USING SOFTWARE TOOLS TO GUIDE STRATEGIC PLANNING IN MANUFACTURING

by

Ranjini Srikantiah

B.S., Electrical Engineering and Computer Science
Massachusetts Institute of Technology, 1995

Submitted to the Sloan School of Management and the Department of Electrical Engineering and Computer Science in partial fulfillment of the requirements for the degrees of

Master of Science in Electrical Engineering
and

Master of Business Administration

In conjunction with the Leaders for Manufacturing Program at the Massachusetts Institute of Technology

June 2000

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Signature of Author

Department of Electrical Engineering and Computer Science
Sloan School of Management
May 8, 2000

Certified by

Professor Sara Beckman, Thesis Advisor
Visiting Professor of Management
Haas School of Business, University of California, Berkeley

Certified by

Dr. Stanley Gershwin, Thesis Advisor
Department of Mechanical Engineering

Accepted by

Arthur Smith
Chairman, Committee on Graduate Studies
Department of Electrical Engineering

Accepted by

Margaret Andrews
Director of Master’s Program
Sloan School of Management
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Abstract

Recently, the computer industry has been evolving at a very rapid pace. New products are being introduced more frequently than ever before, and increasing competition has driven margins down substantially. In many large companies, the onus of delivering products faster, cheaper and more reliably to the customer falls upon manufacturing organizations. Accurate and reliable strategic planning can play a key role in driving down costs and increasing efficiency by streamlining purchasing, production and distribution activities. To aid in planning many manufacturing strategy groups have adopted software decision support tools, some developed by intra-company talent, others bought from software vendors.

The Supply Chain Optimization and Strategy Group at Compaq Computer Corporation adopted two software tools during the summer of 1999. One, designed for long-range planning for manufacturing facilities, was developed in-house. The second, a global supply chain optimization tool, was bought from a third-party vendor. This thesis examines these two case studies and develops guidelines for tool selection, development and implementation.

It is evident from the cases that a company must develop a toolset incorporating a number of different tools, each applicable for certain tasks. Having multiple tools available ensures that there will be a proper fit of tool, task and environment, resulting in successful system implementation and long-term utility. This also enables a company to be fast and flexible in its decision making, leading to a strong advantage in today’s fast-paced industries.

Thesis Advisors:
Sara Beckman, Visiting Professor of Management
Stanley Gershwin, Research Scientist, Department of Mechanical Engineering
Acknowledgments

I gratefully acknowledge the Leaders for Manufacturing Program for its support of this work. I have learned a great deal through this two-year experience, and it has opened up doors I never knew existed.

I would like to thank my advisors, Dr. Stan Gershwin and Professor Sara Beckman, for their help and guidance on this thesis. Their input was most definitely appreciated.

My sincere thanks to Gary Pope, Keith Liggett and Ricki Ingalls at Compaq Computer Corporation for providing valuable direction during my project and for giving me a good dose of Texan humour. Gary and Keith’s feedback during the writing of this thesis assisted me tremendously. I thank Niysaan Bowne for her welcoming nature and amazing intellect. She was always there to help and she truly made me feel at home at Compaq and in Houston. I thank Wendy Fredrickson for keeping us all sane and organized.

Thanks to the “Friends” group in Houston for making sure I never passed a dull moment. And to my special Texan, who made my experience in Houston just a little bit sweeter, I thank you for your kindness, love, and patience, and for showing me that life can, indeed, be quite an adventure.

I could not have completed this program without the love and support of my family and friends. Thank you all for being with me and encouraging me, every step of the way.
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Chapter 1: Introduction and Overview

1.1 Introduction

The computer industry today is evolving at a very rapid pace. New products are being introduced more frequently than ever before, and increasing competition is driving margins down substantially. More and more players in this arena are looking to their manufacturing and supply chain organizations to provide a sustainable advantage in this increasingly challenging landscape. Accurate and reliable strategic planning can play a key role in driving down costs and increasing efficiency by streamlining purchasing, production and distribution activities. To aid in planning many manufacturing strategy groups adopt software decision support tools, some developed by intra-company talent, others bought from software vendors.

A solid understanding of the software tool under consideration is necessary to ensure there is a proper fit of tool, task and environment. Too often companies get caught in the wave of information system implementation without first determining if the product will truly meet their needs effectively. One case in point is Dell’s recent rejection of SAP after a less-than-successful attempt at implementation.1 The software itself, however, is only one piece of the puzzle. Appropriate organizational structures and process norms must be in place to ensure the tool adds value to the corporation as a whole. Data acquisition, actual tool usage, and methods for communicating results may need to be modified to ensure positive results from implementing a new software tool.

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1.2 Project Description

This project was executed over a six-month period at Compaq Computer Corporation in Houston, TX. The motivation for the study was to improve the use of software tools in the Supply Chain Optimization and Strategy (SCO&S) Group to aid in strategic decision making. During the course of the project two different software tools were examined, one aimed at long range planning (LRP) and another intended for global supply chain management (GSCM). In both studies, an analysis of requirements, tool evaluation and selection, and implementation were performed. The lessons learned can prove invaluable going forward as more tools are investigated and adopted by the corporation.

1.3 Thesis Organization

This thesis roughly follows the approach taken during the internship project. First, the basic setting for the project, including the organizational structure at Compaq and the responsibilities of the Supply Chain Optimization & Strategy group is presented. Chapter 3 explores the use of software in a strategic environment. Chapter 4 then outlines the first software tool examined, the long-range planning tool, then Chapter 5 examines the second, a global supply chain modeling tool in the context of a warehousing problem. Chapter 6 then provides analysis and conclusions based on the two studies.
Chapter 2: Project Setting and Background

2.1: Compaq Computer Corporation

Compaq Computer Corporation, headquartered in Houston, Texas, is the second largest computer company in the world and the largest global supplier of computer systems. Compaq develops and markets hardware, software, solutions and services, including industry-leading enterprise computing solutions, fault-tolerant business-critical solutions, enterprise and network storage solutions, commercial desktop and portable products and consumer PCs. Main manufacturing facilities are located in the US, Brazil, Scotland, China, and Singapore.

At the time of this study, Compaq had just hired a new CEO, Michael Capellas, and was undergoing internal re-organizations to establish alignment around new corporate objectives. This was in addition to the on-going restructuring resulting from the recent acquisitions of Tandem and Digital Equipment Corporation. Industry competition was extremely intense, especially in the personal computer market. Margins were eroding, and the company was looking to improve operational efficiencies so it could compete with other original equipment manufacturers (OEMs) such as Dell, Gateway and IBM. A snapshot of Compaq in June 1999, shows the declining financial situation (see Figure 2-1).

<table>
<thead>
<tr>
<th></th>
<th>Q4 1998</th>
<th>Q1 1999</th>
<th>Q2 1999</th>
</tr>
</thead>
<tbody>
<tr>
<td>Revenue</td>
<td>$10,859</td>
<td>$9,419</td>
<td>$9,420</td>
</tr>
<tr>
<td>Net Income</td>
<td>$ 758</td>
<td>$ 281</td>
<td>$(184)</td>
</tr>
<tr>
<td>Total Gross Margin</td>
<td>26.4%</td>
<td>24.7%</td>
<td>20.5%</td>
</tr>
<tr>
<td>Range of share price</td>
<td>-</td>
<td>$30.13 - $49.25</td>
<td>$21.19 - $31.56</td>
</tr>
</tbody>
</table>

Figure 2-1: Revenue, Net Income, Total Gross Margin for Compaq Computer Corporation (In millions, except for share prices)
Compaq attributed the decline in revenue and net income to intense price competition, a non-competitive cost-structure, and inadequate revenue growth. The commercial PC business was “hampered by a selling and distribution model that was no longer profitable.” The Supply Chain Management organization, which includes all manufacturing facilities, logistics and procurement, was seen as a key target for cost reductions.

Compaq’s organizational chart at the time of the study is shown in Figure 2-2 below. Three business units were focused on design and development for distinct product lines aimed towards three customer segments: consumer, commercial and enterprise. The Supply Chain Management Group operated as an umbrella organization, serving all business units from a central focus. It included: Procurement and Alliance Management, Demand Fulfillment (Manufacturing), Worldwide Logistics, and Supply Chain Strategy & Optimization. The heads of all these divisions were in Houston, with the exception of the regional demand fulfillment Vice Presidents who were located at manufacturing sites in their respective geographic areas.

2.2 Supply Chain Optimization & Strategy Group

The Supply Chain Optimization & Strategy (SCO&S) Group served Compaq Computer Corporation in many ways. One function of this group was to pull together

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data from the geographic marketing groups, product divisions, and financial organizations to develop a long-range manufacturing plan in line with the corporate strategy. The group also provided internal consulting services for any manufacturing or supply chain issues as requested. Two to three employees typically worked on any given project, and project lengths ranged anywhere from less than one week to several months. Because the group was part of a corporate function, its efforts were lumped under overhead costs that were then passed on to each division. The group was composed primarily of seasoned Compaq employees who intuitively understood complex issues surrounding manufacturing strategy. Some members were matrixed from the Supply Chain Finance organization.

The group had recently undergone a name change in light of re-organizations at the company. It used to be termed the Manufacturing & Quality group. It transformed to Manufacturing Strategy and then to its current moniker: Supply Chain Optimization & Strategy. This last title gave the group a broader charter than before. Its members became responsible for strategic analysis and optimization of the whole supply chain, not just of the manufacturing sites. But the new responsibilities did not include implementation of new initiatives. SCO&S ran analyses and made recommendations, but did not control action within the supply chain. Because they had visibility to the entire supply chain, the group was in a prime position to optimize manufacturing processes globally throughout all of Compaq's sites. This was a very important function, since senior management believed competitive advantage could be achieved through successful implementation of the right supply chain initiatives. Determining the 'right' initiatives,
then, became the important task at hand. SCO&S had begun to investigate various software tools to aid this decision-making process.

