Strategic Management Journal, Vol. 10, 211–231 (1989)

GENERIC MANUFACTURING STRATEGIES: A CONCEPTUAL SYNTHESIS[1]

SURESH KOTHA
College of Business and Public Administration, New York University, New York, New York, U.S.A.

DANIEL ORNE
School of Management, Rensselaer Polytechnic Institute, Troy, New York, U.S.A.

This paper provides a conceptual framework that links manufacturing to business unit strategy and focuses on developing the notion of 'generic manufacturing strategies' at the strategic business unit (SBU) level. Specifically, an explicit conceptual link is drawn between 'generic' business unit strategies and 'generic' functional structures in manufacturing. It is proposed that the alternate manufacturing structures implicitly represent 'generic manufacturing strategies'. Drawing on ideas and concepts from the business strategy literature and manufacturing literature the paper links Porter's generic strategy framework to a complementary manufacturing structure framework that uses three dimensions: process structure complexity, product line complexity, and organizational scope. Viewed from different perspectives, the 'manufacturing contingency theory' concepts presented implicitly in the paper can be viewed as an extension of classic research on the interdependence between strategy and structure. The frameworks developed here provide a partial synthesis of knowledge in the broader disciplines of engineering and management without sacrificing academic rigor and practitioner relevance.

INTRODUCTION

The early theoretical foundation for the competitive strategy of manufacturing units rested on several rational and intuitively attractive assumptions. They include: (a) a firm's basic reason for existence is to produce something of value; (b) manufacturing has a critical and indispensible role in the creation of that value; (c) there are different ways to compete; therefore a firm must have a strategy and link this strategy to manufacturing (and other functional decisions); and (d) an explicit well-defined strategic planning process is essential in designing, communicating and implementing a strategy that will generate an attractive competitive position (Skinner, 1969).

However, actual management practice has often been inconsistent with these assumptions. Despite the underlying logic of a stronger link between business unit strategy and manufacturing, the actual evolution of manufacturing systems has generally remained a slow incremental process driven by operational necessity and technical opportunity (Abernathy and Clark, 1985; Quinn, 1978). It is perceived that part of the difficulty lies in the traditional tools available for developing and articulating manufacturing strategies. The concepts associated with 'generic manufacturing strategies' presented in this paper were developed in direct response to this dilemma.

[1] The research presented is part of the activities of the 'Technology Strategy Group' within a large industrially sponsored computer integrated manufacturing (CIM) program at Rensselaer Polytechnic Institute (RPI). The industrial sponsors (Alcoa, Eastman Kodak, Digital, IBM, GM, GE, Norton, Northrop, United Technologies) provided partial financial support, resident engineers, and most importantly, a context and a critique for the research. In addition AT&T has provided partial support in the form of curriculum grant titled *Information Management for Manufacturing*. The authors are solely responsible for any errors or oversights in this paper.

0143–2095/89/030211–21$10.50

Received 3 March 1986
Revised 29 September 1988

This paper is an attempt to integrate ideas and concepts from manufacturing, and business strategy literature, in order to provide a partial synthesis. Following this introduction, a brief review of the literature that has emphasized the concept of manufacturing strategy is presented in order to provide a context for the concepts developed later. In the section that follows, the concept of generic business unit strategies is examined using Porter's (1980) framework and the recent extensions of this framework by others. The next two sections focus on articulating: (1) a manufacturing structure typology and (2) the proposed linkage of this structural typology to generic business unit strategies described earlier. Finally, the concluding remarks briefly describe some implications and extensions of the concepts. The concepts in this paper provide a rich theoretical base for considering both the content and the process of 'fit' between the critical elements in manufacturing competitiveness: structure, strategy, technology and performance.

MANUFACTURING STRATEGY: A BRIEF REVIEW

The philosophical foundation of the concept of manufacturing strategy has often been traced to the work of Wickham Skinner. In particular, two of his articles stand out: (1) a 1969 article entitled 'Manufacturing: missing link in corporate strategy, and (2) a 1974 article entitled 'The focused factory'. Later, other academicians picked up on variations of the theme. They include, among others: Hayes and Wheelwright (1979a, 1979b), Wheelwright (1978), Banks and Wheelwright (1979); Hayes and Schmenner (1978); and Schmenner (1976, 1978, 1979).

Since then, four levels of strategy have been commonly articulated to influence manufacturing competitiveness. These strategic levels are industry, corporate, business and functional (for example, see Hofer and Schendel, 1978; Wheelwright, 1984a, 1984b; Fine and Hax, 1985).

1. *Industry level strategy*. At the industry (or government) policy level, the 'strategic' concerns revolve around issues such as: (a) incentives for investment; (b) import and export trade barriers, duties and quotas; (c) the balance between imports and exports; (d) inflation and the cost of capital; (e) transportation and educational infrastructure; (f) health and safety standards; (g) antitrust regulations; (h) employment levels; (i) patent policy, and so forth. It is commonly agreed that such overarching industry or governmental policies can influence the manufacturing competitiveness of specific business units in specific industries. However, there is little agreement on whether more direct and explicit governmental strategies (along the lines of the 'perceived' role of MITI in Japan) have utility within all national economies.
2. *Corporate level strategy*. At the corporate level the concern revolves around (1) the definition of businesses in which the corporation wishes to participate and (2) the acquisition and allocation of resources to these business units (Christensen, Andrew and Bower, 1987; Wheelwright, 1984a, 1984b; Andrews, 1971).
3. *Business level strategy*. At this level, generally referred to as strategic business unit (SBU), or strategic planning unit (SPU), two critical issues are specified: (1) the scope or boundaries of each business and the operational links with corporate strategy, and (2) the basis on which the business unit will achieve and maintain a competitive advantage within its industry (Wheelwright, 1984a).
4. *Functional level strategy*. At this level strategy specifies how functional strategies like marketing/sales, manufacturing, research and development and accounting/control, among others, will support the desired competitive business level strategy and complement each other.

This categorization of strategic levels has several implications for manufacturing strategy.

1. Each of the four levels described above has an important and distinct role to play in achieving competitive advantage. Although elements of a firm's manufacturing strategy are formulated and implemented in all of the lower three levels, the majority of the activities (and literature) have focused on manufacturing strategy at the functional level.
2. In recent years many authors have criticized governmental and corporate level strategies for overlooking and underinvolving manufacturing (see for example Buffa, 1983; Orne and Hanifin, 1987; Reich, 1983). To summa-

rize, the criticism is that corporate preoccupation with 'diversification', 'paper entrepreneurism', and 'short-term profitability' has eroded the manufacturing infrastructure and, as a result, the potential for long-term profitability.
3. In general, systems-oriented decision flow models have been used to link the manufacturing decisions with the business unit goals, corporate goals and the contingencies of the external world. Examples include the work of Fine and Hax, 1985; Jelinek and Burstein, 1982; and Skinner, 1969.
4. Wheelwright's (1984a) article, entitled: 'Manufacturing strategy: defining the missing link', is the only identified article that specifically addressed the concept of corporate manufacturing strategies which transcend strategic business unit boundaries.

An alternate way of viewing the literature on 'manufacturing strategy' is generated by considering the philosophical 'schools of thought' associated with the more general concept of 'strategy'. The following is a very brief summary of the classic 'schools of thought' (see also Hambrick and Lei, 1985). In this summary, reference will be made to the philosophical position evidenced in specific work by specific authors. It should be understood that the characterizations are intended to be illustrative and not necessarily indicative of the whole body of work by an author.

