td>Revenue and Margin Contribution</td>
</tr>
<tr>
<td>Stage in Product Lifecycle</td>
</tr>
<tr>
<td>Lead Time</td>
</tr>
<tr>
<td>Growth Potential</td>
</tr>
<tr>
<td>Product Type</td>
</tr>
<tr>
<td><strong>Total</strong></td>
</tr>
</tbody>
</table>

By using a scorecard, such as the ones seen in Figure 9, a company’s products and customers can be segmented in order to help better understand the demand patterns (forecastability), and for general planning purposes. Products and customers can both be broken down into a simple “ABC” product analysis and/or a “Tier 1/2/3” for products and customers, respectively. “A” products are very high impact items that require lots of the management teams’ time and resources. “A products” and “Tier 1 Customers” usually follow the 80/20 rule, accounting for only 20% of the product mix or customer portfolio, but providing 80% of company revenue. Thus these products and customers have a very high business importance rating. “A” products are critical to a company’s
revenue and growth and consequently, companies will often use exception management to ensure these high impact products are available. "B" products and "Type 2 Customers" are the second type of product segmentation. These segments are of moderate impact, and roughly comprise 30% of the product or customer mix and 15% of revenue. Lastly, "C" products and "Tier 3 Customers" have minor impact on the business and thus management should spend the least amount of time possible on them. They typically comprise 50% of the product or customer mix, but only 5% of the revenues.

Once a company identifies the type of product and customer by its business importance, then tactics can be planned for each type of product or customer that will mitigate risk to balance demand and supply. Therefore, Step One of incorporating risk management into the S&OP process would take place during the data gathering stage and would require a company to identify or segment products into an ABC analysis using a business importance scorecard. This "ABC" segmentation can be applied to customers as well. A company's "A," or "Tier 1" customers usually number around 20 and generally provide a large majority of a company's revenues, whereas "B" and "C" level customers provide less impact to a company's revenue and growth. The business importance scorecard will allow an understanding of how customers or products should be segmented.

6.2 Risk Management Step Two: Segmenting For Tactical Decision Making

Once a company has completed the product and/or customer segmentation, the second step of incorporating risk management into the S&OP process is to take each product and
customer and assign them to one of the quadrants of a matrix based on their “ABC” score (from the company’s appropriate step 1 scorecard) and either forecastability or order lead time, respectively. As seen in Figures 9 and 10, we have developed a matrix for both products and customers.

This segmentation task is completed during step one of the S&OP process, the data gathering phase, and during the demand planning phase of S&OP, during which a company determines a product’s forecastability or demand pattern and a customer’s order lead time requirements. The second step of the S&OP process usually involves looking at an unconstrained forecast brought forth through a statistical analysis or using sales or production actuals. In this step, while the demand planning is taking place, the product’s forecastability must be assessed. Products with a variable demand pattern present different risk as compared to those with a stable demand pattern. Low demand patterns also present different challenges and require different plans of attack in balancing the supply and demand. In addition, a company must look at the order lead time requirements of each of their “Tier 1, 2, or 3” customers in order to determine the service levels required for each level of customer importance. So, based on the results of risk management step one (segmentation) and step two (forecastability/order lead time determination) a product or customer is placed into one of the six quadrants on the two matrices shown in Figure 10 and Figure 11.
Step 2 – Risk Management Tactics: Product