2.3 Chapter Summary

As this project began, Compaq was in a difficult time financially and organizationally. The company was focusing on the supply chain as an area of potential competitive advantage and the Supply Chain Optimization and Strategy (SCO&S) group was looking for tools to guide strategic planning and analysis. Before launching into the specific projects at Compaq, it is helpful to understand the nature of strategic decisions and long range planning especially in a time of rapid change. Chapter 3 will explore these issues, and also examine the nature of software tools in this setting.
Chapter 3: Strategy and Software

3.1 Chapter Introduction

In today's high-technology industry, the overwhelmingly prominent characteristic is the high rate of change. No sooner has one computing product taken hold than another newer, faster, more powerful system is introduced. Compaq announced the launch of a new product almost every week in 1999. Not only were products changing, but organizations themselves were re-organizing to respond to increasing demands from customers. Compaq went through a series of changes to become a flatter, more customer-focused company. Although these restructuring efforts held important benefits in becoming closer to the customer, they also made corporate communication more difficult. There was no longer one top-down communication channel, and cross-functional linkages did not always exist. As a result, company-level information was sometimes difficult to disseminate.

Before delving further into the cases at Compaq, it is important to investigate the role of software in strategic planning. Developing effective corporate strategies depends heavily on accurate internal and external information, but rapid pace of change makes this a very challenging task to manage. Strategic functions are increasingly looking to software tools for assistance. As the models become more complex to handle a greater number of real-world scenarios, they demand more sophisticated strategic-level data. To better understand how strategic planning and software tools fit together, it is important to explore how companies are developing a competitive edge, how software tools can help in this process, and how a software system works.
3.2 Developing a Competitive Edge

Every company wants a sustainable competitive advantage so it may outperform its competitors. In today’s fast-moving industries, efficient supply chain design can provide this edge. To make the right decisions throughout the supply chain, timely and efficient sharing of knowledge is required.

3.2.1 Importance of Knowledge

In his book, Clockspeed, C. Fine proposes that all advantage is temporary, and the faster the industry clockspeed, or rate of change, the more fleeting this advantage is. Companies must learn to simultaneously exploit their current capabilities and consciously build new capabilities to gain a series of temporary advantages. The days of setting long-term strategies for sustainable competitive gains have given way to thinking through the company’s potential on shorter time horizons. Strategic managers must make more decisions more quickly than ever before. Authors of an essay on implementation of information technology in changing conditions remark, “Knowledge has become the most crucial component in the struggle for competitiveness.” The management, coordination and communication of knowledge, therefore, can provide an important advantage for any company that can execute these tasks well, as set forth in Senge’s concept of the Learning Organization.

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3.2.2 Supply Chain Capabilities

According to a 1999 study of 1,120 companies across a number of industries, the use of supply-chain strategies as a differentiating competitive factor was becoming more important in establishing market leadership. A brief glance at the business division strategies at Compaq revealed many dependencies on successful implementation of supply chain initiatives such as direct delivery to the customer. Because of the capital-intensive nature of the supply chain management organization, Hill, Menda and Dilts recommend that this group be proactive in developing corporate strategies: “...making appropriate choices of process to meet future needs are critical manufacturing responsibilities and core themes in corporate strategy debate.”

3.2.3 Decision Making

As mentioned earlier, those responsible for developing strategy in an organization are faced with more rapid, and perhaps more difficult decisions. When made correctly, however, managerial choice can lead to a firm’s survival. In large multi-national corporations such as Compaq, decision-making is distributed among many people in many different geographic locations. This allows people who are closer to the issue at hand to get involved. But it also makes decision makers dependent on efficient distribution of corporate information. This distribution of strategic decision power can lead to problems of uncertainty, equivocality and differentiation of strategies among

different parties. A corporation in which the decision making process is managed well and communicated effectively can have a significant advantage over its peers. By knowing what the impact of various decisions will be on other parts of the organization, thereby working within the extremely complex and integrated nature of large companies instead of against it, managers can make better decisions in shorter time periods. This can lead to a definite (albeit temporary) advantage.

### 3.3 The Role of Software

With all the uncertainty that abounds in the industry and in organizations, it may be questioned if anything can make the task of strategic planning easier. Luckily the recent proliferation of computers in the workplace has led to a wealth of software tools designed to gather and store information. A 1992 survey of management executives reported that a major challenge for executives was to translate the mass of information into effective decision making. A Decision Support System (DSS) is one class of software tools designed to help management solve work problems. These support systems are not meant to replace human decision making, but to aid and support the decisions that must be made in our increasingly complex environment. They typically gather information from various sources, process it through sophisticated mathematical models, and present it so that overall decisions can be made.

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*Sroka and Stanck, p. 371.

3.3.1 Utility

When designed and implemented correctly for the right problems, a software tool can serve as a repository for corporate knowledge, a calculator for mathematical analyses, a simulator for modeling the unknown. More important than just the basic functionality, however, is a tool’s ability to bring various players in a decision making process together around one set of facts and assumptions. The technology and its surrounding processes allow groups to establish communication despite geographic barriers, to focus on generating ideas, actions and solutions, and to provide information. At Compaq the Long-Range Plan was an internally developed tool designed to assist in strategic decision-making. The Global Supply Chain model was a third-party tool chosen to address the managerial need for optimization across the entire supply chain.

In a supply chain context, there are many decisions which need to be made, such as outsourcing, distribution patterns, product differentiation points, production capacity, labour and cost. The decision to produce a new product in a particular factory depends on the available capacity to make this new item, the number of workers required to bring production up-to-speed, and the costs of manufacturing this item in this factory. A software tool that can compare and contrast different production scenarios for this new item can aid management in making its decision.

Ideally, decision support systems should link to corporate objectives and goals. This enables decisions within one group to be made in the context of the entire company. Lockamy and Cox also suggest the decision support system should include performance

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10 Sroka and Stanek, p. 371.
measurements, so feedback can be obtained from making continuous operational improvements.\textsuperscript{11}

### 3.3.2 Tool Selection and Implementation

Using software, no matter how complex it is, will be of little use if executives are unable to apply it toward effective decision-making.\textsuperscript{12} This is where initial investigation and selection of the right tool come into play. Prior to implementing such a system, "...it is necessary to foresee the performances it should improve within the organization, so that every involved person can understand its importance."\textsuperscript{13} The survey of management executives revealed that if a software tool is to be used to support strategic decision making, it should integrate to the extent possible with existing company systems, and should relate to precise management needs.\textsuperscript{14}

The penalty for not evaluating a software tool choice thoroughly enough is that the tool can end up neither used nor useful, resulting in many lost hours on attempted training and implementation. This happens all too often. A study of business forecasting practice showed that only 10\% of the firms surveyed used quantitively based forecasting and of those, the number that tried and abandoned the techniques were about double the number using them.\textsuperscript{15} Not only must the tool be beneficial today, but it must be flexible enough to adapt to the future. Since times are changing so rapidly, the needs of the

\textsuperscript{12} Tank, p. 14
\textsuperscript{14} Tank, p. 14.
decision maker may also change and the software system must be developed and implemented quickly enough to serve these needs.\textsuperscript{16}

What then, can be done to capture the benefits of a software tool without falling into its pitfalls? First, it should be clear that the software is meant to "serve, not dictate, overall business strategy."\textsuperscript{17} Second, it is important to understand the different elements of a software tool and to prepare and manage each appropriately. The next section defines the various components of a software tool and the role each plays in the overall system.

3.4 Elements of a Software Tool System

Software tools come in a variety of flavours. A tool can be as simple as a spreadsheet of basic mathematical computation which resides completely on the user's computer, or as complicated as a third-party interface which links to multiple networked databases across several companies in the supply chain and resides primarily on remote servers. Regardless of its complexity, the tool system can be pared down to a few key components as depicted in Figure 3-1.


\textsuperscript{17} Tank, p. 6.
Software: The most central piece of the software tool system is the software itself. This is represented as the central box in Figure 3-1. It can perform simple mathematical calculations, invoke table lookups, and communicate with other computer systems in the company. This forms the essence of what the tool does. In the two cases studied during this project, the Long Range Plan (LRP) was essentially a spreadsheet application, while the global supply chain model (GSCM) was a more sophisticated mathematical optimization program.

Developer: The functionality of the software is determined by the most important, yet usually least visible, component of the software system: the developer. This may be an individual or a group within the company itself, as it was for the LRP, or it may be an outside vendor, as for GSCM. All software developers have particular goals in mind when developing the software. These goals include what types of problems the software is to solve, how long it would take to solve them, and what overall business results the
software can produce for its users. The developer’s objectives affect whom the intended user is, what type of assumptions will be made by the software, how certain inputs and outputs will be handled, and what the limitations of the software will be. It is in everyone’s best interest for the developer’s goals to be in line with those of the people or groups who will be using the software. If the goals are not shared, this must be understood so the software will not be used erroneously for situations it was not meant to handle. Keeping this in mind can prevent the company from becoming like so many others that adopt, then abandon, their software tools due to misalignment issues.

User: Another key component of the software system is the person who is actually interfacing with the software to execute its functionality. The user may be the developer, or may be someone else entirely. The user’s computer literacy, familiarity with the problem to be solved, and understanding of the software system all play a role in how the user will interact with the software. Most texts on software implementation advise that users be involved in the adoption of a new tool as early as possible. This concept will be explored further in the context of the Long Range Planning case study. In the context of this project, members of SCO&S were the users.

