STRATEGIC ANALYSIS OF A SOFTWARE BUSINESS

By

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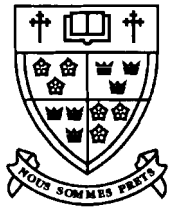

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ABSTRACT

The goal of the software business analyzed in this paper is to grow revenue at an average annual rate in excess of 12% over the next five years, in a market with less than 10% annual growth, and increasingly intense competition. On its current path, it is not likely the focal business will achieve these goals. To do so, this analysis suggests the business should discontinue several non-profitable products, divert the associated resources – and invest in additional resources - toward developing technology that will serve the attractive Manufacturing Execution Software for process industries market segment. In addition, the business should adopt a market (as opposed to sales or operations) orientation to improve customer satisfaction and penetration within served (and targeted) markets. Finally, the business should maximize the synergy among its portfolio of existing products to build a sustainable competitive advantage.

DEDICATION

I would like to thank my family and friends for their support throughout the program and this project.

Eric G. Dorgelo

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1 INTRODUCTION

This analysis centres on a Manufacturing Software Business (MSB) which is a business unit within Company X. Company X is a multi-billion dollar firm and a global leader in the production of electrical equipment, digital controls and information systems for manufacturing machinery and processes. Software revenue is only about 3% of Company X's total revenue. However, MSB's profit margins are significantly higher than that of other business units, and software's strategic value is high due to its positive pull-through effect on hardware sales. In addition, the manufacturing software industry that the MSB competes in is attractive - experiencing double-digit growth and profits within most segments coupled with low competitive intensity and even higher profit potential in the newest segments of the market.

1.1 Background

1.1.1 The Formative Stage – Electro-Mechanical Equipment

Company X started out supplying auto manufacturers with industrial electrical equipment such as switches, panels, rotary dials (rheostats) and meters. It soon expanded its served market to include manufacturers of various consumer-packaged goods such as household supplies. Over the next several years, Company X developed many new electrical products to serve these customers, including motors, drives, sensors, indicators, and more. As the use

of electrical equipment in production processes increased, manufacturers began looking for ways to automate the control of this equipment, with an eye to improving the quality and consistency of their finished products and reducing manual labour. To address these needs, Company X developed electro-mechanical relay "ladder logic" systems that provided automatic control of equipment having "discrete" (on/off, open/closed, up/down, etc.) states, such as actuators and motors.

1.1.2 Rapid Growth - Electronic Controllers

With the advent of digital electronics, Company X became one of the first in the world to offer microprocessor-based controllers that could replace relay ladders and/or pneumatic controls. These devices eliminated the costs of the heavy wiring, relays, panels and electrical boards necessary to implement "hard-wired" ladder controls. Instead, electricians could program them using the same relay ladder symbolic language they were familiar with – thereby minimizing switching costs. In addition, when needs changed, these devices could be easily re-programmed without costly rewiring.

Company X's digital controllers quickly became a leading brand synonymous with reliability, flexibility and performance. As a result, the company began growing revenues and profit at a double-digit annual rate. Due in large part to Company X's industry-leading controllers, and shrewd investments in market development, sales of its equipment began expanding into other manufacturing market segments including the Pharmaceutical and the Food and Beverage segments.

1.1.3 Continued Expansion – Electronic Operator Interface Terminals

Electronic controllers were successful at replacing electro-mechanical relay control ladders, but they still needed connections to switches and other inputs so that equipment operators could send commands to the controller to start or stop or adjust production equipment. Furthermore, operators still needed equipment status information; so status lights, gauges and similar output indicators had to be connected to the electronic controllers. Collectively these inputs and outputs formed the operator interface to the equipment. Although this was effective, it still required wiring between the controller and the operator interface devices and, if changes were required, costly down time and rewiring had to occur.

In response, Company X introduced Electronic Operator Interface Terminals (OIT) to replace the electro-mechanical operator interface devices. These terminals displayed real-time equipment status information on a programmable CRT and sent operator commands from a keyboard or touch screen to the controller over a single network connection. This effectively cut the cost in half; and, since the terminals were programmable without rewiring, just a single network connection between the controller and the OIT was required.

1.1.4 Recent History – PC-Based Software Products

With the exception of "tied" software for programming its electronic controllers and other devices, Company X really produced no software-only products. However, in the 1980's, it became increasingly evident that what the market required was software that could be used to monitor, control, maintain

and optimize *any* vendor's electrical equipment and control devices – and to interface with any vendor's business systems (e.g., order entry, compliance reporting, supply chain management). As a first response to these needs, Company X private-labelled some software for real-time monitoring and visualization, and developed its own rudimentary product for the management of production data.

Despite this, software-only products were not part of Company X's core business – garnering less than 1% of R&D investment. However, in the last 10 years, this has changed. Customer demand for Commercial-Off-The-Shelf (COTS) manufacturing software products has increased significantly - as has the strategic value of software in overall system sales. With increasing frequency, it has been the capability and performance of the software that determined the fate of a sale – not the control hardware itself.

Company X realized it needed to offer its own solutions. In response, it created the software business unit with seed capital and a management team. This business began horizontal integration by acquiring small manufacturing software firms whose application software would collectively create a large portfolio of manufacturing software products. Acquisition targets ranged from technology-only start-ups to established and profitable software firms. Today, the software business is responsible for developing and commercializing software products that monitor and control production equipment, production processes and entire manufacturing operations.

1.2 The Strategic Issue

Despite a market leading position in electrical and electronic control equipment for manufacturers, Company X's software products are not among the market leaders. Consequently, software revenue and profits could be much higher. In fact, more than half of the customers that use Company X's hardware products use software offerings from competitors. To add to this, Enterprise Resource Planning (ERP) and other large software producers are threatening to enter the manufacturing software market, thereby increasing the competition for market share and economic rents. Given this situation, the key strategic issues are, first, how to increase the use of its software products within its large (and still growing) customer base, and, second, how to continue to grow software revenues and market share despite the imminent entry of large ERP and application platform software vendors.

ANALYSIS OF THE MANUFACTURING SOFTWARE BUSINESS' (MSB) CURRENT SITUATION

2 ANALYSIS OF THE GLOBAL MANUFACTURING SOFTWARE INDUSTRY

This chapter describes and analyzes the manufacturing software industry to provide a background for the strategic analysis of the MSB. To conduct this analysis, market segments and competitor groups are identified and an industry-wide analysis is performed using Porter's Five Force framework. This model examines the nature of rivalry, buyer and supplier bargaining power as well as the threat of entry and use of substitutes across the industry. Later in the chapter, political, economic, social and technological factors that affect the industry at a macro level are examined.

2.1 Market Segments

Three major boundaries exist within the manufacturing software industry: manufacturing *process type*, *industry type* and software *product type*. A description of each of these follows.

2.1.1 Manufacturing Process Types

Process types can be generally categorized as *discrete*, *continuous*, or *hybrid*, that is, a combination of the discrete and continuous types.

Discrete manufacturing processes involve the production of discrete (countable) finished goods – for example, cars, bottles, or light bulbs. These processes typically run at high speeds and are somewhat flexible in output –

each item may vary in, for example, size, rate, colour and optional features. Another notable distinction of this process type is that they often start and stop for repairs, shift changes, idle time, etc., without adding costs.

Continuous manufacturing processes involve the production of a continuous stream of finished product – for example, oil, gas, chemicals or electrical power. These processes are typically lower in speed and do not provide significant variability in goods produced. In some types of production, (for example, cement, power, water supply, or chemical), the process cannot stop without incurring significant costs associated with spoiled product, safety concerns, damaged production equipment and/or long restart cycles.

Until recently, control systems designed for continuous processes were not well suited for discrete production, and vice versa. Discrete control systems, on the one hand, are flexible, and are optimal for high-speed applications that frequently start and stop. On the other hand, continuous control systems are less flexible, optimized for slower production processes, and are designed to run non-stop. However, these lines are slowly blurring – suppliers are beginning to produce systems that can control virtually any type of process.

Hybrid Manufacturing processes involve some combination of continuous and discrete processes. For example, a brewer may have a continuous water filtration process and batch fermentation process, followed by a discrete bottling and packaging process.

2.1.2 Customer Segments and Manufacturing Industry Segments

Discrete Industries is the market segment name given to customers that utilize discrete manufacturing processes, while *Process Industries* is the market segment that conduct continuous or hybrid manufacturing operations. **Table 1** shows the major end-user customer segments within each industry segment.

Table 1 - Customer Segments by Industry Segment

Industry Segments	Customer (end-user) Segments
Discrete Industries	Large Customers (> [redacted] % of segment) • Electronics (Manufacturers) • Medical Device • Automotive • Aerospace/defence • Semi-conductor Smaller Customers (< [redacted]% of segment) • Metal Fabricators • Equipment/Machine Builders • Electrical Equipment
Process Industries	Large Customers (> [redacted]% of segment) • Oil & Gas • Food & Beverage • Pulp & Paper • Pharmaceutical • Chemical Smaller Customers (< [redacted]% of segment) • Cement & Glass • Metals & Mining • Power Generation & Distribution • Water Supply, Wastewater Treatment

Data sources: ARC and Frost & Sullivan market research, 2004

Note: Figures have been blacked-out in the table above and elsewhere in this document in order to protect the identity of Company X and to conceal confidential information.

It is important to understand that specific customers within each industry type have their own specific manufacturing process, equipment and regulatory concerns. They may not think of themselves as falling into one or another of these types. Therefore, the generic process types are somewhat of a supplier-created boundary - an abstraction of similar production types – and are less meaningful to end consumers than they are to suppliers.

2.1.3 Software Product Segments

Like industry/process types, product segments are an abstraction or categorization of patterns of customer needs. That is, product type boundaries tend to be supplier generated and based upon classes of users and their typical usage patterns (user role and tasks). Nonetheless, software product segments (types) are of value to consumers, allowing them to search for and compare products of similar types from various suppliers.

However, suppliers tend to avoid using "industry standard" product types, opting instead to invent their own category names in the hopes that this will provide them with a "first mover" advantage, and/or make it difficult for customers (or analysts) to compare their offerings with those of their competitors. For this reason, this paper will use normalized (generic) product type names. A description of each of the major generic product types that make up the manufacturing software industry follows.

Process Simulation and Optimization (PSO) Software allows manufacturing process engineers to perform "what if?" scenario analysis to

determine their effects on production lead times, capacity and yield. Typical scenarios available for analysis include adding, subtracting, or altering production equipment; re-routing raw materials, work in progress and finished goods; and altering the physical layout of a production facility.

Process Monitoring and Visualization (PMV) Software allows production personnel – from plant floor operators to production managers – to obtain real-time information regarding the status of production equipment, cells, lines and entire processes. It can also monitor this information on behalf of the user and notify them of abnormalities that require immediate attention. Lastly, this type of software allows users to perform supervisory control functions like starting, stopping or altering the parameters used by production equipment.

Manufacturing Execution Software (MES) deals with production order scheduling, product tracking and tracing, order execution, performance analysis, data collection and equipment allocation and status.

Asset Management & Condition Monitoring (AM/CM) Software aids in the maintenance of production equipment. Maintenance personnel use it to keep an accurate list of production equipment (assets) and associated service records, scheduled service intervals and detailed service information. Condition monitoring involves automated real-time monitoring of equipment condition status and predictive maintenance capabilities.

