# Manufacturing Strategy:
# What Does It Take To Be World-Class?

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### Abstract

It is especially difficult to articulate what it means to be “world-class” in manufacturing if one thinks strictly in terms of some optimal mix of attributes. This is because there are myriad solutions to the strategic challenges manufacturers face, and new approaches and technologies are being introduced every day. There are, of course, many “best practices” that observer’s associate with being world-class, but in so many instances these practices are industry or firm specific. Whatever the attributes of a company’s manufacturing system, this study argues for an economic value based model for evaluating whether a firm’s manufacturing system is indeed world-class. The standard being advocated here is based on the notion that to be considered world-class, a firm’s manufacturing strategy must make an above industry and market rate contribution to the creation of economic value. Correspondingly, because market value is a function of economic value, a company able to consistently achieve above industry and market rate increases in economic value should expect to see total market capitalization bid up accordingly. We are now in what might be described as the “economic value era” and the creation of economic value is the standard by which any strategy should be judged.

### Introduction

Writing in 1986, Schonberger argued that if a poll were taken to name the twenty best manufacturers in the world, it was likely that most, if not all, of the companies’ chosen would be Japanese. What most were only beginning to understand, however, was just how the Japanese had worked such a dramatic transformation in their ability to manufacture a wide range of high quality, high value-added products. As the evidence accumulated, one thing became abundantly clear, Japanese accomplishments were not a cultural artifact, but were a byproduct of an entirely different way of conceptualizing the manufacturing process and of implementing manufacturing strategy. Different the Japanese approach was, difficult to understand, learn, and teach it was not. In fact, the glue that held it all together was elegant simplicity in the design of products and the systems and processes to produce them, significant investment in the development of human capital, the selective use of technology, and an unswerving commitment to superior quality.

While the Japanese are still highly regarded for their manufacturing prowess, they are as likely as not to be learning from others, as others are to be learning from them. For example, Toyota, regarded in many quarters as the standard by which manufacturers are judged, has been “going-to-school” on others who have achieved prominence in global manufacturing. And if the most recent J. D. Power quality ratings are any indication, it is Toyota and the other Japanese car companies who may now have a “quality gap” to close. Of the top 30 selling cars in the U.S. in 1998, the top three in overall quality were Fords, Toyota and Honda were down the rankings, with the other Japanese car companies even further behind. Of course, the J. D. Power rankings can hardly be taken as a signal that the Japanese are no longer preeminent as manufacturers. If anything, these results are more an indication of the extent to which the rest of the world has caught up with, and in some areas such as semiconductors and chip manufacturing equipment, passed the Japanese as the world's leading manufacturers.

Building on his 1986 examination of world class manufacturing, Schonberger (1996) addresses the shift that has been taking place in terms of manufacturing excellence. He describes the 1970s and early 1980s as "Japan's decade," the late 1980s to approximately 1995 as America's decade," and the period we are now in as the "Global decade." Table 1 presents Schonberger's "eras" of manufacturing and the strategic characteristics of each. Using Schonberger's assessment as a point of departure, this study explores what it will require for a company about to embrace the 21st century to have a world-class manufacturing strategy, and how, whatever a company's product/market orientation, management should judge the effectiveness of that strategy.

**Table 1**
**Schonberger's Manufacturing "Eras"**

| | | |
|---|---|---|
| 1940-50 | Shortages | = Production era |
| 1950-65 | Excess capacity, national | = Marketing era |
| 1965-80 | Concentrated earnings | = Finance era |
| 1980-90 | Intercontinental competition | = Quality era |
| 1990- | Excess capacity, global | = Partnership era |

## Review of the Literature

The literature pertaining to world-class manufacturing and related best practices is both extensive and diverse. Fortunately, summarizing what is considered leading edge thinking is made easier by the fact that firm and industry manufacturing secrets are hard to keep and once a practice or strategy has been proven effective broad adoption tends to occur quickly. Changes that are made tend to occur on the margin, largely in response to innovation. Furthermore, the literature is somewhat redundant in that terms are frequently used interchangeably to describe what are fundamentally similar practices. One example of this is "design for manufacturability" and "concurrent design and engineering."

The term "world-class manufacturing" actually came into popular use during the 1980s, partly as a consequence of the impact Japanese techniques were having on manufacturing (Schoenberger, 1982). One of the most complete early discussions of just what constituted world-class manufacturing, which was mentioned earlier, was Schoenberger's (1986) follow-up to his 1982 study dealing with applications of the "lessons of simplicity." Miller and Vollman (1985) also built on the notion of enhancing manufacturing performance through simplification. They argued for a balanced approach that reduces factory overhead through elimination of unnecessary transactions, increased stability of operations, and that employs the selective use of automation and systems integration. Drucker (1990) argued that “defining the factory is much more than a theoretical or semantic exercise. It has immediate practical consequences on plant design, location, and size; on what activities are to be brought together in one manufacturing complex, even on how much and in what to invest.” Drucker believes that the “postmodern” factory will not be mechanical but conceptual, based on the principles of Statistical Quality Control, the new manufacturing accounting (“manufacturing economics”), flexible manufacturing, and a “systems design” approach in creating an integrated supply chain and manufacturing process.