<table>
<thead>
<tr>
<th>Forecastability</th>
<th>Business Importance</th>
</tr>
</thead>
</table>
| Low A-Level     | Capacity/Inventory/Time Tactics:  
  1.) Range Planning; Produce to Low Demand Confidence Levels, Maintain Flexible Production Capacity for High Demand Confidence Levels  
  2.) Postponement of Final Production Steps |
|                 | Capacity/Inventory/Time Tactics:  
  1.) Use Inventory as the Main Mitigation Strategy as Inventory Write-offs are Low Probability  
  2.) Maintain Excess Production Capacity |
|                 | Capacity/Inventory/Time Tactics:  
  1.) Inventory Buffer  
  2.) Multi-sourcing supply contracts |
|                 | Capacity/Inventory/Time Tactics:  
  1.) Pre-Build Inventory  
  2.) Component Commonality |
|                 | Capacity/Inventory/Time Tactics:  
  1.) Inventory Buffer  
  2.) Multi-sourcing supply |
|                 | Capacity/Inventory/Time Tactics:  
  1.) Pre-Build Inventory  
  2.) Component Commonality contracts |
Step three of the sales and operations planning process is the supply planning stage. It is during this phase that companies would use the matrices in Figure 10 and Figure 11 to decide how to actually go about mitigating their uncertainty. To complement the demand side risk, companies must also analyze how procurement sets up supply based on forecastability and supply uncertainty. Many companies do not include procurement in the S&OP process; however, how contracts with suppliers are set up is a risk management tactic which can help protect companies against unbalanced demand and supply. Figure 12 provides a segmentation analysis for procurement to mitigate risk.
through differentiating contract strategies. In the high supply uncertainty/high forecastability quadrant for example, products with high supply uncertainty but high forecastability would have a risk-hedging supply chain. Therefore, procurement should set up long term fixed contracts because the demand is known and the length of the contract will help ensure supply in an unstable market.

Figure 12: Risk Management Matrix - Procurement

<table>
<thead>
<tr>
<th>Supply/Demand Uncertainty</th>
<th>Forecastability</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>HIGH</strong></td>
<td><strong>HIGH</strong></td>
</tr>
<tr>
<td>Functional Products with Evolving Process</td>
<td>Innovative Products with Evolving Process</td>
</tr>
<tr>
<td>Risk-hedging supply chains</td>
<td>Risk Sharing Supply Chain</td>
</tr>
<tr>
<td>Tactic: Long Term Fixed Contracts</td>
<td>Tactic: Flexible Contract with option for additional product</td>
</tr>
<tr>
<td><strong>LOW</strong></td>
<td><strong>LOW</strong></td>
</tr>
<tr>
<td>Functional Products with Stable Process</td>
<td>Innovative Products with Stable Process</td>
</tr>
<tr>
<td>Tactic: Efficient Supply Chain</td>
<td>Responsive Supply Chain</td>
</tr>
<tr>
<td>Tactic: Short Term Fixed Contracts</td>
<td>Tactic: Spot Market Contracts</td>
</tr>
</tbody>
</table>

In terms of demand risk, based on which quadrant a certain product or customer is placed into in Figure 10 and Figure 11, we have provided actionable tactics that can be used to mitigate the uncertainty of supply and demand for that product or customer. For example, once a product has been segmented by business importance and forecastability, then in the third step of the S&OP process, which is the operations planning phase, the
forecast can be broken down through the tactic of range planning. As seen in Figure 13, Range forecasting involves quantifying a range of potential demand outcomes considered as taking a base, high and low forecast based on the company’s confidence level of the demand, and time frame as more information is gathered. When assessing the range forecast, planners must assess what demand is known, what percentage is not known and the timeframe when more information will be uncovered. For instance if the probability of the demand is high, the company should commit to this demand. Answering these questions surrounding the capacity, inventory, and time will help in developing an accurate range plan.

Figure 13: Range Forecasting

Managing Demand & Supply Uncertainty in S&OP – Blake Johnson, Stanford University
Another visual representation of flexible procurement contract strategies is shown in Figure 14. Here range planning is also used to demonstrate the types of supply contracts to use depending on the confidence in the demand forecast.

Figure 14: Demand Risk Influence on Procurement Contracts

The fourth step in the standard S&OP process is the pre-executive meeting where capacity constraints are assessed and final forecasts and plans are drafts for executive review. In this step, to incorporate risk management within the process, the tactic of range forecasting can be used to translate into a range plan which must then be finalized. The range plan allows proactive planning for the range forecast completed in step three. Where there is demand that is assured, the company will commit to it through a fixed contract. Next there must be an understanding of what the flexible region is which represents the potential upside of the demand. For the flexible region, planners must
understand the amount of flexible demand the company can accommodate and the lead time required to fulfill the upside in demand. Here in the range plan, the S&OP team can analyze and recommend appropriate actions. Therefore, S&OP’s step four requires analyzing tactics chosen in step three to make recommendation on the best way to mitigate risk to the executive team.