Inputs: In order for the software to perform its function, input must be provided. This input can be entered manually by the user, or obtained automatically from existing information databases. In some instances the tool itself will be programmed to have

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certain default inputs. The extent to which automatic defaults are used must be understood because if the user does not verify these inputs they can affect results generated by the software program. Gathering, filtering and reconciling input data is often the most arduous task in the usage of a software tool. If the system can simplify this task in any way, such as retrieving data from other internal computer systems or checking for validity, time spent on this stage can be decreased. When decisions must be made faster and more frequently, this time-saving feature could be invaluable.

Sources: Inputs may be obtained from a variety of sources. In some instances input data can come from the user, based on experience, intuition, or research. Sources of input may also include other internal business functions, communication from upper management, other companies in the industry, industry reports, consultant research, etc. One of the most important considerations for this component of the software system is the credibility and accuracy of the information received from these sources.

Outputs: Outputs of the software can take a variety of forms. Usually a report of some sort, either standard to the tool or customized by the user, is generated to present output. Other outputs may be housed in a table or, in a highly integrated information system environment, sent directly to other computer systems within the corporation. The extent to which outputs interface with other internal systems could be an important factor in selecting the right software tool.
**Recipients:** The outputs might be used only by the user, but other people or groups throughout the company may also use them. At Compaq, for instance, the SCO&S members were the users of the LRP, but the outputs from the LRP were delivered to other senior staff and to manufacturing facilities around the globe. Understanding who will be accessing or referencing the outputs is a key part of ensuring that the correct outputs are obtained from the system. Recipients of the output may not be aware of how it was obtained, so they may be more inclined to question the results. Some method of control may be necessary to ensure output information is not used in the wrong contexts. In other words, the sources of data should be shared with all recipients.

**Processes:** In Figure 3-1, solid black lines link the components of the software system together. Each line represents a process that must be controlled, such as the link between the inputs and the tool. Without a set procedure regarding where these inputs are coming from, for example, results could be inconsistent and unreliable. Too often it is taken for granted that the linkages exist. When they do not, a breakdown in the system occurs and the system may fail to bring about desired results. This can be seen in the LRP tool.

**Assumptions:** Underlying all business processes are the assumptions, or “hidden evils.” Each member of an organization has assumptions that are held “implicitly and unconsciously.” When two people with different basic assumptions use the same software system, results may be interpreted in very different ways. Being as open and clear as possible about these assumptions is absolutely necessary.
3.5 Chapter Summary

This chapter began by presenting the nature of strategic decisions. Effective
decision-making that links knowledge and supply chain capabilities can engender a
competitive advantage. But when using a tool to aid in these decisions, the key elements:
Software, Developer, User, Inputs, Sources, Outputs, Recipients, Processes and
Assumptions must be investigated. Overall, the goal is to ensure a proper fit of the
software tool, the task and the environment so the tool can add value to the company.
The next chapter explores these concepts in the context of the long-range planning tool
project.

Chapter 4: Long-Range Planning Case

4.1 Chapter Introduction

One of the products of Compaq’s SCO&S Group was a manufacturing long-range plan (LRP) that projected volumes, capacities, headcount, and other manufacturing parameters based on marketing forecasts. The LRP was internally developed at Compaq to help identify production issues before they could adversely impact business. As seen in Figure 4-1 above, the longer the forecast horizon, the less confident the forecast becomes, resulting in a large period of uncertainty. In the volatile market Compaq was facing, the confidence curve was dropping sooner and more rapidly resulting in a shorter period of confidence and a longer period of uncertainty. The LRP was designed to minimize future uncertainty by using market figures to project potential manufacturing parameters. The chief driver of the tool since its inception was the Senior Vice President.
of Supply Chain Management. When he retired in the spring of 1999, the SCO&S group saw the opportunity to re-examine this tool and assess its utility.

4.2 Previous LRP Tool and Process

The old LRP tool and process was in need of re-examination. The tool was a basic spreadsheet tool that calculated particular parameters relevant to strategic decision making. The process of using the tool was as streamlined as it could be. The following section describes the tool and process in more detail, and also provides an analysis of the system.

4.2.1 The Tool

The LRP tool was made up of three Excel workbooks used for data input, calculation and reporting. The input workbook contained all needed input data with a macro to generate the calculation workbook. The calculation workbook contained 11 calculation sheets aligned to the input workbook with embedded formulas. The report workbook was user-generated for final reporting. It presented results in aggregate by product and region for a five-year time horizon. The first two years of the plan had data in quarterly buckets. The years after that were presented as lumped annual figures only. The Senior VP required extreme detail for each manufacturing site, and he requested that the plan to look forward to a five-year time horizon. Inputs obtained from various company databases and from conversations with people at the manufacturing sites included figures such as inventory levels, labour hours per product, capital space available, etc. These inputs would be used in simple algebraic formulas to calculate manufacturing-based parameters. Information such as capacity, headcount, number of
production lines, and other manufacturing-based parameters were calculated and reported back to the Senior VP. Marketing forecasts were used to guide the calculations. When marketing figures were insufficient for the desired time horizon, the tool determined demand figures through linear extrapolation. The LRP did not contain any diagrams or text, and did not automatically interface with any existing company systems. It was used as supporting data in strategic discussion sessions, representing the forecasted figures for capacity, headcount, labour, etc. for manufacturing facilities worldwide. An example of an LRP data calculation is shown in Figure 4-2 below.

<table>
<thead>
<tr>
<th>LRP Output:</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Cycle Time Percentage</em> = % of demand that this source site can satisfy in a given period</td>
</tr>
</tbody>
</table>

**Calculation:**

\[
\text{Cycle Time Percentage} = 1 - \left( \frac{\text{Days in Transit}}{\text{Number of days in the period}} + \frac{\text{Inventory Level}}{\text{Number of days in the period}} + \frac{\text{Production Cycle Time}}{\text{Number of days in the period}} + \frac{\text{Raw Inventory Level}}{\text{Number of days in the period}} \right)
\]

**LRP Inputs and Sources:**

- *Days in Transit*: Database 1
- *Inventory Level*: Site personnel
- *Production Cycle Time*: Database 2
- *Raw Inventory Level*: Site personnel

Figure 4-2: Example of LRP data calculation

**4.2.2 The Process**

The LRP was developed once a year, and typically took six weeks to complete. A diagram of the process is shown in Figure 4-3 below.
The process began by combining the demand forecasts from the sales organizations and the product divisions. From this data, ongoing corporate and manufacturing initiatives and objectives, and previously developed plans, the SCO&S group derived capacity and headcount requirements and other manufacturing parameters. Once the plan was developed, a series of conversations ensued with the heads of the manufacturing facilities to ensure that everyone was in alignment with the numbers presented. This was the most time consuming part of the process, since numerical reconciliation had to be performed. After a series of conversations back and forth, agreement was reached, reports were published and the plan was ready to deliver to upper management.

The Senior Vice President of Supply Chain Management presented the information to other senior executives during the annual review session – a strategic
planning meeting attended only by the direct reports of the CEO. Here decisions regarding raw material positioning, product manufacturing location, capacity requirements and staffing and training needs were made based on the information presented in the LRP. It was understood that the leader of each business unit would communicate relevant information shared during this meeting to his/her constituents at his discretion.

4.3 Analysis of the Old Tool/Process

In his book on Long Range Planning, Morrisey recommends that an organization look to its mission, vision and strategy to develop the long range plan, not to past plans. He identifies four main areas that make up long range planning: 1) identifying key strategic areas, 2) analyzing critical issues, 3) developing long term objectives, and 4) developing a strategic action plan. Key strategic areas are those categories which the firm should focus on for the foreseeable future such as financial projections, product development, etc. The critical issues are those long-term strengths, limitations, opportunities and threats which may come into the strategic area space. For example, projected obsolescence of high-volume, high-profit products or services could be the critical issue for a company. Long-Term Objectives represent the strategic positions the company may wish to reach in some defined amount of time. Becoming the largest supplier of a particular product to the market by 2002 would be an example of a long-term objective. Finally, the strategic action plans identify major steps or milestones required to achieve the long-term objectives. Out of all these areas, the LRP as it existed
did analyze critical issues by presenting future numerical figures. Upon examination of
the spreadsheets, areas of concern that could have a negative effect on business were
identified. The LRP spreadsheet tool did not explicitly present long-term objectives or
strategic actions, but since it was used in the context of a larger strategic communication,
this was not necessary. It was homegrown for a particular audience and as such, the LRP
helped senior management gain business-level knowledge, but did not contain elements
of corporate-level knowledge. According to Kuwada, both types of organizational
learning are involved in the long-run development of a firm’s strategic behaviours.21

In an industry that introduced products in an increasingly rapid fashion, spending
six weeks on the development of a long-range plan seemed disproportionately long. By
the time all the numbers were reconciled, a refresh of marketing demand numbers was
available for the near term. This made short-term forecast horizons harder to reconcile
with the sites. Since SCO&S was more interested in the long term numbers, this
reconciliation made the group spend time on something of little value. More generally,
the time horizon for future planning was questioned. Fast changes in industry meant that
meaningful forecasts beyond a two-three years were uncertain. The longer term
projections were harder to identify. Product lifecycles were becoming increasingly
shorter. The only thing certain about future figures appeared to be their uncertainty.