Although it appears to no longer be the case, flexible manufacturing has traditionally ranked higher in strategic importance among Japanese than among U.S. or, for that matter, European manufacturers. Stewart (1992) found that while durability, conformance to specifications, and on-time delivery are taken as givens by Japanese manufacturers, flexible factories, more and better product features, an expanded customer base, and rapid new product introductions are not. Dyer (1994) contends that management must view competition as extending beyond individual companies to encompass “value chains,” and that a lightly integrated, flexible production network using supplier assets that are dedicated to the producer will “virtually always outperform a loosely coupled production network.” Proximity is critical in leveraging such dedicated supplier assets, and because they have consistently underestimated the value to both parties of such assets, U.S. companies have traditionally fallen below an optimal level in their use and even today in some industries find themselves playing “catch-up.”

The move away from higher levels of vertical integration to a reliance on more “virtual” manufacturing systems has for the most part been an evolutionary process. Today the world of global manufacturing tends to be characterized by a continuum ranging from vertically integrated to virtual companies. Companies like GM are at the vertical end of this continuum, struggling to join companies like Dell and Sara Lee at the opposite end. For more virtual companies, global sourcing has become a reality with which most must contend along with the challenges that implementing such a strategy brings (Chase and Aquilano, 1994). As part of the process of developing global manufacturing systems the issue of where to locate has become a critical new strategic concern (Cohen and Lee, 1989). Country, technological and product specific considerations must be balanced to create an optimal mix of value creating activities. Today, for example, expected movements in currency exchange rates have great relevance for a firm’s global manufacturing strategy. Because while transaction exposure can be hedged, this is not the case for economic exposure. The key to reducing economic exposure is to distribute the firm’s productive assets among geographically diverse but economically stable locations so that the firm’s long-term cash flows are less likely to be impaired. Black & Decker is one of the few multinationals known to have taken its reliance on global diversification to the next level by making it part of their offensive strategy. “The key to Black & Decker’s strategy is flexible sourcing. In response to foreign exchange movements, Black & Decker can move production from one location to another to effect the most competitive pricing….. According to the company, the ability to move production of a product in response to changes in foreign exchange movements is a competitive advantage”(Arterian, 1989).

Another location related strategy commonly associated with world-class manufacturing is to locate in proximity to clusters of suppliers or related industries that are internationally competitive. The consequence of this process has been the creation of “centers of excellence” that have become essential to the manufacturing success of a growing number of firms and industries (Porter, 1990). Industries being reshaped by the emergence of such centers include the global automobile industry, specialty steel, various elements of the computer and semiconductor industries, the software industry, biotechnology, and pharmaceuticals.

Strategic decisions regarding the optimal size, number, configuration, and designs of factories are also being dramatically affected by changes in manufacturing technology. Three strategic considerations are of particular interest here: (1) the impact of technology on a firm’s cost structure, (2) its impact on minimum efficient scale, and (3) its impact on flexibility and responsiveness. Today more value is being added through knowledge, technology, and capital than ever before, which is resulting in a dramatic altering of cost structures for so many firms. Fixed costs have come to represent a disproportionately high share of total costs across a spectrum of industries. These high fixed costs are in turn redefining what “minimum efficient scale” means for more and more companies (Hill and Jones, 1995). And as suggested earlier, others are challenging the notion of an ever-increasing minimum efficient scale by employing flexible manufacturing technologies. These technologies are allowing some firms to produce a wider variety of end products at per-unit costs that at one time could only be achieved through long, uninterrupted production runs. Such “economies of scope” are being realized through the development of manufacturing technologies to: (1) reduce set-up times for complex equipment, (2) increase the utilization of machines through better scheduling, and (3) improve quality control at all stages of the manufacturing process (Nemetz and Fry, 1988; Greenwood 1986; Womack, Jones, and Ross, 1990). Furthermore, many firms are now standardizing the design of their factories both in terms of plant layout and equipment requirements. This greatly reduces architectural design costs and it lends itself to economies of scale in purchasing equipment and in training, trouble-shooting, maintenance, and changeovers. In fact, the last four assembly plants GM has built are located in China, Argentina, Poland, and Thailand, and they are virtually identical with respect to design, equipment, and the technology employed (The Wall Street Journal, 1997).

The strategy GM is following in building four virtually identical factories is also significant for the thinking it reflects regarding the use of “state-of-the-art” technology in developing countries. First-world companies entering third-world markets have traditionally employed “hybrid” factory designs and “appropriate technology,” which can range from the most advanced to the most primitive, depending on the economic, sociocultural, and political characteristics of a country. GM’s four new plants were designed by Brazilian and German engineers who’s charge was to duplicate GM’s German assembly plant, the Company’s most efficient and technologically advanced facility. Even though the cost of training less skilled workers will be high, the new standardized plants will only cost $350 million each as opposed $1 billion each, which is the normal price for a new plant of most any size. Needless to say, the difference can finance a lot of training, and makes it easier to understand GM's strategy. And while it is true that other multinationals with multifactory networks have used similar designs in more than one location for years, none have used a "cookie cutter" design and construction strategy, but many are now expected to in the future.

