An analytic approach for quantifying the value of e-business initiatives

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We describe an IBM strategic consulting offering involving a methodology and an analytic tool. The methodology, the Risk and Opportunity Assessment, provides a systematic approach for diagnosing problems in the value chain of the enterprise, and for selecting and prioritizing e-business initiatives. Applying this methodology involves the use of an analytic tool, the Value Chain Modeling Tool, that uses management science and operations research techniques, as well as techniques from the domains of finance and supply chain management, to model the end-to-end value chain of the enterprise. This approach has been successfully used to improve the financial and operating performance of several enterprises.

Much of the value associated with e-business initiatives comes not only from the improvements to information technology (IT) infrastructure, but also from business transformations that impact an organization's people and processes. A critical part of creating business value is identifying the business processes to transform and selecting the right initiatives to enable the transformation. The focus on business value continues during the transformation process, as decisions are made about project scope, scale, and direction.[1-3]

To help customers realize greater business value from their e-business investments, the IBM Research Division teamed up with IBM Business Consulting Services and developed a new business transformation methodology—the *Risk and Opportunity Assessment* (or Assessment, for short). This methodology provides a systematic approach for diagnosing problems in the value chain[4] and for selecting and prioritizing e-business initiatives. It has been tailored to address issues in a number of domains, including supply chain management and product life-cycle management.[5]

The Assessment enables customers—under the guidance of IBM consultants—to identify solutions that improve business responsiveness and resilience. It also provides a consistent framework for evaluating and prioritizing e-business initiatives. Understanding the impact of e-business initiatives on business performance is especially useful in today's difficult economic environment, because companies are investing significant effort in developing business cases to justify their e-business initiatives.[6,7]

The Assessment incorporates a sophisticated analytic tool, the *Value Chain Modeling Tool* (or the tool, for short), that quantifies the relationship between e-business investments and business value. This tool, which is implemented as a Microsoft Excel spreadsheet using Microsoft Visual Basic** macros, is equipped to evaluate scenarios involving risks and uncertainties in the customer's business environment.

The Value Chain Modeling Tool is designed to assess how changes in the speed, responsiveness, and

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variability of business processes affect financial and operational performance. The tool provides an integrated representation of the client's end-to-end value chain, from the initial design of new products to after-sales support. It is thus especially effective for evaluating e-business initiatives focusing on supply chain management, procurement, distribution and logistics, and product life-cycle management. It can be used to assess the impact of a broad array of potential transformations, ranging from targeted initiatives that affect only a single business process, to broader initiatives that span functional and even enterprise boundaries. Although the current version of the tool has been tailored for clients in manufacturing and distribution industries, the overall modeling approach and the Risk and Opportunity Assessment methodology can be applied across industries.

The analytic techniques used in the tool are based on results from two key streams of applied research. The first results from an IBM Research effort that uses management science and operations research techniques to model the impact of operational drivers on the operating performance of an enterprise. The second results from a cross-disciplinary IBM Research effort that integrates tools and techniques from the domains of finance and supply chain management to improve overall business performance. These two streams of research have been applied broadly to improve the financial and operating performance at a number of IBM business units, including Personal Computer, Microelectronics, and Storage.

The structure of the paper is as follows. First, we provide a brief overview of the Risk and Opportunity Assessment methodology. Then we describe the architecture of the Value Chain Modeling Tool and its key components. Next, we describe the use of scenarios and their role in the Assessment. We then discuss a case study and illustrate the scope of our methodology. In the last section we present our conclusions.

The Risk and Opportunity Assessment

The Risk and Opportunity Assessment is a methodology developed by IBM for diagnosing problems in an enterprise value chain, and for pinpointing appropriate solutions. It uses an analytic tool, the Value Chain Modeling Tool, to help clients understand the relationship between financial and operational drivers and enterprise performance. As detailed below, the Assessment involves scenario analysis in which the tool is used to determine the impact of proposed solutions, to compare different options, and to assess their likely effectiveness within the context of a particular business and operating environment.

The Risk and Opportunity Assessment follows a three-step process. The first step is data collection. During this stage of the engagement, the consulting team works with the client to define data requirements, to develop a data collection plan, and to carry out the data collection effort. The team also reviews background information, documents assumptions and sources, and monitors and validates the data collection process.