The final step in the standard S&OP process is the executive meeting where conflict resolution and recommendations are made to address any gap issues or options brought forth by tactics used to mitigate risk, such as range planning for “A” level components. In this final step the risk strategy is determined or approved by company executives. By incorporating a 2 phase risk management approach into the S&OP process, which includes first creating a consensus business importance scorecard and then segmenting based on forecastability and/or order lead time, companies can then implement suggested tactics to address balancing supply and demand as seen in the framework in Figure 15.

Figure 15: Risk Management Framework

Risk Framework

Step 1: Business Importance Scorecard by Product and/or Customer
Step 2: Business Importance vs. Forecastability and/or Order Lead Time segmentation
Decision Making: Implement Tactics
Lastly, Figure 16 presents a visual example of how our risk management framework can be implemented into each of the five steps of the S&OP process. The first step in our risk management framework, the business importance segmentation scorecarding, can be done during the data gathering phase of the S&OP process. Then, during the demand planning portion of the S&OP process, a company can place their products and/or customers into the matrices provided in Figure 10 and Figure 11 based on forecastability and order lead time, respectively. Then in the operations planning phase, the S&OP team can implement the tactics in the product, customer, and procurement matrices that are most appropriate for mitigating risk. During step four of the S&OP process, the pre-executive meeting team can analyze any gaps in supply and demand and decide which additional risk mitigation tactics are needed to close these gaps. Finally, during the executive meeting, top management can determine the overall company risk management strategy.

Figure 16: Risk Management Framework in S&OP Process
Thesis Summary

As supply chains become more complex due to outsourcing, longer lead times, customization, companies have tried to address the balance between demand and supply through S&OP processes that align sale and marketing with operations and finance. While S&OP processes lead to greater alignment with both sides looking at demand, supply, capacity, production and finance for better business results, uncertainty in the demand and supply can lead to stock-outs and markdowns causing revenue loss for companies. Companies have fallen short in implementing risk management into the S&OP process.

Companies are under pressure to cut costs, optimize through efficient means, and never run out of product. Therefore there is a need for a mechanism to balance company commitments to Wall Street and the customer while mitigating any risks that will affect these commitments. A two-fold approach of incorporating risk management into the S&OP process will help companies implement the best tactics to mitigate uncertainty while holding true to business commitments. First, companies must understand the business importance of the different products and customers which will help align all segments of S&OP on the priorities of customers or products. Using a scorecard based on the company’s top factors such as revenue contribution, strategic importance, lead time, product life cycle, etc. The scorecard will help all members agree on what products and customers require the most working capital and the focus of resources during the S&OP process. After the business importance of products and customers is decided, step 2 requires segmentation of the products and customers based on the business importance
placement chosen in step 1, and the forecastability or order lead time, respectively. Matrices allow a risk management tactic to be chosen based on which quadrants the product or customer falls into. The risk management tactics can be applied in order to incorporate uncertainty into the remaining S&OP process, an area previously untapped.

Through our thesis research, there was also concern of how procurement fits into the S&OP process. As apart of our initial survey questions on how supplier reliability is measured, many companies leave supplier accuracy and reliability decisions to procurement relationships without addressing the topic in S&OP process. While this is a company norm, risk management techniques affect procurement. Techniques such as utilizing flexible contracts versus fixed contracts for supply or decisions surrounding multi-sourcing are usually procurement-owned decisions, but nevertheless should be included when incorporating uncertainty in the S&OP process. Including procurement decisions into S&OP risk management is an important area for further research with possibility of expanding S&OP to S&OP² (Sales, Operations, and Procurement Planning).

