

Making Supply Chain Risk Management Part of Your Core Management Process

by
Blake Johnson
Consulting Professor



STANFORD
UNIVERSITY

Making Supply Chain Risk Management Part of Your Core Management Process

Executive Summary

Uncertainty and rapid change in the business environment create gaps between what companies plan for and the actual business requirements they later face. These gaps leave all aspects of a company's performance exposed to the outcome of costly and inefficient efforts at fire-fighting and damage control. To close this critical gap in planning, performance, and accountability, effective managers are adopting *proactive risk management*.

Proactive risk management directly addresses the risks and performance consequences of today's "define and execute to a plan" approach to management by shifting the basis of management planning to performance across a *range* of possible forecast outcomes.

Under proactive risk management, plans and strategies are structured, evaluated, and executed to optimize performance across the *range* of possible supply and demand outcomes a company may face, rather than only the "best guess" or "most likely" forecast outcome. By proactively factoring in the key sources of uncertainty a business faces, management gains visibility to and control over future performance across the potential outcomes of those sources of uncertainty. The result is effective risk management, as well as coordination, alignment, and accountability, in highly uncertain and dynamic business environments.

Four resources are required to implement proactive risk management. First, an enterprise data warehouse is used to store the data required to generate range forecasts, structure and assess business strategies, and record their performance across potential outcomes. Second and third are planning and execution capabilities used to support the design, evaluation, and optimal execution of plans and strategies that perform well across potential forecast outcomes. Fourth is a management process for setting and measuring objectives

and accountability for performance and risk across forecast outcomes to ensure proactive risk management is fully leveraged to best meet management objectives.

Proactive Risk Management

Introduction

In today's business environment managers are accountable for meeting performance goals, building relationships, and executing efficiently, despite exposure to multiple sources of uncertainty outside of their control, including:

- > Forecasted vs. actual demand
- > Price and availability of key inputs and other resources
- > Timing and success of new products and market strategies
- > Performance of key partners
- > Changes in the competitive environment

These, and other everyday sources of uncertainty, impact the management process at its foundation, disrupting planning, execution, performance, and accountability. The "plan vs. reality" gap described below explains why this happens. The remainder of this white paper explains how proactive risk management solves the problem.

The "Plan-Reality" gap

Management is based on plans for revenue and cost, and supporting plans for products, markets, capital expenditures, and operational execution. These plans drive resource investments, customer commitments, and coordination with partners. They also drive performance projections and the incentives and accountability based on them (Figure 1).

Plans are based on forecasts, however, and as the business environment grows more uncertain and complex, forecasts are subject to larger errors over shorter horizons. Errors in forecasts lead to plans that are poorly matched to reality, which drive management decisions, commitments, and

Making Supply Chain Risk Management Part of Your Core Management Process

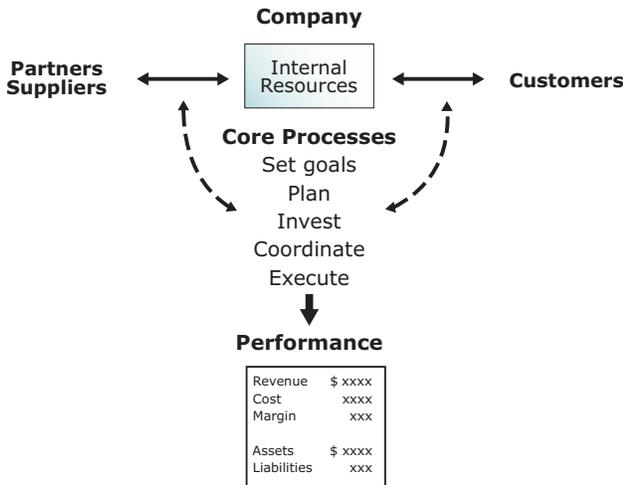


Figure 1. Theory: "Plan-based" management

execution that miss the mark. Fire-fighting must fill the gap that results between plan and reality. As a manual, reactive process, fire-fighting consumes time and resources, strains relationships, and compromises execution and performance (Figure 2).

The "plan-reality" gap, and the management fire-fighting required to address it, has become so common it is now accepted as the new status quo. Managers, however, understand this cannot continue. The impact of fire-fighting on performance and risk, and the demands it places on people and relationships, make it a ticking time-bomb for careers and company performance. Fortunately, there is an alternative.