Batch Management (Batch) Software allows manufacturers to control continuous or hybrid processes that involve "product lots" (batches) moving through a manufacturing system. Each batch has a set of distinct parameters but

uses the same production equipment. Examples of batches would include light vs. dark beer, chocolate vs. vanilla cookies, and heavy paper vs. light paper.

2.2 Manufacturing Software Market Analysis

In this section, the global manufacturing software market is quantified and analyzed. Data describing the size and growth rate of each major market segment is presented. In addition, the position of the MSB and its competitors within each segment is outlined. The analysis indicates that the MSB is competing in a large and growing global market but that it only has a significant presence in the smallest and slowest growing segments of this market.

2.3 Segment Sizes & Growth Rates

Table 2 shows the size and annual growth rate of all the major segments within the worldwide manufacturing software market as of 2005. (Projected by research conducted in 2004) The Batch and AM/CM segments include services revenue, as these systems typically require additional professional services from the supplier. The process industries segment is more than twice the size of the discrete industries segment. Excluding batch management, which includes services revenue, the largest and fastest growing segments are process simulation & optimization, and manufacturing execution – both markets that the MSB does not significantly serve (see **Table 4**).

Table 2 – 2005 (Projected) Worldwide Market Size and Growth by Product & Industry Type

Software Product Type	Process Industries		Discrete Industries	
	WW Market Size (2005, Million USD)	CAGR	WW Market Size (2005, Million USD)	CAGR
Process Simulation & Optimization (PSO)	$[redacted]	[redacted]%	$[redacted]	[redacted]%
Process Monitoring & Visualization (PMV)	$[redacted]	[redacted]%	$[redacted]	[redacted]%
Manufacturing Execution (MES)	$[redacted]	[redacted]%	$[redacted]	[redacted]%
Asset Management & Condition Monitoring (AM/CM)	$[redacted]	[redacted]%	[redacted]	[redacted]
Batch Management (Batch)	$[redacted]	[redacted]%		
Total	$[redacted]		$[redacted]	

Data sources: ARC and Frost & Sullivan market research, 2004

2.3.1 Competitor Positions by Product & Industry

The relative market position of the MSB and its competitors in each market segment is depicted in **Table 3**. It indicates that the MSB does not have a significant position in the largest and fastest growing segments – PSO and MES software for process industries (see **Table 2**). Letters replace actual firm names to protect identity[1]. (MSB = "**A**") Market position decreases from left (best) to right (worst) within each table cell.

[1] The letters used to denote each firm are consistent throughout this document.

Table 3 – Competitor Position by Product & Industry

Software Product Type	Competitor Positions (Process Industries)	Competitor Positions (Discrete Industries)
Process Simulation & Optimization		
Process Monitoring & Visualization		
Manufacturing Execution		
Asset Management & Condition Monitoring		
Batch Management		
Key: A = MSB; Other letters = Rivals (in order of decreasing share)		

Based on: ARC and Frost & Sullivan market research, 2004

In addition, **Table 3** indicates that the MSB is not the market leader in any segment, and is only among the top three firms in Batch and AM/CM software (for discrete processes). However, more than 50% of the revenue associated Batch and AM/CM products flows to Company X's professional services group (see **Figure 6**). With the exception of Batch Management and a small position in Process Monitoring & Visualization software, the MSB essentially does not serve the process market.

2.3.2 MSB Revenue Composition by Product & Industry Segment

Table 4 depicts the portion of overall revenue that the MSB received from each market segment in 2005. Only software license revenue has been included. Revenue from services and software tied to hardware. (e.g., controller programming software, drivers) is excluded. The table shows that Process Monitoring & Visualization (PMV) software for discrete industries generates the

most revenue for the MSB – by a factor of [redacted] – over any other MSB product. However, PMV software is the smallest and slowest growing segment of the manufacturing software market. (**Table 2**)

Table 4 - MSB Revenue Contribution by Product & Industry Segment

Software Product Segment	Industry Segment		% of MSB (2005) Software Revenue
	Process Industries	Discrete Industries	
Process Simulation & Optimization	[redacted]%	[redacted]%	[redacted]%
Process Monitoring & Visualization	[redacted]%	[redacted]%	[redacted]%
Manufacturing Execution	[redacted]%	[redacted]%	[redacted]%
Asset Management	[redacted]%	[redacted]%	[redacted]%
Batch Management	[redacted]%		[redacted]%

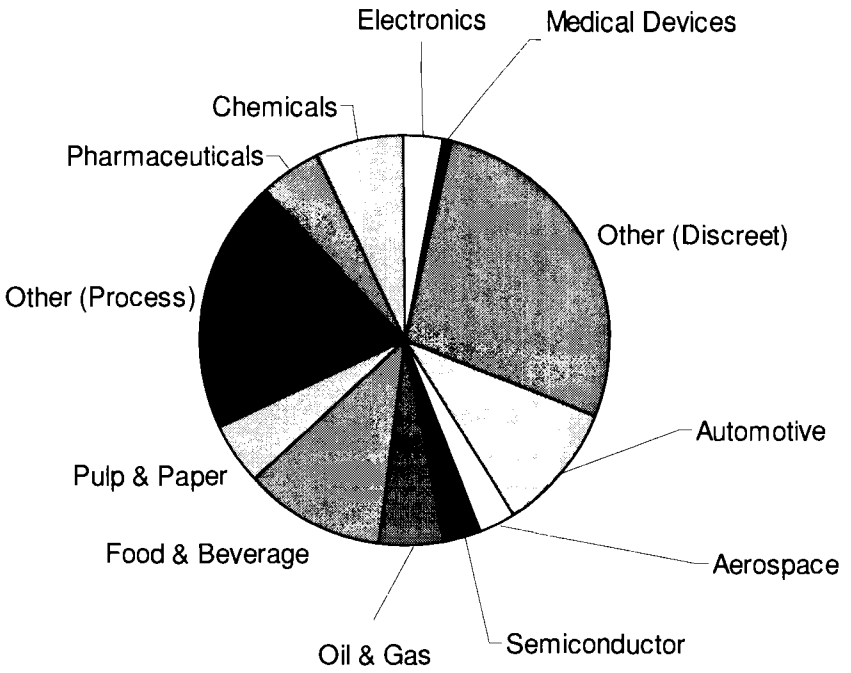
Data source: MSB internal records, 2005

2.3.3 Process Monitoring & Visualization Software Market by Customer Segment

The worldwide market for PMV Software in 2004 across all end-user customer segments is depicted in **Figure 1**.. The MSB has customers in all of these segments. However, given its low market position in the discrete and process industry segments (**Table 3**), penetration into each customer segment is also low. The MSB's strongest penetration for PMV software is within the Automotive, Food/Beverage and Pharmaceutical customer segments.[2]

[2] Source: Author's research of MSB records.

Figure 1 - WW Market for Process Monitoring & Visualization Software by Customer Segment (2004)

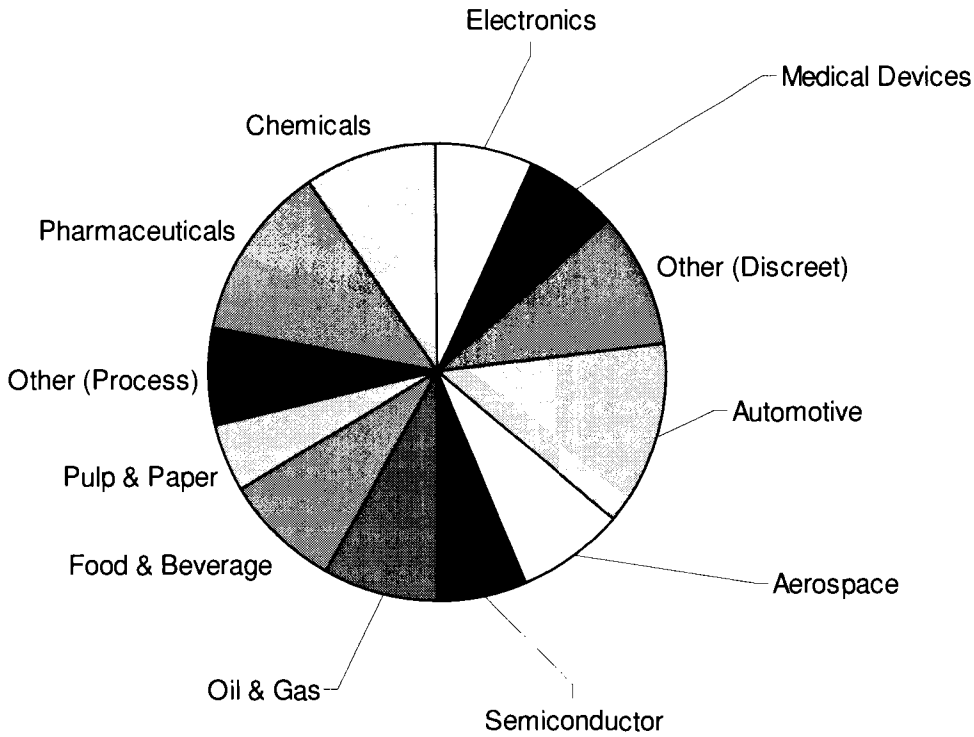


Data source: ARC market research, 2004

2.3.4 Manufacturing Execution System Software Market by Customer Segment

Figure 2 shows the worldwide market for MES Software in 2004 across all end-user customer segments. The MSB has large MES customers in its core end-user segments - automotive, food/beverage and pharmaceutical - where, when combined with some customers in other discrete industries, it holds a leading position in MES software (**Table 3**). However, much of the revenue obtained from this market is for integration services to develop custom (one-of) MES systems. Thus, the revenue flows to Company X, and not to the MSB for COTS products. The process industry segments ([redacted] % of total in **Figure 2**) are un-served by the MSB's MES offerings (See **Table 1** for customers by industry).

Figure 2 - WW Market for Manufacturing Execution Software by Customer Segment (2004)

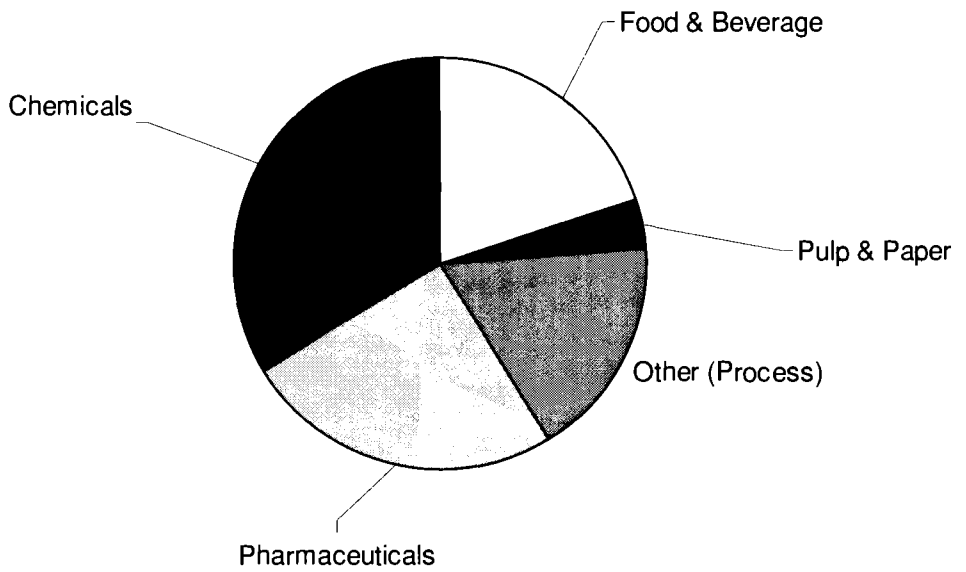


Data source: Frost & Sullivan market research, 2004

2.3.5 Batch Management Software Market by Customer Segment

Figure 3 shows the worldwide market for Batch Management Software in 2004 across all end-user customer segments. The MSB serves all of these customer segments and occupies a leading position in this market (**Table 3**).