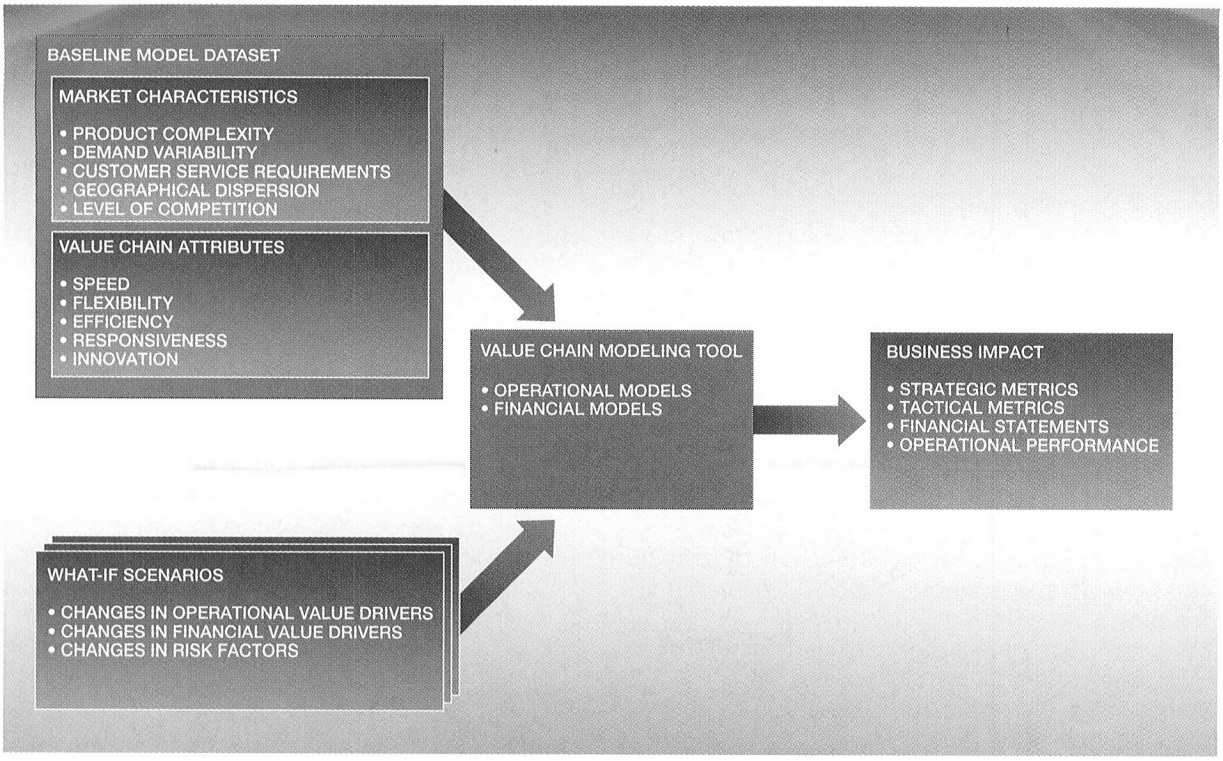
The second step of the engagement is modeling and analysis using the Value Chain Modeling Tool. This stage involves building and validating a baseline model, defining and validating financial and operational drivers, and developing the what-if scenarios used for evaluating proposed solutions. After the baseline model and the scenarios have been created, the consulting team performs what-if analyses to determine the business impact of each proposed solution.

Figure 1 illustrates the use of the Value Chain Modeling Tool in a Risk and Opportunity Assessment engagement. A data set representing a baseline model includes market characteristics, as well as value chain attributes. This information, along with what-if scenarios that represent potential changes to the value chain and its operating environment, serve as model inputs. The analytic model, embedded in the tool, processes this information and calculates the business impact of each what-if scenario.

The third and final step of the engagement is developing a set of findings and recommendations. During this stage, the team performs a high-level cost-benefit analysis, selects and prioritizes solutions, and develops an action plan for business transformation. The consulting team and the client agree on the steps to be taken next, and develop a timetable for follow-on activities.

The Risk and Opportunity Assessment is particularly well suited for providing insight and guidance to a company on the path to becoming an "on demand business." An on demand business is an enterprise whose business processes are flexible and responsive to shifts in customer demand, new market opportunities, and external threats. Because the

Figure 1 Using the Value Chain Modeling Tool



Assessment can help quantify the effect of improved responsiveness and flexibility at various points in the value chain, it can help identify business processes most in need of improvement. It can also help assess the impact of increased business process integration, both within the firm, and in its interactions with customers and suppliers.

The Value Chain Modeling Tool

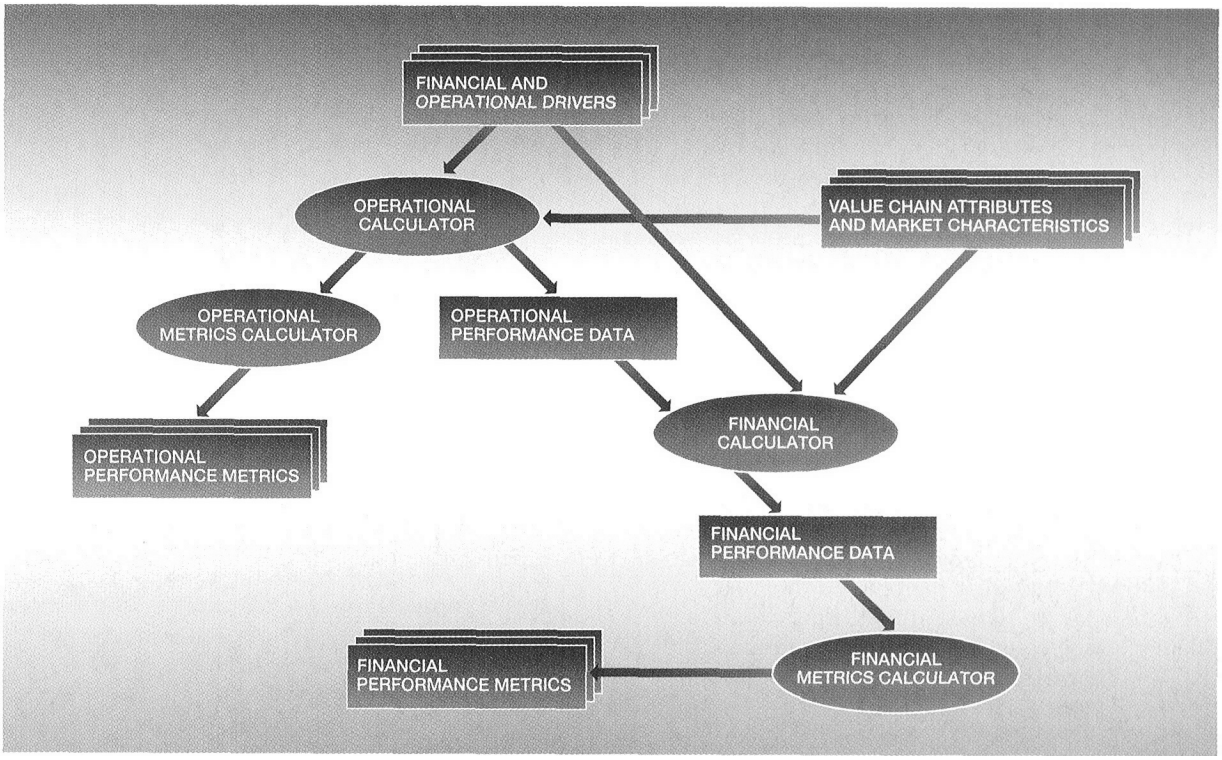
In this section, we discuss the Value Chain Modeling Tool in greater depth. We begin with an overview of its structure and information flows. Next, we describe its inputs, and the financial and operational metrics it computes. We then briefly discuss the tool's key analytic components and describe our approach for modeling the relationship between the main operational and financial drivers and enterprise performance measures. We conclude this section by describing the use of the Value Chain Modeling Tool together with other modeling tools in order to extend its modeling capability to include components at the business process, software application, and information technology (IT) infrastructure levels.