Proactive Risk Management

Rather than bet their job performance and the success of their company and business partners on forecasts and plans they hope will be correct, effective managers are shifting the basis of their core management processes from single "best guess" forecasts to the *range of possible forecast*

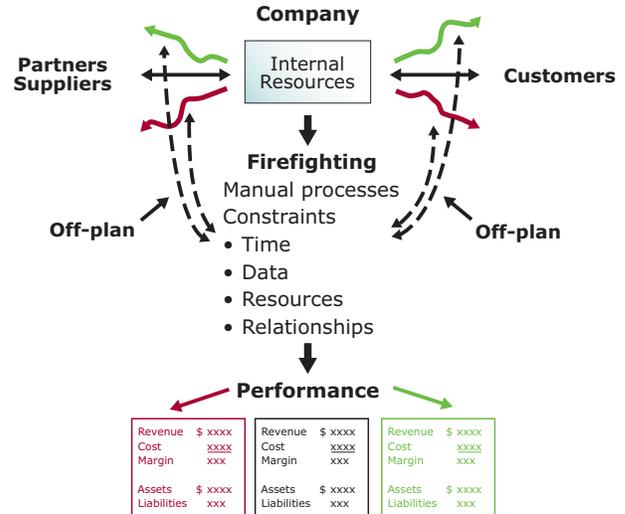


Figure 2. Reality: Fire-fighting and performance surprises

outcomes, and from "bet on the plan" to "playbooks" that enable their company and its partners to respond in a coordinated and timely way as their business environment evolves. To do so they base their management process on the three steps below, illustrated graphically in Figure 3:

- 1) Use "range" forecasts to capture the distribution of possible forecast outcomes
- 2) Evaluate business strategies and implementation plans based on their ability to perform and adapt across this *range* of possible forecast outcomes
- 3) Manage based on the complete view of performance, and the control over performance across the range of possible outcomes of key sources of uncertainty, that steps #1 and #2 provide

Executing these steps gives organizations:

- 1) Visibility to future performance across the range of possible outcomes of key sources of uncertainty
- 2) The ability to proactively and effectively manage that performance, and the risks and opportunities it defines

Making Supply Chain Risk Management Part of Your Core Management Process

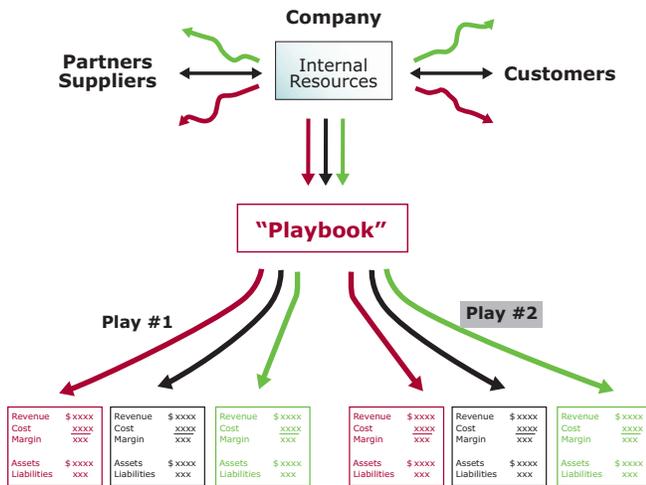


Figure 3. Proactive management of uncertainty

A SPORTS ANALOGY

To see the impact of proactive risk management on performance and control, and how proactive risk management contrasts with plan-based management, imagine a sports team that is managed with a “best guess” planning process:

- > Before the game the coach forecasts what the other team will do
- > Based on this forecast, the coach specifies each player’s responsibilities
- > Once the team is on the field, if the opposing team does something other than what was forecasted, the players gather on the sideline for an emergency meeting with the coach, while the other team carries on

Of course, in reality:

- > Before the game the coach and players develop plays tailored to the opponent and game environment, such as field conditions and weather
- > Over the course of the game the coach and players choose plays that best match the opponent’s play and the outcome of the game as it evolves

- > To execute each play, the team draws on the unique skills of each player, and individual players execute their responsibilities in a coordinated way defined by each play

Proactive risk management impacts business performance and control in much the same way. Moving away from “betting on the plan” allows companies to avoid the risk of finding they have invested in the wrong plan for the business environment and the cost of being sidelined by fire-fighting while their customers and competitors carry on. On the positive side, proactive risk management allows companies to secure and effectively utilize resources well matched to their evolving business environment and to ensure they are leveraged across the supply chain in a coordinated and aligned way.

Proactive Risk Management Integrates and Extends Other Approaches to Risk Management

Before describing how proactive risk management is implemented and presenting examples of how it is being used by leading companies, it is useful to put it and other risk management tools and approaches in a common context. An important benefit of proactive risk management is that it provides a framework which allows other approaches to risk management, including alerting and event management, agility and responsiveness (or “sense and respond”), and inventory buffers, to be integrated and jointly leveraged to provide the greatest overall value. A driving analogy illustrates how this works.