Figure 3 - WW Market for Batch Management Software by Customer Segment (2004)



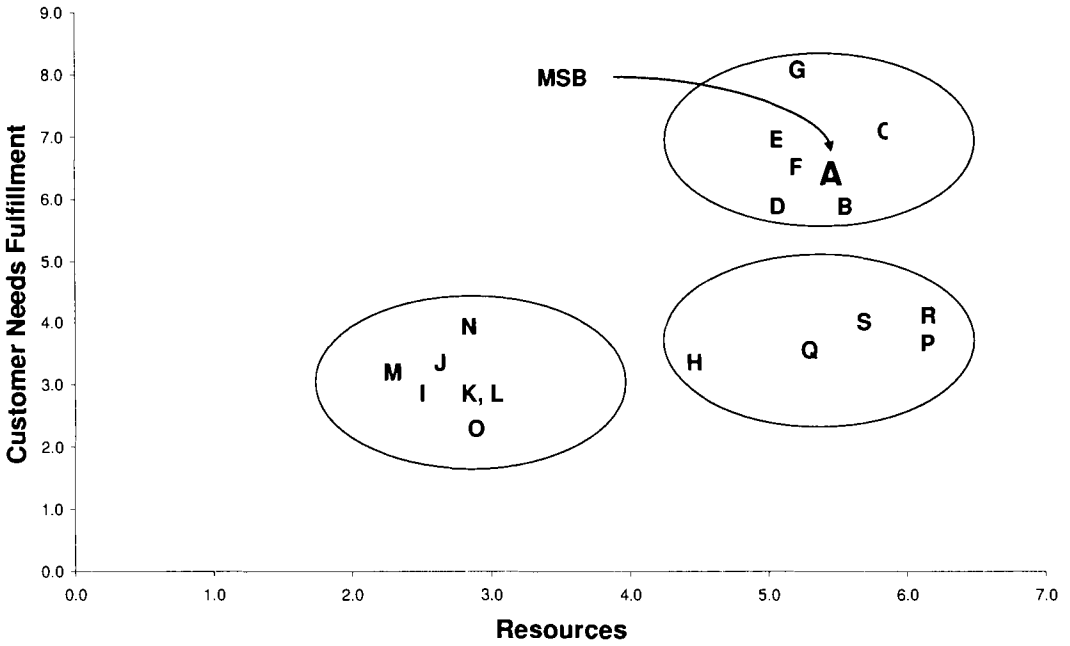
Data source: ARC market research, 2004

2.4 Competitor Groups

Figure 4 shows the MSB's possible competitors in terms of each firm's resource overlap with the MSB, as well each company's ability to fulfil customer needs within the entire manufacturing software market[3].

[3] The letters used to denote each firm are consistent throughout this document.

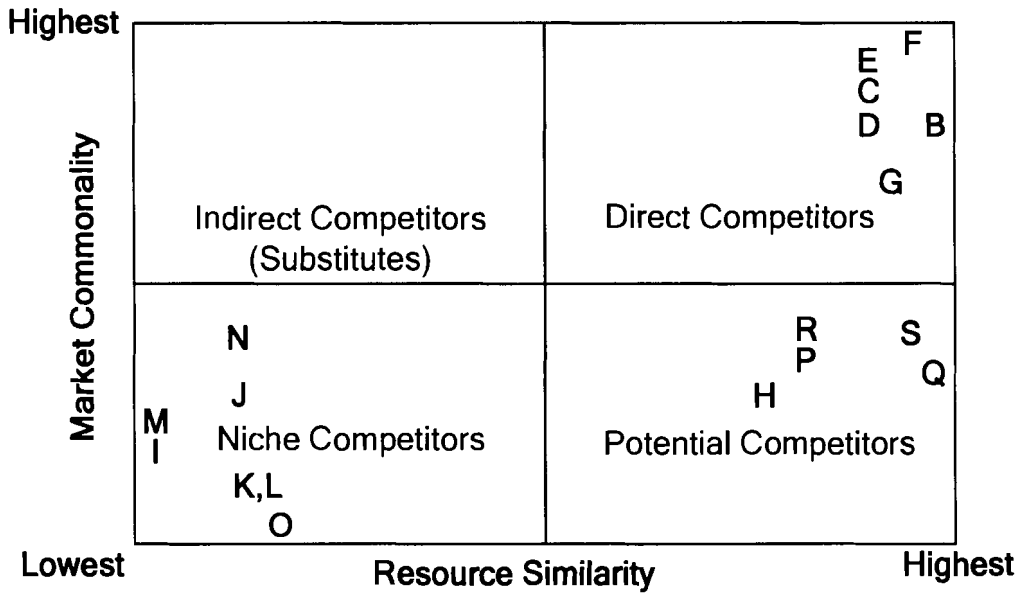
Figure 4 - Competitor Groups



Each company's *Resource Rating* is an arithmetic average of individual ratings that include global service capability, software development, market domain knowledge and customer acquisition capability. Each company's *Customer Needs Fulfilment Rating* is an arithmetic average of individual ratings that include the degree to which a firm satisfies customer needs within each product segment of the manufacturing software market: The greater the number of customer segments a given product serves, and the higher the degree to which it serves them, the higher its category score. In addition, the higher the degree to which a company can serve customers in all geographies, the higher its score. For each firm's scoring computations, see *Appendix 1: Resource and Customer Fulfillment Ratings for Each Competitor.*

Figure 5 is a derivation of **Figure 4** that depicts the degree of *resource similarity* and *market commonality* among the MSB's potential competitor set.

Figure 5 - Firm level resource similarity and market commonality to the MSB



Bergen and Peteraf (2002), define *Market Commonality* as "the degree to which a given competitor overlaps with the focal firm in terms of customer needs served." They go on to define *Resource Similarity* as "the extent to which a given competitor possesses strategic endowments comparable, in terms of type, to those of the focal firm." Hence, in **Figure 5**, firms shown farthest to the right contain resources most similar to the MSB, while firms shown nearest the top serve the most similar set of customer needs.

Bergen and Peteraf define *direct competitors* as firms with a high degree of resource equivalence and market commonality. These firms serve the same markets with resources (knowledge, technology, etc) most similar to the focal

firm. In Figure 5, the Direct Competitors quadrant contains these firms: BCDEF and G. The authors go on to define *indirect competitors* as firms that serve similar customer needs, but with very different resources. This definition recognizes that competitors may include firms that do not share the same technological platform, but provide substitutes. This analysis did not yield any competitors to the MSB of this type.

Firms that serve a significantly different set of customer needs (including a superset or subset) with a significantly different set of resources from the focal firm are not considered (significant) competitors. These are in the Niche Competitors quadrant, and include firms IJKLMN and O. These firms are referred to as *niche competitors* because they all serve a subset of the focal firm's customer needs with a subset of its resources. It is important to note that this situation could easily change – for example, if another firm with more similar resources to the focal firm acquired one of these niche firms.

Lastly, Bergen and Peteraf define *potential competitors* as firms that do not serve a common market, but do possess similar resources to the focal firm. This includes companies HPQRS. **Table 5** summarizes the results of this analysis, by dividing the competitors of Company X's MSB into these three competitor types.

Table 5 - Competitors by Type

Competitor Type	Competitor Symbol
Direct	B, C, D, E, F, G
Niche	I, J, K, L, M, N, O
Potential	H, P, Q, R, S

2.5 Porter's Five Force Analysis of the Global Manufacturing Software Industry

In this section, Porter's five-force framework is used to analyze the attractiveness of the global manufacturing software industry. This is done by identifying the magnitude of the forces exerted on the industry by competitors, buyers, suppliers, new entrants and potential substitutes. Overall, the analysis indicates that the MSB is in an attractive market but that competition from consolidation and new entrants is intensifying.

2.5.1 Nature of Rivalry – Medium

Competitive intensity in the manufacturing software industry is increasing as consolidation occurs. Among them, Company X's direct competitors (except H) have acquired almost all of the major manufacturing software vendors. Less than 10 manufacturing software-only firms (IJKLMNO) with annual revenues in excess of $1 M[4] exist today. At the same time, hundreds of small firms that

[4] Based upon: Author's analysis of ARC and Frost & Sullivan market research, 2004

develop "one-of" solutions for individual customers exist in the service sector. In the manufacturing execution software segment, there is still wide variation in implementation, because each end-user customer segment has considerably different requirements. These differing (and sometimes conflicting) requirements make it very difficult for suppliers of COTS manufacturing execution software to penetrate more than a few customer segments. As a result, there are approximately 60 producers of MES systems worldwide – each catering to the needs of specific customer segments.

Although the aggregate manufacturing software market is still growing at a rate somewhere between 5 and 10% per year, the growth rate is decreasing. At the same time, price elasticity is increasing within specific segments (though not across segments) and competitive concentration is increasing[5] - all indicators of an industry approaching maturity.

However, the MES and Asset Management/Condition Monitoring segments are still quite attractive. They are both experiencing robust growth, have many players with no dominant designs, and their technology platforms continue to evolve at a rapid rate. Industry structure is somewhere between an oligopoly (where rents are still being earned) and a monopolistic competition (where the number of firms is high and firm-created segments are still occurring).

Economies of scale (demand-side network effects) and learning curve effects also exist. The network effects occur particularly at the manufacturing execution and supply chain levels – the larger the supply chain network, the

[5] Based upon: Author's analysis of ARC and Frost & Sullivan market research, 2004

more valuable it is to each member. This is particularly useful in contract manufacturing – where brand owners need to utilize a global network of (out-sourced) contract manufacturers. Learning curve economies occur because of the specialized knowledge required to provide systems for each end-user industry.

2.5.2 Buyer Bargaining Power - Low

Buyer power is increasing for hardware components and within commoditized software components. Buyers of process monitoring and visualization software are increasingly price-sensitive. However, buyer power within the other product segments is still low due to the immaturity of those segments and the level of services required.

2.5.3 Supplier Bargaining Power - High

Microsoft is the dominant supplier to the industrial software industry. As such, they have enormous power associated with their dominant platform design and price of inputs. Virtually all manufacturing software runs on Microsoft's operating systems today. However, this is beginning to change with the emergence of open source platforms and Unix-based ERP systems that need to interface with manufacturing systems.