Through our thesis research we also realized that few companies have one supply chain channel. SemiCo, for example, sells products directly to customers as well as to OEM (original equipment manufacturers), requiring different supply chain methods for delivery, lead-times, and strategy. Understanding how to segment risk management decisions based on channel segmentation is another area of further research.
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Appendix A: Survey Questionnaire

Demand Management (DM), defined as "the matching of supply and demand over time," is within the purview of all supply chain managers and executives. As marketing, merchandizing, and sales personnel pinpoint and influence what the customer wants and when, the supply chain managers from procurement, manufacturing, logistics, merchandise planning, store operations, and customer service need to work together to meet those demands. The three core DM processes are: 1) strategic segmentation of customers for the purpose of offering differentiated services; 2) tactical, medium-term supply-demand planning processes [such as Sales and Operations Planning (S&OP) and Merchandize Planning and Allocation (MP&A)]; and 3) customer order policies, promising and fulfillment. We will be asking you questions about your company’s practices within these DM processes.

I. INFORMATION ABOUT YOU AND YOUR COMPANY

1. What is your Supply Chain Management (SCM) function?
   - Procurement/Sourcing
   - Manufacturing
   - Logistics (e.g., warehouse, inventory management and transportation)
   - Supply Chain
   - Merchandize Planning
   - Store Operations
   - Customer Service
   - Other, please specify ____________________________

2. What industry is your company in?
   - Manufacturing
   - Distribution and Wholesale
   - Retail
   - Third Party Logistics
   - Other, please specify ____________________________

II. ALL DEMAND MANAGEMENT (DM) PROCESSES

3. When trying to match supply and demand, what is the most important objective or goal of each of your company’s three types of DM processes (Check only one objective/goal per column)

<table>
<thead>
<tr>
<th>Objective/Goal</th>
<th>Customer Segmentation</th>
<th>Supply-Demand Planning</th>
<th>Order Policies Promising and Fulfillment</th>
</tr>
</thead>
<tbody>
<tr>
<td>° No real objective/goal, we just try to match supply and demand</td>
<td>□</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>° To maximize and grow revenues</td>
<td>□</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>° To be the most cost-effective and lower costs</td>
<td>□</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>° To maximize profits and operating margins</td>
<td>□</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>° To optimize cash flow and working capital (including inventories)</td>
<td>□</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>° To maintain and improve customer service</td>
<td>□</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>° Other, please specify ____________________________</td>
<td>□</td>
<td>□</td>
<td>□</td>
</tr>
</tbody>
</table>

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4 When trying to match supply and demand during your company’s DM processes, which organization has the most influence in the decision-making (Check only one organization per column)

<table>
<thead>
<tr>
<th>Organization</th>
<th>Customer Segmentation</th>
<th>Supply-Demand Planning</th>
<th>Order Policies, Promising and Fulfillment</th>
</tr>
</thead>
<tbody>
<tr>
<td>No organization influences this process the most</td>
<td>□</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>Supply Chain</td>
<td>□</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>Operations or Manufacturing</td>
<td>□</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>Marketing</td>
<td>□</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>Sales</td>
<td>□</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>Merchandize Planning</td>
<td>□</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>Finance</td>
<td>□</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>Other, please specify</td>
<td>□</td>
<td>□</td>
<td>□</td>
</tr>
</tbody>
</table>

5. Do you do any shaping of demand to align it better to supply conditions during your DM processes? (Check all that apply)

☐ None, Marketing & Sales drive DM processes virtually independent of supply
☐ Marketing or Sales programs are routinely changed to keep plants or operations busy or less busy
☐ Marketing or Sales programs are routinely changed to avoid short or surplus inventories
☐ New product launches are routinely changed to avoid short or surplus supply
☐ On an exception basis, ad hoc marketing & sales actions are targeted to keep plants/operations busy or less busy
☐ On an exception basis, ad hoc marketing & sales actions are targeted to avoid short or surplus inventories
☐ Other, please specify ___________________________

6. What types of collaborative information do you get from your customers about downstream demand

☐ None, our customers do not collaborate with us by sharing this type of information (skip to Question 3)
☐ Some information is shared informally on an ad hoc basis
☐ Information is shared on a routine basis, manually
☐ Information is shared on a routine basis, electronically
☐ Other, please specify ___________________________

7. If collaborative information is routinely shared, how often?

☐ Yearly
☐ Quarterly
☐ Monthly
☐ Weekly
☐ Other, please specify ___________________________

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8. If collaborative information is routinely shared, what types are shared?