DRIVING ANALOGY

Imagine if when we relied on the “best-guess” plan when we drove, provided by a small clean spot in an otherwise dirty windshield. To coordinate with other drivers, we shared plans based on forecasts of where we each expected to be. If we drove this way, we would probably drive slowly and crash a lot.

Making Supply Chain Risk Management Part of Your Core Management Process

Our natural first reaction may be to develop ways to:

- > Absorb the impact from accidents to reduce damage; for example: airbags
 - Risk management analog: Inventory buffers
- > Identify and react to accidents more quickly; for example: anti-lock brakes
 - Risk management analog: Alerting and event management

We may also dream about making the problem go away by:

- > Developing high performance vehicles able to turn, accelerate, and decelerate almost instantly, and encouraging all drivers to drive them
- > Helping drivers reduce their reaction times toward zero to enable them to fully leverage the capabilities of the vehicles
 - Risk management analog: Agility and responsiveness, or "sense and respond"

In contrast, when we actually drive we:

- > Keep our forward and side windows clean to provide full forward and peripheral vision
 - Proactive risk management analog: Range forecasts
- > Use traffic rules and lights to coordinate with other drivers so that we know what to do and what to expect across the range of circumstances
 - Proactive risk management analog: Playbook

In other words, proactive risk management parallels the common sense things we actually do when we drive. By doing so, it 1) provides broad forward visibility, and

2) enables effective coordination and control over future performance, resulting in:

- > Substantial reductions in risk
 - Driving analog: Fewer and less serious accidents
- > Improved coordination and performance
 - Driving analog: Less congestion and fewer conflicts over right of way
 - Driving analog: Higher speeds and lower vehicle and fuel costs

In the same way that even the best vehicles, drivers, and road systems benefit from on-going advances in road and vehicle safety and performance, proactive risk management benefits from well designed inventory buffers and alerting, event management, and agility and responsiveness initiatives. In fact, by redefining the basis for planning, coordination, and execution, and the baseline for risk and performance they enable, proactive risk management provides the right framework for designing, evaluating, and implementing these initiatives, and enables them to focus on the elements of risk they are best suited to address, rather than attempt to compensate for the fundamental flaws of management decisions based on "best-guess" plans.

Implementing Proactive Risk Management

This section provides an overview of the proactive risk management process, and illustrates it with case study examples from leading companies. The application of proactive risk management to relationships between customers and suppliers is addressed first, followed by application to the complex, interdependent activities within a firm. Finally, these components are combined to provide a high level view of the data, analytics, business processes, and management reporting required to implement proactive risk management across a company's activities.

Making Supply Chain Risk Management Part of Your Core Management Process

Using Proactive Risk Management to Structure and Manage Relationships

Managing uncertainty about demand, including when and where specific products will be sold, and supply (including price, availability, and lead time) is a primary challenge of maintaining high performance, low cost relationships. Proactive risk management addresses these challenges by:

1. Quantifying the impact of supply and demand uncertainty on performance, including revenue, margin, cost, availability, liability, and lead time.
2. Enabling buyers and suppliers to proactively leverage their information about uncertainty across the supply chain, and to utilize the supply chain's capabilities to reduce risk and improve performance.

The discussion and examples below show how this can be done, first for commodity products and then for custom products.

Commodity products

Successful buyers and sellers of commodity products:

- > Understand and leverage differences in the circumstances, objectives, and market views of their potential trading partners
- > Proactively quantify and manage the impact of uncertainty about demand, supply, and price on their performance and risk, and the performance and risk of their supply chain

The three steps of proactive risk management meet these requirements:

- 1) Generate range forecasts for key sources of uncertainty
- 2) Evaluate business strategies based on their ability to meet performance objectives across the potential forecast outcomes the range forecasts capture
- 3) Manage based on the complete view of and control over future performance and risk this provides

The example below of two buyers and two sellers illustrates how this is accomplished.

STEP #1: GENERATE RANGE FORECASTS

In the first step, each of the two buyers and sellers develops range forecasts for their key sources of uncertainty, as illustrated in Figure 4. The red, blue, and green lines in each chart represent the simplest possible range forecasts – low, base, and high scenarios.

Buyer #1 is sourcing the material to build a low margin product. As the buyer's demand range forecast shows, the product has a relatively long product lifecycle and low demand uncertainty. In contrast, buyer #2 is sourcing the material for a high margin product with a short product lifecycle and high demand uncertainty.

On the supply side, supplier #1 has limited excess capacity, which it would like to use to capture high margin business. In contrast, supplier #2 is at capacity, and considering a capacity addition.