2.5.4 Threat of Entry - Medium

Bergen and Peteraf (2002) show that, when the degree of resource equivalence is high, the likelihood of attack increases (and response decreases) as we move from direct to potential to indirect competitors. In the MSB's case,

there do not appear to be indirect competitors, so threat of entry mostly exists from the potential competitor group. Because direct competitors know that their attacks will be met with an effective response, they do not attack. A Nash equilibrium exists - meaning that if an attack comes from direct competitors, others within the same competitive group will certainly respond. This is because awareness is greatest among direct competitors and lowest among indirect competitors, since managers may not perceive entry of these firms.

Given this, the greatest threat to entry comes from the potential competitor group (firms HPQR and S), with R being highest and H being lowest. With the exception of S, each of these firms provides business applications (e.g., ERP) that must increasingly interface automatically with manufacturing systems. This, and the attractiveness of the manufacturing market, would provide the motivation for these firms to enter. Firm S is already a large player in manufacturing, but does not have many software offerings. It seems likely that this firm will pursue acquisition and/or collaboration with one or more of the software-only niche players to enable them to expand in the software market.

2.5.5 Competition from Substitutes - Low

Products are considered close substitutes when they are similar in terms of their performance characteristics and occasions for use, and are sold in the same geographic market (Besanko et al., 1996). That is, firms that serve the same customer needs as the focal firm, but with different types of resources (e.g., knowledge, technology), comprise the set potential substitutes. It is

important, therefore, to recognize that competitors may include firms that do not share the same technological platform.

At this time there do not appear to be direct substitutes for the MSB's products. While it is possible to develop one-of software applications that duplicate some of the capabilities in the MSB's products, the hurdles associated with addressing the entire portfolio of customer needs are significant. Thus, there are currently no other known products able to offer the cost-to-performance ratio offered by the MSB and its direct competitors.

2.6 Macro-Environment Analysis

This section examines environmental factors that affect the entire manufacturing software industry. These include existing and emerging political, economic, social and technological factors. Of these, the effects of regulations aimed at improving the security and transparency of manufacturing systems as well as the effects of open-source software and the World Wide Web will have the biggest impact on the MSB, its competitors and its customers.

2.6.1 Political

Spurred on by several well-publicized accidents caused by manufacturing defects and the resultant product recalls, politicians have pushed for regulations aimed at improving the visibility and accountability of manufacturers. In 1997, the US government introduced the "Title 21 Code of Federal Regulations Electronic Records; Electronic Signatures" (21 CFR Part 11) aimed at the food and drug industries. In 2000, the "Transportation Recall Enhancement,

Accountability, and Documentation" (TREAD) act was introduced aimed at the automotive industry. Most countries that trade with the USA have adopted these laws or have introduced similar ones.

These regulations have a broad impact on the affected industries. Compliance and compliance reporting are a complex and costly procedure, significantly driving up costs. As a result, industry associations have taken on the task of reducing the cost and complexities of compliance as an entire industry – rather than at the firm level – by providing guidance, best practices, tools and advice to member firms. For example, the International Society for Pharmaceutical Engineering (www.ispe.org) produced the "Good Automated Manufacturing Practice" (GAMP) guide.

There is widespread belief within the manufacturing industry that it is only a matter of time before similar regulations will exist for other manufacturing customer segments. Thus, regulatory compliance is a large and increasing force in the manufacturing industry. Products and services that reduce regulatory compliance costs will be valuable to the manufacturing industries.

2.6.2 Economic

Software based upon an open-source license (open-source software) is significantly changing the economics of the commercial software industry. Not only are open-source products free for end-users, but many valuable components of commercial software applications (e.g., operating systems, databases, application servers, tools) are free to software developers as well.

Thus, the cost of many of the critical inputs to the software industry is essentially zero. Where software developers used to develop their own components to avoid the associated purchase costs, they can now avoid these costs altogether and focus on developing domain-specific code on top of free components.

However, most open source licenses require derivatives to be open source (free) as well. Some licenses even require all derivative code (that is, code containing a firm's domain-specific intellectual property) to be freely re-distributed back to the open source community. Obviously, these rules are major obstacles for the adoption of open source inputs by for-profit software firms. As a result, most software firms avoid open source inputs altogether, opting instead for closed source commercial inputs and outputs.

However, due to the never-ending quest to reduce costs, end-user demand for open source software is continuing to rise, and there is no reason to believe this trend will stop. In response, some software firms have begun moving to a service-based revenue model: that means they provide the software free, but charge fees for the services needed to design, deploy and maintain the software on behalf of a customer. There are also open source licenses emerging that allow limited commercialization of closed source software (derivatives).

The effects of the Internet, and more specifically the demand for presentation of information in web browsers instead of in dedicated client applications, is threatening profits in the manufacturing software industry as well. The MSB and its competitors started out selling stand-alone software that allowed one user to display information about a process, but have rapidly moved

to client-server based systems allowing many users (clients) access to information on server(s). For the MSB, client revenue has grown to approximately 20% of overall revenue, and its growth rate is accelerating[6]. However, systems are beginning to emerge that display this same information in (free) web browsers and are thereby creating a significant threat to client-side revenue.

2.6.3 Social

The MSB is involved with the production of systems that reduce manual labour requirements and optimize outsourced supply chains associated with manufacturing. As a result, jobs are often lost or altered to the point that new employees are required. Although this does have a social effect, it does not appear to be a significant force at this time.

2.6.4 Technological

The Internet is affecting all information system providers and consumers. In manufacturing, it is dramatically changing the speed, quality and cost of complex supply chains. It is making it possible for global (as opposed to local) supply chains to exist and to work together efficiently and effectively. This is creating demand for integrated manufacturing enterprises that can span site (physical plants) and firm boundaries. To enable this, networks of heterogeneous (multi-vendor) manufacturing systems are required.

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[6] Based upon author's analysis of MSB records

These are the key drivers behind several emerging industry standards aimed at promoting multi-vendor interoperability and modular automation systems. Hence, pressure on the MSB and its competitors to adopt open, interoperable standards such as these is increasing – making it harder to maintain customer lock-in by supplying closed, proprietary designs.

2.7 Summary

This chapter analyzed the growing, multi-billion dollar global manufacturing software industry. The MSB competes in all market segments within this industry but is a leader in none of them. Its top selling product (PMV software for discreet industries) is competing in the smallest and most mature market segment of the industry.

Nonetheless, this is an attractive industry. Profit margins are still high and, while competition is increasing as Company X's direct competitors acquire niche manufacturing software firms, no dominant player yet exists across the entire manufacturing software market. This is attracting potential competitors from large firms that supply ERP, SCM and platform software – with firms Q, R and S being the most likely to enter due to industry attractiveness and synergy with their existing offerings and capabilities.

For all players within this industry, the effects of open-source inputs and the internet will continue to grow as consumer demand increases. As a result, these suppliers will eventually have no choice but to address these technological and economic forces in their business strategies.

3 INTERNAL ANALYSIS OF COMPANY X'S MSB

This chapter presents an analysis of the MSB's existing internal competencies and resources and shows that its key competitive advantage is its broad scope of software products for manufacturing. It also shows that, although it is financially successful, the MSB suffers from excessive time to market cycles – that is, its rate of innovation is slow.

3.1 Ownership and Control

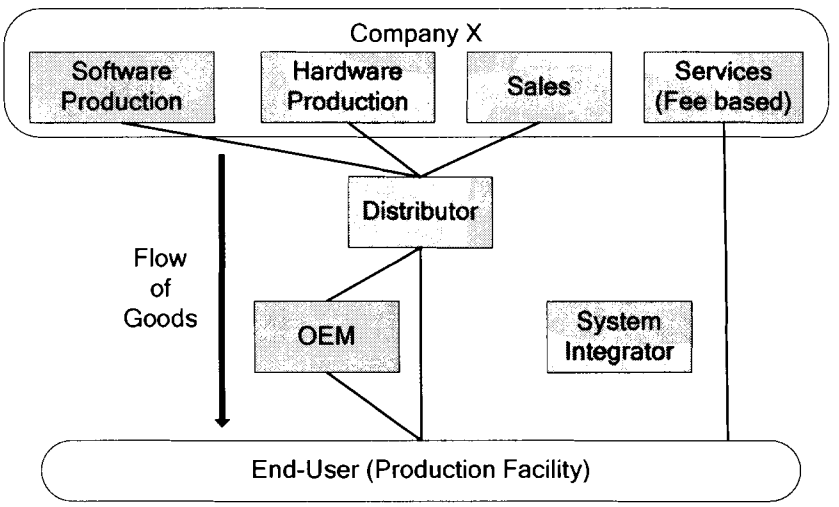
The senior executives, employees and several private and institutional investors own Company X. No single entity owns more than 4%. Given this level of ownership distribution, the senior managers effectively control Company X. However, each of them is also a large individual shareholder - so principal-agent problems would be unlikely at the corporate executive level.

It is unknown whether (or to what degree) the MSB unit managers are also owners - so agency problems may exist between the interests of the shareholders (particularly the executives) and the interests of MSB managers. If agency issues exist, they could be reduced by ensuring the MSB manager's compensation packages are tied to goals that uphold those of shareholders and/or by issuing them shares in Company X.

3.2 Flow of Goods from Company X to End Users

Figure 6 shows the flow of goods between Company X and its customers. The MSB as well as software tied to Company X hardware is produced within the Software Production division depicted in **figure 6**. Hardware production includes any electrical or electronic products. Fee-based services include consulting, system integration, maintenance and technical support.

Figure 6 – Company X's Flow of Goods & Services to Consumer



Based on: Company X internal documents, 2004

3.2.1 Sales

Company X maintains a sales force located around the world. The role of the sales organization is to acquire new customers and service existing ones through a partnership with the distributor channel – targeting end-users, SI's and OEM's within their region. The relative importance of each of these targets depends on the region. Some regions contain many OEM's (e.g., machine

builders) and hence the focus of sales (and distributor) personnel is biased toward OEM's while other regions contain mainly end-users. Sales personnel also educate their region on new and existing products through formal training, launch updates and seminars.

3.2.2 Distributors

Company X relies on a worldwide network of independent distributors to provide sales, service and local support to OEM's, SI's and end users within their region. Typically, these distributors carry a broad (but non-competing) line of industrial electrical equipment from multiple vendors, and maintain inventory to minimize lead times on new or replacement equipment. In return, distributors receive a margin on all goods sold – typically from 10 to 40%, depending on their level of value-add.

3.2.3 System Integrators (SI)

Smaller manufacturers typically outsource the design of a given automation system to integrators, whereas larger manufacturers design their own. In either case, once the required equipment (hardware and software) is specified, the end user purchases it from a distributor geographically local to the deployment site. System Integrators typically do not take title to the equipment - they provide fee-based professional services only (as **figure 6** indicates). However, SI's often act as a proxy sales channel for Company X – influencing end-user buying decisions via product recommendations.