- Historical Point-of-Sale (POS) and Point-of-Consumption (POC) demand data
- Inventories in customer warehouses or stores
- Historical customer warehouse withdrawals
- Customer-generated forecasts of the customer's demand (i.e., demand from the customer's customer)
- Inventory replenishment plans for customers on co-managed inventory programs (e.g., VMI and CPFR) or production needs for Just-in-Time (JIT) manufacturing customers
- Other, please specify

III. TACTICAL MEDIUM-TERM SUPPLY-DEMAND PLANNING PROCESS (e.g., S&OP and MP&A)

9. Are uncertainties (i.e., also termed risks), and of what types, discussed in your supply-demand planning process? (Check all that apply)

- We don't have this type of process in my company (skip to end of survey)
- None, uncertainty is not discussed during the planning process (skip to question 3d)
- Uncertainty in the Demand Forecasts
- New Product launch uncertainties
- In-House Production or Operations uncertainties
- Supplier Risks
- Outsourcing Risks
- Competitive Risks
- Other, please specify

10. When uncertainty is discussed, how is it described? (Check all that apply)

- A forecast or plan range is discussed (e.g., plus or minus a percent of the forecast or the plan)
- Scenarios are discussed such as pessimistic, realistic and optimistic possibilities
- Other, please specify

11. During which meetings of your planning process is the uncertainty of demand and supply discussed?

- A formal review of risk and uncertainty takes place during all meetings in the planning process
- A formal review takes place during middle manager-level meetings only
- A formal review takes place during executive level meetings only
- Other, please specify
13. How do you assess supplier reliability within your supply-demand planning process?
- Supplier reliability is not discussed within the planning process
- Ad hoc supplier performance metrics are used to track supplier reliability
- Formal supplier scorecards are used to track suppliers
- Other, please specify

14. How do you ensure supplier reliability within your supply-demand planning process? (Check all that apply)
- We don't and just have typical buy-sell relationships with suppliers
- Have formal contracts to ensure that production capacity is allocated to our needs
- Have formal contracts to ensure finished goods inventories are kept at supplier sites (such as weeks of supply)
- Have a shared co-managed inventory management program with suppliers to maintain consigned or non-consigned inventory at our site
- Other, please specify

15. Do you account for any unreliability within the supplier base? (Check all that apply)
- No, unreliability within the supplier base is not accounted for
- Yes, we establish contracts that allow for flexibility in procurement by allowing both fixed and optional buys based on future demand
- Yes, we use multiple sourcing for similar materials and components
- Yes, we use forward-buying contracts to avoid fluctuations in spot market pricing (e.g., for energy and commodities)
- Yes, other, please specify

16. In order to minimize the risk to your business, does the planning process utilize profitability segmentation to focus production capacity on the products and customers with higher business importance?
- No, segmentation is not utilized in our planning process
- Yes, both product and customer profitability segmentation is utilized in our planning process
- Yes, but only product profitability segmentation is utilized in our planning process
- Yes, but only customer profitability segmentation is utilized in our planning process

17. What strategies does your company utilize to mitigate uncertainty with new product introductions within your planning process? (Check all that apply)
- None, rely solely on a point forecast for a new product's demand
- Develop a range of demand forecasts (such as plus or minus a percentage range in the forecast)
- Establish a production/replenishment schedule that can be ramped up or down depending on the demand variability
- Pre-build (or make or buy) a certain percentage of likely new product demand
- Prior to the new product being released, establish multiple sourcing to ensure supply
- Other, please specify
18. When promoting products, what strategies within your planning process are utilized to mitigate uncertainty? (Check all that apply)

- None, rely solely on a point forecast of promotional demand
- Develop a range of demand forecasts (such as plus or minus a percentage range in the forecast)
- Develop scenarios of demand forecasts (such as pessimistic, realistic and optimistic)
- Establish a production/replenishment schedule that can be ramped up or down depending on the demand variability
- Pre-build (or make or buy) a certain percentage of likely promotional demand
- Prior to a promotion, establish multiple sourcing to ensure supply
- Other, please specify ________________________________