Finally, the price range forecast in the middle of the figure represents the market price uncertainty each of the firms faces.

STEP #2: DEVELOP PLANS THAT PERFORM WELL ACROSS THE RANGE OF POSSIBLE OUTCOMES

In the second step, buyers use the information captured by their range forecasts to structure a "portfolio" of supply commitments that:

- > Minimizes cost while meeting risk and flexibility requirements
- > Enables suppliers to make effective capacity, production, and inventory decisions

Making Supply Chain Risk Management Part of Your Core Management Process

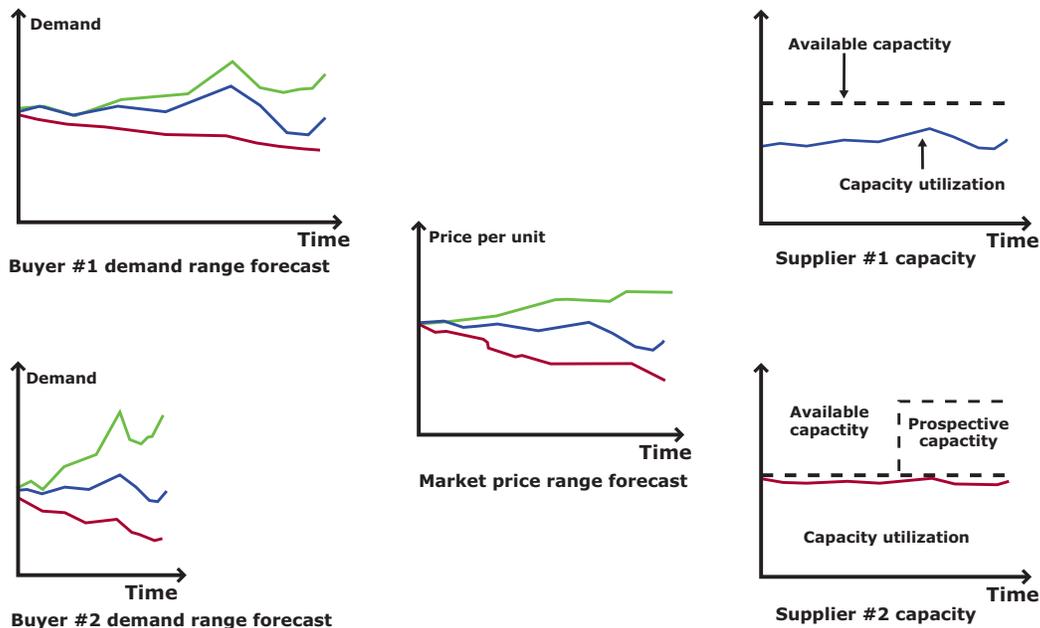


Figure 4.

To do so, buyers first use the information about their worst case demand, which in the simple range forecasts above is represented by their low demand scenario, to reduce their *suppliers'* cost and risk.

Specifically, because the buyer has a high degree of confidence it will require material up to at least its low demand scenario, it can "insure" its supply base against demand below this level at minimal risk. This "insurance" allows the supply base to reduce cost and improve performance through long lead time planning, sourcing, and production, allowing it to create value it can share with the buyer through lower pricing and improved availability.

For example, buyer #2's relatively short-term demand visibility can be used to guide more efficient supplier inventory and production decisions. Because buyer #1 has longer term forward visibility, in addition to guiding supplier inventory and production decisions, it can also guide longer

term supplier decisions such as tooling and capacity investments. As a result, buyer #1's insurance has greater value to the supply base, which enables it to earn a larger price discount. Also, because buyer #1 has less demand uncertainty, it can commit a larger percentage of its overall spend in this way. This enables it to benefit from its "insurance" price discount on a larger fraction of its overall spend.

To summarize, relative to standard sourcing arrangements, under the first step of proactive supply risk management buyers commit the portion of their future demand they are confident will occur. This portion is defined by the region below the low end of their demand range forecast. By committing it, buyers enable their suppliers to reduce cost and risk, and improve performance. As compensation, buyers receive price discounts proportional to 1) the duration of their forward demand visibility, and 2) the level of their demand uncertainty, since together these define the value of the "insurance" their commitments provide.