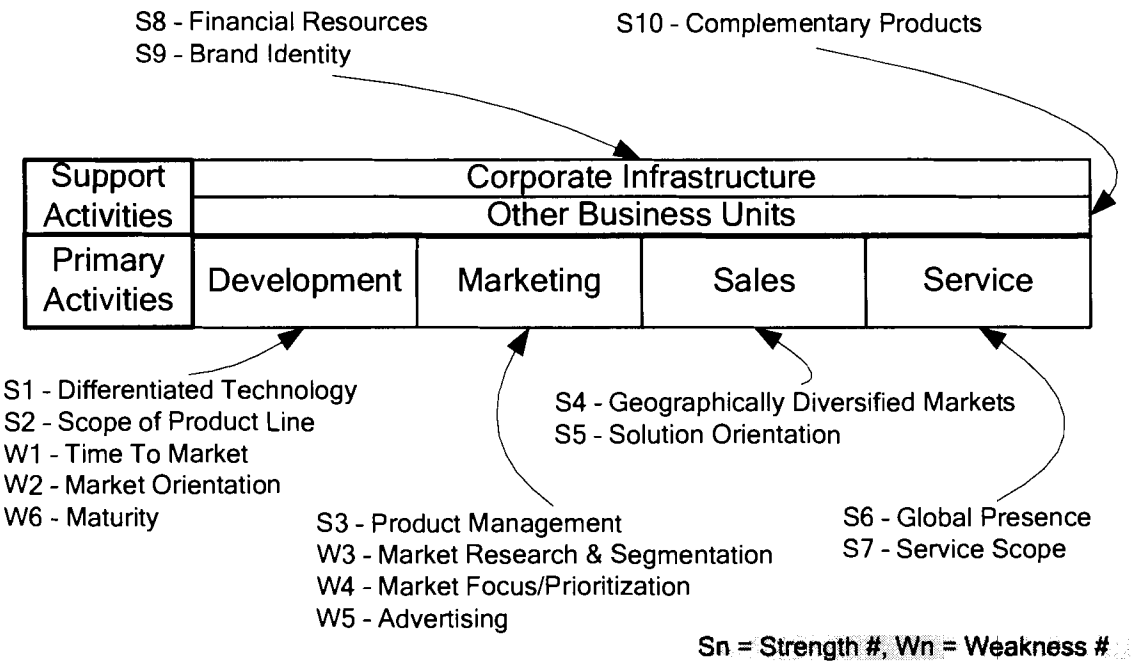
3.2.4 Original Equipment Manufacturers (OEM)

In many cases, the design of a given production system will call for OEM equipment (e.g., production machines) that may contain Company X's hardware and/or software embedded within it. In this case, the end user purchases the equipment directly from the OEM firm. OEM's often get deep discounts from Company X in return for volume but all negotiations and transactions are still conducted via the local distributor – with the distributor sharing equally in discounts with Company X.

3.3 Value Chain Analysis

Figure 7 shows the internal value chain within which the MSB and Company X operate. The diagram depicts each major group within the firm, and shows which groups provide primary as opposed to support activities to the MSB's value creation process. Also shown are the key strengths and weaknesses within each group. The strengths are indicated by the prefix S and the weaknesses are indicated by the prefix W.

Figure 7 - MSB Internal Value Chain



Based on: Modified value chain model. Duncan et al, 1998:

To determine the power of a given strength or weakness on a firm's overall performance, we need to determine whether it is a) valuable to customers, b) rare, and c), difficult to imitate. (Duncan, Ginter and Swayne, 1998) Items that meet the majority of these conditions are "competitively relevant" (Duncan et al, 1998), and are seen in grey in **Table 6**. The main strengths of the MSB include the broad scope of its software product line – including hardware complements. The main weaknesses of the MSB include its lack of market orientation, market prioritization and development maturity.

Table 6 - MSB Resource & Capability Analysis

Resources (Valuable & Costly to Copy)	Power of the Strength or Weakness			
	Value	Rareness	Imitability	Sustainability
S1 - Differentiated Technology	High	High	Low	High
S2 - Scope of Product Line	High	High	Low	Medium
S4 - Geo-Diversified Markets	Low	Low	High	High
S5 - Solution Orientation	High	Medium	Medium	Medium
S6 - Global Presence	High	Low	High	Low
S7 - Service Scope	High	Medium	Medium	Medium
S8 - Financial Resources	Medium	Low	High	Low
S9 - Brand Identity	High	Low	High	Low
S10 - Complements	High	High	Low	High
W3 - Market Segmentation	High	Medium	Medium	High
Capabilities (Ability to integrate resources - Execution)				
S3 - Product Management	Low	Medium	High	Low
W2 - Market Orientation	High	High	Low	High
W4 - Market Prioritization	High	Medium	Low	High
W5 - Advertising	High	Low	High	High
W6 - Development Maturity	High	High	Low	High

Based on: Modified value chain model. Duncan et al, 1998

However, "competitive relevance" is not enough – creating and maintaining competitive advantage is ultimately about providing value to customers (Prahalad and Hamel, 1990). Value is added by cost leadership – offering equal (or better) quality products at a lower cost than competitors can – or by differentiation - providing products that are perceived to be unique relative to some important characteristic. **Table 7** shows an analysis of the MSB's competitively relevant strengths and weaknesses from a cost or uniqueness perspective.

Table 7 - MSB Strengths & Weaknesses by Cost or Uniqueness

Strength/Weakness	Description	Cost or Uniqueness Driver	Location on Value Chain
S1 – Differentiated Technology – Resource	Integration among manufacturing software products makes it easier and less error-prone for customers to build systems	Uniqueness	Development
S2 – Scope of Product Line – Resource	Customer can build complete manufacturing software system with MSB's products. Eliminates multi-vendor system problems and provides economies of scale through re-usable software components and platforms	Uniqueness	Development
S10 – Complementary Products - Resource	Broad line of electrical and electronic products that can be used as complements with MSB software products to build systems	Uniqueness	Other Business Units
W2 – Market Orientation - Capability	Lack of market orientation results in generalized or over-sophisticated products that may not support business strategy or meet customer needs	Cost	Development
W3 – Market Segmentation - Resource	Lack of market research data regarding customer segments for software makes it difficult to develop targeted products	Cost	Marketing
W4 – Market Prioritization - Capability	Lack of specific target customer segments results in over-generalized products, which take longer to develop and are less valuable to targets.	Cost	Marketing
W5 – Advertising - Capability	Lack of advertising means customers only learn about MSB products through direct contact with sales channel	Cost	Marketing
W6 – Development Maturity - Capability	Immature and inconsistent development processes reduce product quality and increase time to market	Cost	Development

Based on: Modified value chain model. Duncan et al, 1998

Thus, as shown in **Figure 7**, the MSB's key advantages stem from the scope of its product line - hardware and software for manufacturing, which is quite

rare among its competitors and thus creates differentiation. In contrast, the MSB's critical weaknesses are a lack of market orientation and the related difficulty in prioritizing development projects as well as lack of demand generation through advertising. These weaknesses drive up development costs and time to market as it becomes harder to focus on specific customer needs – resulting in over-general, highly flexible and difficult to use designs. In addition, customer acquisition costs are driven up due to lack of MSB product awareness. The strategic implications of these strength and weaknesses are described in **Table 8.**

Table 8 - Strategic Implications of MSB Strengths and Weaknesses

Strategic Strength/Weakness	Strategic Implication
Strengths: • S1 – Resource – Uniqueness Driver – Differentiated Technology • S2 – Resource – Uniqueness Driver – Scope of product line • S10 – Resource – Uniqueness Driver – Complementary Products	• A key competitive advantage is the broad scope of the MSB's manufacturing software products. This creates a unique opportunity to provide the best level of integration between these products, resulting in reduced integration and maintenance costs for customers. • This creates significant opportunities for further differentiation by increasing the breadth and depth of software product integration and integration with complementary hardware devices from other business units.
Weaknesses: • W2 – Capability – Market Orientation • W3 – Resource – Market Segmentation Data • W4 – Capability – Market Prioritization	• The lack of focus from insufficient segmentation data results in overly generalized designs, increasing costs, time to market and user frustration with offerings not tailored to their specific needs. • Technology (vs. market) orientation results in innovations that may not be commercially successful – If they are ever commercialized.
Weakness: • W5 – Capability – Advertising	• Lack of customer awareness about MSB products significantly reduces demand.
Weakness: • W6 – Capability – Development Maturity	• Excessive cycle times affect time to market of innovations and next generation products. • Customer-reported defects and frustration reduce repeat purchases and damage brand.

Based on: Modified value chain model. Duncan et al, 1998

Thus, although ten strengths were initially identified, only three of them can be considered key, competitive advantages: scope of product line, integration between products, and complementary hardware products produced

by Company X (**Table 8**). Each of these attributes increases the differentiation level of MSB's products and reduces customer costs of ownership. In addition, barriers to entry are high – only a few firms have the resources to meet all these needs in a cost effective manner.

However, almost all of the weaknesses identified are critical to the MSB's ability to compete (**Table 8**). The lack of market orientation, focus and development maturity leads to over-generalized products that take too long to reach the market, have lower (target) customer satisfaction levels and higher defect rates. Lastly, the lack of advertising and other demand-generation mechanisms make it very difficult for the MSB to succeed in software-only accounts. Any one of these weaknesses, if left unchecked, could have a significant negative impact on the MSB's ability to achieve its goals.

3.4 Current Strategy

Company X designs and manufactures a broad range of electrical, electronic and software products for manufacturers. Global sales and service of all products is handled by third party distributors and supporting regional sales organizations. Sales are direct from distributors to end users in manufacturing industries or to OEM's who supply machinery with Company X's equipment to the same end users.

Recently, Company X has expanded into systems integration and consulting services. Apart from that, growth is primarily through internal product development, which, coupled with cost cutting mechanisms such as out-sourcing,

and lean initiatives, has significantly improved profits. Company X's product-customer approach is broad – trying to address the needs of many segments – with industry vertical teams attempting to tailor standard products to specific industry end-user segments.

3.4.1 MSB's Competitive Stance

The MSB primarily differentiates itself from its competitors by offering a broad line of manufacturing software products that provide synergy with Company X offerings. This is valuable to customers as it provides a "one-stop-shop" for manufacturing systems, and more importantly, reduces the business risks (accountability, liability, etc.) associated with multi-vendor systems. The MSB also offers some ownership cost advantages over multi-vendor systems by reducing the time required to design, implement and maintain a manufacturing control system. This is valuable to large end-users who are willing to pay premiums for solutions that can reduce overall life cycle costs. Thus, this is a high-value, differentiated product strategy.

However, smaller end-users - and particularly machine-builder OEM's – are very price sensitive and typically have much simpler requirements. Consequently, there is also strong demand for low-cost, simple systems, and several low-cost entrants have emerged to fill the need. Historically, the MSB (and Company X) have avoided mature markets like these, since they do not have the cost structure to compete on price – preferring instead to compete in markets where they can add high value through differentiated products and receive economic rents through premium prices. Despite this, Company X (and

the MSB) recently entered the low-cost market by transferring the development and marketing of mature (software and hardware) products to lower-cost regions of the world. This strategy has also freed up the core R&D groups to focus on development of high-value add products.

The MSB's overall stance on technology adoption is to be in the early majority stage. That is, it strives to minimize the cost to its customers of switching to new technology by waiting for proven technology, (usually proven by niche competitors), as opposed to introducing discontinuous innovations. (See Moore, 2002 for details on the technology adoption life cycle.) Most end-users also prefer this stance, since they do not want to take unnecessary risks associated with manufacturing systems built on cutting edge technology.