Finally, there is a growing list of more narrowly defined strategic initiatives that are commonly used to identify world-class manufacturers. These characteristics are frequently referred to a "best-practices" and they have come to represent a core element in the literature pertaining to manufacturing and, more recently, supply-chain management. Unfortunately the terminology is somewhat misleading because while best practices may play a part in improved manufacturing performance, it is clear that to do so they must be selectively employed and effectively implemented. In other words, best-practices are not universally applicable, even within an industry nor, even where they are applicable, should one expect them to be equally potent across applications. Their potency is highly situational and implementation appears to be as important as the practice.

The use of best practices to evaluate a company's manufacturing strategy has actually become a form of benchmarking that managers and analysts use to determine where a company stands relative to some index. Such benchmarking may be quantitative or qualitative. Quantitative benchmarking involves the use of metrics produced from best practices to compare actual performance with "established' world-class quality, time, and cost measures. Qualitative benchmarking seeks to compare current manufacturing practices to the practices of leading manufacturers. Qualitative benchmarking allows one to derive a "profile" of best practices as a basis for comparison much as Roger Smith did in comparing GM's manufacturing system with the best the Japanese had to offer (Drucker, 1990).

Within the context of the firm's manufacturing strategy these practices are strung together to give the system a degree of robustness and virtuosity that it would not otherwise have. The whole idea is to integrate these practices into the firm's manufacturing strategy in a way that allows it to more effectively leverage any core competencies it may have and in so doing add more value through manufacturing than would be possible with any other system configuration. Of critical importance here is that management take a systems approach in balancing the use of capital, technology, and labor. Furthermore, to remain an effective competitive weapon, a firm's manufacturing system must assume an organic character, growing from within in response to organizational innovation while being quick to adopt worthwhile technology and ideas developed elsewhere. Table 2 provides a comprehensive listing of more broadly adopted best practices commonly cited in the manufacturing literature. Again, it is important that a distinction is made between these very specific initiatives and the firm's overall manufacturing strategy, which may utilize a combination of these practices.

**Table 2**
**"Best-practices" in Manufacturing**

| |
|---|
| Automatic storage/retrieval systems |
| Cellular manufacturing |
| Computer-aided design |
| Computer-aided manufacturing |
| Computer-integrated manufacturing |
| Concurrent engineering/design for manufacturability |
| Flexible manufacturing systems |
| Just-in-time system |
| (Just-in-time delivery, Just-in-time inventory control, Just-in-time manufacturing) |
| Kanban system |
| Manufacturing rationalization |
| Materials requirements planning |
| Modular design and construction |
| Quality circles |
| Robotics |
| Statistical process/quality control |
| Syncronous manufacturing/balanced loading |
| Target pricing/costing |
| Total preventive maintenance |
| Total quality control |

If we are in what Schonberger (1996) has described as the Global Decade, what are the strategic implications likely to be for manufacturers? Ernst and Young's (1998) report on manufacturing in the 21st century, which was based on broad input from both industry and academia, reached the following conclusions:

> "Hard" assets will cease to be the source of most of the value added through manufacturing. Instead, assets in the form of relationships with suppliers, customers, and employers will become the primary source of value. "This focus on 'connected assets' will give a whole new look and feel to manufacturing in coming years."
>
> Connected assets will dramatically increase the pace of innovation, promote even more outsourcing, and force management to develop a real-time collaborative relationship with customers, suppliers, and employees.
>
> Connectivity will be achieved through the creation of "new incentive structures, cross investing, third-party mediation, and a wide array of new types of contractual arrangements."

Some of what the Ernst and Young study alludes to can already be seen in the changing role of organization structure in facilitating the manufacturing task. In response to the need to cope more effectively with the growing complexity of manufacturing and sourcing on a global basis, more and more companies are legitimizing materials management by separating it out as a function and giving it equal weight, in organizational terms, with other, more traditional functions. The idea behind establishing a separate materials management function is that procurement; inbound logistics, manufacturing, and outbound logistics should not be treated as separate activities but as three dimensions of "supply chain management." In turn, firms are increasingly using electronic data interchange (EDI) to help coordinate the flow of materials into manufacturing and out to outbound logistics and beyond. EDI has made it possible for firms to maintain around the clock real time contact with suppliers, assembly plants, third-party logistics companies, distributors, dealers, and, in a growing number of instances, final consumers (Hill, 1999).