1. *Unit-specific (atomistic) approach*. The proponents of this method believe that strategic concepts are not generalizable because they are inherently: (a) industry- and business unit-specific; (b) dynamically changing over time; and (c) focus on the unexpected (i.e. not represented in past data or management practice). Many academicians at 'case method'-oriented universities have this philosophical view (i.e. Andrews, 1971; Uyterhoeven, Ackerman and Rosenblum, 1973).
2. *Contingency theory approach*. Proponents of this method believe that the general form of the strategic options available to a business unit are dramatically shaped by contingency factors such as industry type, relative market share, and product life cycle position (Ginsberg and Venkatraman, 1985; Ramanujam and Venkatraman, 1984; Tosi and Slocum, 1984; Harrigan, 1983; Hambrick and Lei, 1985).
3. *Generic strategy approach*. Advocates of this approach point out that commonalities exist in the ways that business units generate competitive advantages across a variety of industries. These common patterns of competition represent generic strategies (Porter, 1980; White, 1986; Hall, 1980; Dess and Davis, 1984; Hambrick, 1983; Galbraith and Schendel, 1983; Miles *et al.*, 1978; Miller and Dess, 1985).
4. *Universal (general principles) school*. This group advocates 'universal laws' of strategy that hold to some extent in all settings. For example, the Boston Consulting Group popularized the 'law' of cumulative experience, calling it 'almost universally observable' (1980). The Profit Impact of Market Strategies (PIMS) program popularized the 'law' of market/share, implying its universal applicability in the statement, 'there is no doubt that the relationship can be translated into dynamic strategies for all businesses' (Buzzell, Gale and Sultan, 1975, quoted in Hambrick and Lei, 1985: 765).

Despite refinements and adjustments in strategic scanning, formulation, implementation and management, the generalizability of strategic concepts remains a source of substantial and continuing debate—as reflected in these alternate schools of thought.

If one examines the literature associated with manufacturing (manufacturing management, manufacturing engineering, and engineering management), it is striking how much of it has implicitly focused only on the two ends of the preceding continuum.

1. From an engineering perspective, the vast majority of the literature is focused on the development of specific technologies. Very little effort is expended articulating the attractiveness of specific technologies in different contexts (i.e. 'boundaries of utility') or the long-term benefits from alternate levels of investment.
2. Although a portion of the engineering literature does describe the technologies employed in specific contexts, little attempt is made to generalize the impact of either: (a) alternate

combinations of technology in the same context, or (b) the same combination of technology in different contexts.

3. The engineering 'systems concepts' that are sometimes represented generally retain the universal (applicable under all conditions) or the atomistic (applicable in only specific contexts) perspectives to research.
4. Much of the manufacturing management literature is system-specific (i.e. forecasting, inventory control, scheduling, shop-floor control, capacity planning).
5. In recent years the heightened interest in quality, flexibility, responsiveness and time to market, reflects both a reaction to, and a re-examination of, the earlier universal (manufacturing) principles of volume, consistency and efficiency. However, the tone of the new prescriptions retains the universal (applicable under all conditions) principles orientation. For example, seldom is a distinction made between different forms of quality (i.e. product features versus end-product consistency) and their fit with different manufacturing strategies and structures.

However, it is interesting to note that during the last couple of decades a few authors have explicitly adopted a contingency perspective of manufacturing strategy. Included in this list are: (a) Hayes and Wheelwright's (1979a, 1979b) articles linking the process and product life cycles; (b) Jelinek and Burstein's (1982) 'contingent-theoretic' view of production; and (c) Talaysum and Goldhar's (1985) examination of the 'structural fit' of FMS (flexible manufacturing system) technology.

Seemingly, no-one has directly and explicitly extended the concept of 'generic strategies' into a manufacturing context. In making this statement two major counter arguments have been considered. First, it is recognized that the execution of a more 'generic' SBU strategy inherently involves manufacturing. Thus, an argument could be made that implicitly 'generic manufacturing strategies' have been previously considered. Second, viewed as relative, within-industry choices, much of the previous contingency-oriented research could be called generic manufacturing strategies. For example, in some sense the relative historical choice of job shop, batch, assembly line, or continuous flow processes could be characterized as manufacturing strategies.

However, in balance, what is presently needed (and is the focus of this paper) is a theoretical model that: (1) recognizes the technological changes in the manufacturing environment; (2) will facilitate the linkage between the manufacturing structure dimensions and strategic orientation of the business unit; and (3) can be validated empirically.

GENERIC BUSINESS UNIT STRATEGIES

In this section the concept of generic business unit strategies is examined using Porter's (1980) framework and the more recent extensions of the framework by other authors. In recent years this categorization of strategies has generated substantial comment, analysis and criticism. In general it has stood up well as an effective and efficient simplification of the complex issues associated with competitive positioning. For example see: Amit, 1986; Dess and Davis, 1984; Hall, 1980; Hambrick, 1983; Hambrick and Lei, 1985; Harrigan, 1985; Kiechel, 1982; McGee and Thomas, 1986; D. Miller, 1985; A. Miller and Dess, 1985; Miller and Friesen, 1986; Porter, 1981; Wheelwright, 1984a; White, 1986; and Williams, 1985.

It is recognized that other authors have presented alternate forms of 'generic' business unit strategies that may have their own distinctive linkage with manufacturing structures—implicitly generating alternate typologies of 'generic manufacturing strategies'. Included in the list of alternate frameworks are the works: (1) Buzzell *et al.* (1975) strategies of building, holding and harvesting; (2) Utterback and Abernathy's (1975) strategies of performance maximizing, sales maximizing and cost minimizing; (3) Hofer and Schendel (1978) strategies of share increasing, growth, profit and liquidation; (4) Wissema, Van der Pol and Messer (1980) strategies of explosion, expansion, continuous growth, slip, consolidation and contraction; (5) Miles and Snow (1978) strategies of prospectors, defenders, analyzers and reactors.

Nevertheless, in recent years much of the thinking on competitive positioning has been influenced by Porter's (1980) comments on industry competitive analysis and the interplay of five competitive forces. The forces that he identified are: (1) the threat of new competitors; (2) the rivalry among existing competitors;

(3) the threat of substitute products; (4) the bargaining power of buyers; and (5) the bargaining power of the suppliers. Notes Porter (1980):

> The collective strength of these five competitive forces determines the ability of the firms in an industry to earn, on average, rates of return on investment in excess of the cost of capital. The strength of the five forces varies from industry to industry, and can change as the industry evolves . . . the five forces determine profitability because they influence the prices, costs, and required investment of firms in the industry—the elements of return on investment.

Within an industry, the differential performance of the firms is a function of their relative ability to influence the same five forces. Usually, some structural uniqueness is a necessary condition for having a long-term sustainable advantage with respect to industry forces (Porter, 1980; Christensen *et al.*, 1987; Henderson, 1984).

The two fundamental types of competitive advantage a firm can possess in its pursuit of uniqueness are: lower cost and/or differentiation. Using a two-dimensional, strategic advantage–strategic target matrix, Porter (as later modified by several authors) indicates that there are four basic strategies used in coping with the five forces (see Figure 1).

The following is a description of the generic strategies which Porter suggested to lead to superior performance.

1. *Industry-wide cost leadership*. This strategy represents an attempt to generate a strategic advantage across the whole industry by generating overall cost leadership in the industry. During the late 1960s and 1970s, this strategy was especially popular, and led to a focus in many units on relative market share position (scale).
2. *Industry-wide differentiation*. The emphasis in differentiation is on achieving and maintaining a chosen form of differentiation such as style or quality, to name but two, through coordinated activities of each functional department. The strategic target is the whole industry.
3. *Segment–cost leadership*. This strategy represents an attempt to generate a strategic advantage in cost position in a narrow segment (niche) of the industry.
4. *Segment–differentiation*. Again the emphasis is on achieving a chosen form of differentiation such as style or quality. However, in this case the strategic target is a narrow segment (niche) of the industry.

