Supply Chain Management on Demand

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Supply Chain Management on Demand

Strategies, Technologies, Applications

With contributions by numerous experts

With 87 Figures

Springer

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Introduction

During the 1990's, the competitive pressures and short product lifecycles have caused many manufacturing and retail companies to focus on supply chain management practices and applications. Along with the Internet-driven e-Commerce, supply chain software companies became the darling of investors and supply chain practitioners. Indeed, more than any other three letter acronym initiatives such as MRP (Materials Requirements Planning), TQM (Total Quality Management), JIT (Just-In-Time), or CFM (Continuous Flow Manufacturing), Supply Chain Management (SCM) was a program which seemed to broaden the boundaries of business optimization beyond the four walls of the companies, as it addressed cross-organizational or even cross-company issues.

More demanding and sophisticated customers expected customized products (e.g. computers, cars) and short delivery times. Customers' buying decisions were often based on availability, not just on quality and price of the product alone. This created demand for more reliable, capacitated production planning and "available to promise" functionalities. Shorter product cycles not only changed the way products had to be manufactured, but also the way inventory (parts, sub-assemblies, and finished goods) had to be managed. Companies made big efforts to reduce their inventories, even with slogans such as "Zero Inventory", which of course was a vision that could not be achieved. However, various intelligent methods of inventory management were introduced to find optimal stock levels.

Continuing shifts in the geopolitical situation (e.g. NAFTA, Extension of European Union) and emerging markets (e.g. Eastern Europe and China) opened new business opportunities and at the same time kept companies busy revising their supply chain structures such as manufacturing locations, warehouse locations, inbound logistics, and distribution operations. This led to an increased demand in strategic supply chain planning tools such as supply chain simulators and location optimization tools.

Furthermore, companies have understood that in order to be more competitive, partners in a supply chain have to closely work together. However, mistrusts between partners have prevented them from adapting new available technologies to collaborate. Often the benefits of improved supply chain management practices have gone to the gorillas in the supply chain such as Wal-Mart and Dell, and much less to their smaller partners.

Indeed, competitive pressures of the 1900's have only gotten exacerbated, with global competition further squeezing profit margins, and the uncertain worldwide political and economic conditions have made the supply chain risks that much worse. Companies need to be able to react to changes more quickly and are also seeking new ways of avoiding risks or sharing risks with their supply chain partners.

As a result of the economic realities and understanding of supply chain management practices, many companies have introduced sound SCM practices and solutions (often referred to as APS or Advanced Planning and Scheduling). In addition most ERP (Enterprise Resource Planning) applications have now incorporated supply chain management functions and are becoming more mature, for example, SAP's APO modules. With the adoption of the Internet for businesses, some companies are successfully practicing collaboration over the Internet. With all these advances, yet, companies are looking for more differentiation to be competitive.

New techniques and practices for highly efficient supply chain management are being made possible by the rapid progress in information and communication technologies, laying the foundation for a new wave of applications. As we experience daily, performances of computer systems are still increasing exponentially. This includes processor speed as well as memory size and bandwidth. This enormous progress makes applications possible that were unthinkable a few years ago.

These advances are especially beneficial for quantitative models for decision making. Operations research methods such as mathematical programming, queuing and inventory theory, and stochastic optimization are receiving new attention in SCM applications, even though they had been in practice in other businesses for many years.

On the 'sell-side', the move from printed price lists and catalogs towards online price information communicated over the Internet has opened possibilities for more flexible pricing. With this, the manufacturing industry is adopting practices that e.g. the travel industry (e.g. airlines) has been using already for many years. On the 'buy-side', electronic connectivity between manufacturers and their suppliers opens new ways for negotiations and contract management. With new forms of more flexible contracts, both manufacturers and their suppliers can better cope with the uncertainties in demand, and its associated risks. Flexible contracts require new decision support systems that use stochastic versus purely deterministic techniques. These techniques have been practiced in the financial markets or the energy markets and now are being adopted for SCM practices. In manufacturing, production planning was traditionally done under deterministic assumptions. But the constraints in demand and supply, the manufacturing and transportation times, and the availability of resources are often stochastic in their nature. New approaches to cope with uncer-

tainty in production planning have been demonstrated. An example is implosion technology that complements classical MRP bill-of-material explosion to take unforeseen material shortages into consideration.

The Internet has become a communication medium that is accessible from practically anywhere in the world. It exceeds the possibilities of electronic data interchange (EDI) by far. For a short period of time, between 1999 and 2001, this development was discussed with much hype under the notion of e-marketplaces. This idea which was driven by the dot.com hype was rather unproductive and therefore we avoid the term e-marketplaces. The fact is that the number of electronic transactions between companies is irresistibly increasing and the integration of processes and information are becoming more and more prevalent. During the past few years, companies have focused on integrating internal applications and business processes in order to reduce costs by automating many of the manual processes, including those associated with supply chain. The same companies have also been integrating with their external partners, suppliers and customers; however, much of such integration still has been in the form of EDI or through extranets which require manual entries. With the advent of new Internet-based standards such as XML and web-services, these companies should be able to integrate the supply chain processes with the external partners more flexibly and automatically. Business process standards such as RosettaNet for the electronics industry or CIDX for the chemical industry, in conjunction with the web-services technologies will also make partner integration much less expensive and time consuming. Even as we write this introduction, these industry organizations are actively working on the standards with the explicit goal of reducing the supply chain process integration costs.