Viewing manufacturing as just one element in the supply chain represents a significant departure from both traditional thinking and current practice for most companies. Nevertheless, for many it appears to be a strategy whose time has come. Inbound Logistics (1999) recently completed a study of just where the art and science of supply chain management stands and the direction the strategy is expected to take. Most companies have not yet achieved the kind of supply chain integration necessary to take full advantage of the concept. This is especially true where the development of flexible partnerships with outside suppliers is concerned. In addition, there is considerable disagreement on how the performance of any supply chain should be measured. In this regard, Lambert (1999) argues that "while the focus has been, up to now, on minimizing distribution and inventory cost, we should be focusing on the profit impact of improving logistics and supply chain management." This point is of some significance because Lambert seems to be calling for a new way of evaluating supply chain management, which is consistent with the position this study takes with respect to the broader issue of manufacturing strategy

## How do You Know When You're World-class in Manufacturing?

If the review of the literature accomplished nothing else, hopefully it underscored the extent to which manufacturing strategy is diverse both within and among industries. It is shear folly to attempt to categorize companies as world-class or not based on the extent to which they are "virtual" as opposed to being more vertically integrated, or by using an array of industry "best-practices" as a standard. For one thing, such an approach simply ignores what is appropriate for a firm's circumstances and how that might change over time. For another, it overlooks the importance of implementation. Furthermore, some might be inclined to make judgments about a company's manufacturing strategy based on product quality, but such an approach completely ignores value. Others would argue that greater cost efficiency makes for being world-class and there are still others who talk in terms of principles based management and a "balanced scorecard."(Schonberger, 1996; Kaplan, 1992; Kaplan and Norton, 1995).

To understand any contribution this study may make to the literature and to management practice it is essential that one have some understanding of just what Schoenberger (1986) and the others that followed his lead meant/mean by world-class manufacturing:

> World-class manufacturing has an overriding goal and an underlying mind set for achieving it. The overriding goal may be summarized by….the motto of the Olympic Games: *citius, altius, fortius*….The world-class manufacturing equivalent is *continual and rapid improvement*….Today there is wide agreement among the world-class manufacturing "revisionists" that continual improvement in quality, cost, lead time, and customer service is possible, realistic, and necessary. There is now good reason to believe that those goals may be pursued in concert, that they are not in opposition. One more primary goal, improved flexibility, is also a part of the package….With agreement on the goals; the management challenge is reduced to speeding up the pace of improvement.

Even with a clearer understanding of just what world-class manufacturing means, one is left to ponder how the analyst, or for that matter, management is to determine whether a company's manufacturing strategy is world-class. If one assumes that there has been continual and rapid improvement in quality, cost, lead time, customer service, and flexibility, how can such improvements be translated into a meaningful index of performance that can be used with confidence to make periodic judgments about within-industry performance? In fact, the definition we have been given for world-class manufacturing really provides no basis for clearly specifying whether a company is or is not a world-class manufacturer. The thesis of this study is that the extent to which a company is or is not world class should be based on the extent to which its manufacturing strategy contributes to the creation of economic value. It makes absolutely no difference what the specifics of that strategy may be, the ultimate test of a firm's manufacturing strategy, the only truly reliable measure, should be whether it creates economic value for shareholders.

## Manufacturing Strategy and the Creation of Economic Value

Efforts to "measure" manufacturing performance has traditionally focused on a variety of accounting based measures including an assortment of cost based numbers like inventory turnover rates, cycle-times, defect rates, and many other similar metrics. In fact, a "science" of such metrics, operations analysis, has developed over time, aided more recently by the emergence of the computer with its ability to crunch massive amounts of data. Today, operations analysts have a real-time ability to take the pulse of a company's global manufacturing system on a minute by minute basis. Unfortunately, this ability to evaluate performance by the numbers conveys what might best be described as an illusion of precision, while saying nothing about how effectively such measurability is contributing to the creation of economic value. This is true for several reasons.

First, accounting based measures of performance may be computed using alternative yet entirely acceptable accounting methods. This can lead to dramatically different results and make an accurate assessment of performance difficult. For example, one would expect a world-class manufacturer to maintain an "optimal" investment in inventory, however, accounting for inventory on a LIFO (last-in, first-out) as opposed to a FIFO (first-in, first-out) basis will affect estimates of cost-of-goods sold. Correspondingly, turnover rates and rates of capital intensity will be influenced as well. And, of course, there is depreciation where a spectrum of methods is commonly employed that can significantly affect the reported value and performance of manufacturing related assets. In addition to distortions that occur for perfectly legitimate reasons, the fact is that accounting based measures of performance are also easy to manipulate. Often times the numbers are managed to mask a bad quarter or to make good numbers look even better. However, if performance is evaluated on a cash-flow basis, these distortions disappear and the focus begins to shift to the creation of economic value.