In each case the fundamental dichotomy between the differentiation and cost leadership strategies is partially based on the simple relationship between price, cost and profits. The focus in both cases is on profits, the cumulative difference between price and cost. Under differentiation,

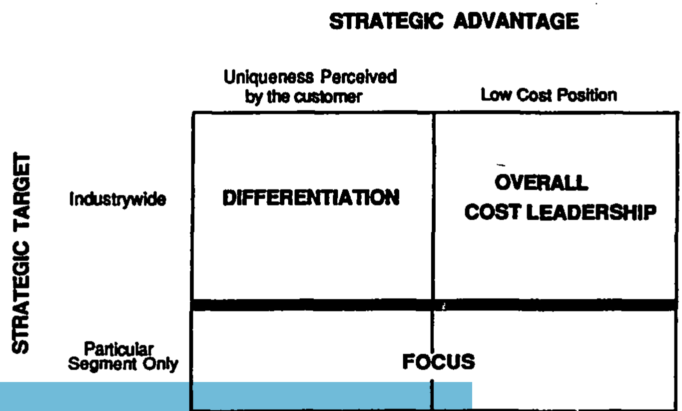

Figure 1. Porter's generic strategies. (Reprinted with permission of the Free Press, a division of Macmillan, Inc. from *Competitive Strategy: Techniques for Analyzing Industries and Competitors* by Michael Porter. Copyright © 1980 by the Free Press.)

profits tend to be improved by developing a uniqueness which is perceived by the customer and will attract a premium price. Under cost leadership, profits tend to be improved by having the lowest cost position.

Traditionally, the lower level of success of the mixed approaches has been attributed to a lack of critical focus producing neither an effective reduction in costs nor differentiation sufficient to attract a premium price. Further, companies taking a mixed approach are invariably positioned in the center of their industry without a defendable competitive advantage. The middle position puts them closer to more competitors who have strengths resulting from their product and process characteristics, which allows them to compete more effectively than the firm 'stuck in the middle'.

In addition, industries often have a higher density of companies at their 'center'. This greater density is often the result of the difficulty of designing and implementing an effectively focused long-term strategy of uniqueness given: (a) frequent changes in top management; (b) internal risks of doing something unique in the industry; and (c) the counter-pressures that inevitably arise from ambitious subordinates eager to increase the importance of their own 'functional empires'. Thus, without strong leadership, business units tend to drift toward the middle.

The attractiveness of Porter's (1980) generic strategies is based on a firm's ability to accurately synthesize and simplify the forms of uniqueness that consistently lead to superior performance. Upon closer examination, Porter's typology of generic strategies actually has three semi-independent dimensions which represent classic methods of generating uniqueness. These dimensions are: (1) relative cost leadership orientation; (2) relative differentiation orientation; and (3) relative strategic target (see White, 1986; Miller and Dess, 1985).

Although not without criticism (Williams, 1985; Hall, 1980), the real power and utility of this framework came in Porter's two observations that (a) the middle ground between these approaches (i.e. mixed strategies) has usually been less effective, and (b) generic strategies are generally more effective if no-one else in the industry is pursuing the same strategy. In other words, firms were generally better off pursuing a pure, generic strategy than attempting mixed strategies or strategies similar to other firms in the industry.

We posit that recognizing and applying a generic strategy changes the industry structure, and generates a significant competitive advantage for the first business unit to implement it. Further, it should be noted that there are other generic strategies that a firm can pursue which are common but less universal, such as vertical integration, diversification, and acquisition of competitors (see Christensen *et al.*, 1987; Kiechel, 1982).

MANUFACTURING STRUCTURE FRAMEWORK

The proposed typology on manufacturing structures uses three dimensions, each of which is a composite of several underlying characteristics. The three dimensions have been labeled: (1) process structure complexity; (2) product line complexity; and (3) organizational scope (see Figure 2 and Table 1). These three dimensions represent a synthesis of the ideas and research of numerous authors on the nature and types of manufacturing typologies and taxonomies.

1. State of-the-art literature reviews were done by the following: Adam (1983); Carper and Snizek (1980); and McKelvey (1975).
2. In addition, the following have done conceptual or empirical work of relevance: Abernathy and Townsend (1975); Abernathy and Utterback (1978); Amber and Amber (1962); Blau *et al.*, (1976); Chiantella (1982); Child and Mansfield (1972); Chase and Aquilano (1981); Goronzy (1969); Hayes and Wheelwright (1979a, 1979b); Hickson, Pugh and Pheysey (1969); Jelinek (1977); Miles *et al.* (1978); Perrow (1967, 1970, 1972); Thompson (1967); Woodward (1958, 1965); and Zwerman (1970).

At least for the moment, it is assumed that construct measurement issues such as: (a) how assessments of specific underlying characteristics should be combined to form assessments of the primary structural dimensions, (b) who within an organization should participate in assessing its manufacturing structure, (c) how their individual responses should be weighted to form a composite for the whole unit, and (d) how to resolve the

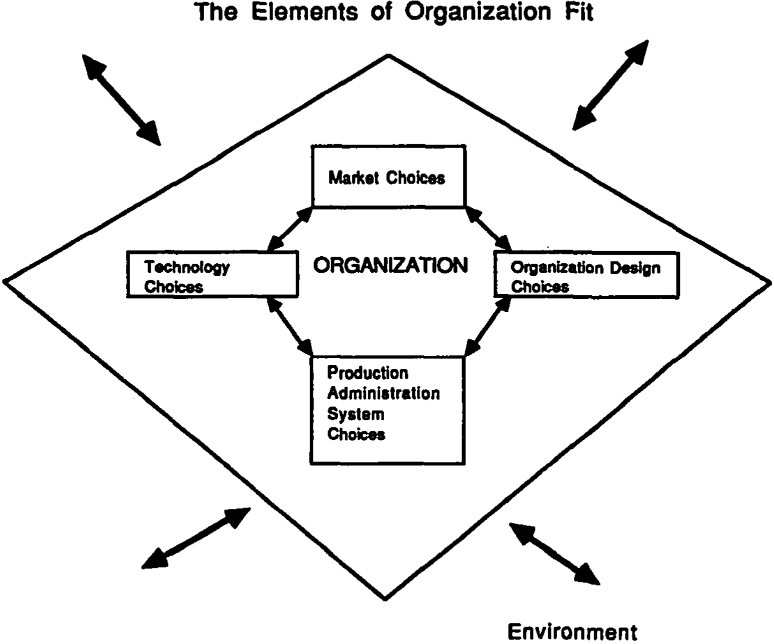

Figure 2. Jelinek and Burstein framework

issue of multiple plants with different structures within the same strategic business unit, have been addressed or can be resolved. It is recognized that there is a close mutual interdependence between construct development and the development of construct measurement methodologies. Often it is possible to articulate constructs which are difficult, if not impossible, to test because of construct measurement difficulties (see Venkatraman and Grant, 1986).

Process structure complexity dimension

Viewing process structure as a primary characteristic of manufacturing organizations is consistent with a substantial bodv of thought. research and

Table 1. Manufacturing structure typology: primary dimensions and underlying variables

Dimensions	Underlying variables
Process structure complexity	Level of mechanization Level of systemization Level of interconnection
Product line complexity	End-product complexity Variety of final product Individual product volumes End-product maturity (experience)
Organizational scope	Geographic manufacturing scope Geographic market focus Vertical integration Customer—market scope Scale

writing. Given the amount of this work there is, not unexpectedly, a variety of seemingly relevant typologies and taxonomies which have been used to categorize process structures.

Perhaps the most important stream of work was initiated with Woodward's (1958, 1965) seminal studies of manufacturing in England. In those, and subsequent studies by other researchers, it was demonstrated that in manufacturing firms, production technology has a systematic relationship with (organizational) structure and management characteristics. Although Woodward's original scale used nine categories, a simpler framework of three primary categories has received more attention. They include: (1) small batch and unit production; (2) large batch and mass production; and (3) process production.