Using the framework of the software tool elements, the LRP software consisted of
simple algebraic equations in a spreadsheet, as depicted in Figure 4-2. The tool was
developed in-house by a member of SCO&S, and only SCO&S directly interfaced with

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Francisco, p. 21.
21 Kuwada, p. 722.
the software. Inputs were obtained as described above from a variety of sources, but no
clear processes were in place to obtain these inputs with a high degree of accuracy.
Because the inputs were sometimes questionable, the resulting calculations had to be
reconciled by the heads of the regional demand fulfillment sites. No separate report was
automatically generated by the LRP, since the ultimate recipient, the Senior VP, preferred
to receive the raw spreadsheet data. Because the strategic information was so sensitive,
few people had access to the information. Other senior executives who were authorized
recipients of the data were given numbered copies. Compaq could not afford a breach of
strategic security in its extremely competitive environment, so many precautions were
taken.

The processes linking the software system components together were not very
rigid; they evolved as necessary. This was one of the difficulties faced by SCO&S in
implementing this process. Contacts at the sites, who were instrumental in reconciling
the data in the plan, would turn over often. This meant that extra time had to be spent in
educating the new contacts when time was already a precious commodity. The process
from output to recipients was also not clearly understood, since the information was
passed at the discretion of senior management. Assumptions were not clearly stated in
the spreadsheets. This led to some discrepancies between manufacturing sites running
different processes. For instance, a low volume, high-touch, cell-based manufacturing
line measured labour needs and space requirements differently from a straight, high-
volume, flow-through line. Yet on the LRP there was only one number reported for
headcount and capacity projections. As Compaq moved towards new and improved
manufacturing processes, the strategic planning tool also needed to be revamped.
4.4 ‘Voice of the Stakeholders’ Study

A perfect time to review the LRP tool and process arrived when the new Senior Vice President of Supply Chain Management came on board. He was not as intent on numerical analysis as his predecessor, so an opportunity to change the tool and process was afforded. It was apparent to members of the SO&S group that the planning process was taking a substantial amount of time, especially in the fast clockspeed environment that Compaq faced. It was also evident that the tool itself might have been limited in its ability to handle the increasingly complex product landscape. Since the tool was being re-evaluated, the group sought to understand what the customers of SCO&S wanted from a long-range planning tool, so a new design could satisfy all constituents of the plan. In order to obtain customer feedback, a ‘voice of the stakeholder’ survey was initiated.

4.4.1 The Stakeholders

Since the supply chain LRP had the potential of affecting numerous groups throughout the company, the voice of the stakeholder survey included people from different functions. Vice Presidents at the manufacturing facilities (or their designated alternates), and members of Finance, Procurement, Logistics, and Human Resources were identified as key stakeholders and interviewed. Interviews were also conducted outside the Supply Chain Management organization, with the heads of the product divisions. This was a marked shift from the way things had operated in the past, since the product divisions had not been seen as direct customers of the LRP. All in all, over fifteen people
were contacted and interviewed. According to Ulrich and Eppinger, conducting one-on-one interviews with about ten people will identify about 80% of customer needs.\textsuperscript{22}

### 4.4.2 The Survey

The survey was administered according to the “Voice of the Customer Survey” protocol laid out by Ulrich and Eppinger in \textit{Product Design and Development}.\textsuperscript{23} (Though this book pertains primarily to manufactured products, the principles of customer surveys can be used for any product delivered from one party to another.) Each interviewee was asked a series of questions pertaining to his involvement with the LRP in the past. He was also asked what he would like from the LRP in the future, keeping in mind what would be important for his constituent group. The survey questions are included in the Appendix. Most of the interviews were conducted face-to-face, but where distance didn’t allow this, phone conversations were held.

### 4.4.3 The Results

One of the key benefits of the survey came from involving the stakeholders in the design process. This engagement is highly encouraged in all information technology implementation manuals and product development protocols. The survey brought to light several areas for potential change in the existing LRP tool and process. Members of SCO&S had suspected some of the issues, but it was valuable to obtain the feedback directly from the various stakeholders. Key interpreted customer needs are presented in Table 4-1 below. Most customers felt that the LRP had to be credible, accurate, and

strategic in nature, linking corporate initiatives with those undertaken by the production sites. Some customers interviewed in the product divisions had never seen the LRP in the past, but felt its effects at the manufacturing sites. This was evidence of a problem in communication. There were times when the product division plans were not in alignment with the LRP. Because LRP data was not always shared in the product divisions below the Senior VP, strategic misalignment occurred.

| **The LRP is Credible** | - the numbers presented in the LRP match with other corporate database systems  
| | - recipients know where input data is coming from  
| | - assumptions are explicitly stated |
| **The LRP helps us Communicate** | - there is more communication with the sites and divisions during LRP generation  
| | - inputs and assumptions for the model are explained  
| | - information about other parts of the company is presented  
| | - product groups and manufacturing sites have more interaction |
| **The LRP is "Strategic"** | - interviewees see overall manufacturing strategies communicated in the LRP  
| | - the LRP has a broader focus than manufacturing within the 4-wall factory  
| | - corporate, marketing, distribution, and alliance strategies and their corresponding manufacturing initiatives are shared |
| **The LRP data is relevant and manageable** | - spreadsheets contain relevant data  
| | - estimates of future values suffice to warn of future business “showstoppers”  
| | - data does not go beyond three years |

Table 4-1: Key Customer Needs Statements from the Voice of the Stakeholder Study

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23 Ibid, Ch. 3.
During the course of the customer survey, the needs of SCO&S were also examined. The group determined that the LRP was required for Supply Chain Management to:

- Align the supply chain around corporate objectives
- Identify gaps and issues before they could impact operations
- Provide a formal planning tool and document that Supply Chain Senior Management could use to guide future business and evaluate various alternatives

These objectives are in line with those outlined by Morrisey for a successful LRP.\textsuperscript{24} SCO&S also wanted the new tool and process to be designed such that cycle time of the LRP could be reduced. This would render it more flexible so it could be used multiple times a year, if necessary, to explore Compaq's potential response to industry changes. This would also allow the group to spend its time more efficiently.

\textbf{4.5: Development of New Tool and Process}

The analysis of user and customer needs led to a new design for the LRP tool and process (the LRP 2000+). Since the "customers" at the manufacturing sites played such a vital role in determining the data that belonged in the LRP, it was decided that information would be obtained directly from them. With this shift, the "users" of the LRP 2000+ included both SCO&S members and the planners at the regional demand fulfillment (manufacturing) sites. These new users were involved in the design and evaluation phases of the new process. Approaches that "put users in the driver’s seat during the implementation and evaluation phases of the succeeding life cycles of the

\textsuperscript{24} Morrisey, p. 2.
system being built have a good chance of ending up with systems that will really be used. This stems from a shared learning experience between the designer and user, and this report has already spoken to the competitive advantages knowledge can bring to a firm.

4.5.1 Alignment

In most texts on strategic planning, extreme importance is placed on getting all functions of the company aligned so the organization can move forward efficiently as one unit. A large ship is often used to metaphorically demonstrate the behaviours of a large organization. Having each business unit independently design its own strategies leads to competing pulls in various directions, causing the ship to remain anchored in one place or to start sinking. In this day and age, a company cannot afford to do either. Strategic development does involve deciding on a course of action and considering its overall implications “with full participation of functional heads” in an expeditious manner. The LRP 2000+ was designed to enhance communication, and therefore alignment, among all key stakeholders.

At the essence of this alignment is open communication. Managers need to understand the implications of their own strategic direction on the rest of the corporation, and vice-versa. They want to know, for example, how manufacturing can support the needs of the markets, or how product mix affects sales revenue and profits. Morrisey acknowledges that some parts of a long-range plan may contain sensitive data that should

26 Hill, Menda, and Dilts. p. 61.
be kept confidential for competitive reasons, but he recommends that it “is not something you should keep under lock and key, to which only the ‘anointed few’ have access.”

Instead, it should be used to build loyalty and gain commitment from people who can contribute to achieving its goals. A software tool used to aid in strategic decision making can be the link between various company divisions, keeping everyone informed and on board around common objectives. The LRP 2000+ was designed with this idea of alignment in mind. It brought people from various functions of the company together to discuss strategic issues. It also enhanced communication between SCO&S and the manufacturing facilities by establishing a set process of how and when information would be passed between them. Clearly stating assumptions in the LRP 2000+ also removed the ambiguity of input source data, bringing about greater alignment.

4.5.2 Tool Input

One of the key issues leading to the long development time of the old LRP was the input reconciliation phase. The root cause of this problem stemmed from the fact that some of the input information for the LRP tool needed to be massaged into the appropriate format. Instead of pulling from a corporate system that was being used for other purposes by some other groups, the LRP 2000+ would obtain data directly from the manufacturing sites. To maintain uniformity of data across all the sites, an input data template was developed and is included in the Appendix.

The template was designed as a simple spreadsheet with instructions spelling out what was expected. Volume predictions were obtained from the marketing groups and

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27 Hill, Menda, Dilts. p. 61.
28 Morrisey, p. 93.
delivered in this input template with explicit mention of where and when the predicted numbers were obtained. This helped everyone understand the sources of information, thus improving credibility. The sites were then responsible for forecasting their own manufacturing parameters such as headcount and capacity based on the given demand volumes. Any assumptions forming the basis for these parameters had to be presented, so others reviewing the data could understand the context of the figures. Since the people at the sites were to input their own data to the LRP, no reconciliation needed to be performed. This part of the process established the link between input sources and the input to the LRP. It also served to reduce overall cycle time for LRP development since the large chunk of reconciliation time was eliminated.