Structure and information flows. The Value Chain Modeling Tool has five main components: the data store, the operational calculator, the financial calculator, the operational metrics calculator, and the financial metrics calculator.

The primary function of the data store is to structure and preprocess the inputs to the Value Chain Modeling Tool and to serve as an integration layer for all other components. The operational calculator uses operations research models to link changes in physical, temporal (delays), and informational flows to changes in operational performance measures. The financial calculator uses an integrated set of financial models and accounting identities to map changes in operational performance measures (as calculated by the operational calculator) into changes in financial performance measures. The operational and financial metric calculators compute the array of operational and financial metrics necessary to generate financial statements.

Figure 2 shows the Value Chain Modeling Tool structure and information flows. The tool inputs in-

Figure 2 Value Chain Modeling Tool structure and information flows



clude value chain attributes and market characteristics as well as financial and operational drivers. The inputs are preprocessed and stored by the data store (not shown in Figure 2). Operational data are transferred (via the data store) to the operational calculator, which calculates operational performance metrics, such as inventory levels, throughput levels, product development cycle times, and network cycle times. These values are stored in the data store, and then passed to the financial calculator, along with additional financial data. The financial calculator produces financial performance data, such as revenue, costs, cash flows, and balance sheet items. These data are then used by the financial metrics calculator to compute financial performance metrics such as profit margins, asset utilization measures, and cash-to-cash cycle time. In an analogous fashion, outputs of the operational calculator are passed to the operational metrics calculator, which computes operating performance metrics such as order fill rates, delivery lead times, and service levels.

Inputs and outputs. In defining the tool inputs, our objective was to gather sufficiently detailed information to enable credible modeling of value chain performance, while keeping data-gathering requirements tractable. In order to accommodate a wide range of value chain issues, the model has a relatively broad set of inputs. However, for many analyses, only a subset of model inputs is required to generate acceptable results. We describe below the key inputs for the tool.

- The *enterprise inputs* consist of data relevant to the enterprise as a whole (the term "enterprise" may refer either to an entire business, or to a particular business unit or division). The data include logistics and other supply chain management costs, as well as high-level-income-statement, balance-sheet, and cash-flow-statement items.
- The *product inputs* consist of data about key product categories or product families. The data include information on product sales, demand variability, customer requirements, order management and planning cycle times, production characteristics, indirect spending, inventory costs, and product quality.

- The *supply inputs* provide information about key raw materials and components used in production. They include direct materials costs, supplier responsiveness, component quality, and inventory carrying costs.
- The *product configuration matrix* describes the high-level relationship between product categories and component classes. It identifies the quantity of each component required to build each product.
- The *distribution inputs* characterize network flows through a multi-echelon distribution network. They provide details on transportation and handling cycle times, as well as transportation and storage costs.
- The *after-sales support inputs* provide information about post-sales support, including customer service requirements, costs associated with warranties, product liability claims, recalls, and field service.
- The *product development inputs* give a detailed view of product development costs and cycle times. Product development costs are attributed to a number of activities, including design, prototyping, mock-ups, data search, testing, tooling, and engineering changes. This information is further broken down by stages in the product development process.

The tool generates a rich set of output metrics that characterize financial and operating performance. There are five categories of outputs as described below.

1. The *performance summary* consists of key high-level financial and operational metrics. It includes a number of high-level strategic and tactical metrics typically included in a balanced scorecard.[9,10]
2. The *financial statements* include a high-level income statement, a balance sheet, and a cash flow statement.
3. The *detailed metrics* are a suite of financial and operational metrics. They include profitability ratios, cash flow ratios, asset utilization metrics, and measures of operating efficiency. They also include a broad array of metrics that assess supply-chain and product-development performance.
4. The *product life-cycle management and product innovation management metrics* are a suite of financial and operational metrics that characterize the effectiveness of the product-development and product-innovation processes. They include detailed reporting of product development costs and cycle times, broken down by product development activity and by stage in the product development pipeline. They also include a number of important measures of product innovation effectiveness.
5. The *metrics by product* are a set of summary and detailed financial and operational metrics broken down by product category or family.