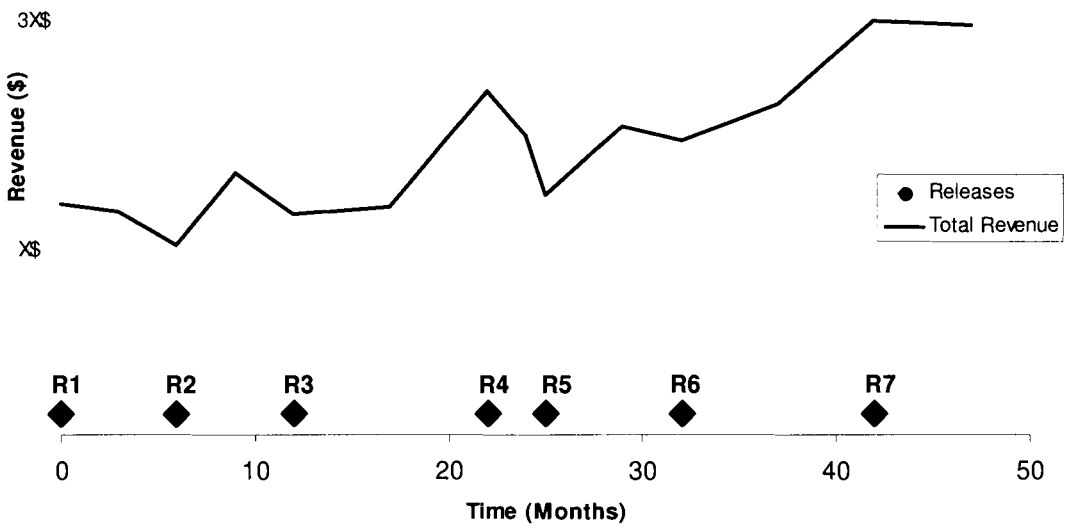
From the perspective of time-to-market for new products, excluding upgrades to existing products, the MSB appears to be quite slow. Since 2000, only one new product (asset management) that has a positive valuation has been released. Three other new products released since 2000 were not commercially successful – they have a negative valuation based on discounted cash flow analysis[7]. There is other promising technology in the development pipeline, but it appears to be in the early stages of development and it is not yet clear how it will be commercialized.

Information obtained from informal customer interviews supports the assertion that time-to-market is a problem for the MSB. For example, there are customers that have waited several years for a specific new feature to arrive.

[7] Based upon MSB product valuation documents, 2004

Despite this, the MSB has succeeded in releasing new versions of its existing products on a very frequent basis. However, there is no clear correlation between release frequency and customer satisfaction or business success. For example, **Figure 8** shows sales revenue over the most recent 47-month, 7 release period for the MSB's PMV software.

Figure 8 - PMV Software Revenue vs. Release Frequency



As seen in **Figure 8**: In some cases, releases did appear to increase revenue, (R3, R5, and R6), while in others, (R1, R4, R7), revenue actually went down. These inconsistent results could be explained by informal sales channel complaints that some releases are "incomplete", resulting in a lack of promotion by the channel[8]. This follows since one release every six months does not give the development organization much time to add real value to its large core

[8] The sales channel can "choose" whether to promote sales of a given software release since there is no customer demand/awareness generated by advertising – its all word of mouth via sales.

products - either in the form of innovative new features or general enhancements.

The evidence found[9] suggests that the MSB tends to be what business academics refer to as *engineering-driven*, *customer-compelled*, or *production oriented.* (Day 1998) and not what is generally referred to as *market oriented.* (Narver et al 1990, Day 1994, Jaworski et al 1993, Matsuno et al 2002) Internal documents indicate that it is quite common for individual sales opportunities or innovative technology advancements to drive product development. However, there is very little evidence of market orientation such as market research regarding customer segmentation, preferences, price elasticity and willingness to pay – as well as market size and projected demand.

In addition, over [redacted]% of the MSB's products have a negative valuation[10]. Upon inspection, most of this is due to lack of market orientation at the commencement of these development projects. Project goals were often documented as "to satisfy customer X or Y's request" or "to utilize technology Z", rather than to fill the needs of specific market segments with known size and willingness to pay. This suggests that most incremental innovations (new features added to existing products) are sales and/or individual customer driven. That is, they occur in response to a potential "Big Financial Order" (BFO) that may result if a particular feature is developed. The number of these requests appears to be high, and product development teams consume a large portion of

[9] By inspection of MSB development project documents, 2000-2004
[10] Based upon MSB product valuation documents, 2004

their capacity fulfilling them[11]. This lack of market orientation, combined with the attention given to BFO's, has resulted in a short-term focus weighting. As of 2005, only 6% of the MSB's R&D resources were assigned to long-term projects with expected deliveries in excess of 1 year.

3.4.2 MSB's Internal Value Chain

Excluding software products tied to Company X's controllers and other equipment, acquisitions of software-only firms have created 82% of the current value of the MSB's product portfolio[12]. Teams from these acquired firms have continued to increase value through development of new iterations of their core products lines, as well as the development of a small number of close complements (line extensions). Thus, the development of periodic enhancements to established product lines, i.e., on-going development activities associated with its high-value, differentiated products, contributes significantly to the MSB's profits.

However, the products that make up the MSB's low cost offering have some of the highest valuations based upon discounted cash flow (DCF) analysis. This, coupled with the fact that these products are now being developed and marketed by low-cost (off-shore) resources, would imply that this is the MSB's most profitable activity.

[11] MSB Development project documents, 2000 - 2004
[12] MSB product valuation documents, 2004

3.5 Financial Performance

Disaggregated financial statements are not available: As of 2005, Company X's operating margin was over [redacted]% - an increase of 4% from 2004. The MSB operating margin is well in excess of this[13]. In addition, firm level return on invested capital was over [redacted]% as well - also an increase from previous years. Economic rents are being earned, since the firm's cost of capital is 12%

3.6 Summary

This MSB enjoys a rare advantage within its competitor group– its broad range of software products and the complementary products and resources of Company X. Customers highly value complete systems that come from a single vendor in order to reduce their business risks. However, the lack of specific target customer segments is creating a tendency to develop products that are "all things to all people" resulting in higher costs, time-to-market and lower (target) customer satisfaction. While this does negatively affect profits and efficiency, the financial performance of the MSB is still strong.

[13] Based on author's analysis of MSB (2005) records

4 ASESSMENT OF MSB'S CURRENT SITUATION

The purpose of this chapter is to assess the MSB's current situation and, based upon this assessment, project future performance if it remains on its current path. This is done by assessing current performance using the balanced scorecard model, which looks at performance from the financial, customer, internal and learning & innovation perspectives. Based on this assessment, it is projected that the MSB will not meet its current business goals unless it adopts a new strategy. To help select the optimal strategy, the final section of this chapter examines various meta-choice models and concludes that new strategies be selected using a multi-goal choice approach as opposed to one that chooses strategy strictly on the basis of profit.

4.1 Balanced Scorecard – Current Assessment of MSB

Table 9 shows a balanced scorecard from the four perspectives – financial, customer, internal and learning/innovation - suggested by Kaplan and Norton (1991). Within each perspective, strategic objectives that are appropriate for Company X's MSB were selected based upon internal discussions and, for each objective, appropriate measure(s) were applied. Finally, scores assessing current performance were assigned to each strategic measure. The individual perspectives and the rationale behind each score are described in the sections below. Overall, the MSB currently has a low to medium score based upon these metrics.

Table 9 - MSB Balanced Scorecard

	Strategic Objectives	Strategic Measures	Score
Financial	F1 – Profitability	Operating Margin	Medium
	F2 – Growth	Growth rate vs industry	
	F3 – Efficiency	ROIC	
Customer	C1 - Satisfy targeted consumer	Share of target segment	Medium
		Customer satisfaction (by target)	
	C3 - Ease of implementation	% projects on time	
	C2 - Improve partner profitability	SI project margins	
Internal	I1 - Market Focus	satisfaction by target, # of targets	Low
	I2 - Time to market	Approval to delivery time (new features)	
	I3 - Unmet needs	% needs not met per target	
	I4 – Quality	Defects per user per target	
Learning & Innovation	L1 - New products	% revenue from new products	Low
	L2 – Next-generation time	Approval to delivery time (new products)	
		% of intellectual assets on long-term	
	L3 - Process improvement	CMMI Level	
	L4 - Organization involvement	Employee survey	

4.1.1 Financial perspective (Medium Score)

Despite the fact that Company X is earning economic profits (> [redacted]% margins) and is experiencing strong growth (> 10% 2004 to 2005), MSB investments in several unsuccessful projects had a negative impact on use of assets. That means that more focus on profitable projects would significantly increase the utilization of intellectual assets. Hence, the MSB currently achieves only a medium score.

4.1.2 Customer Perspective (Medium Score)

A 2005 survey of hundreds of customers from all served regions and segments – including sales and distributors (internal customers) - gave the MSB its best ratings for order accuracy, availability, meeting delivery expectations and technical competence of support personnel. Lowest ratings were received for "ability to overcome issues and solve problems" (troubleshooting tools), ease of integration, and ease of use.

In 2001, the MSB moved to a release model where all products are released together once every six months. Prior to this, each product was released independently and was scope-driven, as opposed to date-driven, resulting in wide variability in actual versus scheduled release dates, and increased difficulty for customers wishing to plan their upgrade cycle. The new strategy appears to be driving the highest satisfaction scores.

Combining the low survey results with MSB technical support records would indicate that customers are experiencing the most frustration during the initial phase of implementation – integrating all the MSB products into a running system. Given that the MSB's broad scope of products is one of its competitive advantages (**Table 8**), it appears there is significant opportunity to add customer value and further differentiation by resolving these issues.

4.1.3 Internal Business Perspective (Low Score)

According to MSB records, some projects have taken over four years to complete, and a high percentage of customer requests take years to address, or are never addressed. This appears to be due in large part to the volume of

requests and the conflicts among internal stakeholders. The sales and support stakeholder group is generally concerned with addition of features to "get the next sale", and the resolution of customer irritants. Product management stakeholders are generally concerned with short-term growth of their individual products, and business management stakeholders are concerned with profitability and long-term growth.

What appears to be missing is an over-arching strategy that would help select the optimum development investments among all the competing options. Without this, the development teams try to satisfy as many (sometimes conflicting) stakeholders as possible. The result is "all things to all stakeholders" designs that lead to long cycle times and lower quality from every stakeholder's perspective.

The MSB's synchronized software release strategy (every six months) was partly an attempt to reduce cycle times. While it has improved on-time delivery (actual vs. schedule), it has not reduced the cycle times needed to address specific customer requests or complete longer-term projects. In effect, the actual scope of each release (features and/or functions per release) has decreased, due to lack of focus, constant time pressure and the debugging overhead associated with every release.

4.1.4 Innovation and Learning Perspective (Low Score)

Although the MSB has launched multiple new products since 2000, only one of them has been commercially successful (valuation > 0 based on DCF

analysis). Thus, while these products may have been innovative from a technology perspective, this innovation did not translate into added financial growth and value.

Furthermore, the pressure to deliver every six months has resulted in low staffing levels (less than 6% of R&D) on long-term (> 1 yr) projects, because resources are frequently moved back to "the next release project" in order to meet delivery targets. Thus, the ability to produce next-generation technology and products in a timely manner has suffered.

The MSB has invested heavily in process innovation. Its development team is an aggregation of teams from acquired firms. Thus, there is a wide variety of software development processes and process maturity. To address this, the MSB is adopting industry standard software development processes across all teams. In theory, this should improve productivity and quality. However, concrete performance results are not yet available.