These kinds of "distortions" also occur where investment in working capital and plant and equipment are concerned. For example, as a firm grows sales there will normally be an associated increase in working capital. Focusing strictly on manufacturing, that means an increase in investment in cash and marketable securities to support manufacturing related cash outflows and increased investment in inventory. Investment in inventory involves cash payments for materials, labor, and overhead. These cash outflows are, of course, reflected as assets on the balance sheet but they are not included in cost-of-goods-sold, a commonly used measure for evaluating manufacturing performance. Correspondingly, accounts payable represents, among other things, unpaid bills related in part to manufacturing and this tends to overstate cash outflows associated with the cost-of-goods-sold.

Plant and equipment are depreciable assets and they are accounted for at cost. This cost is allocated over the life of the asset and presumably reflects the rate at which these assets are being used up. In reality, declared depreciation almost never accurately reflects the dissipation of economic value (these assets tend to be far more valuable in productive terms that their book value suggests) and the way these assets are depreciated can dramatically affect a variety of measures commonly used to evaluate manufacturing performance. Furthermore, because depreciation is a tax-deductible expenditure but is non-cash in nature, it tends to distort earnings based measures of performance. Also, because revenue flows are not adjusted for incremental investment in plant and equipment, any earnings based measures of manufacturing performance are further distorted. This is clearly not the case if the focus is on cash flow and, correspondingly, the creation of economic value.

A second reason accounting based measures of manufacturing performance are inadequate for judging whether a company is world-class is because they ignore the time value of money. Economic value is based on the presumption that a dollar of cash received today is worth more that a dollar of cash received next year. For example, accounting based measures will not reflect the economic value of the cost savings from a newly installed just-in-time inventory system or of improved earnings from a more flexible manufacturing system that allows the firm to more quickly serve a wider array of markets. And there are countless examples of "growth" companies that have invested in inventory and plant and equipment only to see sales and earnings grow and the value of the business decline. To create economic value management must generate operating returns on invested capital that are greater (perhaps much greater) than the firm's cost of capital. None of the measures commonly used to evaluate manufacturing performance effectively address this reality.

Finally, a third reason accounting based measures of manufacturing performance are inadequate has to do with risk. A firm's cost of capital is in reality a risk-adjusted hurdle rate that reflects the economic return demanded by investors. With this in mind, even the most casual observer would recognize immediately that none of the broadly used measures of manufacturing performance; accounting based or otherwise, effectively adjust for the risk inherent in a strategy. Does it make sense; for example, to evaluate Boeing's manufacturing strategy for the 777, a high-risk strategy incorporating virtual design and manufacturing, using the same criteria one would use to evaluate a more conventional strategy? Investors would not and did not, and neither should management, analysts, or anyone else for that matter. Correspondingly, the accounting return on investment in plant and equipment, another commonly used measure of manufacturing performance, is computed using a variety of methods. For example, some firm's include plant and equipment at gross book value while others use a net book value approach. Some companies include the capitalized value of leases for plant and equipment as part of manufacturing assets while others do not. Neither of these approaches adequately addresses the issue of risk, nor do they adjust for the time value of money. But risk and the time value of money are of prime importance to investors and it is investors that assign a value to a company's strategy.

The argument here is that to be world-class in manufacturing, a firm must by definition have a manufacturing strategy in place that makes an optimal contribution to the creation of economic value. In this regard, there is no better arbiter of whether a company's manufacturing strategy is world-class than the collective wisdom of the market. Is it the right strategy, is it being effectively implemented, is our quality world class, are we as flexible as we should be? Conventional measures of manufacturing performance will only provide answers to questions like these in hindsight, if at all. The market will let you know virtually overnight and no matter how elegant the design or how revered the engineering and assembly may be, no matter what the metrics may tell you, what really counts is the creation of economic value. And those managers who would argue otherwise should be encouraged to go ask Porsche.

## The Basic Model

What follows is the development of an economic value based model for evaluating a firm's manufacturing strategy. The premise here is that a world-class manufacturing strategy is one that allows the firm to produce more economic value relative to the industry and to the market than any of the firms it competes against. Here economic value is defined as the present value of future cash flows that obtain from investment in manufacturing related assets, design and engineering, and the human capital employed in manufacturing.

The creation of economic value tends to be a function of the following six “value drivers” (Rappaport, 1998):

$g_s$ = sales growth rate

EBITM = a firm’s operating profit margin

t = the cash rate of taxation

$\partial$NWC = the firm’s net working capital investment rate relative to the change in revenue

$\partial P\&E_{net}$ = a firm’s investment rate in net plant and equipment relative to the change in revenue