Operational and financial calculators. The operational calculator uses stochastic quantitative models from the field of operations research to link changes in physical, temporal and informational flows to changes in operational performance.[11–14] The operational calculator estimates the impact of value chain characteristics, such as supply delays, production cycle times, and demand variability, on metrics such as inventory, unit sales, and customer service (see sidebar for an illustration). It also calculates the impact of product development characteristics, such as product development delays, on unit sales.

Value chain processes that are modeled in detail include planning, product development, supply management, production, distribution, and order fulfillment. These processes affect value chain performance by introducing delays, variability, and constraints into the system. Delays make the enterprise less responsive to changes in the external business environment. Variability influences the predictability of value chain performance, making it harder to meet customer service targets. Constraints, such as limited production capacity, affect the responsiveness to change of the enterprise.

More specifically, companies with long product development cycle times may be late to market, and therefore may lose market share to more agile competitors. Companies with long planning cycle times are less responsive to variability in customer demand, and are thus forced to compensate by either holding more inventory, or by sacrificing delivery performance. Poor planning processes can introduce additional system variability, as happens when, for instance, poor demand planning results in inaccurate demand forecasts. This makes it harder for a company to effectively match production to customer demand, causing poor supply chain performance. Finally, manufacturing capacity constraints and supply constraints limit a company's ability to respond to major upturns in customer demand.

The financial calculator uses accounting identities and financial models to map the output of the operational calculators from physical units to financial measures.[15,16] Product development costs, production costs, logistics costs, and inventory costs are

Quantifying the financial impact of operational change

In order to clarify the role of analytic models in the Value Chain Modeling Tool, we describe here a simplified analytic model that illustrates our approach for quantifying the financial impact of changes to operational performance.

Consider a manufacturing company with a planning process that determines the products to manufacture. This process begins with customer demand forecasts provided by the marketing and sales organization. Next comes master planning, performed jointly with the manufacturing organization, which is an assessment of the manufacturing capability. Following the completion of the planning process, the company manufactures its products and ships them to the final customer, usually through a distribution network comprised of multiple distribution centers and warehouses.

Suppose this entire process—from creating the demand forecast, to actually shipping products to the final customer—takes 32 days. This time lag, which we refer to as "end-to-end cycle time," introduces uncertainty in the planning process. In essence, when the company creates its demand forecast, it needs to predict demand 32 days in the future—the time when customers will actually be purchasing its products. Because customer demand in the marketplace is always changing, the further ahead a company needs to predict demand, the less accurate its forecasts will be. To compensate, the company needs to hold more inventory.

To compute the impact that a reduction in planning cycle times has on inventory levels, we begin by using a simple heuristic to estimate the impact of cycle time delays on forecast accuracy. We then use a simple safety stock calculation to estimate the impact of the resulting forecast accuracy on inventory levels.

One rule of thumb uses the square-root function to calculate forecast error as a function of end-to-end cycle time. Suppose the company can forecast daily demand a week in advance with 30 percent error. Then the error of forecasting daily demand 32 days in advance is $(32/7)^{1/2}(30\%) = 64$ percent. This error determines the inventory required to accommodate the uncertainty, known as *safety stock*. We estimate this quantity using a standard safety stock calculation.[1] In a stationary environment the safety stock is given by a multiplier $k\sigma$, where k is the safety factor, determined by the service target of the company, and σ is the standard deviation of demand during lead time (32 days). Suppose daily demand can be represented as independent and identically distributed random variables with a mean of 100 units per day. Then, $\sigma = (\Sigma_{i=1,\ldots,32}(100\ (i/7)^{1/2}(30\%))^2)^{1/2} = 261$. It is assumed the standard deviation of demand i days ahead is $100(i/7)^{1/2}(30\%)$. Suppose the objective is to meet demand with off-the-shelf inventory 98 percent of the time. This gives us a safety factor of k = 2.05 (k is simply the independent variable value corresponding to a 0.98 value for the cumulative standard normal distribution). Therefore, the company has to hold a safety stock of $k\sigma = 2.05 \times 261 = 535$ units (or 5.35 days of supply).

Now, suppose the company is evaluating a business transformation that will reduce total planning cycle time by ten days. The end-to-end cycle time will be 22 days instead of 32 days. Then, $\sigma = (\Sigma_{i=1,\ldots,22}(100\ (i/7)^{1/2}(30\%))^2)^{1/2} = 180$. Therefore, the safety stock will be as follows: $k\sigma = 2.05 \times 180 = 369$ (or 3.69 days of supply). Hence, by implementing this business transformation, the company can cut inventory by about 166 units (over 1.5 days of supply).

Reference

1. A. C. Hax and D. Candea, *Production and Inventory Management*, Prentice-Hall, New York (1984)

modeled in considerable detail. There are also calculations to estimate costs associated with processing returns, costs due to defective products, and opportunity costs associated with lost sales. A simplified analytic model of this type is illustrated in the sidebar.