In recent years, variations of Woodward's categories have often been used to examine the impact of alternative manufacturing process structures. For example, Abernathy and Townsend (1975) proposed three process stages based on the maturity of the process in its life cycle. These categories (uncoordinated, segmental and systemic), reflect the variation of material flow, technology, labor, scale and product influence during the life of the process.

A later example is represented in the work of Hayes and Wheelwright (1979a, 1979b) which used four process categories: jumbled flow (job shop); disconnected line flow (batch); connected line flow (assembly line); and continuous flow. Drawing on the preceding work, they recognized the dynamic nature of the production process nothing that 'just as the product and market pass through a series of major stages, so does the production process used in the manufacture of that product'. They argued that many of the

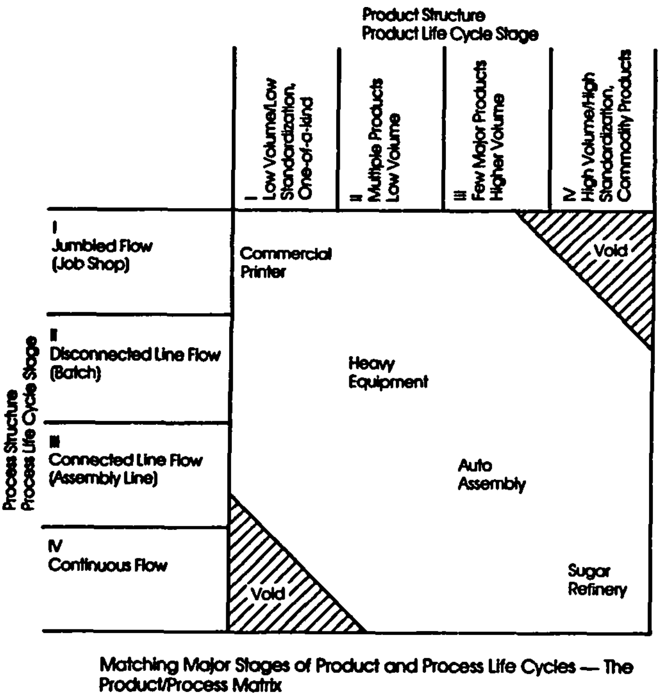

Figure 3. Hayes–Wheelwright framework. (Reprinted by permission of the *Harvard Business Review*. An Exhibit from 'Link manufacturing process and product life cycles' by Robert H. Hayes and Steven C. Wheelwright (January/February 1979). Copyright © 1979 by the President and Fellows of Harvard College; all rights reserved.)

characteristics of productive units were a function of two primary dimensions with complimentary life cycles—process structure and product structure (see Figure 2). They proposed that the relationship between the two provided a basis for exploring some of the strategic options from a manufacturing perspective.

Unfortunately, this traditional classification scheme is presently losing its utility. In a broader sense the difficulty is the result of changes in manufacturing technology which have altered the meaning of some of these traditional labels associated with process structures. For example, traditionally discrete parts manufacturing was generally done in batch or assembly line environments. However, with the introduction of flexible manufacturing system (FMS) concepts, these structures can now share some of the same characteristics of continuous flow environments and some of the characteristics of job shop environments.

The process structure dimension presented here, while building on the traditional approach, incorporates some more recent ideas by Chiantella (1982) and is labeled process structure complexity. As conceived, this dimension is a composite of three underlying variables: (1) mechanization level; (2) systemization level; and (3) interconnection level. In the following paragraphs each of these underlying variables will be briefly described.

Although specific process stages may differ in their levels of mechanization, systemization, and interconnection, the focus here is on the dominant characteristic of a whole manufacturing system. Often, but not necessarily, this represents a composite (summation) of the primary characteristics of the dominant process stages.

Chiantella (1982) describes the classes of mechanization generally as shown in Table 2.

The level of systemization employed to control a process is also of interest. Chiantella (1982) identifies six levels that vary from taking data from processes to 'closing the loop' and using the data obtained to direct the process. The six levels proposed are shown in Table 3.

Chiantella (1982) determines the level of automation for a particular process structure by representing these levels of systemization and classes of mechanization on a matrix—the degree of automation increases as the level of systemization increases and as the class of mechanization increases. This measure—the degree of automation—is used to depict automation advancement throughout the manufacturing line.

A process variable that has not been explicitly mentioned is the level of interconnection (integration) between the various process operations. This variable describes the integration level between the various process operations and is a composite of several subordinate factors as shown in Table 4.

In summary, it has been proposed that this first dimension of the manufacturing structures typology be called 'process structure complexity'. Further, it is suggested that process complexity is a composite function of: (a) the level of mechanization; (b) the level of systemization; and (3) the level of interconnection. Table 5 provides a few examples of business units which

Table 2

	Mechanization level	Functional description
1.	Manual	A human operator performs an operation manually with a minimum of tools. Component assembly using simple fixtures and hand tools would be an example
2.	Machine	The operator employs mechanical assistance in performing an operation, as in the fabrication of parts using milling machines, lathes or presses
3.	Fixed program	A fixed program machine may employ pneumatic logic, mechanical sequencing or numerical control to execute a sequence of operations. No provisions are made for exceptions to the normal process
4.	Programmable control	Under programmable control a machine may execute a sequence of operations and compensate for exception that many occur. A machine may be programmed to perform different tasks as well

Table 3

	Systemization level	Application functions
1.	Data collection	Recording past occurrences—documents (reports) produced at some later time
2.	Event reporting	Capturing information as events occur—documents are produced when and where required
3.	Tracking	A continuing profile of event information for a series of operations or movements
4.	*Monitoring*	*Dynamically comparing actual events to those planned. Alert messages* are produced
5.	Guide	Providing action alternatives, and capturing the course of action taken
6.	Control	Executing a control action when predefined event conditions occur

Table 4

	Interconnection factor	Description
1.	Discontinuities	Discontinuities in the material—process flow tend to be related to the level of work in process (WIP) inventories. As WIP is decreased there is a greater need for integration between the process stages.
2.	Technological interdependences	Even with the presence of substantial WIP inventories, it is possible that different stages in the production process be technologically interdependent. As the interdependence increases there is inherently a greater need for integration between the process stages
3.	Operational flexibility	Operational flexibility is primarily associated with the mix of lead times through the factory and frequency of change in the production schedules. As the required level of flexibility increases there is a greater need for integration between the process stages

are perceived to be at different positions on this dimension.

Product line complexity dimension

The second dimension in the typology of manufacturing structures is labeled product line complexity. As presented this dimension is a composite of several underlying variables such as the following:

1. *End product complexity*. As one moves from low-complexity to high-complexity product lines, the complexity of the end (or final) products tends to increase. For example, (1) in an absolute sense an F-16 fighter is much more complex than a ceramic coffee mug and (2) in a relative sense a Datsun 200ZX sports car is more complex than a basic Ford Escort sedan.
2. *Variety of final products*. As the number of different final products increases, the complexity of the product line increases. For example, International Paper in Ticonderoga, New York produces large volumes of basically one type of photocopy paper—a product line of low complexity. Conversely, a nearby company (Mohawk Paper Co., Cohoes, New York) produces thousands of different, speciality papers in low volume—a more complex product line.
3. *Individual product volumes*. As the individual product volumes decrease the frequency of production changeovers and the variety of final products tends to increase. Thus individual product volumes tend to be inversely related

Table 5. Manufacturing structure typology: process structure dimension

Category	Typical characteristics	Examples
High process structure complexity	Very few discontinuities and work in process inventories (WIP) Highly linear material flow ('product focus' for the facility layout) Very high level of production standards Machine pacing of material flow Very low levels of component redundancy and alternatives in material flow	Sugar refining plant Petrochemical processing plant Paper processing plant Large-scale, automotive assembly
Medium process structure complexity	Moderate levels of discontinuities and WIP Moderate levels of linearity for the material flow for specific products (mixed 'process focus' and 'product focus' to the facility layout) Moderate level of production standards Individual and group control of material flow pacing Moderate levels of component redundancy and alternatives in material flow	Lawn mower assembly Airplane assembly
Low process structure complexity	Numerous discontinuities and WIP 'Process focus' to the facility layout (nonlinear material flow for specific products) Few production standards Individual operator control of material flow pacing High levels of component redundancy and alternatives in material flow	Small-scale commercial printer Typical French or Chinese restaurants

to product line complexity. In the preceding example, International Paper produces high volumes of one type of paper and Mohawk Paper produces low volumes of many different papers. Their total volumes are not necessarily different.

4. *End-product maturity (experience)*. Increases in end-product maturity tend to be related to several factors: (a) increases in organizational experience with the product; (b) a reduction in the number of different end products; and (c) increases in individual product volumes. Accordingly, if all other factors remain constant, increases in organizational experience with the products in its product line tend to decrease the effective complexity of the product line (and conversely).

Thus, the second dimension—product line complexity—is a measure of the type and variety of the product lines of the business unit. One end of the continuum represents productive units with short, simple product lines (commodities) with high volumes on mature, individual products. The other end of the continuum represents production units with wide product lines, complex in design (custom and one of a kind) with relatively low volumes on individual products.

Table 6 provides a few examples of business units which are perceived to be at different positions on the product line complexity dimension. These examples represent differences on an absolute scale (across all industries). Since some of these specific examples are from the same industry, they should also provide some insight into relative industry scaling.

Using similar two-dimensional (product and process) models a variety of authors have made comments about the complementary and dynamic nature of these two dimensions (Hayes and Wheelwright, 1979b; Buffa, 1983; Orne and Hanifin, 1987). In general these authors have suggested that historically, as an industry matures, most companies in an industry tend to move down the diagonal to more integrated processes with more commodity type products. Thus a band around the diagonal represented a 'natural' match between product and process structure.

Table 6. Manufacturing structure typology: product line complexity dimension

Category	Typical characteristics	Examples
High product line complexity	Very high end (final) product complexity Large variety of final products Small volumes on specific final products Low levels of product maturity	General Motors Saturn plant—high variety of car models and many custom features IBM's East Fishkill plant final—thousands of different computer chips Boeing 747 Plant—extremely complex end-product
Medium–high product line complexity	Moderate end (final) product complexity Moderate variety of final products Moderate volume of specific final products Moderate levels of product maturity	'Normal' modern, automotive plant with assembly line Mohawk Paper speciality plant—thousands of different papers; Norton's sandpaper plants—thousands of different types and final forms
Medium–low product line complexity	Low end (final) product complexity Moderate to low variety of final products Moderate to high volumes on specific final products Moderate to high levels of product maturity	International Paper's photocopier paper plant Henry Ford's original Model T plant—'any color as long as it's black' Garden Way's rototiller plant
Low product line complexity	Very low end (final) product complexity Low variety of final products High volumes on specific final products High levels of product maturity	Small soda or milk bottling plant Fast food 'mini factory' (i.e. McDonald's) 'Typical' cement plant

Positions off the diagonal band were viewed as representing a 'mismatch' between the product structure and the process structure (see Figure 2). Although the 'mismatch' did not always lead to lower levels of profitability, they were positions which should be considered carefully before adoption. For example, traditionally simple job shop process structures were not perceived as compatible with short, simple product lines produced in high volumes. Given the high individual product volumes, it appeared that integrating the process would lead to significant scale and learning curve advantages. Conversely, complex, highly integrated continuous flow process structures were perceived as incompatible with wide, complex product lines each with relatively low volume on individual products. Discontinuities in the production process were generally perceived as essential to handle the scheduling and control complexities of the product line.

In recent years, as mentioned earlier, developments in flexible manufacturing system (FMS) technologies are challenging this logic. A large part of the motivation for such (FMS) systems is the ability to make a large number of 'one of a kind' products at variable costs that are competitive with highly integrated facilities dedicated to a short product line at high volumes with specialized equipment (Kotha and Orne, 1987; Talaysum and Goldhar, 1985; Wheelwright, 1986).

Organizational scope dimensions

The third dimension in the typology of manufacturing structures is labeled organizational scope. As presented, this dimension is a composite of several underlying variables such as the following:

1. *Geographic manufacturing scope*. The organizational scope of a business unit tends to increase as the number and geographic scope of its manufacturing plants expands. Points along this continuum have often been labelled regional, national, multinational and global.
2. *Geographic market focus*. The organizational scope of a business unit tends to increase as

the geographic coverage of its marketing efforts expands. Again, points along this continuum have often been labeled regional, national, multinational and global.

3. *Vertical integration*. The organizational scope of a business unit tends to increase as the level of vertical integration increases (i.e. the number of process stages coordinated within one business unit). For example, many paper industry companies (such as International Paper) have forest, logging, pulp and paper-making operations. Conversely, some companies (such as Mohawk Paper) are substantially less integrated—concentrating only on the paper-making process.
4. *Customer—market scope*. The organizational scope of a business unit tends to increase with increases in the number of different customer, market and distribution channels. Each of these different segments may need different levels of responsiveness in the following types of areas: order entry, inventory service, shop-floor scheduling.
5. *Scale*. The organizational scope of a business unit tends to increase with the absolute scale (or volume) of its operations. Related, but subordinate, variables are relative market share and relative experience curve positions—critical dimensions of competitive strategy.

This third dimension in the typology of manufacturing structures was necessary for several reasons. First, many critical structural characteristics of a manufacturing system are not considered in the two preceding dimensions of process structure and product line complexity. Second, competitive or organizational scope is a powerful tool for creating competitive advantage. Thus, this dimension is a critical link with typologies of generic strategies. Third, the need to process logistical and distribution information, often with computer and communication technology, is a direct function of the organizational scope. Thus, this dimension is a critical link with some forms of advanced manufacturing technology.

Again, before proceding with specific examples of the categories associated with organizational scope, it is necessary to point out an extremely important issue associated with strategy formulation: the definition of industry and strategic business unit boundaries. This issue has been addressed in a previous article by one of the authors (Orne and Hanifin, 1987). Throughout these sections it is important to keep in mind that the intended unit of analysis is basically consistent with the classic concept of 'strategic business units' (SBUs)—independent units which currently exist or could be formed. Specifically, the unit of analysis is not the corporation as a whole, nor specific interdependent functional areas manufacturing within a division. It is recognized that the appropriate definition (and definitional process) of these strategically independent units (SBUs) is essentially simultaneous, yet inherently complex and controversial (Day, 1981; McGee and Thomas, 1986; Porter, 1980; Henderson, 1984), especially in an international context (Doz, 1980).

Perhaps a specific example will better illustrate this issue. In the early 1970s the Norton Company's abrasive businesses were, presumably incorrectly, organizationally segmented into a number (eight or nine) of 'SBUs' based on both product type and geographic region. Later, it became clear that these units often shared (at least within a product type) common technology, competitors, and experience curves. Accordingly, the planning process and organizational structure was modified to define the SBUs more broadly.

Pragmatically, the issue associated with the proper definition of strategic business unit boundaries can be partially finessed by the inclusion of a sixth underlying variable.

Divisional interdependence. The organizational scope of a business unit tends to increase as the number and the depth of the strategic and operational interdependence with other strategic business units (in the same corporation) increases. Essentially, this broadens the strategic focus of the business unit and increases the informational exchange requirements.