$k_0$ = the firm’s weighted average marginal cost of capital

Where the economic value of the firm ($EV_0$) is derived as a function of the present value of future operating cash flows ($OCF_t$) as follows:

$$EV_0 = Sales(1+g_s)(EBITM)(1-t) – Sales(g_s)(\partial NWC+\partial P\&E_{net}) = OCF_t/(1+k_0)^t$$

plus a residual value ($RV_{t-\infty}$):

$$RV_{t-\infty}/(1+k_0)^t$$

and including all cash and marketable securities. The economic value of shareholders equity ($EVSE_0$) becomes:

$$EVSE_0 = EV_0 – \text{total liabilities}$$

Manufacturing strategy contributes to the creation of economic value by providing the firm with two types of competitive advantage-cost leadership and differentiation. Cost leadership and differentiation are in turn a byproduct of what Porter (1990) first described as a collection of value adding activities that can be described in terms of a “value-chain.” Disaggregating the firm into its strategically relevant activities serves to highlight manufacturing’s potential role with respect to value added, and it also helps one better understand the relationship between value added and the creation of economic value. Porter’s value chain is shown in Figure 1. Of interest here are procurement, inbound logistics, operations, and outbound logistics, the firm’s supply chain activities. The link between manufacturing strategy, supply chain management, and the creation of economic value is captured in Figure 2. The flow of cash through the business begins with sales that are in part a function of price and quality, two variables strongly influenced by manufacturing strategy. Operating profit (EBIT) is in turn strongly influenced by cost-of-goods sold, which consists of direct labor, materials,

**Figure 1**
**Value Chain**

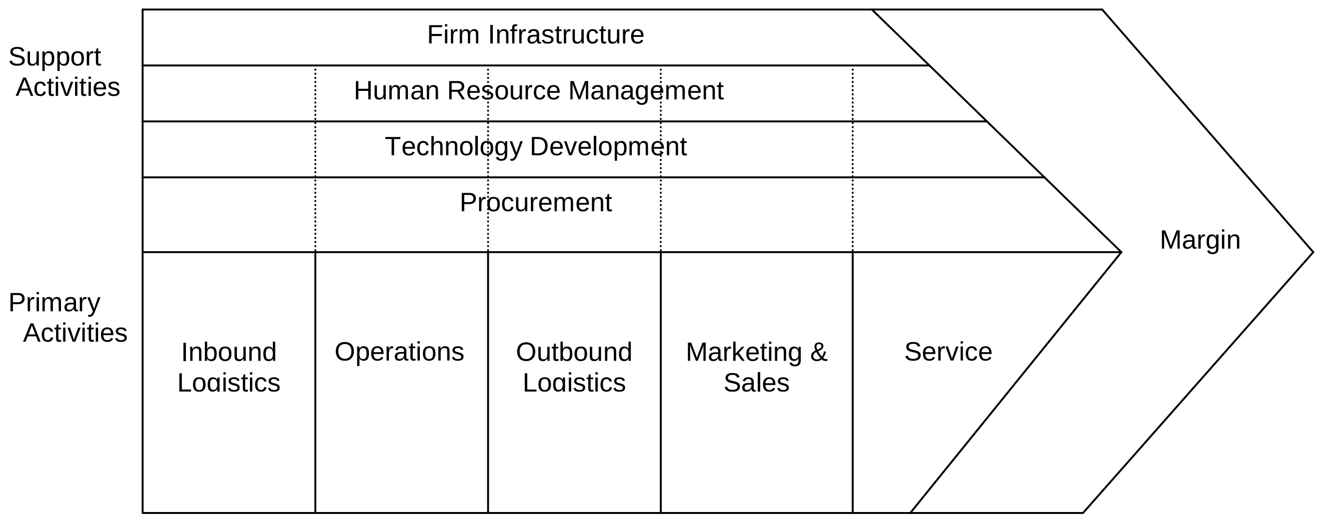
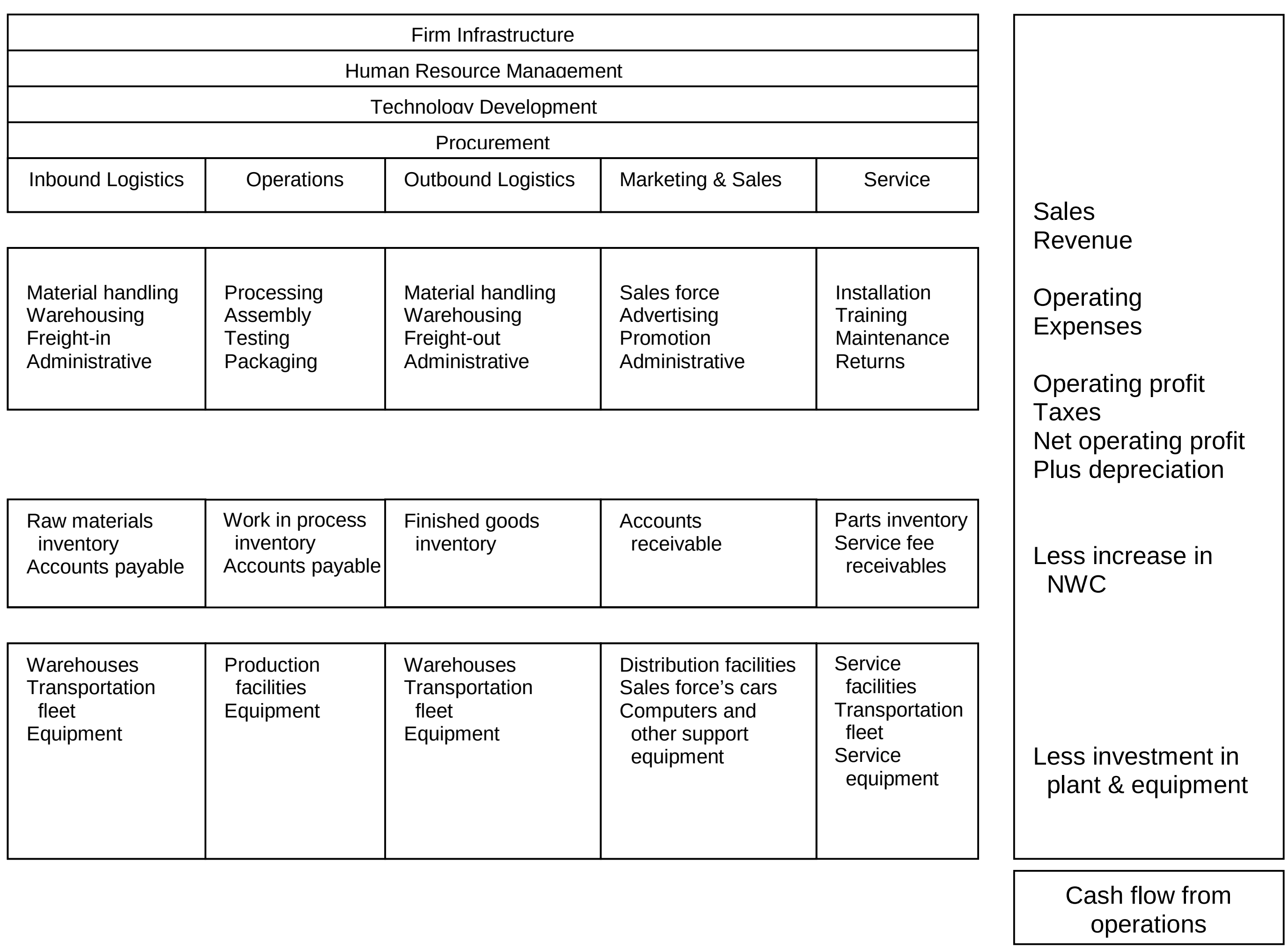