4.2 Summary

The MSB currently competes in an attractive industry. Demand in all served market segments is increasing, industry profits range from 20-35%, and overall growth is between 5-10% with some segments growing significantly faster. This is attracting potential competitors, and competitive intensity is increasing as large, multinationals purchase smaller software firms. Despite this competitive pressure, the MSB has been relatively successful in posting strong growth, earnings and profits consistent with industry averages.

However, profit could be much higher, since the MSB does not occupy a leadership position in any of its served market segments, and its highest revenue product (process monitoring and visualization) competes in the smallest segment of the manufacturing software market. The MSB has also produced a recent string of products that have been commercially unsuccessful. This has weakened return on assets and diluted its ability to maximize investment in its high-value products and projects.

The MSB appears to lack market focus: there is little of the information regarding market segmentation, demand, growth, and customer preferences that would help prioritize investment in development projects and define an overall strategy. As a result, development teams are designing over-generalized products in the hopes that they can meet the needs of all segments. However, this is spreading them too thin, resulting in increased cycle times, lower product quality, and lower satisfaction of most stakeholder and market segment needs. Perhaps most significantly though, some of the most attractive segments in the manufacturing software market are severely under-served or not served by the MSB at all.

Lastly, customer awareness of MSB products is low. Very few articles or advertisements were found in a survey of 2005 industry publications. Company X does advertise and maintain a strong industry presence; however, its message focuses on its hardware products and integration services – not on software. In contrast, the MSB's direct competitors had a much larger visibility in the same

media. It is very difficult to increase market share without target customer awareness.

4.3 Projected Performance Based Upon Current Strategy

If the MSB does not change, it is reasonable to assume that its market position will remain unchanged or will decrease depending on the actions of its direct competition. It will not enter new market segments with existing products or add new products to already served markets. Lastly, market awareness of its products will not improve and software customer acquisition will generally only occur because of a hardware sale.

Without new markets or increased market share, existing markets will dictate demand and growth. These markets – sale of simulation/optimization, process monitoring & visualization, and asset management/condition monitoring products to discrete industries – collectively represent [redacted]% of the MSB's current revenue (see **Table 4**). These served markets are mature; forecasted annual growth averages [redacted]% (See **Table 2**) - well below the MSB's goal of 12%. The MSB will not significantly participate in the much more attractive market segments. It seems likely that large ERP and/or Supply Chain Management (SCM) software players will attempt to enter the manufacturing execution software segment in particular, due to the attractiveness of this segment as well as the synergy with their existing products.

Without the ability to focus on the most attractive market segments, the MSB's speed to market, ability to meet user needs (performance) and quality

(predictability, defects) will continue to suffer as development teams struggle to produce software that can "be all things". Software ownership costs to users will remain higher than necessary as users struggle to integrate, deploy and maintain difficult to use – but highly flexible – products.

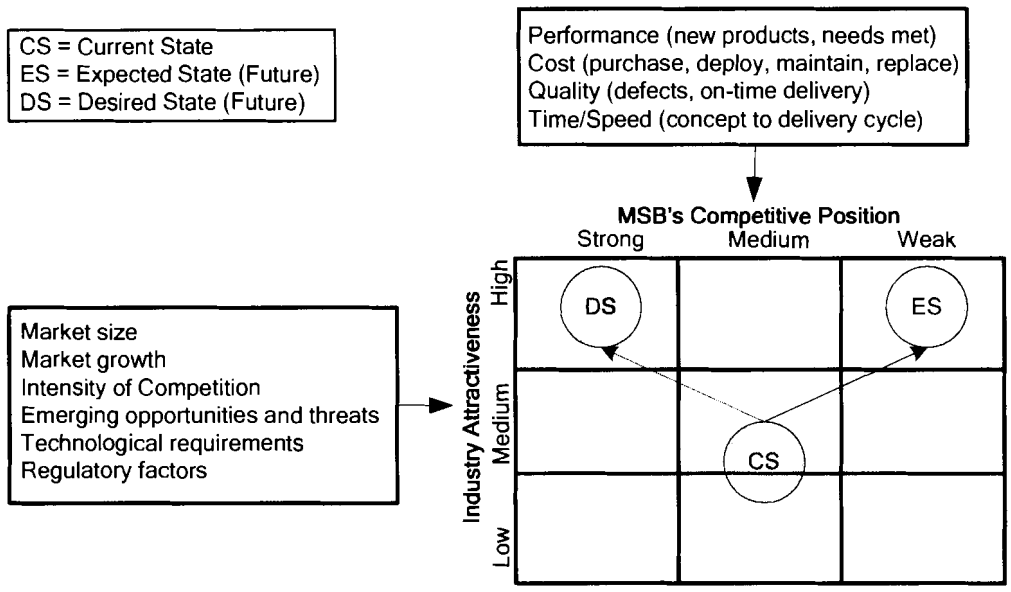
From an external perspective, out-sourcing of manufacturing (contract manufacturing) will continue to increase to the point where global manufacturers will own the brand, but not the manufacturing assets. This will drive the need for highly flexible manufacturing systems that can interoperate with heterogeneous ERP systems across a multi-firm supply chain in a highly automated manner. Firms that can supply these systems will become the dominant suppliers to global manufacturing enterprises. Systems that can minimize the increasing costs of design, integration and maintenance of multi-vendor manufacturing systems will see strong demand.

In addition, regulations aimed at protecting consumers from defective products due to manufacturing problems will continue to increase – as will the cost and complexity associated with compliance. Along with this, governments will begin mandating improved security. Systems that can protect a manufacturer from unauthorized operations ranging from inadvertent to malicious to those intended to cause mass destruction (e.g., chemical spills, power outages, water supply contamination, etc) will see strong demand.

In summary, firms that can rapidly address these emerging needs with innovative solutions will prosper, while those that cannot move quickly enough will experience reduced profits. If the MSB continues on its current path, it

appears likely that its competitive position will deteriorate – despite the increasing attractiveness of the markets it serves. (**Figure 9**)

Figure 9 – MSB's Expected Path Given Current Strategy vs. Desired



In **Figure 9**, CS represents the MSB's current state – it is moderately competitive in a moderately attractive market segment. ES represents the expected future state (without strategic changes) where the MSB's ability to compete has weakened despite the existence of even more attractive markets. DS represents the desired future state: the MSB in a strong competitive position within a highly attractive industry.

4.4 MSB's Strategic Direction Choice Method

The MSB is part of Company X and therefore its goals cannot be exclusively profit maximization, since this could motivate it to select a strategy

that negatively affects the profits of other business units, and/or aggregated profits. Although trade-offs cannot be completely avoided, in practice the MSB's goals should be complementary to those of Company X, and, ideally, synergistic. In addition, full monetization of all MSB goals is not possible due to the large variance in estimation and valuation errors associated with highly complex, risky technology projects.

Given that profit is not the MSB's only goal, and that not all goals can be monetized, the optimal method for analyzing strategic choice would the multi-goal approach, as opposed to DCF, Profitability analysis or modified DCF. (Vining and Meredith, 2000) Chapter 5 presents such an analysis, and is summarized in **Table 10**.

5 SOLUTION ANALYSIS

The purpose of this chapter is to analyze strategy alternatives for the MSB as well as goals with which to evaluate each strategy. The strategies and goals presented are based upon the analysis and assessment of the MSB's current situation and projected performance conducted in previous chapters. At the end of the chapter, each proposed strategy is ranked against each strategic goal. Entry into the MES for process industries market segment received the highest ranking in this analysis.

5.1 Business Level Alternatives

From the analysis of chapters 2 and 3, four-business level strategic options have been developed that could help the MSB achieve its goals. Each option is mutually exclusive. These options are analysed according to the strategic goals of Company X and the MSB, in order to determine the most favourable option. Conclusions and recommendations follow in chapter 6.

5.1.1 B1: Enter Manufacturing Execution Software (MES) for Process Industries Segment

The goal of this business strategy option would be to enter the attractive Manufacturing Execution Software (MES) for process industries market segment. The MSB is not a player in this segment today (**Table 2** and **Table 3**). This option would require product and market development.

Implementation of this strategy would involve the movement of all resources from negative valuation products (i.e., discontinue these products) to a new MES-for-process-industries team, as well as investment in new intellectual assets. The strategy would also leverage existing MES technology and knowledge (scope and learning economies) and be designed to be synergistic with process monitoring and visualization software.

5.1.2 B2: Expand Share of Process Monitoring and Visualization (PMV) for Process Industries Segment

The goal of this business strategy option would be to expand the MSB's share of the marginally attractive Process Monitoring and Visualization (PMV) software market for process industries. The MSB is a small player in this segment today. This option would require product and market development.

Implementation of this strategy would involve the movement of all resources from negative valuation products (i.e., discontinue these products) to a new PMV-for-process-industries team, as well as investment in new intellectual assets. The strategy would leverage existing PMV technology and knowledge (scope and learning economies) to build a new product specifically targeted at process industries. Lastly, this strategy would be synergistic with Company X's expansion into electronic controllers and other electrical equipment for process industries.

5.1.3 B3: Enter Asset Management/Condition Monitoring (AM/CM) for Process Industries Segment

The goal of this business strategy option would be to enter the attractive Asset Management & Condition Monitoring (AM/CM) software market for process industries. The MSB is not a player in this segment today – it is a small player in AM/CM for discrete industries only. This option would require product and market development.

Implementation of this strategy would involve the movement of all resources from negative valuation products (i.e., discontinue these products) to a new AM/CM-for-process-industries team, as well as investment in new intellectual assets. The strategy would leverage existing AM/CM technology and knowledge (scope and learning economies).

5.1.4 B4: Enter Process Simulation & Optimization for (PSO) Process Industries Segment

The goal of this business strategy option would be to enter the huge and attractive Process Simulation & Optimization (PSO) software market for process industries. The MSB is not a player in this segment today – it is a small player in PSO software for discrete industries only. This option would require product and market development.

Implementation of this strategy would involve the movement of all resources from negative valuation products (i.e., discontinue these products) to a new PSO-for-process-industries team, as well as investment in new intellectual assets. The strategy would leverage existing PSO technology and knowledge (scope and learning economies).

5.2 Strategic Goals

The goals and criteria used to evaluate each strategic option are listed below in order of importance.

1) **Synergy:** the degree to which a given strategy creates more value when combined with other products, assets or capabilities within Company X than it can alone.

2) **Short-term Profit:** the amount of profit a given strategy can generate within a two-year timeframe.

3) **Long-term Profit:** the amount of profit a given strategy can generate within a three-to-five year timeframe.

These are all top-level proxy goals for the strategic measures in the balanced scorecard: (**Table 9**) that is to say, all strategic measures in the balanced scorecard have a direct effect on one or more of these goals. Based upon internal discussions, top decision weighting was given to "synergy" due to its compound effects on the profits of multiple products as well as customer value.

5.3 Analysis of Alternative Options in Terms of Goals

Option B1 (MES for Process segment) earns the highest synergy rating (5) compared to the other options, because it allows the MSB to leverage existing MES assets (people and software) as well as its PMV software and controllers for process industries. This means it can also leverage its installed base of customers and expand its footprint in these accounts to include MES software. In

addition, it can design its MES offering to be highly complementary to its PMV software and controllers, and thereby reduce customer ownership costs while increasing customer satisfaction. Option B2 (PMV for process) also earns a good synergy rating (4) with Company X's controllers for process and its existing installed base of PMV software in the process industries - but it cannot leverage existing MES assets.