With both increased computing power and connectivity, new applications come into reach, which extend the scope of decision making from single enterprise to multiple enterprises or even the entire supply chain network and which recognize the fact that decisions that have to be made within one enterprise cannot neglect the facts that are not controlled by themselves but are determined by the business environment such as changing demand, changing prices, or changing supply situations. Connectivity and the integration of business processes have laid the foundations for an increased visibility over the entire supply chain. Software technologies like portals, data warehouses, reporting systems, and on-line analytical processing (OLAP) are providing the necessary information and visibility for the decision makers. The next step is to assist the decision maker to quickly and optimally respond to unexpected situations. Intelligent analytics can automatically determine the best decision alternative and predict its consequence on the supply chain performance. We use the phrase “sense and re-

spond" to characterize such a supply chain management system that is able to respond quickly and optimally to unexpected situations.

With the innovative practices and technologies described in this book, companies are able to reach a new level of excellence in managing their supply chains. We call this Supply Chain Management on Demand. According to IBM's definition, an On Demand Business is an enterprise whose business processes – integrated end-to-end across the company and with key partners, suppliers and customers – can respond with flexibility and speed to any customer demand, market opportunity or threat. An On Demand Supply Chain is a highly dynamic, adaptable business model that integrates information and decisions across all participants in an extended enterprise. Supply Chain Management on Demand is radically changing the way an company thinks about its organization and processes. It is transforming the supply chain from a competitive necessity to a competitive advantage.

In the remaining section of this introduction, we briefly review each of the chapters in this book. These chapters were written by supply chain researchers, consultants, and supply chain practitioners who have not only developed the practices but have deployed these practices in various supply chains at IBM and other companies. They address some of the advances in supply chain management practices we discussed above.

In Chapter 1, William Grey, Kaan Katircioglu, Dailun Shi, Sugato Bagchi, Guillermo Gallego, Mark Adelhelm, Dave Seybold and Stavros Stefanis present a new approach for rationalizing supply chain investments. Traditional ROI analysis has a number of shortcomings. Projected supply chain benefits, such as reductions in inventory carrying costs or logistics expenses, are notoriously difficult to quantify. Putting too much emphasis on cost savings and revenue improvements often means neglecting metrics that support long-term strategic objectives. And traditional approaches rarely consider risk. The analytic tools developed by Grey et al. overcome these shortcomings. These tools form the basis for new risk and opportunity assessments that consultants can use to help their clients make better and more intelligent decisions and extract greater value from their supply chain initiatives.

In Chapter 2, Steve Buckley and Chae An discuss the value of simulation in the context of analysis, planning and control of supply chains. Supply chain simulation complements other analytical techniques such as spreadsheets and mathematical optimization. A particular strength of simulation is the ability to consider uncertainty that is found everywhere in the supply chain, for example in customer demand, lead times and supply availability. Although optimization under uncertainty is an important research topic, few commercial supply chain optimization tools already sup-

port it. As Buckley and An point out, supply chain simulation has become an easily accessible, easily usable and flexible technology to address a wide range of supply chain problems under uncertainty.

Chapter 3, by Feng Cheng, Markus Ettl, Grace Lin and David Yao, focuses on inventory as one of the main cost drivers in supply chain management. Inventory costs, which include price protection, financing, inventory write-downs (price erosion), and inventory write-offs (obsolescence) can have a tremendous impact on business performance. The complexity of today's end-to-end supply chains makes it a serious challenge to determine where to hold safety stock in order to minimize inventory costs and to provide a committed level of service to the final customer. Cheng et al. describe the development of analytical models for the optimal placement of safety stocks in multi-echelon supply chains that are subject to forecast, lead time, and attach-rate uncertainty. They focus on applications in high technology supply chains.

In Chapter 4, Aliza Heching and Ying Tat Leung describe how traditional pricing practices are changing in the era of e-business. They provide an overview of common pricing practices and the strategic and tactical pricing-related decisions faced by a seller of products. They describe key features offered by commercial pricing systems. Finally, Heching and Leung review some case studies which demonstrate the level of financial benefits that have been derived from implementation of price optimization systems. The case studies also serve to illustrate the typical first steps taken by businesses that wish to experiment with price optimization.

In Chapter 5, Brenda Dietrich, Daniel Connors, Thomas Ervolina, J.P. Fasano, Robin Lougee-Heimer and Robert J. Wittrock give an example of how limitations of traditional manufacturing resource planning (MRP/MRP II) systems can be overcome by supplementary mathematical planning systems. MRP systems break down the finished goods demand into material requirements according to the BOM structure (material "explosion"). The assumption is that all materials – either produced in-house or ordered from suppliers – will be available when needed for production. This is rarely the case due to the uncertainties that are inherent in supply chains. Dietrich et al. have developed an "implosion technology" that takes into account materials shortages and solves the "resource allocation problem" to optimally determine which end products should be produced under the limited material availability. Successful deployments have shown that this technology can significantly reduce the cycle time of the planning process and increase manufacturing efficiency.

In Chapter 6, Robert Guttman, Jayant Kalagnanam, Rakesh Mohan and Moninder Singh provide an overview of the various functions in sourcing and procurement. They provide a brief description of IT technologies and the mathematics that underlie these technologies, discuss the functionality

offered in current commercial platforms, and provide a roadmap of future useful features.

In Chapter 7, Colin Kessinger and Heiko Pieper present a solution that incorporates risk and uncertainty into sourcing and procurement decisions. The solution is based on mathematical models that adapt and extend financial engineering techniques. As Kessinger and Pieper point out, a number of companies have already adopted this technology to proactively manage risk and flexibility in their supply chains. Their Supply Risk and Flexibility Management (SRFM) framework focuses on risk-adjusted sourcing costs, quantifying the performance of supply agreements (contracts) against a range forecast. A set of industry examples spanning the Automotive, Consumer Packaged Goods and High-Tech sector demonstrate the use and benefits of this approach.