Thank you for your time and for providing us with valuable input.
Appendix B: Survey Results

Question 9

*Most companies only discuss uncertainty in demand planning and new product launching but only 58% of respondents discuss supplier uncertainty.*

<table>
<thead>
<tr>
<th>Are uncertainties (i.e. also termed risks), and of what type, discussed in your supply-demand planning process?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demand Forecasts: 79.4%</td>
</tr>
<tr>
<td>New Product launch: 62.9%</td>
</tr>
<tr>
<td>Production / Operations: 47.4%</td>
</tr>
<tr>
<td>Supplier risks: 58.8%</td>
</tr>
<tr>
<td>Outsourcing Risks: 28.9%</td>
</tr>
<tr>
<td>Competitive Risks: 50.5%</td>
</tr>
<tr>
<td>None/No process: 4.1%</td>
</tr>
<tr>
<td>Other: 3.1%</td>
</tr>
</tbody>
</table>

Source: Demand Management Solutions Group (DMSG) Survey, April 2008 (120 respondents)

Question 10

*Most companies discuss uncertainty in terms of a range forecast or scenario plan.*

What uncertainty is discussed, how is it described?

| A forecast range: 63.7%                                      |
| Scenario: 61.5%                                             |
| Other: 3.3%                                                 |

Source: Demand Management Solutions Group (DMSG) Survey, April 2008 (120 respondents)
Question 11

Only 12.6% of respondents discuss risk management in Executive Level meetings.

During which meetings of your planning process is the uncertainty of demand and supply discussed?

Source: Demand Management Solutions Group (DMSG) Survey, April 2008 (120 respondents)

Question 12

30% of respondents use forecast accuracy to set up Just-in-case scenarios for transportation or distribution.

Does your company analyze forecast accuracy? If so, how do you utilize this information in your supply-demand planning?

Source: Demand Management Solutions Group (DMSG) Survey, April 2008 (120 respondents)
Question 13

41.3% of respondents use Supplier scorecards in the S&OP process to access supplier reliability.

![Bar chart showing how respondents assess supplier reliability](image)

Source: Demand Management Solutions Group (DMSG) Survey, April 2008 (120 respondents)

Question 14

90% of respondents use contracts to ensure finished goods or allocated inventory from their suppliers.

![Bar chart showing how respondents ensure supplier reliability](image)

Source: Demand Management Solutions Group (DMSG) Survey, April 2008 (120 respondents)
Question 15

26% of respondents do not discuss risk in the supply base.

Do you account for any unreliability within the supplier base?

<table>
<thead>
<tr>
<th>Not discussed</th>
<th>Flexible contracts</th>
<th>Multiple sourcing</th>
<th>Forward-buying contracts</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>26.1%</td>
<td>43.5%</td>
<td>42.4%</td>
<td>20.7%</td>
<td>6.5%</td>
</tr>
</tbody>
</table>

Source: Demand Management Solutions Group (DMSG) Survey, April 2008 (120 respondents)

Question 16

35.2% of respondents do not use any customer or product segmentation

In order to minimize the risk to your business, does the planning process utilize profitability segmentation to focus production capacity on the products.

<table>
<thead>
<tr>
<th>Segmentation not used</th>
<th>Product &amp; customer segmentation</th>
<th>Product segmentation</th>
<th>Customer segmentation</th>
</tr>
</thead>
<tbody>
<tr>
<td>35.2%</td>
<td>46.2%</td>
<td>16.5%</td>
<td>2.2%</td>
</tr>
</tbody>
</table>

Source: Demand Management Solutions Group (DMSG) Survey, April 2008 (120 respondents)
Question 17

Only 17.4% of respondents are not utilizing any risk management tools in their S&OP process.

What strategies does your company utilize to mitigate uncertainty with new product introductions within your planning process?

Source: Demand Management Solutions Group (DMSG) Survey, April 2008 (120 respondents)

Question 18

17.8% of respondents are not using risk management strategies when promoting products.

When promoting products, what strategies within your planning process are utilized to mitigate uncertainty?

Source: Demand Management Solutions Group (DMSG) Survey, April 2008 (120 respondents)