From a short-term profit perspective, options B2 (PMV for process) and B3 (AM/CM for process) get top rating (3). B1 (MES for Process segment) is slightly behind due to the longer time required for it to meet market demands. Option B4 merits the lowest rating because the MSB does not possess products or knowledge that serves this segment in a significant way and the barrier to entry is high as this is a complex segment.

From a long-term profit perspective, options B1 (MES for Process segment) and B4 (PSO for process) get the top rating (4) due to the attractiveness of these markets. B3 (AM/CM for process) is next (3) with B2 (PMV for process) as the lowest long-term profit option because of the maturity and smaller size of the PMV market.

The results of this analysis are summarized in **Table 10**. Option B1 (MES for Process Industries) gets the highest total score in terms of meeting all the MSB's goals and priorities. Options B2 (PMV for process) and B3 (AM/CM for process) are close followers and might also be pursued if B1 proves not to be viable. Option B4 is a distant possibility due to the large learning barriers that must be overcome before entering this market.

Table 10 - Strategic Option Ratings vs. Goals

		Rating Scale: 1-5			
		Options			
Goal	Weight[14]	B1	B2	B3	B4
Synergy	3	5	4	3	2
Short-Term Profit	2	2	3	3	1
Long-Term Profit	1	4	2	3	4
Weighted Score		23	20	18	12

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[14] A weight of 3 indicates highest importance and 1 indicates lowest.

6 CONCLUSIONS AND RECOMMENDATIONS

Company X's MSB has a reasonably strong position in an attractive industry. It is earning profits consistent with industry averages (20-35%) and is experiencing moderate to strong growth. However, it is achieving these profits and growth primarily by serving the most mature and the smallest segment of the manufacturing software market – process monitoring and visualization for discrete industries. In addition, the MSB is still investing in the on-going development and maintenance of non-profitable products, reducing its overall profitability and efficiency.

To resolve these problems, the MSB should move all of its intellectual assets from under-performing products and acquire additional resources to expand into the larger and more attractive MES for process industries segment of the manufacturing software market. This recommended strategy is described in section 5.1.1 and analysed in section 5.3 of this report. The MES for process industries segment is large, rapidly growing and highly fragmented; many small services firms are filling customer needs, but no dominant player exists. The attractiveness of this segment – and the need for MES software to interface with back-end business systems – is attracting large ERP and SCM software vendors. While it is likely that these firms will (or already have) enter the MES market, they will not be able serve all customer needs without tight integration of manufacturing equipment and control systems – the type of complements

already produced by Company X. Thus, the MSB has resources and capabilities to fill these needs in a unique way – by offering unmatched integration between business systems, (e.g., ERP, SCM), and manufacturing systems.

This expansion strategy is also highly synergistic with the MSB's process monitoring and visualization software, as well as with Company X's recent move to supply controllers to the process industries. The value generated by these products working together as complementary components of a manufacturing system could well exceed the sum of the values of each individual product. In addition, the MSB could leverage its existing MES assets and likely generate some increases in short-term profits. In addition, moving intellectual assets to products that are more profitable will improve asset utilization. (Efficiency)

Recommendation 1: *Expand into the attractive MES for Process Industries segment by moving all intellectual assets from underperforming products – and acquiring new resources - to the development of new products that are aimed at filling this segment's needs.*

Assessment of the current situation surrounding Company X's MSB also revealed other problems that are reducing profitability and efficiency. The MSB is not a market leader even in its strongest PMV software segment. Consequently, growth and profits could be much stronger if it were to increase its share within its served market. This could possibly be achieved by something as simple as increasing customer awareness of the MSB's PMV products via advertising, etc. However, given that Company X's hardware products are a market leader in

discrete industries, it seems more likely that customers are choosing competitor's software products[15] for performance or quality reasons.

This paper's analysis suggests that performance and quality deficiencies are primarily due, first, to over-generalized designs, and second, to a product release cycle that does not provide sufficient time to genuinely satisfy customer needs. As a result, product releases contain features that are not complete, are not necessary, or are so flexible (generalized) that they are very difficult to use. Both of these problems can be largely attributed to the MSB's lack of market orientation. That is, the MSB does not target specific customer segments at the onset of its development projects – nor does it appear to understand the buying habits and preferences of its target customers. Such preferences might include technology adoption lifecycles, (if and when the customer can upgrade to minimize downtime and maximize added value), willingness to pay, what they value, and other matters easily identified by market research.

By moving to a market (as opposed to sales or technology) oriented model, the MSB could significantly improve (target) customer satisfaction and consequently increase its share of served markets. Targeting specific customer segment(s) would reduce feature development times by allowing simpler more focused designs to be acceptable. In turn, this would increase productivity by reducing or eliminating the development of unwanted (waste) features. Lastly, by

[15] According to MSB information, more than half of Company X hardware customers choose an alternate supplier for complementary software.

moving to a longer release cycle (twelve months or more[16]), the MSB would further satisfy customers that cannot or will not adopt at a more frequent rate. This would have the added benefit of providing the MSB development organization with more time to add value and quality to each release.

Recommendation 2: *Move to a market-oriented model. Define clear target customer segments for each development project and move to an annual or longer release frequency.*

The MSB could also significantly increase its penetration of its primary market (PMV software for discrete industries) by further leveraging one of its strengths: the breadth of its software and hardware products for manufacturers. This could be accomplished by investing in the development of product capabilities that maximize the synergy between Company X's hardware and software products, with the aim of improving ease of use and minimizing the ownership costs associated with implementation and deployment. Such action would provide a significant cost advantage over competitors and may compel a large portion of the Company X customers not using MSB software (50 %) to migrate – which would almost double MSB revenues.

Recommendation 3: *Invest in the development of technology that maximizes the synergy among MSB software and Company X hardware to build a sustainable competitive advantage.*

[16] Informal observation of the software industry suggests that it typically takes longer than 12 months to develop significant new features/capabilities or new products.

APPENDICES

Appendix 1: Resource and Customer Fulfillment Ratings for Each Competitor

Dimension	Firm																		
	A (MSB)	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
Resource (0-10)																			
Global service (training, support, etc)	8	8	8	6	6	6	6	6	1	1	1	1	1	1	2	7	7	10	9
Software Development Capability (Speed, Quality, Innovation)	4	4	4	4	4	4	4	4	3	3	3	3	3	3	3	6	6	10	8
Breadth of Manufacturing solutions	9	9	9	10	9	10	10	9	6	6	4	4	4	6	4	4	2	3	4
Breadth of Business solutions	5	5	6	4	5	5	5	3	2	3	4	4	3	3	4	10	10	5	6
Manufacturing Customer Acquisition Effectiveness	8	8	8	9	8	8	8	8	4	4	4	4	4	4	4	5	3	6	4
IT Customer Acquisition Effectiveness	4	4	5	3	4	4	4	2	1	2	3	3	2	2	3	10	10	8	8
Resource Rating	**5.4**	**5.4**	**5.7**	**5.1**	**5.1**	**5.3**	**5.3**	**4.6**	**2.4**	**2.7**	**2.7**	**2.7**	**2.4**	**2.7**	**2.9**	**6.0**	**5.4**	**6.0**	**5.6**
Market (0-10))																			
Process Simulation & Optimization	4	1	1	1	6	5	8	3	0	0	0	0	0	10	0	0	0	0	0
Process Monitoring & Visualization	8	9	10	8	8	7	10	5	8	8	2	2	2	1	0	1	1	5	4
Production Management	6	7	9	2	8	10	8	1	1	4	8	8	5	6	1	4	3	2	2
Production Data Management	7	7	9	7	7	7	8	7	7	7	6	6	10	6	3	6	6	6	6
Asset Management	6	1	3	7	2	9	8	0	0	0	0	0	0	0	10	4	4	4	4
Batch Management	9	8	8	8	10	1	7	1	1	1	0	0	0	0	0	3	3	2	2
Geographic Market Access	7	8	10	8	8	8	8	7	4	4	4	4	5	5	4	8	8	10	10
Customer Fulfillment Rating	**6.7**	**5.9**	**7.1**	**5.9**	**7.0**	**6.7**	**8.1**	**3.4**	**3.0**	**3.4**	**2.9**	**2.9**	**3.1**	**4.0**	**2.6**	**3.7**	**3.6**	**4.1**	**4.0**

Based on: Industry market reports (ARC, AMR, Frost & Sullivan) and information from corporate web-sites, 2005

REFERENCE LIST

Anthony, R. N., Hawkins, D. F., Merchant K. A., *Accounting Text & Cases* (11th Ed.), McGraw-Hill, New York, 2004.

Bergen, Mark and Peteraf, Margaret A., "Competitor Identification and Competitor Analysis: A Broad-Based Managerial Approach." *Managerial and Decision Economics*, 23(4/5): 157-169, 2000.

Besanko D, Dranove D, Shanley M., *Economics of Strategy*, (2nd Ed.) John Wiley & Sons Inc., New York, 2000

Day, George S., "What Does it Mean to be Market-Driven?" *Business Strategy Review,* Volume 9 Issue 1, 1-14, 1998.

Day, George S., "The Capabilities of Market-Driven Organizations." *Journal of Marketing,* Volume 58 (October): 37-52, 1994.

Duncan J. W., Ginter P. M., Swayne L. E., "Competitive Advantage and Internal Organizational Assessment", *Academy of Management Executive,* 1998, Vol. 12, No. 3

Jaworksi, Bernard J, & Kohli, Ajay, K., "Market Orientation: Antecedents and Consequences", *Journal of Marketing*. Vol. 57, 53-57, 1993.

Kaplan, Robert S. and Norton, David P., "The Balanced Scorecard: Measures That Drive Performance" *Best of Harvard Business Review*, July-August 2005

Matsuno, Ken and Mentzer, John T. and Ozsomer, A., "The Effects of Entrepreneurial Proclivity and Market Orientation on Business Performance." *Journal of Marketing,* Vol. 66, (July 2002):18-32, 2002.

Moore, Geoffrey A., Crossing the Chasm: Marketing and Selling Disruptive Products to Mainstream Customers, HarperCollins, New York, 2002.

Narver, John C. and Slater, Stanley F., "The Effect of a Market Orientation on Business Profitability", *Journal of Marketing,* Vol. 54, (October), 20-35, 1990.

Prahalad, C.K. & Hamel, Gary, "The core competency of the corporation", *Harvard Business Review* 68 (3): 82, 1990.

U.S. Department of Transportation, *Transportation Recall Enhancement, Accountability, and Documentation (TREAD) Act (2000),* Retrieved February 20, 2006 from http://www.nhtsa.dot.gov/nhtsa/Cfc_title49/publ414.106.pdf

U.S Food and Drug Administration, *21 CFR Part 11 Electronic Records; Electronic Signatures Act (1997),* Retrieved February 20, 2006 from http://www.fda.gov/ora/compliance_ref/part11/FRs/background/pt11finr.pdf

Vining, Aidan R. and Meredith, Lindsay. "Metachoice for Strategic Analysis," *European Management Journal*, 18(6): 605-618, 2000.