4.5.3 Tool Output

The LRP output data was still delivered in spreadsheet form, since this was determined to be an acceptable format. Instead of delivering only the raw data from each site to the senior management staff, however, SCO&S aggregated the information in a manner relevant to each recipient, allowing for “drill down” pages which included more details. This method made the data more manageable, and served the purpose of alerting senior management to potential disruptions to business on a macroscopic level.

Though it did not get implemented in this phase, a document outlining key strategies, such as percentage goal of direct shipments, and their impact on the LRP data, competitive information and benchmarking metrics was to be part of future spins of the LRP. This addressed the need for higher level strategic information, positioning each division in the context of the corporation and the overall industry. This would help
customers see how their divisions could contribute to overall goals and objectives of the company.

The Voice of the Stakeholder survey showed that information reported for a five-year time horizon was not very valuable, or even useful, in such a rapidly changing industry. Extra time and energy was thus being spent by the SCO&S group to predict future values that no one needed. By looking at previous LRP sessions, it was observed that though overall volume predictions had been roughly accurate in the past, actual product mix volumes were very different. The computer industry was changing too quickly to predict market volumes so far ahead, and the trend was bound to continue. To increase the accuracy and credibility of the LRP, two key needs as reported by the customers, the new LRP was designed to look at a more manageable three-year horizon.

4.5.4 The New Process

In order to clearly establish links between the SCO&S group and other divisions in the company, the LRP 2000+ consisted of a new process. It is shown schematically in Figure 4-4 (next page). The timing of the internship did not allow for full implementation of the new process, so it is presented here as the expected plan. During the annual planning cycle, SCO&S would obtain volume predictions from the geographic marketing groups and then meet with product division representatives to ensure alignment and to obtain their product development plans. SCO&S would combine this with high level strategies and goals set forward by the Supply Chain Management organization. This is represented as the “SCM Strategy Filter” in Figure 4-4. The volume predictions would then be sent to the regional manufacturing sites in templates for them to fill out. When delivering the input templates to the sites, SCO&S would also
Figure 4-4: LRP 2000+ Process Flow

deliver a strategic document explaining the company’s overall direction, initiatives for the Supply Chain Division, and perhaps some mention of how this was reflected in the volume predictions for a particular manufacturing site. SCO&S and Supply Chain Finance would then collect all input templates, combine them as necessary for senior management, and deliver them in time for the company-wide strategic review. Final plans would be shared with the product divisions to complete the loop.

To keep the planning process up-to-date and accurate, it was recommended that the product divisions and SCO&S come together mid-year to conduct a review of past performance, and to adjust the LRP as necessary for future production. As Morrisey cautions, LRPs “…are not academic recordings to be filed and forgotten or ignored when it is convenient to do so.”29 They must be an active part of on-going, dynamic, strategic communication throughout the corporation. Face-to-face meetings are a powerful way of exchanging and processing information. Decisions and changes could be made quickly

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29 Morrisey, p. 19.
with full realization of which other groups might be impacted. Explicitly presenting assumptions and input data sources in the LRP would make it easier to maintain as a living document. According to Brézillon and Pomerol, “A [system] that is not maintained is a dead one.”

Overall, the new process helped to establish links between all parties involved, so the LRP could be a useful software tool. By keeping it up-to-date and accurate, and aligned with supply chain and corporate objectives, it could serve as a valuable decision support tool for any supply chain managers. It also served to keep all manufacturing facility information organized in one place, so a summary of the entire company could be seen at a glance. This would enable the LRP to be an effective tool for future decision making for the SCO&S group.

4.6 Chapter Summary

Responding to customer feedback regarding credibility, communication needs, and strategy, the new homegrown LRP tool provided a better solution for the SCO&S environment. By aligning interdisciplinary members of a team around common strategic objectives, and by streamlining the data gathering process, the team was able to come up with a process and tool that would suit its needs for faster, more flexible information transfer and strategic design. A quick look at the elements of a software tool and how they were incorporated in the new tool reveals:

1) the software itself was kept simple (algebraic formulas only) and was built in-house;

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30 Brézillon P., Pomerol J.-Ch., p. 54.
2) the inputs and sources were clearly identified and were a direct part of the process;

3) the recipients were kept in mind regarding the format of the outputs, and information was clearly explained in the LRP tool so future recipients could understand the figures presented;

4) the process between SCO&S and other outside parties was clearly defined;

5) assumptions were clearly stated on the data input form.

Designing the tool with the help of the stakeholders gave them a sense of involvement in the entire process, aiding in the ultimate implementation of the tool. It also ensured the utility and usefulness of the tool from their perspectives.

The next chapter looks at a different software tool, the Global Supply Chain Model (GSCM) and its implementation in the context of a warehousing logistics case study.
Chapter 5: Warehousing Project Case

5.1 Chapter Introduction

In many companies these days, deciding where to store and distribute inventory is quite a challenge. Satisfying customers often dictates that the inventory should be held as close to the customers as possible to save on delivery time and to assure appropriate customer responsiveness. Streamlining logistics costs, however, usually means that the number of warehouses should be kept to a minimum to avoid overhead burden. Overriding all these discussions is distribution strategy and how it fits in to the larger goals of the organization. At Compaq, discussions were being held regarding where to warehouse monitors being shipped to the North American region from the Far East. In an effort to improve order-to-delivery times and overall costs, Compaq wanted to compare various logistics options. To aid in the decision-making, a newly purchased software tool was used. This project showed the benefits and pitfalls of using a third-party tool in strategic manufacturing analysis. It also brought to light some issues regarding tool scope which were not explored for the Long Range Planning tool.

5.2: Problem Statement

Monitors were in high demand by North American customers of Compaq, but they posed some of the most difficult logistical issues because of their bulk, fragility, and high transportation costs. In 1999 alone, Compaq shipped over 3.5 million monitors, making it the largest monitor vendor in the world. Since most computer systems were
shipped with monitors, a large number moved through the distribution system with great frequency. At the time of this case, Compaq was receiving monitors daily in a vendor-owned and operated warehouse on the west coast, then sending them by train or truck to customer locations in the 48 contiguous states. Figure 5-1 depicts the distribution chain.

Figure 5-1: Simplified Monitor Distribution Chain

About 20% of all monitors were being shipped in large volumes to Compaq’s Distribution Alliance Partners (DAPs). The DAPs were part of a distribution strategy recently implemented that had pared down the total number of direct-buying channel partners from 39 to four.31 Continued implementation of the strategy set a limit on the number of partner warehouse locations that could receive direct shipments so as to reduce Compaq’s transportation costs and inventory.32 Although the fragility of monitors and conventional wisdom regarding number of warehouses would both suggest that one warehouse for monitors was economical, the logistics group was interested in exploring the cost implications of establishing a second vendor-owned warehouse in North America.

31Hausman, E. and Campbell, S. “5 Channel Turning Points/Integrated Distribution – Distributors draw on lessons from the direct model to retool the IT supply chain.” Computer Reseller News, Sept 6, 1999, p. 44.  
One of the reasons for this move was to align the warehousing strategy with a new transportation strategy under investigation called Port Diversion. In this strategy, monitors could be diverted directly from the receiving ship port to points inland in ocean containers and Compaq would be charged the bulk ocean shipping rates from origin through to end destination (see Figure 5-2). This could save on transportation costs since before this method, ocean rates were being incurred only to the port in California, then monitors were being shipped at relatively high truck rates from there to the end destinations. Port diversion was also a postponement strategy that would allow Compaq to direct monitor shipments to end destinations just before port docking instead of determining end locations at the time of shipment loading in Asia. Normal ocean shipping time from the Far East to California was 2 weeks. Being able to determine end location just prior to receipt of monitors would allow Compaq greater flexibility over its inventory positions. It would also allow Compaq to further its direct shipment capabilities.

To investigate this problem, the logistics group turned to the mathematical modeling experts of the manufacturing supply chain optimization and strategy group. The logistics group had already come up with some intuitive answers to the problem on their own, but they were hoping that a mathematical model could verify their results.
SCO&S had recently evaluated and chosen a third-party software tool to assist in global supply chain management. Although this project was focused on transportation logistics and warehousing, it afforded an opportunity to simultaneously obtain results and explore the capabilities of the new tool in the context of a relatively simple inventory problem. The group could learn about the tool through smaller, more manageable projects before launching into full-scale supply chain investigations.

5.3: The Global Supply Chain Model (GSCM) Tool

During the spring and summer of 1999, SCO&S investigated third-party software tools that might model Compaq’s global supply chain. Ideally, the group wanted a tool that would be intuitively easy to use, quick to implement, and that could obtain and send data from/to existing Compaq information systems. The tool would be used to evaluate overall strategies and specific one-time projects as needed so it had to be flexible. They wanted the tool to help them solve problems regarding optimal placement for products within factories, optimal number and location(s) for warehouses, and other planning issues. After comparing a number of third-party optimization software tools, Compaq chose the Global Supply Chain Model, (GSCM), a product developed originally by Digital Equipment Corporation and Insight Corporation.

5.3.1 Tool Selection

One employee who was a pivotal member of the tool selection team had extensive research expertise in mathematical modeling tools. He had attended training sessions for the various systems under consideration, talked to developers, and generally understood the capabilities of each tool. His thorough analysis of the various tools assured other
members of the team that Insight's product would, in fact, provide the best value for the company. The Global Supply Chain Model was an optimization package that could take into account duty drawback, tax shelters, and other factors that play a role in global operations better than any other tool on the market. It was also available at the right prices, and the developer was keen on working with SCO&S to fine-tune the capabilities of the tool. As mentioned before in the context of the LRP, user-centered design tends to aid greatly in the successful implementation of a software tool. This case was no exception.