The financial calculator employs a "bottom-up" modeling approach whereby low level metrics are aggregated into higher level metrics. In general a firm's cost structure is modeled in terms of both fixed and variable costs. For example, manufacturing costs are decomposed into fixed and variable production costs. Variable production costs are further decomposed into direct materials costs and costs associated with the procurement and delivery of direct materials. Different stages of production are modeled to accurately reflect the incremental value associated with each step. This improves the accuracy of estimates of inventory values and cost of sales. Product development expense is itemized with over 20 expense categories covering five stages in the product development cycle. The impact of cost drivers, such as the number of product development projects and number of engineering changes, is modeled in detail.

Using the Value Chain Modeling Tool in conjunction with IT modeling tools and business process analysis tools leads to a better understanding of the business model.

Using the Value Chain Modeling Tool with other e-business modeling tools. In this section, we position the Value Chain Modeling Tool with respect to other e-business modeling tools. In particular, we focus on tools used to assess changes at the business process, software application, and IT infrastructure levels.

The IT infrastructure, the applications, and the business processes in an enterprise all play a critical role in creating business value. IT infrastructure capabilities—including speed, flexibility, capacity, efficiency, resilience, and security—determine the types of applications that can be run and their performance. Applications support business processes in various functional areas of the organization. These applications affect the accuracy, speed, and productivity of these business processes. Business processes, in turn, affect operating performance at different points in the value chain, and these have a direct impact on the overall business performance of the enterprise.[17–20]

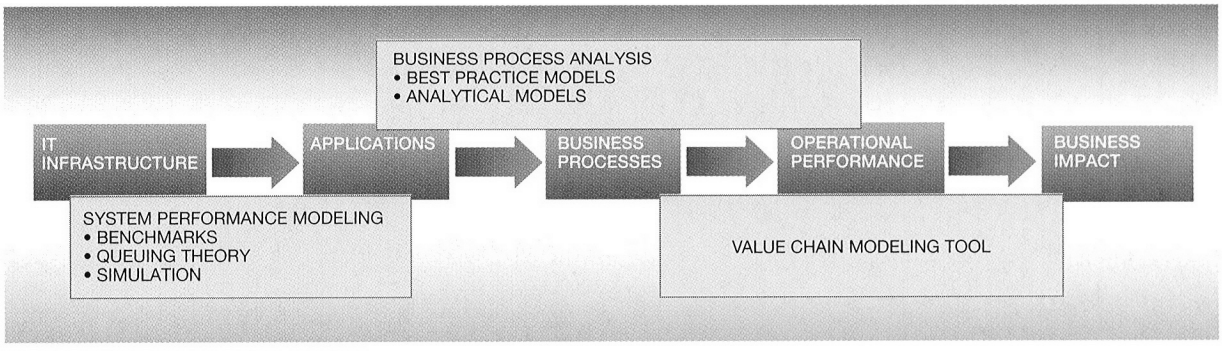
Figure 3 illustrates the way these elements interact, that is, each one impacts the one downstream. The IT infrastructure, for example, does not create business value directly; it does so through its role as an enabler of applications and business processes. Modeling the business impact of infrastructure investments is thus a multi-step process. First, we analyze how the proposed investment will affect infrastructure performance. Then we analyze the downstream impact of changes in infrastructure performance—first on applications and business processes—then on operational and business performance.

There are a number of analytic approaches for modeling the performance of IT infrastructure, applications, and business processes.[21] System performance modeling uses techniques such as benchmarking, queuing theory, and simulation to evaluate the impact of changes to IT infrastructure on the performance of applications.[22–24] The coverage of these techniques is illustrated in Figure 3 by the box labeled SYSTEM PERFORMANCE MODELING. Consulting organizations apply best-practice methodologies to redesign business processes, often in conjunction with the deployment of IT applications.[25–27] Other business process analysis techniques, including business process simulations, can be used to model how changes to business processes and IT applications affect operational performance.[28,29] These techniques are illustrated in Figure 3 by the box labeled BUSINESS PROCESS ANALYSIS.

Although these analytic approaches can be used to model some aspects of the value chain, they do not always quantify the broader financial implications of e-business investments.[30,31] The Value Chain Modeling Tool, while designed to quantify financial impact, does not explicitly model the performance impact of investments in e-business infrastructure and applications. As Figure 3 illustrates, integrating the outputs of these lower-level models with the Value Chain Modeling Tool should lead to more accurate results and a better understanding of business impact.

As an example, consider a system performance modeling effort that assesses the impact of an infrastruc-

Figure 3 Modeling tools for analyzing e-business performance



ture investment on low-level IT metrics, such as response time and availability. Business process analysis can then be used to estimate how this would affect low-level operating metrics, such as process cycle times, rework rates, and throughput. Finally, this information can be passed to the Value Chain Modeling Tool and used to assess business impact.

Analysis of what-if scenarios

An important function of the Value Chain Modeling Tool is the use of what-if scenarios for evaluating the benefits and risks of potential e-business initiatives. The tool offers a number of different analyses, including a financial impact assessment, a cost-benefit analysis, a strategic fit analysis, an assessment of key performance indicators, and a sensitivity analysis. Examples of several of these analyses are provided in the brief case study discussed in the next section.

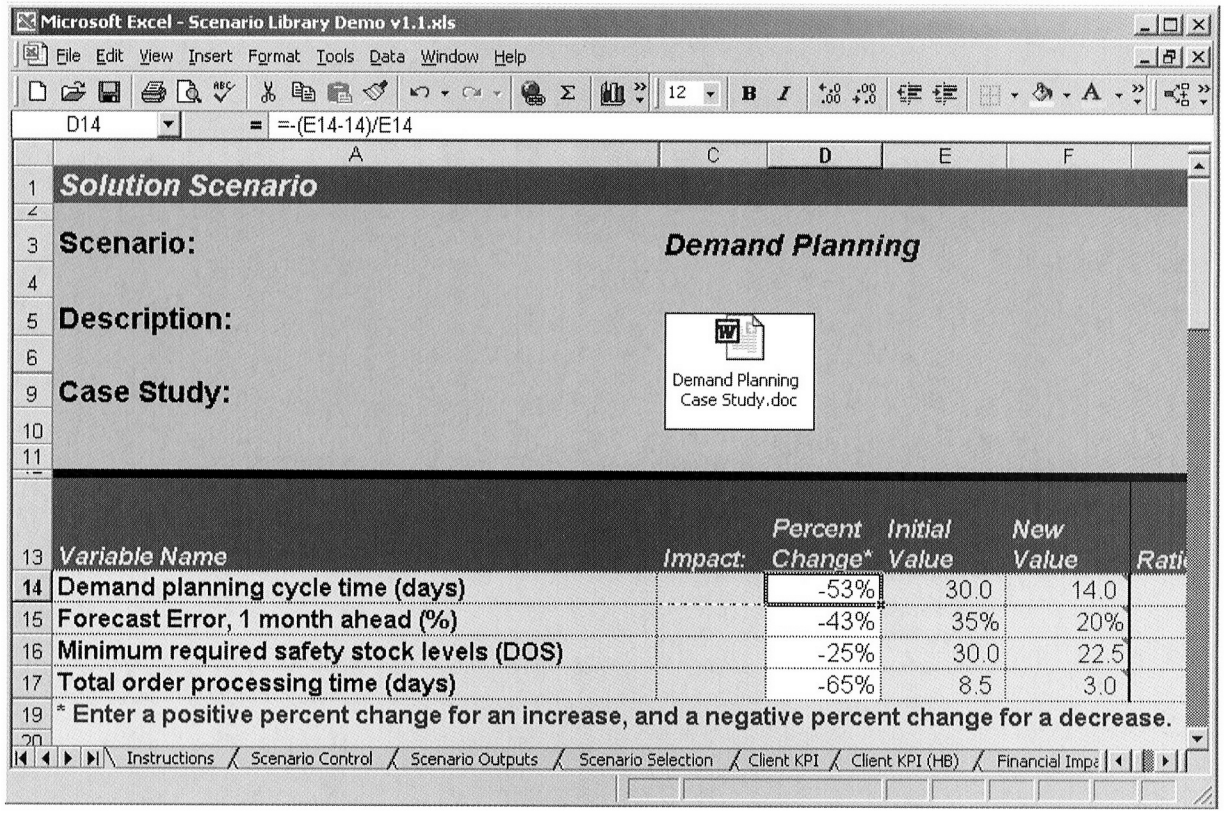
The tool supports two types of what-if scenarios: solution scenarios and risk scenarios. *Solution scenarios* can be used to characterize a broad array of potential initiatives, ranging from an end-to-end value chain transformation to the deployment of a point solution. Each solution scenario identifies the operational metrics directly affected by the proposed e-business initiative, as well as the expected impact of the transformation on the operational metrics. For example, a solution scenario designed to assess the impact of an e-business initiative to support customer collaboration might specify the expected improvements in operational metrics such as forecast accuracy and demand planning cycle time.

Risk scenarios assess the performance of proposed solutions in a dynamic and volatile business environment. Risk scenarios specify changes in internal and external metrics associated with risky future business events, such as major shifts in customer demand or unexpected supply shortages. As an example, consider a risk scenario designed to assess the impact of a sudden decline in customer demand. Unit sales would probably decline, and heightened industry competition would probably lead to a decrease in average selling prices. If the demand shortfall were caused by financial difficulties in a particular customer segment, customer payments would most likely be delayed. Customers would probably become more demanding and might only make purchases if a product were available within the desired lead time.

Solution scenarios provide a structured approach for quantifying the impact of initiatives on a firm's financial and operational performance. Risk scenarios assess the responsiveness and robustness of the client's value chain in the face of an uncertain business environment. By analyzing pair-wise combinations of risk and solution scenarios, the impact of proposed initiatives on the firm's risk profile can be assessed.

Standardized sets of solution and risk scenarios can be stored in a *scenario library*. Individuals knowledgeable in a particular domain can develop basic scenarios that identify key operational drivers affected by the solution. These scenarios can then be distributed to other practitioners for their use. During an engagement, these standard scenarios serve as templates that can be customized to reflect the characteristics of a specific client. Practitioners can also use the scenario libraries to create new scenarios that address specific client needs.

Figure 4 The scenario for the demand planning solution (screen shot)



Case study

In this section, we use a case study to illustrate the application of the Risk and Opportunity Assessment in practice. The case study shows how the Value Chain Modeling Tool can be used to analyze and prioritize a set of potential initiatives being considered by the Motorcycle Division of a major automobile manufacturer. Although the study is based on work performed with an actual client, the information we present has been altered to preserve confidentiality.

The Motorcycle Division produces a broad array of on-road and off-road vehicles, including motorcycles, all-terrain vehicles, and motor scooters. The company has a truly global reach and serves major customer markets in Europe, North America, Japan, and Southeast Asia. Its business is highly competitive, and the firm believes that its success depends on meeting a number of critical business objectives, including increased product development effectiveness, improved responsiveness to market needs, increased cost competitiveness, and enhanced brand image. In addition to its highly competitive industry structure, a number of factors make the motorcycle business particularly risky. These include high demand volatility, worldwide constraints on production capacity, and sensitivity to foreign exchange rate volatility.

The management of the Motorcycle Division was considering fundamental changes in their business practices and asked IBM to help them assess a set of new initiatives designed to transform their value chain. This transformation would address several critical "pain" points affecting competitiveness, including excessive inventory levels, high transportation costs, and long manufacturing lead times. An analysis of the client's value chain revealed a number of underlying factors that required improvement,

such as long production and planning lead times and poor demand forecast accuracy. The client also needed to streamline its complex distribution network and reduce excessive warehouse transfers caused by poor inventory positioning.

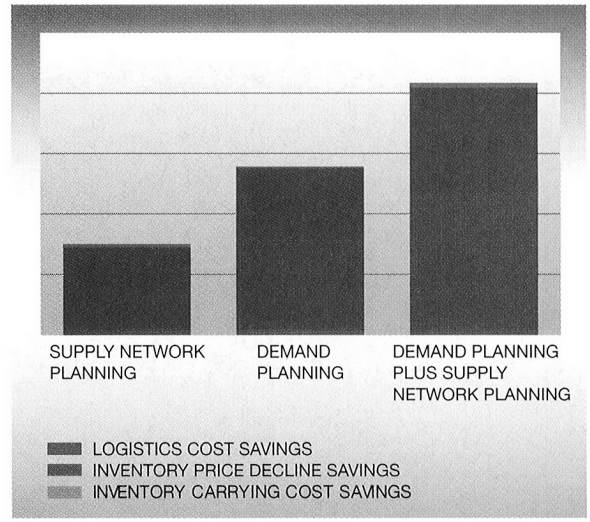
IBM worked with the client to identify a number of specific initiatives that could affect key value drivers and thus lead to achieving the client's business objectives.

Two potential solutions that we analyze here in detail are *Demand Planning* and *Supply Network Planning*. We also consider a third solution consisting of the simultaneous deployment of Demand Planning and Supply Network Planning. This solution had the potential to deliver the complementary benefits of the first two solutions, while significantly reducing deployment costs.

We decided to use the Value Chain Modeling Tool to quantify the business value associated with each of these initiatives. We began by gathering the data necessary to build and validate the base case (the baseline model). After validating the base case with the help of the client, we defined and validated the financial and operational drivers affected by each of the initiatives. We determined that the proposed Demand Planning solution would improve demand forecast accuracy. It also would reduce demand planning cycle times and order processing delays and would decrease required inventory safety stock levels at the client's distribution centers. We further determined that the proposed Supply Network Planning solution would reduce procurement and production planning cycle times, and improve logistics efficiency. It also would enable the client to make further reductions in inventory safety stock levels, in addition to those supported by Demand Planning.

We then defined a set of risk and solution scenarios. A solution scenario was created for each proposed initiative. Figure 4 shows the solution scenario for Demand Planning. For each of the operational drivers affected by the initiative, anticipated changes are entered. As shown in the figure, after the transformation the demand planning cycle time is 14 days, instead of 30 days. Average order processing times are anticipated to decline from 8.5 days to three days. Improved forecasting processes are expected to reduce forecast error from 35 percent to 20 percent. Furthermore, more reliable planning is expected to reduce minimum required inventory safety stock levels from 30 days to 22.5 days. Two risk scenarios were also created. In the first, worsening economic conditions lead to a sharp and unexpected decline in customer demand. In the second, an improving business climate results in a sudden increase in customer demand.

Figure 5 Financial impact of proposed solutions



After defining the scenarios, we performed a what-if analysis to assess the business impact of each of the proposed initiatives. Sample results of this analysis are shown in the remaining figures. Figure 5 shows the annual financial benefit of each solution. The Demand Planning solution has a higher benefit than Supply Network Planning, and the combined solution (Demand Planning and Supply Network Planning) has an even larger benefit. For all solutions, the most significant savings are associated with reductions in inventory. These include lower inventory carrying costs, and smaller inventory write-downs and write-offs. There is also a comparatively small (but significant) logistics cost savings associated with the Supply Network Planning solution.

We next performed a strategic fit assessment. We first identified a set of Key Performance Indicators (KPIs) that were closely aligned with the client's business objectives. The Value Chain Modeling Tool was then used to assess how each proposed solution affected each of the KPIs. As shown in Figure 6, a Supply Network Planning deployment leads to a moderate improvement in Shareholder Value Added and Return on Net Assets, and a large improvement