This adjustment in the organizational scope dimension is most necessary under the following conditions. First, the corporation is very large and highly interdependent: operational control dictates the creation of interdependent divisions. Perhaps the best example is IBM. Many of the divisions use similar technology to provide similar products to similar customers. Second, the

Table 7. Manufacturing structure typology: organizational scope dimension

Category	Typical characteristics	Examples
High organizational scope (global)	Operations such as manufacturing, marketing in most countries Operations coordinated between countries and process stages High levels of vertical integration and manufacturing scale Numerous customer, markets and distribution channels	IBM electronic fabrication and assembly Nissan—Datsun automotive fabrication and assembly
Medium–high organizational scope (multinational)	Operations such as manufacturing, marketing in multiple countries Operations moderately coordinated between countries and process stages Moderate to high levels of fabrication and vertical integration and manufacturing scale Moderate to high mix of customers, markets and channels	Norton sandpaper fabrication and assembly Kodak Film, fabrication and assembly
Medium organizational scope (national)	Operations in one large country (i.e. U.S., Germany or Japan) Operations moderately coordinated between process stages Moderate levels of vertical integration and manufacturing scale Moderate mix of customers, markets and channels	Mercedes–Benz automotive fabrication and assembly National 'Beer' manufacturing (i.e. Budweiser)
Medium–low organizational scope (regional)	Operations in one small country or region (i.e., U.S. northeast) Moderate to low levels of coordination between process stages Moderate to low levels of vertical integration and manufacturing scale Moderate to low mix of customers, markets and distribution channels	'Typical' cement operation (regional) Regional milk bottling operation
Low organization scope	Operations in only one local area (i.e. Boston) Low levels of coordination between process stages Low levels of vertical integration and manufacturing scale Narrow mix of customers, markets and distribution channels	Ben & Jerry's speciality ice cream, Vermont Albany, New York Nueman's Ale Company

decision-maker (person concerned with 'fit' or 'synergy') is an intermediate manager with only a limited strategic or operational influence with the other divisions. Implicitly its lack of inclusion here represents the specific intent to advocate for (a) strategy formulation and (b) the analysis of fit to be done for independent strategic business units. Normally, if there is a high level of divisional interdependence, then the unit of the analysis should be broadened to reduce the interdependence. Effectively, this would explicitly increase the organizational scope.

GENERIC MANUFACTURING STRATEGIES

We now review the proposed manufacturing structure framework combined with Porter's generic strategies in an attempt to provide a conceptual synthesis (see Figure 4).

This synthesis hinges on two assumptions. First, as pointed out earlier, in pursuing the cost leadership strategy the emphasis is on cost reduction and firms strive to become the low cost producer. Efforts are focused on cost control in order that above-average returns may be forthcoming even at low prices (Porter, 1980; Miller, 1985). Thus, we posit, business units with cost leadership strategy tend to have manufacturing structures with low product line complexity and high process structure complexity. Since the objective is cost reduction, the process structures of these business units will tend to have fewer discontinuities, machine pacing of material flow, and fewer work in process inventories—all of which are key sources of relative cost reduction (see Table 8). Further, these units will tend to emphasize simpler product lines with low variety and high volumes—again, these are key sources of relative cost reduction (see Table 6).

Second, the strategy of differentiation attempts to create a product or service that is, or is perceived to be, unique by customers. Business units with this strategy orientation will tend to have more complex product lines and more discontinuities in the process structure. The discontinuities in the process structure facilitate both the wider product line complexity and more service flexibility—both of which are key sources of differentiation (see Tables 6 and 8). Within the context of the manufacturing structure framework, business units can generate structural uniqueness—through generic strategies—by moving to the corners labeled 2, 3, 6 and 7 in Figure 4.

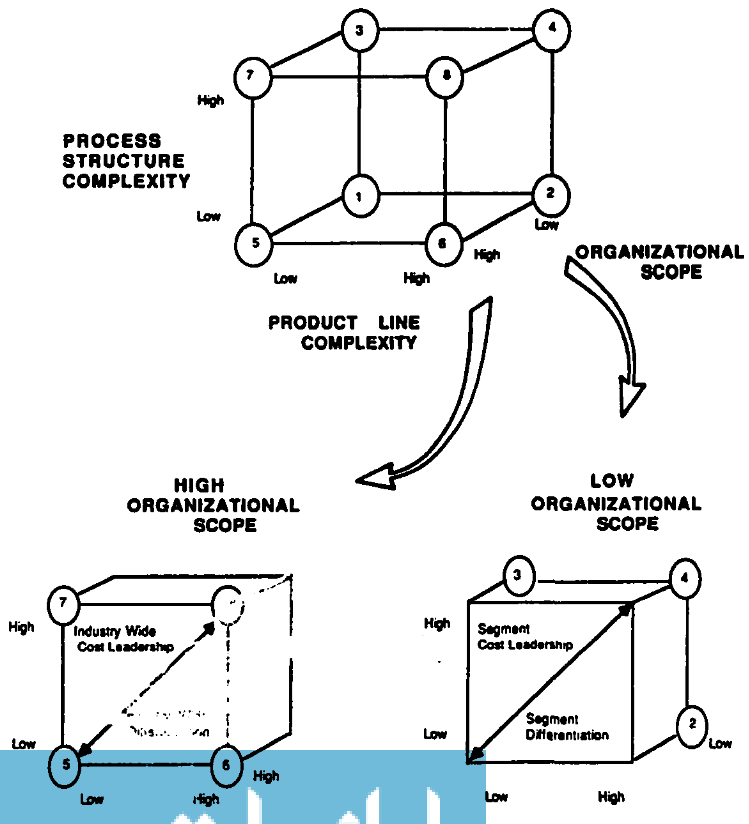

Figure 4. Synthesized framework: a conceptual representation

Point 2—Segment, differentiation strategy: units with this strategy tend to have low organizational scope, relatively complex product lines, and production processes with numerous discontinuities.

Point 3—Segment, cost leadership strategy: units with this strategy tend to have low organizational scope, relatively simple product lines, and highly integrated production processes.

Point 6—Industry-wide, differentiation strategy: units with this strategy tend to have high organizational scope, complex product lines and modestly integrated production processes.

Point 7—Industry-wide, cost leadership strategy: units with this strategy tend to have high organizational scope, relatively simple product lines and highly integrated production processes.

Although two other corners in the original Hayes and Wheelwright (1979a) framework would be considered infeasible, they may actually be reasonably attractive positions.

Point 8—Industry-wide, cost and differentiation strategy: units with this strategy would tend to have very high organizational scope (scale), complex product lines, and production processes that are highly integrated. Recent advances in computers and communication technology are making this (point 8) an attractive profit leadership position, especially for firms in industries with consolidated oligopoly structures (Schonberger, 1985). Often this position is implicitly (and mistakenly) associated with the 'Ideal Factory of the Future'.

Point 1—Segment, neither cost nor differentiation strategy: units with this strategy would tend to have a small level of organizational scope (scale), simple product lines, and production processes that have many discontinuities. This is, in fact, the position held by many units in fragmented industries, with low entry barriers and the absence of industry scale and learning curve advantages.

The remaining portions of the cube are perceived to be highly unattractive regions.

Point 4—Segment, mixed strategy: units with this strategy would theoretically have very small organizational scope (scale), complex product lines and highly integrated production processes (assembly line or continuous flow). This position is infeasible because large investments would have to be made in process controls to handle the scheduling and control complexities of the complex product line. Yet these large investments are generally impractical, given the small organizational scope.

Point 5—Industry-wide, mixed strategy: units with this strategy would theoretically have very high organizational scope (scale), simple product lines, and production processes with many discontinuities. This position is unattractive because the simple product line generally would not generate premium prices (i.e. point 6 is a better differentiation position) and the discontinuities in production process would build in excessive costs given the product structure (i.e. point 7 is a better cost leadership position.)

Miscellaneous mixed strategies: the remaining portions of the cube represent companies with mixed strategies which are generally associated with inferior unit performance: a product line of medium complexity, a production process with a medium level of integration, and/or a medium level of organizational scope. Perhaps the most unattractive position (and unfortunately the most common) is the one with a medium level on all three axes—a position in the center of the industry with no distinctive structural characteristics.

Table 8 lists the generic strategy orientations and their associated manufacturing structure characteristics as used within the context of this article. Tables 9 and 10 provide the general categories, characteristics and examples associated with each generic strategic orientation. In the application of this framework several critical issues need to be recognized. They include:

1. *Dimensional interdependence:* Although conceptually independent, the three environmental dimensions—product, process and scope—are in practice interdependent. One approach to resolve this is to normalize one for specific regions of the other two. For example, the organizational scope scale could be different for different regions of the product and process dimensions. However, from a technological perspective the choice of tech-

Table 8. Manufacturing strategy typology: relative cost leadership orientation

Category	Relative characteristics	Examples
Strong cost leadership	Strong focus on cost reduction and cost control High level of process engineering skills Strong focus on the elimination of discontinuities and work in process inventories High level of production standards High level of machine pacing of material flow	Ford Motor Company (Model T years) McDonald's chain
Medium cost leadership	Moderate focus on cost reduction and cost control Moderate level of process engineering skills Moderate focus on the elimination of discontinuities and work in process inventories Moderate level of production standards Moderate level of machine pacing of material flow	General Motors (circa 1935) Burger King chain
Weak cost leadership	Low focus on cost reduction and cost control Low level of process engineering skills Low emphasis on the elimination of discontinuities and work in process inventories Low level of production standards Low level of machine pacing of material flow (high level individual operator pacing)	Rolls-Royce California Smoothie (health foods)

nology may be a function of both the absolute and the relative (normalized) position on each scale.

2. *Absolute vs. relative industry scaling:* For the purposes of selecting a competitive strategy, it is generally more useful to use relative industry scaling for each dimension. This spreads out the companies, highlighting the empty spaces (voids) in the industry. However, from a technological perspective the choice of technology is mostly influenced by a unit's position on absolute scales across all industries.

Table 9. Manufacturing strategy typology: relative differentiation orientation

Category	Relative characteristics	Examples
Strong differentiation focus	Strong focus on products and services designed for premium value Relatively high end-product complexity High variety of final products High level of product engineering skills High level of flexibility in production scheduling (flexible service and order lead times)	Rolls-Royce
Medium differentiation focus	Moderate focus on products and services designed for premium value Relatively moderate end-product complexity Medium variety of final products Medium level of product engineering skills Medium level of flexibility in production scheduling (flexible service and order lead times)	General Motors (circa 1935)
Weak differentiation focus	Low focus on products and services designed for premium value Relatively low end-product complexity Low variety of final products Low level of product engineering skills Low level of flexibility in production scheduling (flexible service and order lead times)	Ford Motor Company (early years)

Table 10. Manufacturing strategy typology: relative strategic target

Category	Relative characteristics	Industry
Broad strategic scope	High relative market share High relative scale High geographic scope (both manufacturing and sales) High level of vertical integration High variety of customer, market and channel segments	Nissan–Datsun General Motors
Medium strategic scope	Medium relative market share Medium relative scale Medium geographic scope (manufacturing and/or sales) Medium level of vertical integration Medium variety of customer, market and channel segments	Chrysler
Narrow strategic scope	Low relative market share Low relative scale Low geographic scope (both manufacturing and sales) Low level of vertical integration Low variety of customer, market and channel segments	Mercedes–Benz Rolls Royce

Given the broad technological choices, the relative industry scaling fine-tunes them to reflect the specific competitive orientation within the industry.

3. *Definition of industry boundaries:* The choice of industry boundaries is critical, especially if relative industry scaling is used in isolation to drive the strategic and technological selection process. For this reason it is often useful to extend the basic framework to include adjacent industry segments.
4. *Other dimensions of competition*: In reviewing this framework it is important to recognize that sometimes the execution of the generic strategies is along dimensions not represented in the framework.

Further, the emphasis here is on concept development, thus ignoring the construct measurement issues. But we agree with Venkatraman and Grant (1986) who, importantly, argue that it is necessary to validate strategy measures systematically, because a strong linkage between concepts and their measures enhances theory development.

CONCLUDING REMARKS

What we have proposed here is a new conceptual framework that uses three primary dimensions: process structure complexity, product line complexity, and organizational scope. It builds on the traditional ideas put forth by Hayes and Wheelwright and others, and incorporates some of the recent trends in the manufacturing environment.

The concepts in this paper provide a rich theoretical base for considering both the content of fit and the process of fit between the following critical elements in manufacturing competitiveness: structure, strategy, technology and performance. The framework suggests a number of interesting avenues for further research. The framework itself requires further study in different manufacturing environments in different industries. While numerous authors acknowledge the need for linking business unit strategy to functional strategy, the literature on strategy gives brief attention to this area of research. Here we have presented a viable approach to link business unit strategies to manufacturing structure, using the well-received generic strategy typology proposed by Porter (1980). Using the ideas presented, researchers can explore the 'fit' between generic business strategy and manufacturing strategy, and its relationship to performance using the approaches advocated by Drazin and Van de Ven (1985).

Further, it is possible to expand the area of interest to include a typology of computer-integrated manufacturing (CIM) technologies to explore the concept of 'fit' among business-level strategy, manufacturing structure, and choices in CIM technology. Thus, it might be possible to explore whether certain structural positions and strategic orientations correspond to a certain set of CIM technologies. The main research question to explore is whether the business units that exhibit a 'congruence or fit' among strategy, structural position and choices in technology outperform competitors who lack this 'congruence or fit'.

ACKNOWLEDGEMENTS

We wish to thank Robert Hawkins, Ruth Cohen and Martha Grabowski for their suggestions on an earlier draft of this paper. We are indebted to industrial sponsors (Alcoa, Eastman Kodak, Digital, IBM, GM, GE, Norton, United Technologies, and AT&T) for providing the support and context for this research. We also thank the four anonymous *SMJ* referees for their helpful comments.

REFERENCES

Abernathy, William J. and Kim B. Clark. 'Innovation: mapping the winds of creative destruction', *Research Policy*, **14**(1), 1985, pp. 3–22.

Abernathy, William, J. and P. L. Townsend. 'Technology, productivity and process changes', *Technological Forecasting and Social Change*, **7**(4), August 1975, pp. 379–396.

Abernathy, William J. and James M. Utterback. 'Patterns of industrial innovation', *Technology Review*, **80**(7), June–July 1978, pp. 40–47.

Adam, Everett E. Jr. 'Towards a typology of production and operations management systems', *Academy of Management Review*, **8**(3), 1983, pp. 365–375.

Amber, G. S. and P. S. Amber. *Anatomy of Automation*. Prentice-Hall, Englewood Cliffs, New Jersey, 1962.

Amit, Raphael. 'Cost leadership strategy and experience curves', *Strategic Management Journal*, **7**, 1986, pp. 281–292.

Andrews, K. R. *The Concept of Corporate Strategy*. Dow Jones-Irwin, New York, 1971.

Banks, R. L. and S. C. Wheelwright. 'Operations versus strategy—trading tomorrow for today', *Harvard Business Review*, May–June 1979, pp. 112–120.

Blau, Peter M., Cecilia McHugh Falbe, William McKinley and Phelps K. Tracy. 'Technology and organization in manufacturing', *Administrative Science Quarterly*, **21**, March 1976, pp. 20–40.

Boston Consulting Group. *The Experience Curve Revisited*. Boston Consulting Group, Boston, 1980.

Buffa, Elwood S. *Modern Production/Operations Management*, 7th edn. John Wiley and Sons, New York, 1983.