5.3.2 GSCM Details

The details of GSCM are outlined in a 1995 Interfaces article by Arntzen, Brown, Harrison and Trafton. The product business units and Corporate Logistics and Manufacturing group at Digital initiated development in 1989. It was designed to help decision makers: 1) analyze the supply chain for new products, 2) analyze the supply bases for commodities, and 3) study companywide or divisionwide supply chains. Digital planned to use the tool to model problems from supplier selection to overall product movement strategies, including inventory placement, facilities planning, and the like. At the core of the system is a mixed-integer linear programming solver that uses branch-and-bound enumeration methods to minimize a weighted combination of total cost and total time. Being able to minimize cost or time or a combination of the two in evaluating solutions was appealing to Compaq, since a primary focus of the organization

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was to cut order-to-delivery time and costs. Most optimization programs only allowed for minimization of costs or maximization of profits.

5.4: The Warehousing Model

As outlined in Chapter 3, perhaps one of the most important parts of software tool usage is understanding what inputs are required and obtaining accurate input. Time spent in this task avoids the "garbage-in-garbage-out" phenomenon seen all too often in software system usage. Some interesting challenges occurred in this phase of the project, since documentation for the tool was not extensive and some data input values were not intuitively obvious. There were a number of different places within Compaq internal systems where monitor demand and shipment data resided, so obtaining the appropriate data required some effort. Learning curve issues also played a role in setting up the model correctly. Luckily for the team, the developer was quite responsive to questions and provided ample assistance. With a little bit of diligence, an appropriate model was constructed using the tool.

5.4.1 Demand

To address the distribution issue at hand, demand had to be determined for monitors within North America. The decision was made to construct the model based on year-to-date shipment values, since great fluctuations in demand patterns were not expected from one year to the next. There were many different stock keeping units (SKUs) for monitor models based on size, manufacturer, and special characteristics. A categorization of year-to-date monitor demand revealed that three monitor sizes, 15", 17" and 19" accounted for about 90% of the shipments in North America. Analysis was
based only on these models, since they would represent the bulk of transportation costs incurred from the California warehouse. Realizing the quality of data input to the software system played a key role in the quality of model output, demand numbers were cross-checked to ensure that the data was as accurate as possible.

DAP locations were defined as demand centers. One customer endpoint per state was also defined which accounted for all non-DAP demand. This was a simplification to actual transportation costs, however only bulk shipping was relevant to the baseline model since local transportation costs would be incurred regardless of volume distribution method.

5.4.2 Transportation

The trucking rates obtained were quoted state-to-state in dollars per pound ($/lb) for less-than-truckload hauls, and in dollars per mile ($/mile) for full truckload hauls. The ocean rates were quoted in dollars per ocean shipping container ($/container). GSCM required all transportation rates in dollars per hundredweight ($/cwt), and rates could not be defined for different product types unless each product type had its own transportation method. This would add many layers of complexity to the model so it was determined that the model could be run with an average $/cwt value. Assumptions had to be made about container loading and average weight per carton. All shipping containers were modeled as 40-foot-equivalents (FEUs) flat-loaded (without pallets). All full-truckload shipments were assumed to be made in 53’ trailers. For ocean shipments, the following conversion method was used:
\[
\text{Ocean } \frac{\$}{\text{cwt}} = \sum_{M=15''}^{19''} \left( \frac{\$}{\text{container}} \times \frac{\text{cartons}}{\text{containerM}} \times \frac{\text{lbs}}{\text{cartonM}} \times \frac{\text{100lbs}}{\text{cwt}} \right) \times \frac{\text{DemandM}}{\text{TotalDemand}}
\]

where M was the monitor type (15", 17", 19"). This conversion obtained the average $/\text{cwt}$ based on demand. For full truckloads, a similar method was used:

\[
\text{FTL } \frac{\$}{\text{cwt}} = \sum_{M=15''}^{19''} \left( \frac{\text{lbs}}{\text{cartonM}} \times \frac{\text{cartons}}{\text{truckM}} \times \frac{\text{100lbs}}{\text{cwt}} \right) \times \frac{\text{DemandM}}{\text{TotalDemand}}
\]

Less than truckload rates were simply converted from $/\text{lb}$ to $/\text{cwt}$ by multiplying by 100. Capacity was unlimited on all lanes.

### 5.4.3 Facilities

It was known when purchasing the tool that GSCM did not yet contain functionality to handle shipments directly to the customer. (This was an enhancement that was expected, but would not be available for this maiden modeling run.) The software's bill-of-materials database structure required every product to pass through the same number of nodes from source to demand. The algorithm for computing cost of goods was developed for this particular node structure. It was fine for product development, since each raw material or component could be added at a different stage of the process. But Compaq was looking at a pure distribution model in which essentially transportation charges were being optimized. Since this case required direct shipments, a dummy warehouse for port diversion had to be established. This warehouse had no costs associated with it. It was simply a placeholder to enable the model to run correctly.
5.4.4 Overhead and Handling Fees

Since the warehouses were vendor-owned, most overhead costs were not included in the analysis. Material handling fees at each hub were incorporated, and any container going through port diversion had both a container fee and a handling fee. A one-time setup cost for a new warehouse facility was estimated. GSCM had logic rules to ensure that this cost would only be incurred if the warehouse was used. It was assumed that adding a new warehouse and/or implementing port diversion would not affect the existing handling fee charged in California.

5.4.5 Inventory Holding Costs

Inventory holding costs were not included in this analysis since monitors tended to move quickly through the system to the end user. Also, Compaq did not incur these costs directly and since the main thrust of this investigation was to compare transportation charges incurred with or without a second warehouse and with or without end-stage port diversion, inventory costs were not necessary. Obsolescence costs were also not considered because the monitors were moving very quickly through the system at very high demand, and models did not tend to change too much year-to-year for the basic 15”, 17”, and 19” monitors.

5.4.6 Scenarios

During the development of the model, the team realized that the problem could be framed more effectively in two phases than in one. For the first phase, the focus was on the actual cost benefits of diversion given total customer demand in the states and at the
DAP locations. The three different scenarios explored in this first phase are outlined in the following chart:

<table>
<thead>
<tr>
<th>Case</th>
<th>Diversion to 2nd Warehouse?</th>
<th>Diversion to DAPs?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Case 1</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Case 2</td>
<td>✓</td>
<td>X</td>
</tr>
<tr>
<td>Case 3</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

An "X" in the chart shows diversion was not in place, a check mark shows that is was. Case 1 was the base case model to obtain a baseline for costs. All monitors were being shipped from California by truck to all customers locations. In the second scenario, diversion was only allowed to the second warehouse. Truckload shipments were made out of California or out of the second warehouse to customers. The third scenario allowed for diversion to a second warehouse and to the distribution partners.

For the second phase, it was assumed that diversion would be in place.

Separating those customer types with specific distribution strategies and cost structures, known as pipeline customers, refined customer demand volumes. Sensitivity of cost savings on the location of the warehouse was explored. The team placed the second warehouse in multiple potential cities throughout North America. This allowed the software tool to pick the optimum location, given standard ocean and state-to-state transportation rates.

### 5.5 Tool Results

The GSCM tool provided a number of valuable results for the project. The results verified what the team had intuitively believed before building the model. This lent validation to the tool itself since this was the first time it was being used at Compaq.
5.5.1 Tool Output Formats

As described earlier, one key process that must be managed in software tool usage is the receipt of output and its distribution to the appropriate recipients. Many third-party tools interface with standard spreadsheet and text editor applications to allow output reports to be generated in a printable format. Such an interface must be tested and examined to determine if customer needs are satisfied by the standard reports generated. If not, custom reports must be designed either by the end user or by the developer, depending upon how sophisticated the tool is. Tools developed in-house are usually designed with direct user needs in mind so output formats are discussed in the early stages of development. With third-party tools, however, the process of communicating needs to the developer and receiving the desired outputs can often take unanticipated time and money. In some cases, standardization issues may prevent particular report formats from being allowable by the software vendor. It is important to address the issue of suitable outputs before purchasing a third-party tool because the tool is quite useless if its results can not be communicated appropriately.

GSCM did have methods for exporting results data to spreadsheets. Production, shipment and transportation output appeared in spreadsheets as well as freight costs incurred. Summary and detailed cost and shipment reports could also be generated and shared with others quite easily.
5.5.2 Model Results

The results of the first pass are seen in Figure 5-3. Cost savings were realized by implementing diversion to the second warehouse and to the DAPs. From no diversion to diversion to the 2nd warehouse, costs savings were 9.8%. Allowing diversion to DAP locations as well gave overall cost savings of 13%. The primary driver of savings was reduced transportation costs. Though an additional fixed cost and increased material handling fees were incurred in establishing a second warehouse, these were greatly overshadowed by the relative change in freight rates between diversion and trucking.

The percentage of shipments using diversion is shown in Figure 5-4. These results were only seen in relative terms. Absolute values had very little meaning since so many assumptions were made in constructing the model. The team acknowledged these assumptions, but valued the results obtained because they gave a good estimate of where
in the system high transportation costs were being incurred. This helped them verify that diversion would, indeed, be a good strategy to investigate further.

![Diagram showing percentage of shipments using diversion]

**Figure 5-4: Percentage of Shipments Using Diversion**

The second phase had a different customer demand profile because certain pipeline customers had been removed from the analysis. They had different factors dictating inventory and distribution strategies so it was not certain that they would implement the diversion strategy. Despite the refinement in demand volumes, the second pass of the monitor model revealed that the location used in phase 1 was indeed the optimal choice.