**Figure 2**
**From Value Added to the Creation of Economic Value**



and overhead, all of which are manufacturing related costs. Operating cash flow is also affected by investment in working capital and plant and equipment, with much of what is invested going to manufacturing. After adjusting for any non-cash expenditures (adding back depreciation and amortization) and taxes, the resulting cash flow from operations is discounted using the appropriate cost of capital. It is cash flow from operations that serves as the basis for valuing the firm and its strategies; in this case the focus is on that element of cash flow from operations derived from the firm's manufacturing strategy.

"This activity-oriented classification scheme has important advantages over conventional accounting classifications which often merge costs involving several activities or, in other instances, may separate costs that properly belong to a single activity. Strategic alternatives are essentially based on scenarios involving tradeoffs within an activity or between activities and therefore are more easily assessed by an activity-based financial information system than by conventional accounting systems"(Rappaport, 1986).

The model for calculating the economic value added by manufacturing actually builds on Rappaport's (1998) model for determining the change in economic value for the firm and it provides the mechanism by which managers can operationalize the approach being advocated here. In this regard Rappaport argues that what corporate decision-makers need is an "operationally meaningful concept that enables managers to assess the value creation potential of alternative strategies." The economic value added by manufacturing ($EVAM_t$) is derived as follows:

$$EVAM_t = Sales_t(g_s)(EBITM_{\Delta Sales})(1–t)/k_0 – Sales_t(g_s)(\partial NWC_{\Delta Sales}+\partial P\&E_{net\Delta Sales})/(1+k_0)$$

where:

$Sales(g_s)$ = incremental sales

$EBITM_{\Delta Sales}$ = operating profit margin on incremental sales

t = cash rate of taxation on incremental earnings

$\partial NWC_{\Delta Sales}$ = incremental net working capital investment rate

$\partial P\&E_{net, \Delta Sales}$ = incremental investment rate in net plant and equipment

The first term in the $EVAM_t$ model represents the present value of the firm's incremental cash flows from its manufacturing strategy. This would be equal to sales generated by the firm's manufacturing strategy minus all manufacturing related costs and adjusted for depreciation and taxes. The second term represents the present value of the firm's incremental investment in manufacturing related assets (e.g., cash and marketable securities earmarked for manufacturing, inventory, and plant and equipment). To grow economic value the firm's operating profit margin on incremental sales ($EBITM_{\Delta Sales}$)

must be greater than its incremental threshold margin ($ITM_t$), the operating profit margin that equates the present value of cash inflows with the present value of cash outflows.

A firm's incremental threshold margin can be derived by setting the present value of cash inflows and outflows from manufacturing related investment equal to each other and solving for $ITM_t$, where:

$$ITM_t = (\partial NWC_{\Delta Sales} + \partial P\&E_{net,\ \Delta Sales})(k_0)/(1 + k_0)(1 - t)$$

An essential insight here is that a manufacturing strategy must yield a positive operating profit margin spread ($EBITM_t$ – $ITM_t$) on incremental sales in order to create economic value. Once management has established the: (1) investment requirements, (2) risk characteristics ($k_0$), (3) incremental threshold margin for the strategy ($ITM_t$), and (4) the duration over which the operating profit margin spread is expected to remain positive, a reduced version of the $EVAM_t$ model can be employed to calculate the economic value added by the firm's manufacturing strategy, as follows:

$$EVAM_t = Sales_t(g_s)(EBITM_t - ITM_t)(1 - t)/(k_0)(1 + k_0)^{t-1}$$

Next an example of the application of the basic model is developed using Harley-Davidson 1997-1998.

## An Application of the Basic Model

Harley-Davidson's "ongoing manufacturing strategy is designed to increase capacity, improve product quality, reduce costs and increase flexibility to respond to changes in the marketplace"(Harley-Davidson, Inc., 1999). Looking at just motorcycles, sales grew by $1.6 billion, an increase of 15.4 percent over 1997. Operating profit increased by $63.6 million and Harley-Davidson's incremental operating profit margin was four percent. Harley-Davidson's incremental investment in working capital related to manufacturing (cash and marketable securities allocated for manufacturing were estimated to be 41 percent of total assets) and inventory was $45.1 million and their incremental net working capital investment rate was .0282. The Company's incremental investment in plant and equipment net of depreciation was $98.9 million and their incremental investment rate in net plant and equipment was .062. Harley-Davidson's cash rate of taxation was 36.5 percent and their cost of capital was estimated to be 13 percent. Using the reduced version of $EVAM_t$ the economic value created by Harley-Davidson's manufacturing strategy from 1997 to 1998 can be estimated as follows:

$$ITM_{1997-1998} = (.0282+.062)(.13)/(1+.13)(1-.365) = .016$$

and:

$$EVAM_{1997\text{-}1998} = (\$1.6\text{ billion})(.04-.016)(1-.365)/(.13)(1+.13)^{1-1} = \$187.6\text{ million}$$

For 1997-1998, Harley-Davidson's investment of $144 million in its manufacturing strategy created $187.6 million in economic value, an economic return on investment of approximately 30 percent. Because economic value drives market value, one would expect any company that consistently invests in strategies yielding above industry and market economic returns to see its market value bid up accordingly. It is this kind of manufacturing strategy that deserves to be considered world-class and it is $EVAM_t$ that should be the standard by which manufacturing strategies are judged.

## Summary

This study has attempted to demonstrate through an extensive review of the literature that world class manufacturing is an ephemeral and difficult to define concept. Different companies in the same industry frequently employ wildly different manufacturing strategies and appear to enjoy similar levels of success when judged in terms of commonly used measures of performance. A virtual potpourri of "best practices" exists that many observers use to identify what they believe are world-class manufacturers and Schoenberger (1986) has provided a definition of world-class manufacturing that builds on the Olympic ideals of "faster," "higher, "stronger." Nevertheless, identifying companies that truly deserve to be called world-class in manufacturing remains a daunting and imprecise task. In this regard, too many managers and analysts rely on a time-honored collection of metrics to evaluate manufacturing performance. As this study demonstrated, most companies depend heavily on accounting based measures of manufacturing performance, which can be easily manipulated, and that fail to adequately account for investment requirements, the time value of money, and risk.

The premise of this study is that a firm's manufacturing strategy deserves to be called world-class only if it contributes sufficiently to the creation of economic value. Whether the company employs a JIT inventory system, outsources, and practices "total quality management" is really neither here nor there. If it does all of these things and more, yet its manufacturing strategy does not create adequate economic value, it does not deserve to be considered a world-class manufacturer. More specifically, this study argues that to achieve world-class stature a firm must have a manufacturing strategy that leads to the creation of economic value at an above industry and market rate. This is what investors want and it should be what management wants. A model was introduced for determining the economic value added ($EVAM_t$) by a firm's manufacturing strategy and an application of the model was developed using data for Harley-Davidson. The $EVAM_t$ model builds on Rappaport's (1998) thinking with respect to the creation of shareholder value, and provides a mechanism by which practicing managers can operationalize an economic value based analysis of manufacturing strategy.

The creation of shareholder value is the standard by which companies and managers worldwide are now being judged. It simply does not make sense that a firm's functional strategies would be judged differently. The model advocated here is consistent with this line of reasoning and with well-established economic theory. There is nothing wrong with pursuing a manufacturing strategy that generates the equivalent of Olympic Games like performance---*continual improvement in quality, cost, lead-time, customer service,* *and flexibility.* However, the harsh reality is that even Olympic Games like performance will be inadequate if it does not lead to the creation of economic value.

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