In Chapter 8, Moritz Fleischmann, Jo van Nunen, Ben Gräve and Rainer Gapp review the field of reverse logistics. They discuss its opportunities and its challenges and indicate potential ways for companies to master them. They highlight what makes reverse logistics different from conventional supply chain processes, but also point out many similarities. Fleischmann et al. review key results from academic literature and complement them with illustrations of reverse logistics practice at IBM.

In Chapter 9, Michel Draper and Alex Suanet give an overview of recent developments in service parts logistics management. They make a comparison with traditional (finished product) supply chain management and describe the specifics in the service parts supply chain. The concepts are illustrated by examples. Draper and Suanet see rapid changes in the service logistics environment and include their vision on further developments in the near future.

In Chapter 10, Santhosh Kumaran and Kumar Bhaskaran position business process integration as one of the major enabling technologies for supply chain management. In today's business environment, there is an increasing demand for flexibility of IT solutions. In order to stay competitive, enterprises must be able to quickly respond to changing business conditions. Business Process Integration and Management (BPIM) constitutes a set of technologies that serve as the foundation for creating flexible and agile supply chain solutions. The authors present a vision for future supply chain management systems, identify the technical challenges in realizing this vision, and outline a solution leveraging BPIM technologies.

In Chapter 11, Chris Nøkkentved gives an overview of collaboration in the supply chain. He explains the evolution from supply chains to e-supply networks, driven by the growing business usage of the Internet. He describes the new competitive landscape of e-supply networks and discusses new forms of inter-company relationships. Nøkkentved distinguishes col-

laborative processes between manufacturers and customers, between manufacturers and suppliers, and between manufacturers and 3rd party logistics providers. He concludes his chapter with implementation considerations.

In Chapter 12, Steve Buckley, Markus Ettl, Grace Lin and Ko-Yang Wang introduce the Sense-and-Respond paradigm for intelligent business performance management. Sense-and-Respond is a new customer-centered approach that provides real-time responsiveness necessary for organizations to proactively manage their supply chain. Buckley et al. describe a Sense and Respond Value Net Optimization framework that continuously recognizes and transforms events of business processes, generates and provides access to current business performance indicators, and immediately triggers appropriate actions across the entire enterprise and beyond. Two pilot applications of the Sense-and-Respond framework are presented.

Chae An and Hansjörg Fromm

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1 Beyond ROI[1]

William Grey, Kaan Katircioglu, Dailun Shi, Sugato Bagchi,
Guillermo Gallego, Mark Adelhelm, Dave Seybold, and Stavros Stefanis

Faced with heightened competition and a weak economy, companies are spending far more time developing business cases to justify their supply chain initiatives. Executives, consultants, software vendors, and project leaders alike have turned to return on investment (ROI) analysis as their tool of choice. But is this newfound interest in financial analysis paying off? Or is it just creating more confusion and sometimes driving poor investment choices? When it comes to analyzing supply chain initiatives, ROI analysis often falls short.

IBM Research, in collaboration with IBM Global Services, has developed a new approach for rationalizing supply chain investments. By taking ROI to the next level, it helps you make better decisions and extract greater value from your supply chain.

1.1 Where ROI Falls Short

When properly applied, ROI analysis is a powerful tool. And greater management attention to quantifying business impact certainly leads to more intelligent supply chain investments. However, ROI analysis is especially difficult to apply when analyzing supply chain improvements. Projected supply chain benefits, such as reductions in inventory carrying costs or logistics expenses, are notoriously difficult to quantify. Although the "hard" benefits reported in a typical ROI analysis may appear authoritative, they often rely heavily on assumptions about the impact of anticipated operational improvements. In many cases, these assumptions represent little

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more than educated guesswork by individuals who won't actually be called on to deliver the improvements.

Another potential difficulty with traditional ROI analysis is that it doesn't consider interactions between supply chain initiatives. Firms typically have a portfolio of supply chain projects that they plan to deploy. Since these projects frequently have overlapping benefits, analyzing each project independently can lead to double counting. It may also ignore synergies between initiatives with interdependencies that make them *more* valuable when they are deployed together. Furthermore, unless a consistent framework is used to quantify the supply chain benefits of different projects, comparisons will not be valid.

The strength of ROI – its unerring focus on a narrow set of financial benefits – can also be a weakness. By placing too much emphasis on the cost savings or revenue improvements associated with a supply chain investment, companies may neglect other metrics that are also critical to business success. This encourages investments in initiatives that generate short-term gains, without helping the company achieve its long-term strategic objectives.

Another shortcoming of traditional ROI analysis is that it often doesn't adequately address risk. Initiatives may be delayed, or may not deliver their anticipated value. Projected benefits are sometimes sensitive to assumptions about the external business and economic environment. Initiatives that perform well in a strong market may deliver only limited value if economic conditions deteriorate. Other initiatives that position a company to take advantage of new market opportunities may show few tangible benefits when analyzed using static ROI analysis.

ROI analysis tends to be reactive, rather than proactive. Detailed business cases are usually created late in the game – *after* potential supply chain initiatives have received internal sponsorship and support. Instead of designing initiatives to improve their business, decision-makers find themselves designing business cases to justify their initiatives. By failing to act early, executives miss an opportunity to reshape or redirect their initiatives' scope or focus in ways that would increase business impact.

1.2 ROI is dead. Long live ROI …

Despite its shortcomings, ROI analysis *can* and *does* provide a solid basis for analyzing business value. However, organizations often fail to exploit its full potential. By carefully rethinking your approach to the ROI process, you can transform ROI into a far more effective decision-support tool. To help you do this, we recommend six concrete steps you can take to extract additional value from your supply chain investments:

- ***Go deeper***. Analyze the causes of supply chain value, not just the effects.
- ***Quantify the impact***. Build a richer model to evaluate the link between supply chain performance and business value.
- ***Be consistent***. Develop a common, consistent framework for comparing and evaluating initiatives.
- ***Don't just follow the money***. Consider management objectives that go beyond immediate financial benefits, and focus on strategic intent.
- ***Consider risk***. Understand each initiative's likelihood of success, and how it helps your supply chain adapt and respond to changes in your business environment.
- ***Put ROI to work***. Don't just use financial analysis to defend your initiatives. Instead, use it to define your supply chain strategy, and to focus and manage your supply chain efforts.

Properly applied, these steps can help you make better investment decisions, thus improving the performance of your supply chain.

1.2.1 Action 1: Analyze Supply Chain Value Drivers

Traditional ROI analysis works well when quantifying the benefits of a supply chain initiative that has a direct impact on *financial* performance. This would be the case, for example, for an initiative focused exclusively on cutting costs through headcount reductions.

In practice, though, supply chain initiatives usually deliver much of their business value by improving *operational* performance. Such improvements ultimately translate into better financial performance. However, estimating *how much* they improve financial performance requires going beyond traditional ROI.

Consider, for example, the case of a hypothetical personal computer manufacturer considering a major redesign of its supply chain. The company's management was evaluating a number of initiatives, including demand planning, supply network planning, and order fulfillment management solutions.

The first initiative being evaluated was the demand planning solution. By automating the planning process, it would lead to a small cut in headcount. But the real payoff was expected to come from significant reductions in Finished Goods Inventory. The company's management team was comfortable estimating savings from headcount reductions. But how much would inventory *really* come down? Without a credible mechanism for evaluating the financial impact of operational improvements, management would be forced to resort to educated guesswork.

The first step in quantifying the impact of the demand planning solution is to understand how it affects the company's *supply chain value drivers*. By our definition, a supply chain value driver is an operational metric that passes two important tests. First, it must be directly affected by a supply chain solution or initiative. Second, the metric must have an impact – albeit an indirect one – on at least one of the firm's Key Performance Indicators (KPIs). Think of a supply chain value driver as a "lever" that an initiative can turn to impact business performance.

The proposed demand planning solution affects a number of supply chain value drivers, including demand planning cycle time and forecast accuracy (see Fig. 1.1) These supply chain value drivers (and the others shown in the figure) ultimately impact one of the firm's KPIs – in this case Finished Goods Inventory. For example, shorter planning cycle times make a business more responsive to variability in customer demand, reducing the need for inventory. And more accurate demand forecasts make it easier to effectively match production to customer demand, also resulting in less inventory.

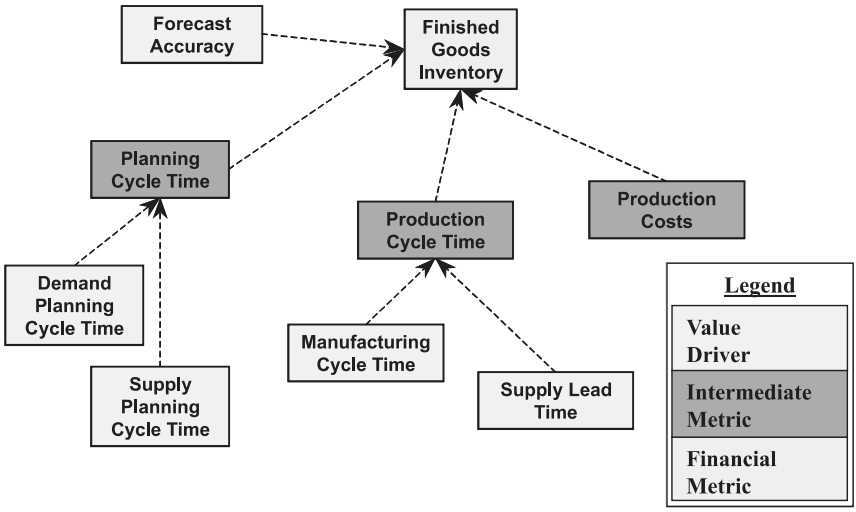

Fig. 1.1. Inventory Value Drives

Since the impact of an initiative on supply chain value drivers is relatively easy to estimate, value drivers provide a solid basis for assessing business impact. The management team evaluating the demand planning solution was having a difficult time determining how much the initiative would affect inventory levels. However, they were reasonably certain of its impact on key value drivers: The initiative would cut weekly demand planning cycle times in half, and increase forecast accuracy by about 10 percent.

1.2.2 Action 2: Quantify Value Driver Impact

Of course, understanding the relationships between supply chain value drivers and financial performance is only half the story. The next step is *quantifying* these relationships. There are a number of ways to accomplish this, including interviews with subject matter experts, analysis of historical data, pilot projects, and mathematical modeling.

The simplest approach is to interview subject matter experts and solicit their estimates of how much a change in a value driver, such as forecast accuracy, would affect inventory levels. Although this approach involves more art than science, it still increases the accuracy of the ROI analysis.

An even more effective approach is to analyze historical data. By comparing historical changes in value drivers such as forecast accuracy with changes in financial metrics like inventory levels, a clearer picture of the quantitative relationship between the two begins to emerge.

One frequent problem with this approach is the difficulty of finding accurate data. Even if data is available, analyzing it can be tricky. Many factors besides forecast accuracy affect inventory levels, and it may be difficult to determine their relative contributions. If a firm's operating environment changes, old relationships may no longer be valid.

Techniques such as multiple regression analysis can be used to assess the impact of supply chain value drivers, such as forecast accuracy, on inventory performance while controlling for other variables. If benchmarking data is available, it can be analyzed in a similar fashion. However, many companies are skeptical of using benchmarking data, because they believe that it may not reflect the unique characteristics of their business.

An excellent way to quantify the relationship between value drivers and financial metrics is to use data collected during a pilot project. A pilot is a project of limited scope, designed to probe the potential of a major initiative before committing to its deployment. Pilots can be carefully controlled and monitored, so data availability is usually not a problem. Because a typical pilot impacts only a few value drivers and financial metrics, analysis of the pilot results is comparatively straightforward. Results from the pilot also reflect current operating conditions. Despite the benefits, in many cases it is not feasible to perform a pilot, because it may introduce additional costs or unacceptable delays.

Finally, the impact of supply chain drivers can be quantified using mathematical models. For example, IBM has created its own proprietary model, which it has used successfully for evaluating supply chain initiatives. This approach has a number of distinct advantages. Once a model has been built and validated, it can be broadly applied to different situations, even if they have not been encountered in the past. Complex interactions between supply chain value drivers and financial metrics are often

difficult to estimate empirically; without using a mathematical model it may not be possible to effectively capture such interactions. Over the last several decades, a broad range of supply chain issues have been addressed in management science and operations research. Practitioners have developed a number of stochastic quantitative models that can be applied to estimate the impact of many supply chain value drivers on certain key financial metrics. In addition, techniques such as Monte Carlo simulation and discrete event simulation can provide further insights into the link between operational changes and financial performance (see section 1.4: Supply Chain Value Modeling at IBM).

To illustrate this approach, we used a mathematical model to analyze the impact of several key supply chain value drivers on a number of financial and operational metrics (see Figure 1.2). The figure shows the impact of each value driver on one of these metrics – finished goods inventory. For the drivers analyzed here, inventory was most sensitive to changes in forecast error, supply lead time, production planning cycle time, and master planning cycle time. Sensitivity was measured as the inventory improvement caused by a unit change in the value driver. For example, the figure shows that a one-day reduction in supply lead time would result in about a three million dollar inventory improvement.

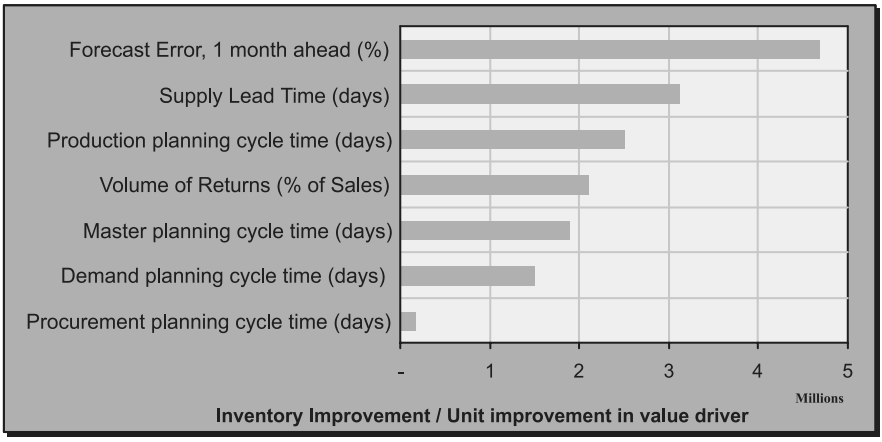

Fig. 1.2. Financial and Operational Impact of Key Value Drives

1.2.3 Action 3: Use a Common Framework

Typically when organizations evaluate a portfolio of supply chain initiatives, they create a separate business case for each initiative. Each business case has a unique set of assumptions about how its initiative will affect fi-

nancial performance. Initiatives are analyzed independently, with no consideration of how interactions between initiatives affect performance.

One of the biggest advantages of quantifying impact at the value driver level is that it provides a common basis for evaluating multiple supply chain initiatives. Instead of being viewed in isolation, these projects can be analyzed as a portfolio. A single model is used to evaluate each initiative. The model uses a common set of assumptions about the impact of supply chain value drivers on financial performance. This helps create a level playing field for comparing initiatives. It also provides a framework for using more sophisticated techniques to analyze initiative interactions, such as synergies and diminishing returns. (See section 1.5: Understanding Value Driver Interactions).

To illustrate this approach, we present a simplified example of how it could be applied to estimate the business impact of a set of initiatives. Although our example focuses on calculating inventory impact, in practice other measures of financial performance would be considered as well.

The process begins by estimating the impact of each initiative on key supply chain value drivers (see Fig. 1.3, which shows a table with the output of this step for the hypothetical personal computer manufacturer). The first column in the table has a list of supply chain value drivers. The next three columns show how each initiative is expected to affect each value driver.

	Impact of Solution on Value Drivers			
Value Drivers	**Demand Planning Solution**	**Supply Network Planning Solution**	**Order fullfillment management Solution**	**Impact of Value Driver on Inventory**
Procurement planning cycle time (days)	-	23	-	200,000
Master planning cycle time (days)	3.5	4	-	1,900,000
Supply Lead Time (days)	-	6	-	3,100,000
Production planning cycle time (days)	3.5	6	-	2,500,000
Premium Freight Costs($)	-	$ 420	-	-
Demand planning cycle time (days)	3.5	-	-	1,500,000
Forecast Error (%)	10%	-	-	4,700,000
Customer Service Management Costs ($)	$ -	$ -	$ 721	-
Defective Orders (% of total orders)	-	-	0.5%	-
Invoicing Errors (% of total invoices)	-	-	2.3%	-
Total order processing time (days)	-	-	4.3	-
Volume of Returns (% of Sales)	-	-	0.5%	2,100,000
Order ship to Customer invoice (days)	-	-	11.0	-

Fig. 1.3. Impact of Solutions on Key Value Drivers

The proposed demand planning solution supports collaborative forecasting and planning with customers. It is thus expected to improve forecast accuracy and enable the company to move from weekly to bi-weekly planning for a number of key processes. These expected improvements are entered in the column labeled “demand planning solution.” As shown in the table, the solution is expected to cut each of these planning cycle times by three and half days, and reduce forecast error by 10%.

Similar entries are made for the other two solutions. Supply network planning is expected to reduce procurement planning cycle times from a month to a week and enable the company to perform daily production scheduling. It would also dramatically shrink supply lead times and cut costs for expediting component shipments. Order fulfillment management would help the company increase the speed and accuracy of its order processing, shipping, and invoicing processes.

The inventory impact of each solution can now be calculated. To make this easier, we included a column in the table showing the impact of each value driver on finished goods inventory. (Note that this is the same information that was shown graphically in Fig. 1.2.)

According to the table in Fig. 1.3, the demand network planning solution is expected to reduce master planning cycle time by three and a half days. For each day the company reduces master planning cycle time, it is projected to cut inventory by about $1.9 million. By taking the product of these numbers, we estimate that master planning cycle time reductions would reduce inventory by $6.65 million. ($1.9 million times 3.5.)

Of course other value drivers, such as procurement planning cycle times and production planning cycle times would be expected to provide additional inventory benefits. And this simple calculation ignores issues like diminishing returns and synergies. More sophisticated modeling techniques, however, can be used to analyze these complex value driver interactions.

Fig. 1.4 shows model outputs reporting the annual financial benefit of each solution, after accounting for the impact of multiple drivers and value driver interactions. Supply network planning has by far the greatest impact, followed by demand planning. Order fulfillment management is a distant third. For all solutions, the most significant savings were associated with Inventory reductions. These included savings in inventory carrying costs and a reduction in write-downs for inventory obsolescence and price declines.

1.2.4 Action 4: Link ROI to Business Strategy

One shortcoming of traditional ROI is that it places too much emphasis on a narrow set of financial benefits. This encourages investments in supply chain initiatives that generate short-term gains but fail to cultivate the key resources and capabilities needed to achieve long-term strategic objectives.

To overcome ROI's myopic focus, extend your analysis to consider a broader set of metrics. This can be done formally, by linking the analysis directly to a balanced scorecard that includes both financial and non-financial metrics. Or it can be done informally, by identifying a set of KPIs

considered critical to business success. The financial benefits reported in a traditional ROI analysis can then be extended to include these additional KPIs. Not all balanced scorecard metrics can be readily quantified, of course. However, including those that *can* improves decision making by providing a clearer view of business impact.

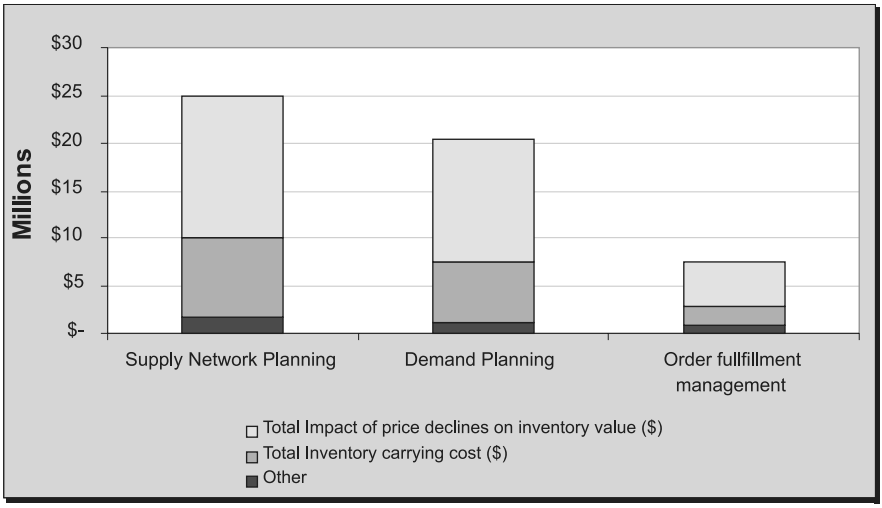

Fig. 1.4. Financial Impact

The hypothetical personal computer manufacturer tracked a number of KPIs, including net income, inventory turnover, and on-time delivery. All three measures were an integral part of the firm's balanced scorecard: net income as a financial metric, inventory turnover as a measure of the effectiveness of internal business processes, and on-time delivery to assess performance from a customer perspective.

Net income was already reported as part of the firm's ROI process. However, inventory turnover and on-time delivery were not. To calculate these additional balanced scorecard measures, follow an approach similar to value-driver analysis.

The first step is to analyze the relationships between the additional KPIs and the financial and operational metrics quantified earlier (see Fig. 1.5). In some cases, these relationships are simply accounting identities.[2] For example, inventory turnover is the ratio of cost of goods sold (COGS) to inventory.[3] In other cases, supply chain value drivers need to be analyzed

[2] For a good treatment of accounting ratios, see: Stickney (1998).

[3] Strictly speaking, inventory turnover is usually defined as cost of goods sold divided by *average* inventories.

as well. For example, on-time delivery performance depends on the balance between finished goods inventory levels and end-to-end supply chain cycle time. Companies with long end-to-end cycle times are less responsive to shifts in customer demand and can only achieve high on-time delivery performance by holding additional inventory. More responsive firms can hold less inventory without sacrificing delivery performance.

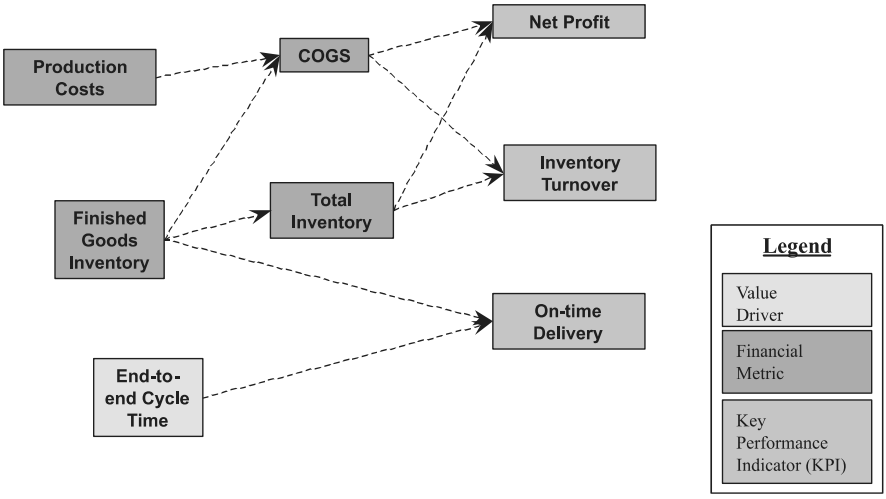

Fig. 1.5. Linking ROI to Strategic Metrics

The next step is to quantify the relationships. For accounting ratios such as inventory turnover, this just requires a simple calculation. More sophisticated analysis is needed to quantify complex interactions – such as the relationship between inventory, supply chain responsiveness, and on-time delivery. Again this can be addressed in a number of ways, including interviews with subject matter experts, historical analysis, and mathematical modeling.

Analyzing a broad set of strategic metrics can provide additional insights that improve decision making. To illustrate this, we calculated the impact of each solution on a number of the personal computer manufacturer's balanced scorecard metrics (see Fig. 1.6).

When viewed through a purely financial lens, supply network planning is by far the most attractive solution (see Fig. 1.4). Its impact – in terms of the narrow measure of financial return reported in a typical ROI analysis – was over twice that of the order fulfillment management solution.

However, when viewed from a strategic perspective, a different story emerges. Order fulfillment management looks much stronger. Because of its impact on accounts receivables, the solution significantly improves on-time delivery, an important contributor to customer satisfaction. It also af-

fects multiple financial metrics, including shareholder value added, cash-to-cash cycle time, and days receivables outstanding. Of the three solutions, it has the broadest and most significant impact on the firm's balanced scorecard. Strategically, order fulfillment management appears to be a more compelling choice.

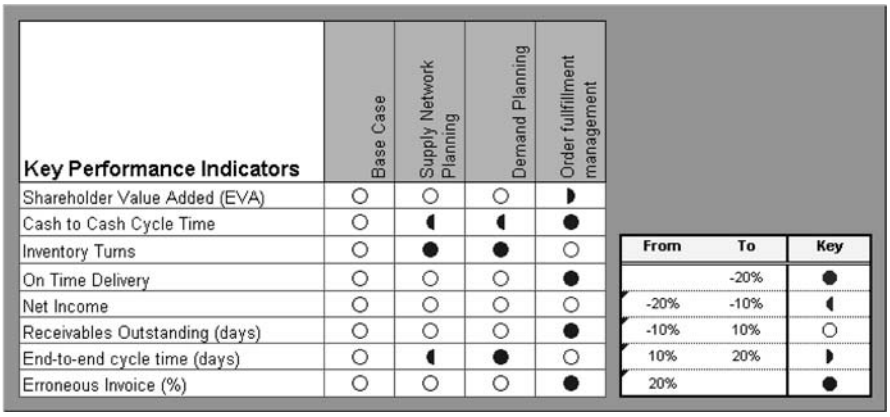

Fig. 1.6. Impact of Solutions on Strategic Metrics

1.2.5 Action 5: Consider the Risks

Traditional ROI analysis often fails to adequately address risk. For supply chain initiatives, risks can be grouped into two broad categories: implementation risks and business risks. Implementation risks include project delays, cost overruns, and outright project cancellations. Business risks are changes in the business or operating environment that either render an initiative obsolete or impair its ability to deliver business value.

The first step in analyzing implementation risk is to develop a qualitative understanding of the levels of risk associated with different initiatives. In general, initiatives with broader scope and greater complexity have higher risk. For IT projects, the maturity of the technology also affects risk. For example, it is generally less risky to implement packaged software than to develop a custom application. Projects can be ranked according to their perceived level of risk. Decision makers can assign a higher hurdle rate to projects with greater risk or insist on a more rapid payback (Hubbard 1998).

To gain a better understanding of business risks, begin by asking yourself what can go wrong. Then consider how changes in the business environment will affect results. Will the solution still deliver its anticipated benefits even if business conditions deteriorate? What potential problems will emerge if conditions suddenly improve?

When assessing risk, don't forget to consider the upside. With supply chain investments, you are often paying for increased efficiency, flexibility, and responsiveness. Increased speed and flexibility creates opportunities to gain market share if industry conditions unexpectedly improve. And initiatives intended to improve supply chain efficiency may provide a valuable safety net during an industry downturn.

Scenario analysis works well for quantifying how different initiatives respond to risk – both on the upside and the downside. Scenario analysis begins by defining a set of "what-if" scenarios that correspond to risky future states of the world. Each scenario modifies key assumptions of the original business case to reflect changing operational, business or economic conditions. A new business case is generated for each scenario, which is then compared with the original. Companies can develop a common set of risk scenarios and then use them to test each initiative being evaluated.

To show the insights that can be gained by assessing risk, we used scenario analysis to test how two solutions being considered by the personal computer manufacturer – demand planning and order fulfillment management -- would perform under different business conditions. We considered two scenarios. In the soft demand case, we assumed that a tough business climate caused a sudden decline in unit sales, accompanied by pricing pressure. In the strong demand case, we assumed that improving economic conditions increased unit sales and firmed up pricing.

Notice how differently business risk affects the two solutions (see Fig. 1.7). When demand is soft, the demand planning solution actually performs better. By improving forecast accuracy and responsiveness, the solution enables the company to more rapidly adjust its inventories to match lower levels of customer demand. When compared to its performance in the base case, it delivers an additional two million dollars in annual benefits. Order fulfillment management, on the other hand, performs worse in a down market. Although the solution improves order management execution by increasing the speed and accuracy of order management processes, it does nothing to improve supply chain responsiveness. When demand drops, it provides no protection against a build-up of excess inventory.

The results are similar when demand rises unexpectedly. The demand planning solution enables the personal computer manufacturer to perform more effective inventory planning, thus reducing lost sales due to inventory stock-outs. Although order fulfillment management improves execution, it can't prevent an increase in lost sales.

In the previous section, we found that the Order fulfillment management solution had a significant impact on a broad set of KPIs. However, in the highly volatile personal computer industry, the Demand Planning Solution does better at reducing risk.

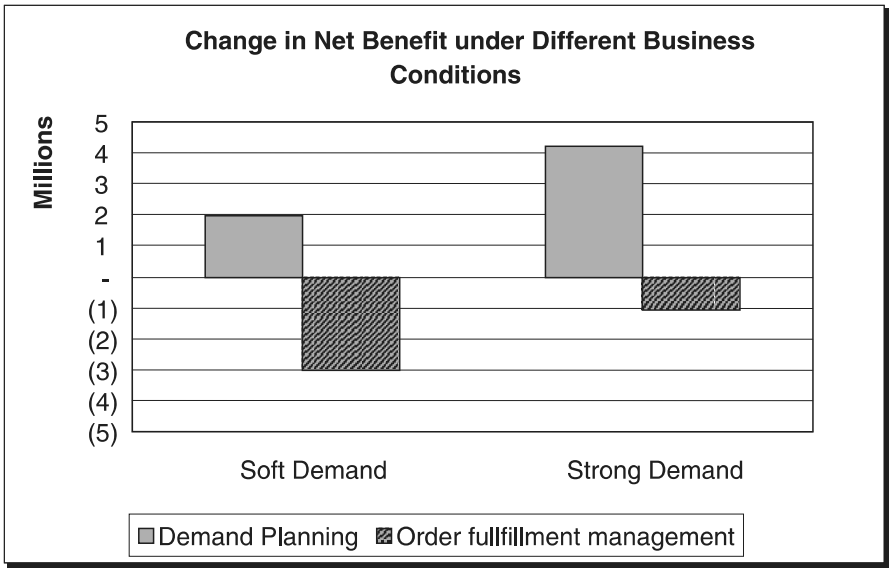

Fig. 1.7. Risk Analysis: Change in Net Benefit under Different Business Conditions

1.2.6 Action 6: Put ROI to Work

Most supply chain organizations take a just-in-time approach to ROI. They dust off the spreadsheets and crank the numbers when the time comes to develop a financial justification. Once a project has been approved, financial analysis becomes a thing of the past. However, the focus on business value should not begin and end with the business case. Once you have developed an effective and consistent framework for analyzing business impact, there are a number of ways you can use it to improve decision making.

First, begin to apply financial analysis earlier, *before* you have developed your supply chain strategy. You can eliminate much of the guesswork from the strategy process by identifying the supply chain value drivers with the greatest impact on your company's business objectives and using this knowledge to specifically target initiatives that impact these drivers. Mathematical models are particularly effective at this stage because they can be used as a diagnostic tool to analyze the unique characteristics of your business and then to pinpoint opportunities for improvement. Mathematical models also make it easy to rapidly analyze and test multiple options using what-if analysis.

Financial analysis can also play an important role *during* project development and rollout. An analysis of the project's potential business impact

can help you make more intelligent choices when defining project scope and functionality. By understanding how interactions between initiatives affect business performance, you can do a better job at sequencing and prioritizing the rollout of your initiatives. Additional analysis can also help identify opportunities to redefine and redirect your supply chain efforts when business conditions change or project schedules start to shift.

Finally, our framework can help monitor the performance of initiatives *after* they have been deployed. Assessing the performance of an initiative by monitoring its performance against financial objectives is often a challenge. Because so many factors can affect financial measurements, they often behave like a moving target. This can make it difficult to judge how well a project is meeting its objectives.

This problem can be addressed by using supply chain value drivers – rather than financial metrics – as performance benchmarks. Because initiatives act directly on value drivers, their performance can be more easily measured. It thus becomes easier to tell whether a project is actually delivering value. The result: less finger pointing, and more accountability.

1.3 Making it Happen

The transition to an integrated process for managing your portfolio of supply chain initiatives will not take place overnight. To ease the transition, we suggest you begin with an incremental approach. Start by analyzing a single project. This gives you an opportunity to learn more about your supply chain value drivers and to quantify their impact. It also enables you to begin developing an integrated framework for analyzing performance and risk.

To ensure success, choose your first project carefully. This initial project should be highly visible and ideally have CEO sponsorship. As part of the project's budget, funds should be specifically allocated to develop the framework. Make sure that the CFO supports the effort and gets his staff involved.

Once you have begun to develop the framework, build on it. As new initiatives are conceived, evaluate them using the framework. Begin to consider interactions between new initiatives and projects that are already underway. Eventually, you can use the framework to guide the design, timing, and scale of all new initiatives.

Most companies base their supply chain decisions on past trends and experience. As a result, they often find themselves fighting last year's battle, only to fall further behind their best-in-class competitors. Making the right decisions requires a deeper understanding of how changes in your supply chain impact business performance. By using a consistent tech-