### 5.5.3 Analysis of the Tool

Though the GSCM tool was quite sophisticated for global modeling in which duties, tax holidays and local content rules played a major role, it was too complex for the particular task at hand. The forced bill of materials structure made it necessary to 'trick'
the system to send items direct to the customer. The user-defined constraints which were mean
to give valuable flexibility to customers were not intuitive, lacked help files, and did not have any bearing on this particular scenario. Yet leaving these constraint fields blank led to errors upon running the optimizer. Debugging tools were present, but some messages were written in a code indecipherable to the user. Many of these issues were to be addressed in the next software release, but at the time of the monitor project they caused delays. For the simple task at hand, the complicated inputs were not necessary.

Moving to the “Results” side of the software tool, it was obvious that GSCM reported model outputs in well-constructed reports. These reports could be easily generated and passed along to other decision makers with relatively little modification required. Since both inputs and outputs could be presented in Excel spreadsheets, a macro could be written to automatically import/export data to and from the tool and existing Compaq systems as necessary.

Though the monitor distribution problem under-utilized the global capabilities of GSCM, it required too much of the transportation rate options. Being able to define only one $/cwt rate between any two points for a given transportation method was very rigid and not aligned with Compaq’s transportation contracts. This input structure also made less-than-truckload (LTL) and full-truckload (FTL) costs very hard to calculate, since capacities could not be entered on a per-product, per-truck basis (the number and weight of 15” monitors that could fit on a truck was different from the number and weight of 17” monitors). LTL rates were quoted based on overall number of pounds shipped, and they varied significantly across the range. For instance, if shipment volume was less than 500 lbs, the rate charged was about 70% higher than the rate for a shipment volume of more
than 7,000 lbs on this same lane. GSCM lacked the user-defined logic that would be necessary to make the tool choose the appropriate transportation rate based on shipment weight.

Evaluating GSCM as a decision support tool, it can be seen that it was not really meant for the situation at hand. More generically, any problem that involves multiple modes of transportation and expects optimization to be based on the rates of these different modes is not well-suited for GSCM in its current configuration. The model was run and results were found, but a simple linear program using Excel solver may have produced similar results. This was an important lesson learned, since part of implementing a new tool involves understanding its capabilities and limitations regarding various problem scenarios. There is a caution here that managers should not jump to a new, fancy tool to solve just any problem simply because it is new and fancy. It appears that the use of GSCM for this monitor problem came about because it was the new optimization tool, and it was assumed that this would be a relatively simple problem to model. But there must be a fit between the tool and the task at hand. The requirements of the problem and the various methods by which a solution can be found should be thoroughly evaluated so the appropriate and most efficient one can be chosen.

As far as overall support goes, one of the needs obtained from the survey of planning executives is that the strategic planner should be able to use a system “without having to consult the software supplier at every glitch.”Granted GSCM was in a developmental phase, but without help files and adequate model debugging applications the tool could only be used by people familiar with the underlying mathematical

34 Tank, p. 14.
modeling. This could impact expanded use of the tool, since each user would have to be trained appropriately.

Despite the misalignment for this particular scenario, it did appear that GSCM could provide long-term value to Compaq. Its ability to model multiple future periods could be helpful to see predicted effects from a strategy enacted today. This could help reduce the uncertainty of decision-making. The developer was available and very willing to help build a successful model during this project. Though there was no formal process link between the developer and Compaq, maintaining that close relationship was very helpful. If the connection stays intact going forward, Compaq could ensure that its needs will be addressed in future versions of the software. This could be a win-win situation for both parties.

Arntzen et. al. set forth the idea that GSCM should be only one piece of a strategic evaluation. Since it is a model and models can only represent reality, not actually imitate it, the tool does have its limitations. Other intangible factors, such as political or cultural issues surrounding particular decisions, play a significant role in dictating the outcome. GSCM solutions should be used as a benchmark, or perhaps a launching pad for more thorough investigations. Armed with the objective, mathematical outputs from GSCM, the logistics group went forward with their plans to further investigate the port diversion solution.

35 Arntzen et al., p. 80.
5.6 Chapter Summary

The GSCM case study shows that not every tool can be used for every task. Even when a tool is carefully evaluated before selection, as GSCM was before it was deemed the optimization package of choice for SCO&S, it will always be chosen with particular problem scenarios in mind. Learning the capabilities and limitations of a tool from the onset is definitely valuable, as the tool can then be used more efficiently as time goes on.

Again, applying the element analysis that was performed at the end of chapter 4, we can see that:

1) despite being a third-party tool, the developer was very willing to work with the Compaq team to ensure successful implementation;

2) the tool itself contained a structure and mathematical underpinnings which were not ideally suited for the task at hand;

3) the process link from the input and sources to the software allowed for the import of information from standard Excel spreadsheets, leading to greater ease of use;

4) the output reports were thorough and could be exported to Excel to allow for other graphs and charts to be made easily;

5) assumptions were not clearly stated in the tool, so input defaults had to be found and massaged to suit the scenario.

In conclusion, though GSCM gave acceptable results, it was not the most efficient tool for the task. A key factor leading to efficiency, then, is the fit between tool and problem.
In the final chapter, both case studies and the lessons learned from them will be compared. Based on these, a set of guidelines for implementing a software tool for decision support will be introduced.
Chapter 6: Analysis and Conclusions

6.1 Chapter Introduction

As the computer industry moves forward, there will be more complex, more challenging decisions to be made in a strategic context. In the specific realm of supply chain strategic planning, decisions regarding manufacturing location, facilities planning, materials positioning, staff training, and the like must be made. The impact of these decisions on the organization could play a key role in the company’s competitive health. Always staying one step ahead of the competition is a sure method for success.

6.2: Case Comparison

From the cases presented, it is evident that the key to success and satisfaction in software tool implementation is the proper fit of tool, task, and environment. In the LRP case, developing the tool in-house allowed the team to specifically address the problems outlined in the voice of the stakeholder study. This ensured a match between tool and task. By involving the stakeholders in the design process, the link between tool and environment was also established. In the GSCM case, the problems arising from a mismatch of tool and problem were seen. Though good results were obtained in the end, the path to getting them may have been a little more arduous than necessary. Figure 6.1 shows the comparison between the two tools.
<table>
<thead>
<tr>
<th>Development</th>
<th>LRP 2000+</th>
<th>GSCM</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>In-house with specific problems of stakeholders in mind</td>
<td>Generic 3rd party tool, though developer was very accessible and responsive</td>
</tr>
<tr>
<td>Software</td>
<td>Excel Spreadsheet with algebraic formulas and explanatory text</td>
<td>Linear programming optimization with company’s own mathematical algorithm</td>
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<td>Purpose</td>
<td>To provide information about manufacturing facilities to strategic decision-makers; to enhance communication of this information to all relevant stakeholders</td>
<td>To optimize a given supply chain scenario for further analysis and evaluation</td>
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<td>Usage Pattern</td>
<td>On-going information repository for company with periodic updates</td>
<td>Model constructed by group members for specific project as and when needed</td>
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<tr>
<td>Users</td>
<td>SCO&amp;S and manufacturing facility planners (on-site)</td>
<td>SCO&amp;S members</td>
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<tr>
<td>Inputs</td>
<td>Entered into tool through input data template</td>
<td>Depends on project; can be imported through Excel</td>
</tr>
<tr>
<td>Sources</td>
<td>Marketing and manufacturing sites</td>
<td>Depends on project</td>
</tr>
<tr>
<td>Outputs</td>
<td>Spreadsheet with relevant planning parameters and corresponding strategic plans</td>
<td>Reports generated by tool; results can be exported to Excel</td>
</tr>
<tr>
<td>Recipients</td>
<td>Senior level executives; stakeholders in other departments</td>
<td>SCO&amp;S; sponsors of project being investigated</td>
</tr>
<tr>
<td>Processes</td>
<td>Established through new design</td>
<td>Learned through training</td>
</tr>
<tr>
<td>Assumptions</td>
<td>Clearly stated in input template and in results</td>
<td>Embedded in software</td>
</tr>
</tbody>
</table>

Figure 6-1: Comparison table of LRP 2000+ and GSCM
6.3 *The Company Toolset*

It is evident from these cases that after a tool is obtained or developed, it is not necessary to apply it to every problem that comes down the line. Careful thought about the tool and its limitations can provide valuable insight into its utility for any given problem. This leads to the concept of the company toolset. There is no requirement that a group or a company must choose only one optimization package or one software decision support tool to satisfy all its needs. In fact, this may do more harm than good, since each tool is designed for a specific set of problems. Just as a handyman has several different tools in the toolbox and would never dream of using a hammer to drive a screw into the wall, so too should a company have several tools at its disposal, each for a different set of problems. The SCO&S group had this method, as they designed the LRP tool for longer-term strategic planning and communication, and wanted the GSCM tool for the analysis and optimization of particular initiatives or strategies.

A key to following this strategy, however, is having thorough understanding of each software tool. Without it, the software may be used for the wrong situations. For instance, had GSCM’s strengths and limitations been known before embarking on the monitor modeling project, another more straight-forward, classic method of optimizing the problem may have been explored. In the LRP 2000+ Guide, specific information regarding input sources and data calculations was presented to users so they could better understand the LRP. This improved credibility in the tool.

It may be argued that the true capabilities of a tool can only be learned through its use, therefore some misalignments are bound to occur in the beginning stages of
implementation. This is a legitimate point. Efforts must be taken, however, to understand the tool as thoroughly and as quickly as possible to avoid inefficient use of time down the road. Maintaining a close relationship with the developer is critical at this stage, since knowledge transfer should come directly from the source.

A small set of well-designed tools can provide a powerful arsenal for any group, allowing them to quickly and efficiently make reliable business decisions. Since speed of decision-making is increasing as the industry picks up its pace, this toolset can only provide a desirable advantage.