Figure 6 Results of the strategic fit assessment

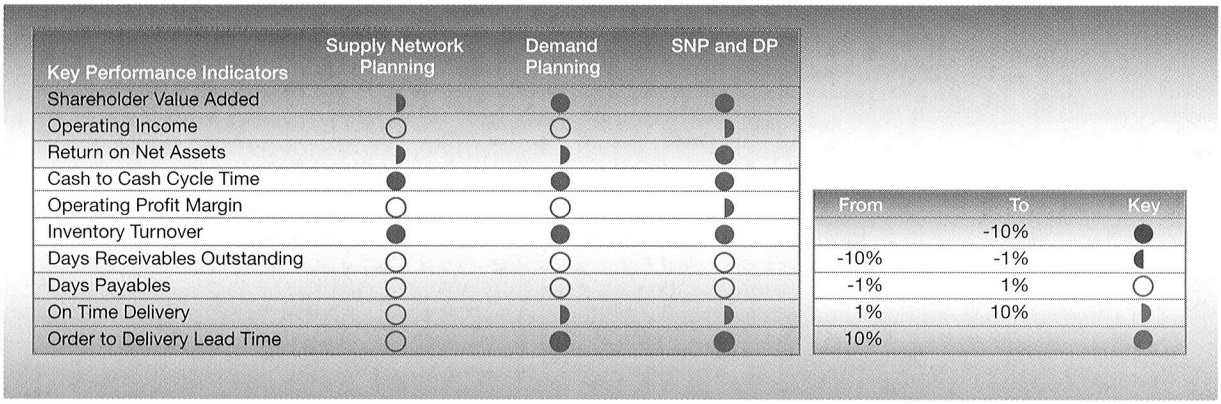
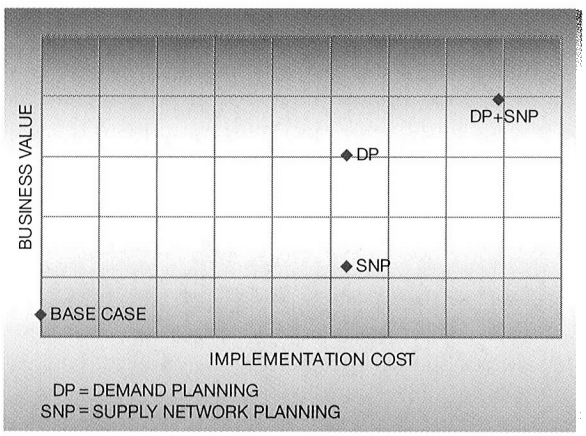


Figure 7 Results of the cost-benefit analysis



in Cash to Cash Cycle Time and Inventory Turnover. Its impact on other metrics is negligible. A Demand Planning deployment, on the other hand, has a stronger and broader impact. It leads to a large improvement in Shareholder Value Added, Cash to Cash Cycle Time, Inventory Turnover and Order to Delivery Lead Time. It also has a moderate impact on Return on Net Assets, and On Time Delivery.

Finally, we performed a high-level cost-benefit analysis—the results are shown in Figure 7.[32] Implementation costs are the same for Demand Planning and Supply Network Planning, but Demand Planning offers significantly higher business value. The combined Demand-Planning and Supply-Network-Planning initiative is somewhat more attractive than Supply Network Planning alone, however, because certain resources could be shared during a joint deployment. This creates an opportunity for additional cost savings, making the combined Demand-Planning and Supply-Network-Planning initiative an attractive option.

We used the risk scenarios defined earlier to test the robustness of each initiative to changes in the external business environment. All initiatives proved robust to risk; under both pessimistic and optimistic scenarios, they continued to have a positive impact on operational and financial performance. Scenario analysis also helped to assess how each initiative affected the firm's resilience to business uncertainty. The Demand Planning initiative was particularly effective at increasing value chain resilience because it increased forecast accuracy and responsiveness. In the face of an unexpected decline in customer demand, the client would be able to more rapidly adjust inventories to match lower levels of customer demand. On the other hand, if demand suddenly increased, the Demand Planning initiative would improve the effectiveness of inventory planning. This would reduce lost sales due to inventory stock-outs.

Summary

In this article, we describe a new strategy offering and a decision-support tool designed to help IBM customers realize greater business value from their e-business investments. The strategy offering, the Risk and Opportunity Assessment, provides a systematic approach for evaluating e-business initiatives. It more closely aligns e-business implementations with bus-

iness strategy, and helps identify solutions that improve business responsiveness and resilience. It has been customized to address a number of important domains, including supply chain management and product life-cycle management.

The Risk and Opportunity Assessment methodology uses an analytic tool, the Value Chain Modeling Tool, to quantify the business value of e-business investments. The Value Chain Modeling Tool uses stochastic quantitative models from the field of operations research to assess how changes in value chain speed, responsiveness and variability affect operational performance. The tool uses financial models to evaluate the financial impact of changes in operational performance. The tool provides an integrated representation of an end-to-end value chain. Key processes that are modeled include product development, procurement, manufacturing, distribution and logistics, sales and order fulfillment, and after-sales support. Although the tool has been tailored for manufacturing and distribution industry value chains, the modeling approach can be applied across industries.

The Value Chain Modeling Tool is also equipped to evaluate the benefits and risks of potential e-business initiatives. The tool supports two types of what-if scenarios: solution scenarios and risk scenarios. Solution scenarios provide a structured approach for quantifying the impact of initiatives on a firm's financial and operational performance. Risk scenarios assess the responsiveness and robustness of the value chain in the face of uncertainty in the business environment. The tool can perform various analyses, including a financial impact assessment, cost-benefit analysis, strategic-fit analysis, and sensitivity analysis.

Faced with a difficult economy and heightened competition, IBM customers are devoting greater resources to developing business cases to justify their e-business initiatives.[33,34] Because the tool described in this paper provides a rigorous, quantitative framework for assessing business impact, it is very useful for developing a business case. The tool has proven its effectiveness in defining e-business strategy and managing e-business initiatives in multiple client engagements.

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