Making Supply Chain Risk Management Part of Your Core Management Process

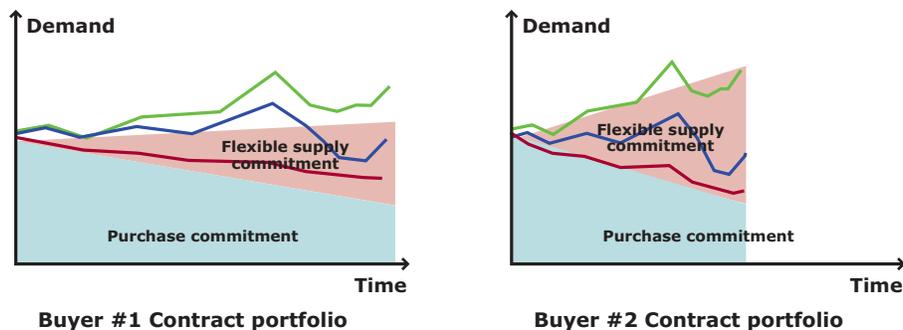


Figure 5.

In the second step, buyers turn their focus to securing contingent supply for their uncertain potential demand, as represented by the region between the bottom and the top of their range forecast, or in the simple example above, between their low and high demand scenarios. In this region it is suppliers who “insure” buyers by drawing on their ability to provide flexible production and delivery. To ensure they have access to needed supply at the lowest possible cost of insurance the supply base must incur to guarantee it, buyers must use their demand range forecast to quantify the size of the region, and communicate a credible and specific request for that quantity of flexibility.

For example, because buyer #1 has lower demand variability and longer term forward visibility than buyer #2, its flexibility requirements are proportionally smaller and it can communicate them to its suppliers at greater lead time. As a result, its flexibility costs will be smaller. However, because the margin on the product it is sourcing the material for is low, its most profitable strategy may not be to secure assured supply all the way up to its high demand scenario, and in particular for the upper part of this region, where the probability of demand actually being realized is lowest. In contrast, because buyer #2 is sourcing the material for a high margin product, it is likely that its optimal flexible supply commitment will cover all potential demand. See Figure 5.

SUPPLIER PERSPECTIVE

The analysis above focused on constructing buyer “contract portfolios” that both meet buyer requirements and minimize the cost and risk the supply base must incur to support them. As a second step, buyers and suppliers must also determine 1) the supplier best suited to serve each of these buyer contracts, and 2) how this choice of supplier impacts cost, value, and risk across the supply chain.

In the example above, supplier #1 has excess capacity it seeks to fill with high margin business, while supplier #2 has no excess capacity and is considering adding capacity. As a result, supplier #1 is well suited to serve the flex contracts the two buyers require, and in particular the high margin, short-term flex contract buyer #2 requires. In contrast, supplier #2 is well suited to buyer #1’s longer term, higher volume purchase commitment, which may provide just the “anchor” demand it requires to make investment in its new facility viable.

More generally, because buyers architect individual contracts to match the risk characteristics of the different “segments” of their demand defined by the regions of their range forecasts, each of these individual contracts have very different risk characteristics. As a result, the “portfolio of suppliers” best suited to this portfolio of contracts is often equally diverse across its capacity resources, geographic location, and other business circumstances and objectives.

Making Supply Chain Risk Management Part of Your Core Management Process

MANAGING PRICE UNCERTAINTY

Finally, to manage their exposure to price risk, buyers and suppliers choose price terms for their contracts. These may include either fixed price schedules or “market” or “index” based pricing that follows market conditions, subject to potential price caps and floors. See Figure 6.

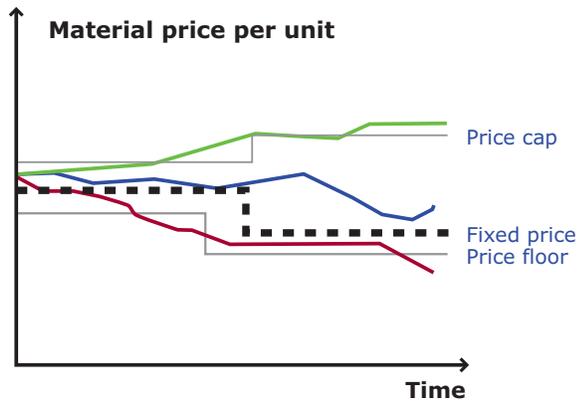


Figure 6.

In most cases, the right pricing terms for a specific buyer or supplier are the terms that give its costs and revenues the same exposure to price changes, and therefore manage margin risk through “asset-liability” matching. For example, a buyer that is sourcing material for a product sold under fixed price contracts should in general seek fixed-price supply to lock in its product margin. Similarly, a supplier with a variable price-based cost structure should choose market or index-based pricing for its sales contracts.

Who’s doing it

HEWLETT PACKARD

Hewlett Packard buys over \$30 billion of high technology components per year, nearly all of which are subject to substantial fluctuations in price and availability. As a result, HP began using the proactive risk management process described above in its procurement activities in 2000.

Paraphrasing Greg Jacobus, the first manager of HP’s procurement risk management group, “Previously we were paying one ‘flex-loaded’ price for every unit we bought. Procurement risk management has allowed us to eliminate that flex premium for material we’re sure we’re going to need, and to negotiate appropriate pricing for upside supply to meet our best case sales outcomes. The net result is lower average per unit prices *and* higher service levels.”

FORD MOTOR COMPANY

Ford uses sophisticated range forecasts of the price of key commodities such as steel, which include tens or hundreds of price scenarios, to structure and evaluate supply contracts and portfolios of supply contracts. Consistent with the discussion above, Ford structures its contracts with individual suppliers to leverage their specific strengths, business circumstances, and objectives. It then builds portfolios from these individual contract building blocks to best meet its overall objectives for supply cost and risk.

Custom products

The proactive risk management process for commodity products described above, and the tailored portfolios of “fixed” and “flex” contracts used to implement it, apply equally well for custom products, and deliver comparable benefits for supply chain performance and risk. However, because the one-to-one nature of buyer-supplier relationships for custom products makes effective coordination even more essential, it is often worthwhile to extend the process to include a third dimension of uncertainty, which is learning over time.

Learning about demand uncertainty occurs as better information about future demand becomes available over time. In the proactive risk management process, this on-going resolution of uncertainty about future demand is captured by the evolution of demand range forecasts over time (see Figure 7). This learning is used in the proactive risk

Making Supply Chain Risk Management Part of Your Core Management Process

management process to provide the best possible guidance for the key decisions suppliers must make at each key lead time in advance of product shipment. For example, a supplier may need to:

- > Make a tooling decision six months in advance
- > Initiate production two months in advance
- > Stage finished goods inventory two weeks in advance

Alternatively, a supplier may have the option to:

- > Begin production in a facility in China six months in advance
- > Begin production at a more expensive domestic facility two months in advance
- > Ship from a distribution facility two weeks in advance

To provide suppliers with the best possible guidance for each of these decisions, buyers can structure their flexible supply contracts to include purchase options matched to the lead time of each of the supplier's key decisions.

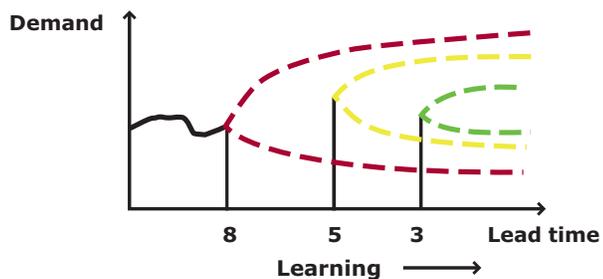


Figure 7.

To do so in the two scenarios above, the buyer and supplier may negotiate one flex supply commitment with low pricing, but which requires the buyer to place committed orders at a six-month lead time. Because the six-month lead time matches the lead time of the first production decision the supplier must make (in the first example, the tooling decision, and in the second example initiation of production in

China), buyers can use the demand information available to them six months in advance to improve those decisions. In return, the buyer benefits from the reduction in supply cost and the assurance of upside supply suppliers can provide with this improved planning information.

Next, at a two month lead time, the buyer can use a second, complementary flex commitment to communicate the additional information it has gained about its future demand by two months in advance of product delivery. When the buyer communicates this additional information the supplier can make the best possible planning decision at a two month lead time (which in the first example above is how much production to initiate, and in the second example, how much domestic production to initiate). Finally, a third flex commitment with a two-week order lead time can be used to allow the buyer to guide the supplier's final, two-week lead time decision with further updated information in a similar way.

To summarize, adding lead time as a contract dimension enables supplier planning, and therefore supply chain performance and risk, to benefit from the on-going improvement in information about demand that becomes available to the buyer over time. This adds a dynamic dimension to the "fixed" and "flex" contract portfolios of the commodity material example above. By doing so, the amount of flexibility the buyer requires as the lead time to delivery drops can be reduced, and with it the cost and liability the supply base must incur to support the buyer's requirements.

Who's doing it

INTEL

The largest component of Intel's manufacturing expense is the cost of the sophisticated tools required to manufacture semiconductors. Those tools account for roughly 80% of the cost of Intel's manufacturing facilities. Because the lead times for these tools range from six to 12 months, semiconductor manufacturers like Intel have traditionally been

Making Supply Chain Risk Management Part of Your Core Management Process

required to place orders for them based on highly uncertain forecasts of demand, up to a year in advance, creating large risks of excess capacity and costly lost sales.

To address this risk, Intel has adopted the use of “tool procurement options.” Tool procurement options provide the right to buy tools at reduced lead times and, therefore, to leverage improved demand information as it becomes available over time. In exchange for this right, Intel assumes a portion of the cost and risk the tool supplier must assume to guarantee the reduced lead time.

Because delivery lead time for semiconductor manufacturing tools is driven by the lead time of key components, to support a reduced lead time supply commitment a tool supplier must secure the components required to “buy down” the tool lead time to the committed level. Because more key components must be “staged” to support shorter lead time options, a natural trade-off exists between the cost and the lead time of procurement options. By evaluating this cost schedule in combination with the rate it expects to learn about demand over time, as captured by its range forecast, Intel can optimize the number and lead time of the options it purchases and utilizes (see Figure 8).

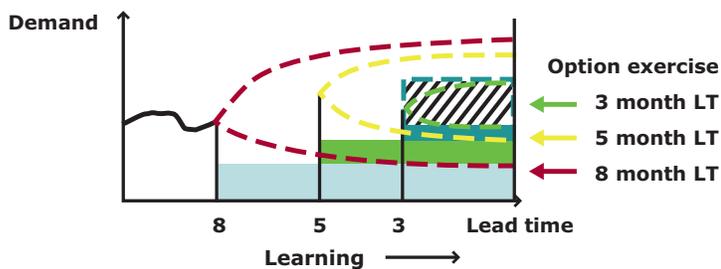


Figure 8.

AGILENT TECHNOLOGIES

Agilent Technologies has used portfolios of sourcing contracts of the kind described above, composed of purchase commitments together with both short and long lead time

flexible supply agreements, to manage its relationships with suppliers of custom components for several years. In addition to realizing cost and risk savings, both Agilent and its suppliers report that by proactively managing uncertainty they have been able to substantially reduce fire-fighting, performance surprises, and conflict in their relationships, and by doing so reduce the amount of both staff and management time required to maintain the relationships.

Using Proactive Risk Management to Manage Complex, Interdependent Activities Within a Company

In addition to relationships with key partners, proactive risk management can be applied to reduce risk and improve the performance of complex, interdependent activities executed within firms. For example, product design decisions impact both a product’s marketing and sales potential and its material sourcing and manufacturing requirements. Because there are many different activities of this kind, in this section a representative example is reviewed. This is Ford’s use of proactive risk management to jointly optimize its investment in assembly capacity, its sourcing cost and flexibility, and its component commonality.

JOINT OPTIMIZATION OF VEHICLE ASSEMBLY CAPACITY FLEXIBILITY, COMPONENT SOURCING FLEXIBILITY, AND COMPONENT COMMONALITY AT FORD MOTOR COMPANY

Ford is able to predict its overall vehicle sales with reasonable accuracy, but faces much greater uncertainty when trying to forecast the sales of individual models and options on those models. Of course the later is the level at which it must match demand to supply.

In the auto industry, creating production flexibility to serve demand uncertainty at the model and option level is challenging and expensive due to the complex machinery, tooling, and manufacturing processes required, both at automakers such as Ford and their component suppliers.

Making Supply Chain Risk Management Part of Your Core Management Process

For example, although Ford can build factories with the flexibility to assemble two or more vehicles, flexible assembly capacity is both more expensive and generally has lower throughput rates than capacity optimized to a single model. In addition, for Ford to realize the value of flexible assembly capacity, its suppliers must be able to provide equal or greater flexibility in their supply of components, which is also costly. To determine the total cost of production flexibility, Ford combines the costs of the assembly flexibility and the supply flexibility required to support it.¹

Finally, because the variability of Ford's demand is largest for individual models and gradually smoothes as it is aggregated across multiple models, Ford also evaluates the opportunity to include common components across its models. The use of common components allows Ford to reduce the amount of supply flexibility required to support the same level of assembly flexibility, and therefore its overall cost of production flexibility.

To implement this approach, Ford first creates range forecasts of the demand for individual models. Next, to quantify the reduction in demand variability that can be achieved by aggregating demand across models using component commonality and flexible assembly capacity, it also analyzes the correlation in demand across models. To execute the initiative, rather than build a single team with members from factory design, procurement, and product design and engineering, Ford breaks the problem down into tractable pieces to ensure efficiency and accountability. Specifically, a team from factory design is given responsibility for analyzing the cost and feasibility of alternative levels of assembly flexibility, a team from procurement the same responsibility for

evaluating alternatives for supply flexibility, and a team from product design responsibility for working with engineering and marketing to assess the performance impact and market value of alternative choices for custom versus commodity components. To make the best combined decision, product line managers combine the results from each group. Once a decision has been made, Ford ensures each team is held accountable for implementation and execution.

Future State: Enterprise-wide Proactive Risk Management

This section describes the resources required to support deployment of proactive risk management across a company's activities, including its external relationships and its key internal activities. The resources include data, analytics, business processes, and management reporting (see Figure 9).

At the foundation is the *data layer* provided by an enterprise data warehouse that stores:

- > **Data from across the business required to generate range forecasts for supply, demand, price, and other key sources of uncertainty**
- > **Information about business assets and relationships required to analyze the performance of prospective business strategies across the potential forecast outcomes captured by the range forecasts**
- > **Information about the "playbook" execution plan and projected performance of business strategies across the potential forecast outcomes for use in planning, execution, performance management, and accountability**

¹ A major European auto manufacturer overlooked the need to secure sufficient supply flexibility to support its planned investments in assembly flexibility. As a result, it only factored in the cost of assembly flexibility when it assessed the overall cost of flexible production, which led it to build a highly flexible assembly facility. Shortly after the new assembly facility was opened, it became clear its production flexibility would be constrained by insufficient supply flexibility. Although additional supply flexibility was obtained, the level of supply flexibility required to support the full assembly flexibility of the plant proved uneconomic. As a result, the company was left with an expensive, low throughput assembly facility with underutilized flexibility.

Making Supply Chain Risk Management Part of Your Core Management Process

Capabilities required to

Management Layer	Objectives, incentives, and accountability for performance across potential outcomes of uncertainty
Planning Layer	Design and evaluate playbooks to: <ul style="list-style-type: none"> > Meet management objectives > Optimize supply chain performance across potential outcomes of uncertainty
Execution Layer	Execute playbooks based on evolving circumstances Dynamically update range forecasts
Data Layer	Enterprise Data Warehouse Data required to: <ul style="list-style-type: none"> > Generate range forecasts > Design and evaluate business strategies > Record performance across outcomes

Figure 9.

Next is the **execution layer**. In this layer analytics are used to:

- > Dynamically update range forecasts over time as new information arrives in the enterprise data warehouse
- > Update the “playbook” to coordinate execution and respond to dynamic updates in range forecasts and other key business drivers

In the next level, the **planning layer**, managers use analytics to develop and dynamically adapt plans and strategies over time to address:

- > Changes in their business circumstances and objectives, and those of their key customers, partners, and suppliers
- > Dynamic updates of range forecasts

The top layer is the **management layer**. Business unit managers and other senior executives use the analysis and reporting capabilities in this layer to monitor actual current performance and projected future performance across potential forecast outcomes to ensure that:

- > Operational managers are executing according to the agreed “playbook” and delivering the performance projected for the demand and supply outcomes that are being realized
- > Planning and business managers responsible for designing and implementing business strategies are executing to management’s performance objectives for each product line and business segment, including trade-offs between cost, risk, market share, and profitability
- > Appropriate incentives and accountability are in place to drive ongoing improvements in performance on each of these dimensions

Making Supply Chain Risk Management Part of Your Core Management Process

Summary and Conclusions

Proactive risk management enables companies to close the “plan-reality” gap that results when companies execute to “best-guess” plans in business environments that are uncertain and dynamic. It does so by providing 1) visibility to performance across the range of possible forecast outcomes, and 2) the ability to structure, evaluate, and execute “play-books” that coordinate both internal activities and external relationships to ensure performance objectives are met across potential forecast outcomes. By doing so, proactive risk management enables effective and predictable management of performance in an uncertain environment, and delivers substantial reductions in risk and improvements in performance.

References:

I INTEL

Vaidyanathan, V., Metcalf, D., and D. Martin, “Using Capacity Options to Better Enable Our Factory Ramps,” *Intel Technology Journal*, Vol. 9, Issue 3, pp. 185-191.

Johnson, Blake, “Optimizing Tool Availability and Lead Time with Procurement Options”, *Proceedings of the Thirteenth Annual International Symposium on Semiconductor Manufacturing*, San Jose, California, September 2005.

II FORD

Everson, Mark and Blake Johnson, “Joint Optimization of Vehicle Assembly Capacity Flexibility, Component Sourcing Flexibility, and Component Commonality at Ford Motor Company” *Parallax View*, Chainlink Research, Boston, Massachusetts, June, 2004.

III AGILENT

VanDam, Chuck, “Supply Chain Risk and Flexibility Management at Agilent Technologies” *Parallax View*, Chainlink Research, Boston, Massachusetts, June, 2004.

IV HP

Nagali, Venu, “Procurement Risk Management at HP”, *Conference on Integrated Risk Management in Operations and Global Supply Chain Management: Risk, Contracts and Insurance*, University of Michigan, June 2006.