6.4 Guidelines for Software Selection & Implementation

From these cases, a set of key guidelines for tool selection and implementation can be derived.

6.4.1 Questions for Tool Selection

In order to choose the right tool for the task, the following questions must be answered:

1. What is the problem at hand? What must the software provide? In the cases above, two very different problem sets were being addressed. The LRP 2000+ sought to make long-range planning decisions easier. The GSCM was designed to optimize specific modeling problems. Both dealt with strategic decision making, and the company was faced with faster and faster decision cycles. So both software tools were needed to make accurate decisions more efficiently.
2. **What tools are available to solve this problem? Is a new tool necessary?**

The SCO&S group had defined particular problems that needed to be addressed, and they realized the tool they had did not satisfy their needs. Realizing when to update a toolset is critical to keeping it updated and useful for the issues at hand.

3. **If a new tool is required, should it be developed in-house or bought from a third party?** It was wise for SCO&S to develop the LRP tool in-house because it was meant for strategic analysis. Since each company has its own needs and processes surrounding strategic planning, a corresponding tool will best serve the group if it is designed in-house. The GSCM tool helped address the new responsibilities of SCO&S, since prior to the recent re-organizations they group was only responsible for manufacturing strategy. There were several supply chain optimization tools on the market for SCO&S to examine, so they could choose the one that would best suit the group’s anticipated needs.

4. **Who will be using the tool? Who will be receiving the outputs? How savvy are they?** Addressing these questions up front helps to determine how much work may be required to educate users and recipients. It also can help determine which tool will be appropriate. For example, a graphically intuitive tool may be better suited for users who are not as familiar with computer systems.
6.4.2 Implementation Issues

After addressing these questions, the fit between task, tool and environment should be established. Key guidelines for implementation are:

- **Simplify**: Make sure the amount of effort being spent in acquiring input data is balanced by the quality and perhaps quantity of outputs generated by the system. Don’t overcomplicate the issue; a simple back-of-the-envelope calculation may be sufficient for certain stages of analysis. Always start with a simple model, then methodically build up complexity. This can reduce the occurrence of errors in the system.

- **Know what type of decision needs to be made**: Not all tools are suitable for all problems. This was made obvious in the use of GSCM for the monitor modeling project. Knowing the type of decision desired helps to determine the intended output of the system. To what end will the results be used? What assumptions would affect the output of the tool?

- **Include the incidence of the future and of preferences**: Take efforts to eliminate (or at least reduce) uncertainty by looking at possible impacts of today’s decision on tomorrow. Allow the system to be flexible enough so users can customize it to their own needs. User-centered design leads to greater tool utility, and therefore greater tool use.

- **Maintain honest and open communication**: State assumptions up front, talk to people face-to-face; get people involved from the beginning. Software tools can aid greatly in communicating ideas through objective means, but only
insofar as channels exist to share these ideas. In other words, the process linkages from Figure 3-1 must exist.

6.4.3 Establishing Process Linkages

Process links as set forth in Figure 3-1 must be developed and maintained between elements of the software system. When processes do not exist, (as in the old LRP between inputs and the tool), inconsistency, inaccuracy, and general uncertainty result. Being aware and in control of the various processes can point to a corporate advantage, since this leads to better knowledge management.

6.4.4 Incorporating Flexibility

Flexibility is a necessity for any software support system today. Customer needs change, therefore user needs change, and a decision support tool must also change. The harder a tool is to modify, the more time must be spent updating it. Most companies cannot afford to dedicate resources to this task when there are many more fires that need to be fought. As a result, the system could wither away and die as informal decision-making processes take over. Again, a system which is not maintained is a dead one. GSCM had flexibility embedded in certain aspects of the tool but was quite rigid in others, as seen during the monitor project.

6.5: Conclusion

As Morrisey so elegantly phrases it, “Regardless of the sophistication of the analytical tools used in the process, sound managerial judgment is the cornerstone of an
effective Long Range Plan.\textsuperscript{36} So no matter how many bells and whistles a software system for strategic planning may have, it is still only a tool and should be used as such. When designed and used properly, however, a system that marries task, tool, and environment can provide an extremely powerful advantage. Managing knowledge and information is one of the most difficult tasks in corporations today, especially in large companies that are rapidly expanding. Using software tools to guide strategic planning can make complicated decision-making more efficient. When speed and flexibility may be key differentiating factors, this may lead to a sustainable competitive advantage.

\textsuperscript{36} Morrisey, p.4.
References


Appendix

Strategic Long Range Planning Interview Guide 74
LRP 2000+ Region and Site Templates 75
Strategic Long-Range Planning Interview Guide

Name: 
Function: 
Date: 

1. Background: Have you been through the LRP process before? If so, in what capacity?

2. Output Usage Scenario: In the reports given to you from the Supply Chain Strategy group for preliminary view, what data elements would you look for first? (what's the "bottom line" in your mind, what are you comparing the data to, etc)

3. Data: What type of information is most useful/meaningful to you? (ie. Order cycle time metrics, labour and overhead, capacity, capital, etc) Why? (What types of decisions are being based on these numbers?) What are the essential elements that are critical for you to successfully complete/develop a strategy?

4. Business constraints: What are the essential drivers for your business? What level of granularity do you expect for LRP data? (@ product level: hierarchy and @ factory level: line/capital definition - how many lines?)

5. Current deficiencies: Is the LRP in its current form missing any data that would be helpful for you in making your decisions? Please comment on the presentation of the data in its current format as well.

6. Division Strategic Planning Process: What is your typical strategic planning process (sequence of events)? Where does the Long-range planning data from the Supply Chain Strategy group fit into your process? (Include timeline.)

7. Time horizon (if not already addressed above): When would receipt of long-range data be most beneficial to you? (ie. In sync with yearly review, operations review, at the end of a quarter, at the beginning of a quarter, etc.) How often would you like to receive long-range information?

8. Process: What is your opinion of the current LRP process? Possible followup: How could it be made easier/faster/etc?

9. Any other comments?
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LRP 2000+: Regional Template Guide

This guide has been prepared to assist you in filling out the Regional Template above, and to also indicate where provided data has been obtained from. Please do not change any data that has already been populated in the fields above. Wherever possible, data from the worksheets below will be directly transferred to the cells in the template. When this cannot occur, instructions have been provided.

This workbook consists of a "Regional Template & Guide" worksheet and a "Site Template & Guide" worksheet. Please copy the Site Template and send it to each of your sites. Include your site worksheets in this workbook when you send this template back to us.

| Overall volumes: | Obtained from XXX plan on 10/01/99. Breakdown is shown below. |
| Division volumes: | Obtained from the same. Breakdown is shown below. |
| % In-House: | As reported in the deployment strategy sheet of the strategy document accompanying this template. |
| % Direct: | As set in Ed Straw's Supply Chain Metrics. |

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<table>
<thead>
<tr>
<th>Industry Std Servers In-House</th>
<th>Industry Std Servers Total</th>
<th>% In-House</th>
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<table>
<thead>
<tr>
<th>Main and Acc Comm In-House</th>
<th>Main and Acc Comm Total</th>
<th>% In-House</th>
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<tbody>
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<table>
<thead>
<tr>
<th>TDM Products In-House</th>
<th>TDM Products Total</th>
<th>% In-House</th>
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<tbody>
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<thead>
<tr>
<th>Workstation Div In-House</th>
<th>Workstation Div Total</th>
<th>% In-House</th>
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<tr>
<th>EU Enterprise Group Total</th>
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<th>EU Enterprise % In-House</th>
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</tbody>
</table>
Use the worksheet below to calculate the unit and space production capacity in your region. Be sure to include Alliance partner information if relevant.

**Unit Capability:**
Compute the number of units of each product division that can be produced in your region. Replace "Site 1, Site 2, Alliance 1" etc. with the actual names of your sites and alliance partners.

<table>
<thead>
<tr>
<th>Site</th>
<th>Q1 99</th>
<th>Q1 00</th>
<th>Consumer</th>
<th>Consumer</th>
<th>Consumer</th>
<th>Consumer</th>
<th>Consumer</th>
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</table>

Report the total numbers in the appropriate cells in the Regional site template above.

**Space:**
Compute the amount of square footage available for production in your region.

<table>
<thead>
<tr>
<th>Site</th>
<th>Q1 99</th>
<th>Q1 00</th>
<th>Actual Used</th>
<th>Actual Used</th>
<th>Actual Used</th>
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</table>

Report the total numbers in the appropriate cells in the Regional site template above.

**Direct Labor:**
Compute the projected number of DLs needed for your region. (DLs include Manufacturing Associates, Material Associates, and electronic technicians who are working directly on the line.)

**Contract DL:**
Compute the projected number of contract DLs needed for your region.

**Indirect Labor:**
Compute the projected number of ILs needed for your region.

**Contract IL:**
Compute the projected number of contract ILs needed for your region.

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</table>

Report the total numbers in the appropriate cells in the Regional site template above.

If there are any overall hiring strategies in place for your region, indicate them here:
Total SC Goal (NPR): This is the total supply chain cost for your region. This includes all direct and indirect costs incurred, and is developed through Corporate and Regional Supply Chain Entities. Report this as a percentage of Net Profit Revenue.

Forecast (NPR): Report your projected supply chain costs in the template above.

Delta (%): This will be computed in the template as the difference between the Goal and the Forecast numbers.

Performance Metrics:
Enter Company Performance Metrics here including present status and future goals.

Use this space to report anything which has played a role in determining values for the template, or which may impact these values in the future: