MANUFACTURING STRATEGY: AT THE INTERSECTION OF TWO PARADIGM SHIFTS*

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The concept of "manufacturing strategy" is still, in human terms, barely past adolescence. In years, it is younger than most of the MBAs who study it today. So it is not surprising that—like them—it has been undergoing almost continual growth and elaboration throughout its short life, as it tested itself against the real world and as that world evolved. Today it is facing perhaps the greatest challenge in its short history, as it finds itself in the crossfire of debates about core aspects of its two parent disciplines: manufacturing management and competitive strategy. This paper begins by briefly reviewing some of the key steps in the conceptual development of the manufacturing strategy paradigm, then describes the attacks now being directed at both the manufacturing management and the competitive strategy paradigms, and finally discusses the new perspectives that these two paradigm shifts are shedding on some familiar problems.

(MANUFACTURING STRATEGY; COMPETITIVE STRATEGY, CAPABILITIES)

1. The Evolution of Manufacturing Strategy: The First Decade

Until the early 1980s, most American managers thought about manufacturing in terms of a paradigm whose roots went back well over a hundred years. The "American system of manufacturing," with its emphasis on mass markets, standard designs, and mass production using interchangeable parts, revolutionized manufacturing in the middle of the last century. Modified and elaborated by the principles of "Scientific Management," as promulgated by Frederick Taylor and his disciples, as well as by such great industrialists as Andrew Carnegie, Isaac Singer, and Henry Ford, this new paradigm was the foundation upon which the U.S. built itself into an industrial powerhouse by the 1920s. (See, for example, Abernathy and Corcoran [1983] and Chandler [1991].)

The ideas that work was most efficiently done when divided up and assigned to specialists, that managers and staff experts should do the thinking for workers (so they could concentrate on "doing"), that every process was characterized by an innate amount of variation (and hence an irreducible rate of defects), and that communication in an organization should be tightly controlled, so as to avoid possible confusion, and should proceed through a hierarchical chain of command—were accepted as dogma. The best manufacturing process was one based on long runs; it utilized equipment that was specialized for each stage of the process and whose capacities were matched as closely as

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possible, and it used inventories to buffer different stages both from each other and from
the erratic behavior of suppliers and customers. Work should be organized and conducted
systematically, in a logical sequence, and under tight supervision.

The assumption that there was “one best way” to manage manufacturing was disputed
by a number of critics over the years¹, but it received its most effective challenge from
Wickham Skinner (1969) in his now-classic *Harvard Business Review* article “Manufactu-
ring—missing link in corporate strategy.” The kernel of Skinner’s argument was
that (1) different companies have different strengths and weaknesses and can choose to
compete in different ways (and therefore should adopt different “yardsticks of success”);
(2) similarly, different production systems (the composite of decisions in a number of
key decision areas) have different operating characteristics; and therefore, rather than
adopting an industry-standard production system (3) the “task” for a company’s man-
ufacturing function is to construct a production system that, through a series of interrelated
and internally consistent choices, reflects the priorities and tradeoffs implicit in its specific
competitive situation and strategy.

That basic conceptual framework, despite the passage of 25 years, the emergence of a
very different world order for industrial competition, and a continual barrage of ques-
tioning and skepticism, has proven to be remarkably robust. Most of those who write on
the subject of manufacturing strategy have adopted it, implicitly or explicitly, and many
companies have adopted practices that have their roots in it. For example, as described
in the accompanying article by Lawrence Bennigson, the decision by the “Morine Com-
pany” to shift its competitive priorities to give more weight to customer service required
that it make a number of interrelated changes in its manufacturing system.

**Focused Factories**

The notion of a focused factory follows naturally, almost inevitably, from the essential
idea that “each strategy creates a unique manufacturing task.” In his famous sequel,
“The focused factory,” Skinner (1974) pointed out that a single factory, even if equipped
with the most modern machinery and systems, will inevitably experience almost irreco-
ncilable inconsistencies and conflicts, and a loss of overall effectiveness, if it attempts
to serve two or more markets that are being pursued using different competitive strategies.
Such a factory, he argued, could only be converted into a competitive asset by breaking
it up into separate “focused” facilities, for each of which the “entire apparatus is focused
to accomplish the particular manufacturing task demanded by the [specific] strategy . . . .” This article, with its emphasis on simplicity, clarity, and reducing overhead,
foreshadows the notion of “lean manufacturing.”

**Product/Process Evolution**

Another offshoot from the initial formulation of the manufacturing strategy paradigm
was the idea that a company’s manufacturing system should adapt over time to reflect
the changes in its competitive environment. For example, during the early part of its
“life cycle,” a product generally is available in a variety of configurations, most of which
sell in relatively low volumes. As the product matures, however, it typically evolves

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¹ For example, Professor John McLean developed a course called Advanced Production Problems at the
Harvard Business School during the late 1940s. To illustrate how companies within the same industry often
chose different competitive strategies and configured their manufacturing operations differently, McLean adopted
what he called an “industry approach” to the course. By devoting a number of classes to a single industry,
McLean was able to demonstrate to his students that companies within the same industry often adopted very
different competitive strategies and very different policies with respect to important manufacturing issues such
as the location of facilities, production control methods, vertical integration, and the administrative structure
of plants. That course, and the basic notions conveyed in it, had a powerful impact on the students who took
it—among them a young Wickham Skinner.
toward a smaller number of higher volume (e.g., commodity) products. Hayes and Wheelwright therefore suggested (1979a and 1979b) that both the competitive strategy and the manufacturing system of a "typical" company in the industry might be expected to evolve in a predictable manner over time. They used a "product-process matrix" to visualize both that likely path as well as the other trajectories that a company might follow. Using this matrix, they also were able to illustrate a number of the opportunities and pitfalls a company might encounter as it attempted to adjust (or, often more damaging, failed to adjust) to commonly observed market shifts.

Up to this point, most discussions of the manufacturing strategy paradigm had been dominated by the notion of "strategic fit;" that is, a company’s manufacturing system should reflect its competitive position and strategy. "Focus" provided both a means to achieve this fit and a discipline for maintaining it in the face of the continual barrage of potentially distracting opportunities that confront most business organizations. And the "product-process matrix" helped guide the adjustments in strategy and systems that were likely to be required in a changing world. But it was clear from the beginning that a paradigm defined by such concepts alone was inadequate to explain corporate success and failure. How can one explain, for example, the fact that even though several airlines may adopt very similar competitive strategies, choose the same kind of planes, use the same ground crews at each airport, and adopt very similar passenger reservation systems—some turn out to be far more successful than others?

If "fit" and "focus" aren't enough, what other concept(s) must be added? Such additional considerations as the "ability to implement" and "management commitment" have been proposed, but most fall under the umbrella of "organizational learning." In the 1970s, most discussions of learning were conducted within the somewhat narrow confines of the so-called "learning (or experience) curve." Predicting the nature of the cost reductions that would be expected to result from various competitive strategies, and the resulting impact on corporate growth and profitability, was the subject of a flood of articles during this period. We will return to examine another way of thinking about the learning/organizational improvement phenomenon later in this paper.

So, by the late 1970s, American managers and academics had assembled the basic ingredients of a theory describing how a company’s manufacturing organization could be converted (in Skinner’s words) from a “corporate millstone” to a “competitive weapon.” All this theory lacked, despite its conceptual appeal, was the kind of persuasiveness that could be provided only by being able to examine a number of companies that were following its prescriptions and had thereby achieved competitive success. But in the mid-1970s, most American companies wrapped themselves in the straight jacket of "industry practice" and chose to compete through innovative marketing approaches, new product introductions, or financial maneuvers—almost any way except through manufacturing prowess. The notion that manufacturing, if properly configured and managed, could provide a powerful competitive advantage was essentially a theory in search of practitioners. This was soon to change.

2 Abernathy and Wayne [1974] folded this kind of analysis into the manufacturing strategy paradigm, using the example of Henry Ford’s Model T to illustrate both the cost-reducing power of the learning curve and how Ford’s strategy of extreme cost reduction inevitably led to a loss of flexibility. This opened a window of opportunity to Alfred Sloan at G.M. and reinforced the notion that an operating system that is extremely good at one thing is likely to be bad at something else.
agement practices, and realized how vulnerable many U.S. industries had become, they began to understand that Japan's success was primarily a triumph of sheer manufacturing virtuosity. At that time, most Japanese companies were producing similar products to those offered by western companies, and were marketing them in similar ways. What made these products attractive was not just their cost (which usually was less than could be justified by lower Japanese wages), but their low incidence of defects, their reliability, and their durability.

At last, the still-small band of manufacturing strategy aficionados had an opportunity to test their theories against a large number of real companies that had been able to parlay exceptional manufacturing ability into competitive success. And, for a while, it appeared their theories worked. Japanese companies by and large did adopt consistent policies in their pursuit of high productivity, low defect rates, and low inventories. They also operated focused factories; in fact, their emphasis on "repetitive manufacturing," "just-in-time" production scheduling, and smooth work flows caused them to be almost obsessive in their pursuit of long runs of limited product lines. And their emphasis on "continual improvement" appeared, at least initially (to eyes that were somewhat desperately looking for familiar reference points), to mirror our fascination with learning curves.

But as our eyes slowly adjusted and began to pick out the details of Japanese management practices, certain paradoxes became evident. During the 1980s, a new paradigm of manufacturing management began to emerge that challenged some of the basic manufacturing strategy concepts.

Are "Tradeoffs" Really Necessary?

Skinner and his disciples had argued that different production systems exhibited different operating characteristics: some were good at low cost, some at high quality, some at fast response times, etc. In designing a production system, therefore, managers had to decide which competitive dimensions were most important. If some of these objectives were in conflict, they had to make tough choices based on a careful analysis of the tradeoffs between them. Many Japanese factories, however, appeared to surpass their American counterparts on several dimensions. They achieved lower cost, higher quality, faster product introductions, and greater flexibility—all at the same time. The influential 1990 book The Machine that Changed the World trumpeted the virtues of this approach, which it termed "lean manufacturing" (Womack et al., 1990, p. 13):

The lean producer [in contrast to the mass producer] combines the advantages of craft and mass production, while avoiding the high cost of the former and the rigidity of the latter . . . it requires keeping far less than half the needed inventory on site, resulting in fewer defects, and produces a greater and ever-growing variety of products.

Similarly, with their "sandcone theory," Ferdows and De Meyer argued (1990) that different competitive priorities not only were not necessarily in conflict with one another, but they could even reinforce one another. They suggested, in fact, that a company could improve almost simultaneously along a number of fronts by following a specific order in the type of improvements it pursued. Such assertions appeared to undercut the notion that tradeoffs are required.

Do Factories Have to be Focused?

Although Japanese factories initially appeared to place great emphasis on restricting product variety and encouraging uninterrupted work flows, during the 1980s, many elite Japanese companies embarked on an orgy of product proliferation. Sony, for example, introduced almost 300 versions of its basic Walkman (disclaiming the need for market research, it advocated simply introducing a new model and seeing how it sold), and Seiko was renowned for its ability to introduce a new watch model every working day.
Didn’t this refute the necessity for “focus?” Here again, “lean manufacturing” appears to be the answer:

Toward this end, lean producers employ teams of multiskilled workers at all levels of the organization and use highly flexible, increasingly automated machines to produce volumes of products in enormous variety. (Womack et al., 1990, p. 13).

Among practitioners, there was a growing sense that Japanese companies had effectively made the manufacturing strategy paradigm obsolete by demonstrating that their way of configuring manufacturing operations was uniformly superior to other approaches. The “Japanese” or “lean” approach to manufacturing became the emerging dogma of manufacturing management during the 1980s. It was characterized by an emphasis on quality, flexibility, and speed over volume and cost. People should be broadly trained, rather than specialized. Staff was “overhead” and overhead was bad. No amount of variation or rejects should be accepted; the organization should work tirelessly to reduce them. Communication should take place informally and horizontally, among line workers rather than via prescribed hierarchical paths through the organization. Equipment should be general purpose (preferably using some form of programmable automation) and organized in cells designed to produce a group of similar products, rather than specialized by process stage. Throughput time was more important than labor or equipment utilization rates. Inventory, like rejects, was considered “waste.” Supplier relationships should be long-term, cooperative, and managed on the basis of trust. Activities associated with product development should not be done sequentially, but concurrently. Product development should be organized through cross-functional teams.

The problem is not that this new approach is wrong. We have argued its virtues ourselves, and it has produced impressive results at many companies. The problem is: If this new “dominant design” for manufacturing operations is correct, what role is left for strategy? Quality and flexibility may have replaced cost, but haven’t we again settled on “one best way” to compete? Can establishing the direction for a manufacturing organization be replaced by “benchmarking”—the identification and adoption of “best practice,” wherever it can be found? Should we accept unquestionably the idea that every factory should work to eliminate inventories and adopt Just-In-Time production scheduling? What then are we to make of the growing resistance to the JIT concept in Japan (see, for example, Cusumano [1994])? Of the fact that Toyota’s newest factory in Japan has abandoned both the Kanban system (which Toyota pioneered) and mixed-model assembly? Or that, during the recession of the early 1990s, cost once again became the most important concern for many customers?

During the time these skirmishes were taking place between the defenders of the traditional manufacturing strategy paradigm and the advocates of lean manufacturing, in a different quarter another controversy was gathering momentum. This was about the basic concept and purpose of competitive strategy itself.

3. The Competitive Strategy Paradigm Under Attack

The modern paradigm for competitive strategy is based on the notion of strategic fit, and probably reached its most rigorous (and widely accepted) expression with the publication of Michael Porter’s book, *Competitive Strategy* (1980). In it, he outlined an approach to strategic management that combined the traditional concerns of strategies—the famous “corporate strengths & weaknesses, opportunities & threats” (SWOT) framework that had been advocated by Andrews (1971) and others—with the tools and concepts of industrial organization economics.

Porter argued that five industry-level forces—emanating from competitors, customers, suppliers, potential new entrants, and substitute products—as well as natural barriers to entry (such as economies of scale) or exit, shaped the inherent profitability of different
competitive strategies in given industries. Using this “five forces” framework, it was possible to derive actions that a company might take to create a defensible position for itself in a particular competitive environment, or even influence the nature of competition to its advantage. The goal of business strategy, seen through the prism of this framework, is to seek “sustainable competitive advantage” by entering (or positioning oneself within) industries and businesses that are either structurally attractive or can be made so through deliberate actions.

Porter’s framework offered a systematic approach for thinking about the nature of industrial competition, as well as for analyzing the competitive situation that a specific company might find itself in. Therefore, in one sense it provided a set of tools and concepts that were largely complementary to those of manufacturing strategy. Using the framework, managers could derive an appropriate competitive strategy and establish competitive priorities. The manufacturing strategy framework, as it existed in 1980, could then be used to translate those competitive priorities into a set of supportive manufacturing decisions and policies.

On the other hand, the framework also created a sharper demarcation between the domains of competitive strategy and manufacturing strategy than had existed before. Not only were these two domains separated by problem focus (simplistically: where to compete vs. how to compete there effectively), but also by conceptual approaches. Whereas the roots of Porter’s framework were in industrial organization economics and were based on industry-level studies, the manufacturing strategy framework was based on the specific nature of manufacturing and technology at the firm level. The clear separation between the two frameworks is apparent from a quick scan of the two most widely used books on their respective subjects: Porter (1980) and Hayes and Wheelwright (1984). Both were written at about the same time, and cover many of the same topics, but they employ entirely different sets of tools. This troubled many of those who tried to operate at the natural interface of strategy and operations management.

Despite the considerable insight the Porter framework provided for both scholars and practitioners, it was essentially static in nature. Just as the old Ricardian notion of comparative advantage could not explain the rising power of Japanese industry in world competition, neither could this position-oriented definition of competitive advantage explain (except, sometimes, in retrospect) the success of individual Japanese companies. Their approach to competition not only changed, sometimes with bewildering speed, from low cost to high precision to flexibility to innovativeness, but through such changes they often were able to transform the nature of competition within a whole industry.

Throughout the 1980s, people grappled with this paradox in different ways, often building on foundations laid years before by Schumpeter (1942) and Penrose (1959). Wernerfelt (1984), for example, argued that strategic analysis should shift its attention from industry forces and product market positioning to developing and exploiting the unique set of “resources” (such as technical and organizational skills) upon which a firm’s long-term profitability depended. Similarly, Teece (1980, 1982) and Wernerfelt and Montgomery (1988) asserted that corporate diversification was sometimes justified because it enabled a company to extract additional value from its specific organizational and technological capabilities (in contrast, Lauenstein and Skinner [1980] warned that diversification too far outside its arena of competence tended to distract a company from the core task of building superior resources). Prahalad and Hamel (1990) contended that firms should focus on building “core competencies” that could create competitive advantages in a variety of markets. More recently, Teece and Pisano (1994) provided an explicit statement of the dynamic aspects of the resource-based view (which they labeled the “dynamic capabilities approach”). They argued that firms should be viewed not just as a portfolio of assets and separable businesses, or even as a bundle of human
resources and organizational capabilities, but also as a set of "mechanisms" by which new skills and capabilities are selected and built.

From the manufacturing strategy side, Hayes (1985) arrived at a similar conclusion. He observed that many of the most successful companies tended to focus more on building basic internal capabilities than on achieving specific market or financial goals. Such capabilities, developed through a long sequence of incremental advances, could either be very general (such as extremely precise process control, which permitted very low defect rates and/or product miniaturization), or quite specific, such as developing experience in certain technologies or markets. Then, as new business opportunities were created by changes in markets, technologies, and the competitive environment, these companies would exploit those that were particularly susceptible to the specific capabilities they had created. These new initiatives, in turn, would provide the impetus to create new capabilities. This is, in essence, the capabilities-based approach to strategic planning.

4. The Implications for Manufacturing Strategy

In the preceding sections, we have attempted to briefly describe the paradigm shifts that are occurring in both manufacturing management and competitive strategy. Now, in the light of these shifts in thinking, we discuss some of their implications, as well as the questions raised by them.

Elevating the Importance of Manufacturing

The most important implication arises out of the basic philosophy underlying the new view of competitive strategy: that companies succeed in the long run not just by building competitive fortresses for themselves, or by equipping themselves with the latest technologies or facilities, but more importantly by being able to do certain things better than their competitors can. A decision to move one's production to a low wage area, for example, can provide only a temporary advantage at best; unless a company is exceptionally good at managing such facilities, its competitors can do the same. Similarly, a company might be able to acquire access to a certain technology, but not the ability to mass produce products embodying that technology, to sell them effectively, or to improve that technology over time (just as you might be able to buy the latest sailboat and sails, but still lose races because you aren't a very good sailor!). Such skills can only be developed with experience, and over time.

The fact that they are difficult to imitate or transfer, indeed, is what makes them so valuable; to the extent they are organizationally specific, the competitive advantage provided by special operating capabilities is much more sustainable than that provided by something one can buy. For example, the Morine Company built its successful new strategy around the capabilities inherent in its existing manufacturing structure and infrastructure. Having a number of factories, each of which operated semi-autonomously and was equipped to produce a wide range of products, gave the company the option of dedicating separate plants to specific product lines and thereby simultaneously reducing changeover costs and delivery times. Morine's competitors, which lacked these capabilities, would have found it very costly to replicate the same approach.

The implication of this more operations-based and dynamic view of competitive strategy for manufacturing strategy is profound, as it both elevates the importance of the manufacturing function (where many of a company's most critical capabilities reside) and raises new questions about the nature of its strategic management. The structural and infrastructural decisions that have been the means for implementing a chosen competitive strategy now take on a more dynamic role. Rather than simply providing certain capabilities, they also serve to guide and cultivate the development of desirable new capabilities.
A New Role for the Manufacturing Organization

Skinner’s original notion of the proper role for manufacturing was essentially supportive in nature. He stated that “the purpose of manufacturing is to serve the company” by configuring itself so that “its entire apparatus is focused to accomplish the particular manufacturing task demanded by the company’s strategy and marketing objective.” As one examined the best industrial companies in the world (the so-called “World Class Manufacturers”), however, it became apparent that their manufacturing functions played a somewhat different role. Rather than simply carrying out their assigned mission, they appeared to have the authority to redefine that mission.

In an attempt to define this larger role, and put it into the context of the other kinds of roles that manufacturing could be asked to play, Wheelwright and Hayes (1985) proposed their “Four Stages” of manufacturing effectiveness. The best companies did not stop once they had structured their manufacturing organizations to support their competitive strategies (the goal in Skinner’s early writings). They challenged (and supported) their manufacturing organizations to become so proficient that they generated new opportunities for the other functional groups. In the process of creating such opportunities, these elite “Stage Four” manufacturing groups were able to participate in—even instigate—the reformulating of the company’s competitive strategy.

Although this framework provided a vision of the potential contribution that a company’s manufacturing organization could make to its competitive success, and a rough metric it could use to track its progress toward that goal, it left vague certain key issues. For example, if a Stage Four manufacturing organization were given the freedom to go beyond the requirements of its company’s competitive strategy in developing new or unique capabilities, what should guide its selection of the capabilities to pursue? If the focus, and sense of purpose, provided by an overall strategy were removed, would not the company risk encouraging a sort of corporate anarchy as different functions set off in different directions?

A Greater Emphasis on Manufacturing Infrastructure

To see the impact of this shift in roles, recall that manufacturing strategists initially focused most of their attention on “structural” decisions, such as how much production capacity to provide, what kind of factories to build and where to build them, the type of process technology to adopt, and vertical integration/sourcing decisions. In a sense, this focus on (an implicitly somewhat static) structure mirrors the emphasis that the traditional competitive strategy paradigm placed on industry position; to his credit, Skinner insisted on the importance of human factors and “production systems” right from the beginning. The new paradigm reaffirms his insistence that manufacturing “infrastructure”—the software, in a sense, that a firm employs to select and control the performance of its hardware, and which includes the policies and systems that govern such activities as capital budgeting, human resources, quality/process control, material flows, and performance measurement—is more important than structural decisions. These systems should be designed to encourage the continual adaptation and improvement of an organization’s skill base rather than to achieve some “optimal” strategic fit.

The essence of this philosophy is captured in a slogan seen throughout Milliken & Co., one of America’s best manufacturing companies: “The hard stuff is easy. The soft stuff is hard. And the soft stuff is more important than the hard stuff.” This dominance of software over hardware helps explain why many observers of world class Japanese and German companies have returned to report that their facilities and equipment are no better than those of their U.S. competitors (see e.g., Garvin [1988]). Apparently, their

3 As Steven Wheelwright has pointed out, structural decisions require hard analysis, but the “soft” infrastructural issues often defy analysis. Instead, they require organizational commitment and management leadership.
superior infrastructures simply allow them to extract better performance from these hard assets. They are not better positioned (in fact, Japanese and German producers today are rather poorly positioned, in strategic terms), so they simply try to be better at doing the most important things. Note that such emphasis on an operation’s infrastructure is perfectly consistent with “lean manufacturing;” structural elements are conspicuously absent from its basic building blocks: JIT, TQM, cross-functional integration, and the delegation of problem identification and solving to the shop floor.

The foregoing, by the way, suggests another reason why companies may have been so slow to adopt the traditional manufacturing strategy framework. Not only is it in conflict with the traditional “mass production” mentality as well as with the philosophy and role definitions associated with “lean manufacturing,” but managers who were instinctively sympathetic with the more “people-intensive” capabilities-based approach may have been uneasy with manufacturing strategy’s early emphasis on structural issues.

A New Perspective on Key Manufacturing Decisions

The analyses of various structural and infrastructural decisions within the context of the traditional manufacturing strategy paradigm (see, for example, Hayes and Wheelwright [1984]) usually did not encompass the fact that such choices not only affect a firm’s operations today (“first order effects”), but also have important, and fairly predictable, consequences for the kind of operating capabilities it will be able to acquire in the future (“second order effects”). Let us briefly reconsider three such decisions in light of the more dynamic, capabilities-based approach.

PLANT Focus. Under the traditional approach, the decision whether to focus plants by product lines or by processes might be evaluated as follows. If different products are sold in markets that require different competitive priorities (for example, low cost in one, innovation in another), focusing along product lines—the approach the Morine Company decided to adopt—would be preferable. Different facilities could then tailor their equipment, operating policies, and skill sets to the needs of their particular markets. If, in contrast, different product families competed in roughly similar ways (e.g., low cost), but different segments of the production process required very different operating policies and capabilities, then a process focus would be preferable.

A focus choice also has dynamic implications, however, in that it also shapes the directions a company can take in the future. Since it is usually easier to transfer learning within a plant than across plants, the choice of focus will influence how different capabilities are developed and diffused throughout an organization. A network of product-focused facilities, like a company organized around strategic business units, runs the risk of fragmenting its core operating skills. Although all facilities may have certain technologies and skills in common, localized learning can lead to isolated pockets of process expertise. As a result, if events force a plant closure, valuable knowledge can be forever lost to the company.

A process focus creates reciprocal risks. As different plants accumulate specialized process expertise, an understanding of how different process steps fit together may be lost. This may reduce a company’s ability to introduce new products or make other changes that require associated adjustments throughout the process chain. Similarly, if one expects that certain process skills (e.g., ultra high-precision machining) will become increasingly important in the future, it may be appropriate to begin building such capabilities in existing facilities, whatever their focus.

VERTICAL INTEGRATION. Most companies have approached vertical integration through a series of “make-buy” decisions for individual parts or services (e.g., should a company make its own brake pistons or buy them from an outside supplier?). Such decisions would be made by analyzing the relevant production and organizational costs
of the two alternatives. If one visualizes companies as bundles of evolving capabilities, rather than as portfolios of products and businesses, however, the traditional make-buy analysis becomes suspect. Instead of thinking in terms of "parts" (e.g., brake pistons) that get incorporated into "products" (braking systems), one should think in terms of those capabilities that are closely linked and mutually reinforcing, and those that can safely be separated. Moreover, if a potential supplier possesses capabilities that are essential to a company's future competitive success, it must either work to assimilate those capabilities or develop very close, partnership-like relations with that supplier.

There is also an important dynamic dimension to such decisions. Choosing the activities that are to be performed internally today shapes a firm's ability to perform other activities internally in the future. For example, in the field of biotechnology, not only does close interaction between process scientists and manufacturing facilities help improve the flow of technology from R&D into manufacturing, but exposure to the realities of manufacturing also augments the skills of the process scientists (Pisano 1995).

**Production Planning and Inventory Control.** Over the past decade, many people have grappled with whether to adopt an MRP-based "push" system or a JIT-based "pull" system for production control. Now it is becoming clear that these two approaches are not as incompatible as first thought; in fact, they often complement one another. For example, a company might use an MRP system to control procurement and raw material inventories, while utilizing a JIT system for shop floor control. While the static tradeoff between the two is no longer as sharp as has sometimes been argued, they offer some interesting dynamic tradeoffs.

Suppose a plant establishes the long-term goal of drastically reducing its lead times and inventories. It can proceed toward this goal along either of two routes. One might be to begin by adopting a JIT system. Unfortunately, this approach might lead to major problems if the plant lacks the requisite skills for making such a system successful (e.g., fast changeover times and low defect rates). It will, however, create strong incentives to reduce set-up times and defect rates, encourage the development of other JIT-associated skills, and induce a continuous improvement mentality (see, for example, Karmarker [1989]). Over time, a true JIT system might emerge.

An alternative route would be to begin with an MRP system. Like the first approach, the initial results would not be very promising. Lead times, in fact, might even increase for awhile, since MRP systems tend to be rather clumsy in handling rush orders. On the other hand, MRP exerts pressure to improve shop floor discipline and develop better data and computer skills, which also support effective production scheduling. Once MRP control has been established, the lead times in the system can then be steadily whittled away until it approaches a pure JIT system.

Notice that both approaches, under the scenarios we have painted, might eventually allow the company to respond quickly to customer demands with low inventories. Which is the best way to proceed? Little research has been done on this question, but we suggest the answer should depend in part on the kind of organizational capabilities the company prefers to build. Starting with an MRP-type system instills skills in using computers and managing databases, neither of which would be fostered by a JIT approach. Pull systems, on the other hand, encourage skills related to managing problem-solving on the factory floor, rapid response to operating problems, and incremental process improvement. Each approach, in short, may leave the organization with a different set of skills and thus a different set of strategic options in the future.

**Continual Improvement.** A company that adopts a capabilities-based approach to operations strategy has to commit itself to continual improvement because capabilities are ephemeral—they wither if not used, and become obsolete if not continually nourished and reinforced. Even if a firm makes the appropriate tradeoffs between, say, cost and
delivery performance, it will not prevail against competitors that are able to achieve higher performance along both dimensions. This suggests that the manufacturing strategy framework must expand to incorporate the notion of *paths of learning*, or “improvement trajectories.” [See also the article by Kim B. Clark in this issue].

Consider a company that is competing by offering a broader product range than its competitors. As shown in Figure 1, this strategy has necessitated certain operating choices, such as the adoption of more flexible production equipment, that have caused its costs to be higher than those of a competitor (referred to as the “specialist”) that offers a narrower range of lower-priced products. According to the Porter framework, the two firms are not direct competitors because each offers its customers a different bundle of attributes (i.e., they belong to different “strategic groups”). And, according to the traditional manufacturing strategy framework, the “task” for each is to configure itself appropriately so as to support its chosen competitive strategy.

However, assume now that a new competitor that has mastered “lean manufacturing” enters the market. This new approach gives it an advantage in both cost and flexibility. In effect, it is operating on a better production frontier than either the “specialist” or the “broad range” firms (see Figure 2). This “lean” competitor clearly provides a serious threat because it can offer both the product variety of the “broad range” firm and the low costs of the specialist.

In this situation, it is unlikely that our broad range firm can reduce its costs to those of its two competitors simply by repositioning itself along its current frontier. To survive, it must move to the new frontier. The question is, how? One approach (arrow 1 in Figure 3) is to reconfigure itself according to prescripts of “lean manufacturing,” which would necessitate adopting an entirely different operations infrastructure. Once it had made the transition to the new frontier, it could then adjust its position along it based on how it wanted to differentiate itself from its rivals, and adopt an operations strategy supportive of that specific position. For example, it might choose to be a broader range (but slightly more costly) supplier than the “lean” firm (arrow 2). Conversely, it might move to a

![Figure 1](image-url)
lower cost, but less flexible position. In either case, it would have to make the specific structural choices that provided the desired balance between cost and flexibility.

A second possible path is essentially the reverse of the first (Figure 4): the broad range firm would first change its manufacturing strategy to support being a lower cost specialist—in effect, repositioning itself along its current frontier. Once that transition was accomplished, it would make the "lean" infrastructural changes that would give it more flexibility.
without increasing costs. This sequence would also get it eventually to its desired position on the new frontier. Note that both approaches are very consistent with both the traditional concept of manufacturing strategy and lean manufacturing. They only differ in what comes first. Advocates of “lean manufacturing” tend to argue that the major challenge is making the transition to the new frontier, and that adjusting one’s position along that frontier is just “icing on the cake.” Those who are intimidated by the magnitude of the changes required by the lean manufacturing approach might see the second approach as being much easier to implement.

Tradeoffs and Focus: A Reprise

The capabilities-based approach to strategy also stimulates alternative ways of thinking about some of the previous questions we raised. First, are tradeoffs necessary? Rather than focusing primarily on static (first order) tradeoffs, the emphasis of much of the early writing about manufacturing strategy, the concept of improvement trajectories provides a vehicle for thinking about dynamic, second order tradeoffs. As discussed above, it is possible for a company to improve along more than one dimension (e.g., cost and flexibility) at the same time, but not all performance dimensions can be improved at the same rate. Figure 5 depicts two possible operating trajectories, each of which is characterized by improvements in both cost and flexibility performance, but they differ in the relative rates of those improvements. The “cost-biased” trajectory places greater emphasis on reducing costs (but flexibility still improves), while the opposite is true of the “flexibility-biased” trajectory. Through their structural and infrastructural policies, therefore, managers are still faced with critical tradeoffs, but these are more subtle than those addressed by the early writers on manufacturing strategy: they involve not only the competitive dimensions themselves, but also their rates of improvement.

Second, how important is focus? The answer depends in large part on the company’s improvement trajectory and where it is on that trajectory. Consider the two trajectories
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A company following either trajectory will become more flexible over time, and may therefore find itself better able to manage a complex (unfocused) factory. This makes focus less important, so it may choose to have less focused factories without sacrificing high performance. However, a company progressing along the "flexibility-biased" trajectory should be able to operate factories that are less focused than a company moving along the "cost-biased" trajectory.

A New Perspective on Strategic Choice

Since the value of a given capability depends partly on the future opportunities that present themselves, how should a company—given the difficulty of predicting the future in today's turbulent world—select which capabilities to develop? Can this be done consciously, or is it essentially a crap shoot, where the lucky winners survive (to be offered up as examples by researchers) and the losers disappear, apparently the victims of simple bad management? Also, to what extent can a company exercise real strategic choice as regards capabilities, or is it largely the prisoner of its history, the residue of capabilities developed previously (perhaps even accidentally)?

We assert that strategic choice is still as important as ever, but that its nature has changed in a fundamental way. Rather than guiding tradeoffs among static performance dimensions (e.g., cost vs. flexibility), which was the major concern of most of the early discussions of manufacturing strategy, its new role is to make possible dynamic tradeoffs through the selection, development and exploitation of superior capabilities. Neither the traditional approach to manufacturing strategy nor its "lean manufacturing" challenger provide much guidance about this new role. Once a company had followed the dictates of manufacturing strategy and configured itself to meet the needs of its competitive strategy, there was little operations could do to provide additional differentiation. It could, of course, strive for continual improvement, but as soon as its competitors had similarly aligned their manufacturing structures and infrastructures with their competitive
strategies and embarked on comparable improvement programs, everyone would be evenly matched again. Similarly, adopting “lean manufacturing” leaves little room for differentiation: once all competitors have adopted TQM, JIT, and other of its components, how can manufacturing further contribute to a competitive advantage?

The capabilities-based approach suggests a richer, and less imitable, set of ways by which a manufacturing organization can differentiate itself, but how much strategic freedom does—and should—it have? There is a big difference between “flexibility” as a system performance characteristic (e.g., the ability to change products, input materials, or production volumes rapidly) and strategic flexibility. The latter reflects the fact that while certain manufacturing structure and infrastructure choices may have quite clear-cut implications for performance (e.g., cost or flexibility, innovativeness or control/reliability), they may have relatively little effect on other tradeoffs (the adoption of an MRP program, for example, is unlikely to have much impact on the tradeoff between innovativeness and defect rates).

It is generally possible, in fact, to achieve a certain level of performance (low cost, say) through different combinations of structural and infrastructural decisions. Therefore, companies have considerable leeway in making the strategic choices that provide a given set of competitive priorities. German companies, for example, may configure themselves very differently from the Japanese companies they compete against. As a result, designing a manufacturing strategy is still somewhat of an “art form.” Another implication of this strategic freedom is that unless a company has a clear sense of purpose, it can easily expend its energies on manufacturing improvement programs that don’t have much impact on things that are competitively very important to it.

Conversely, through its strategic choices, a company implicitly constrains its flexibility to alter its competitive priorities in the future; the decisions it makes effectively lock it into certain modes of behavior. Manufacturing structure/infrastructure choices not only affect static tradeoffs (movements along a frontier), but have consequences for organizational learning and skill accumulation. These “path dependencies” imply that the sequence of moves may affect where an organization ultimately ends up, and also act to limit its ability to make future changes in its competitive priorities. Structural changes can often be achieved largely by buying different types of equipment or changing the location and organization of facilities, but infrastructural elements tend to be much more difficult to change because they are deeply embedded in the organization and are so dependent on its people’s tacit operating knowledge. The “broad range” firm discussed earlier, for example, might well have found that the kind of changes it could make were limited to a relatively narrow region; in particular, it may be almost impossible for it to achieve the low costs of its “specialist” competitor, as depicted in Figure 4.

Therefore, when considering changing one of its structural or infrastructural elements, a company should consider how that change might affect its ability to make future changes in its competitive priorities. Returning to the Morine Company, the network of general purpose plants that resulted from its earlier decisions made it relatively easy for Morine’s management to make the decision to base its new competitive strategy on a vast improvement in customer service while still pursuing lower costs. It would have found it much more difficult to become the low cost producer if its industry had instead evolved toward standardized products and more commodity-like competition. A company starting with a different plant network and set of capabilities, however, might have found it much easier to seek dramatic cost reductions, while working steadily to improve service levels. Manufacturing can still play a “Stage Four,” proactive role in selecting and developing useful capabilities, but that role is perhaps more constrained than we once believed.

5. Conclusions

In today’s fiercely contested and ever-changing competitive environment, manufacturing strategy no longer is concerned just with making short-term tradeoffs among com-
petitive priorities like cost, quality, and flexibility. And manufacturing management should not be concerned primarily with choosing which currently fashionable improvement technique to adopt or identifying other companies to emulate. Long-term success still requires that a company differentiate itself from its competitors by offering something unique and valuable to customers—whether this be especially quick service, high reliability, low costs, or innovative products.

Therefore, it is not enough to strive to be a "lean" or even a "world class" manufacturer. Each of these goals by itself is both insufficient and, in fact, somewhat simplistic. At best, you end up only "as good as" (that is, no better than) your toughest competitors, and find yourself continually playing catch-up with them. The companies that are able to turn their manufacturing organizations into sources of competitive advantage are those that can harness various improvement programs, like JIT or TQM, in the service of a broader manufacturing strategy that emphasizes the selection and growth of unique operating capabilities.

Although we are only able to provide partial, and somewhat unsatisfactory, answers to many of the questions raised above, we find it encouraging that the new paradigms for both manufacturing management and competitive strategy are converging again around common issues, as they did 25 years ago. Moreover, their synthesis—the new capabilities-based approach to manufacturing strategy—not only provides new perspectives on familiar issues, but it reaffirms the importance of manufacturing’s role in a company and suggests new ways in which it can contribute to competitive success.

References

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