Buzzell, Robert D., Bradley T. Gale and Ralph G. M. Sultan. 'Market share–a key to profitability', *Harvard Business Review*, January–February 1975, pp. 97–106.

Carper, William B. and William E. Snizel. 'The nature and types of organizational taxonomies: an overview', *Academy of Management Review*, **5**(1), 1980, pp. 65–75.

Chase, R. B. and N. J. Aquilano. *Production and Operations Management*, 3rd edn. Irwin, Homewood, Illinois, 1981.

Chiantella, Nathan. 'Achieving integrated automation through computer networks', *SME/CASA Computer Integrated Manufacturing Series*, **1**(2), pp. 2–21.

Child, J. and R. Mansfield. 'Technology, size and organizational structure', *Sociology*, **6**, 1972, pp. 369–393.

Christensen, C. R., K. R. Andrew and J. L. Bower. *Business Policy: Text and Cases*, 6th edn. Irwin, Homewood, Illinois, 1987.

Day, G. S. 'Strategic market analysis and definition: an integrated approach', *Strategic Management Journal*, **2**, 1981, pp. 281–299.

Dess, Gregory G. and Peter S. Davis. 'Porter's (1980) generic strategies as determinants of strategy group membership and organizational performance', *Academy of Management Journal*, **27**(3), 1984, pp. 467–488.

Doz, Yves L. 'Strategic management in multinational companies', *Sloan Management Review*, **21**(2), 1980, pp. 27–46.

Drazin, R. and A. Van de Ven. 'Alternative forms of fit in contingency theory', *Administrative Science Quarterly*, **30**, 1985, pp. 514–539.

Fine, Charles H. and Arnoldo C. Hax. 'Manufacturing strategy: a methodology and an illustration', *Interfaces*, **15**(6), November–December 1985, pp. 28–46.

Galbraith, Craig and Dan Schendel. 'An empirical analysis of strategy types', *Strategic Management Journal*, **4**, 1983, pp. 153–173.

Ginsberg, Ari and N. Venkatraman. 'Contingency perspectives of organizational strategy: a critical review of the empirical research', *Academy of Management Journal*, **10**(3), 1985, pp. 421–434.

Goronzy, Friedhelm. 'A numerical taxonomy of business enterprises'. In A. J. Cole (ed.), *Numerical Taxonomy*, Academic Press, London, 1969.

Hall, William K. 'Survival strategies in a hostile environment', *Harvard Business Review*, September–October 1980, pp. 75–85.

Hambrick, Donald C. 'An empirical typology of mature industrial-products environments', *Academy of Management Journal*, **26**(2), 1983, pp. 213–230.

Hambrick, Donald C. and David Lei. 'Towards an empirical prioritization of contingency variables for business strategy', *Academy of Management Journal*, **28**(4), 1985, pp. 763–788.

Harrigan, K. R. 'Research methodologies for contingency approaches to business strategy', *Academy of Management Review*, **8**, 1983, pp. 398–405.

Harrigan, K. R. 'An application of clustering for

strategic group analysis', *Strategic Management Journal*, **6**, 1985, pp. 55–73.
Hayes, Robert H. and R. W. Schmenner. 'How should you organize manufacturing?', *Harvard Business Review*, January–February 1978, pp 105–118.
Hayes, Robert H. and Steven C. Wheelwright. 'Link manufacturing and process and product life cycles', *Harvard Business Review*, January–February 1979a, pp. 133–140.
Hayes, Robert H. and Steven C. Wheelwright. 'The dynamics of process–product life cycles', *Harvard Business Review*, March–April, 1979b, pp. 127–136.
Henderson, Bruce D. 'The application and misapplication of the experience curve', *Journal of Business Strategy*, **4**(3), Winter 1984, pp. 3–9.
Hickson, David J., D. S. Pugh and Diana C. Pheysey. 'Operations technology and organization structure: an empirical reappraisal', *Administrative Quarterly*, **14**, 1969, pp. 378–397.
Hofer, Charles and Dan Schendel. *Strategy Formulation: Analytical Concepts*. West Publishing Company, New York, 1978.
Jelinek, Mariann. 'Technology, organizations and contingency', *Academy of Management Review*, January 1977, pp. 17–25.
Jelinek, Mariann and Michael C. Burstein. 'The production administrative structure: a paradigm for strategic fit', *Academy of Management Review*, **7**(2), 1982, pp. 242–252.
Kiechel, Walter III. 'Corporate strategists under fire', *Fortune*, 27 December 1982, pp. 34–39.
Kotha, Suresh and Daniel Orne. 'The concept of fit in manufacturing: implications for investments in CIM technology', Working Paper, School of Management, Rensselaer Polytechnic Institute, Troy, N.Y., 1987.
McGee, John and Howard Thomas. 'Strategic groups: theory, research and taxonomy', *Strategic Management Journal*, **7**, 1986, pp. 141–160.
McKelvey, Bill. 'Guidelines for the empirical classification of organizations', *Administrative Science Quarterly*, **20**, December 1975, pp. 509–525.
Miles, Raymond E. and Charles C. Snow. *Organizational Strategy, Structure, and Process*. McGraw-Hill, New York, 1978.
Miles, Raymond E., Charles C. Snow, Alan D. Meyer and Henry J. Coleman. 'Organizational strategy, structure and process', *Academy of Management Review*, July 1978, pp. 546–562.
Miller, Alex and Gregory G. Dess. 'The appropriateness of Porter's (1980) model of generic strategies as a method of classification and its implications for business unit performance', University of Tennessee, Working Paper No. 212, 1985.
Miller, Danny. 'Porter's business strategies in small firms, environmental and structural correlates', Working Paper, University of Montreal, 1985.
Miller, Danny and Peter H. Friesen. 'Porter's (1980) generic strategies and performance: an empirical examination with American data', *Organizational Studies*, **7**(1), 1986, pp. 37–55.
Orne, Daniel and Leo Hanifin. 'International manufacturing strategies and computer integrated manufacturing (CIM): a review of the emerging interactive effects', in Lev, Benjamin (ed.), *Production Management: Methods and Studies*. North-Holland, Amsterdam, 1987.
Perrow, Charles. 'A framework for the comparative analysis of organizations', *American Sociological Review*, **32**, 1967, pp. 194–208.
Perrow, Charles. *Organizational Analysis: A Sociological View*. Wadsworth, Belmont, California, 1970.
Perrow, Charles. *Complex Organizations: A Critical Essay*. Scott Foresman, Glenview, Illinois, 1972.
Porter, Michael E. *Competitive Strategy: Techniques for Analyzing Industries and Competitors*, Free Press, New York, 1980.
Porter, Michael E. 'The contributions of industrial organization to strategic management', *Academy of Management Review*, **6**(4), 1981, pp. 609–620.
Quinn, James Brian. 'Strategic change: "logical incrementalism"', *Sloan Management Review*, Fall 1978, pp. 7–21.
Ramanujam, Vasudevan and N. Venkatraman. 'An inventory and critique of strategy research using the PIMS database', *Academy of Management Review*, **9**(1), 1984, pp. 138–151.
Reich, Robert B. 'The next American frontier', *Atlantic Monthly*, March and April issues, 1983, pp. 43–58.
Schmenner, Roger W. 'Before you build a big factory', *Harvard Business Review*, July–August 1976, pp. 100–104.
Schmenner, Roger W. 'Revisiting the focused factory', *Harvard Business Review*, Working Paper, No. 78–25, 1978.
Schmenner, Roger, W. 'Look beyond the obvious in plant location', *Harvard Business Review*, January–February, 1979, pp. 126–132.
Schonberger, R. J. *Operations Management: Productivity and Quality*, Business Publications, Plano, Texas, 1985.
Skinner, Wickham. 'Manufacturing—missing link in corporate strategy', *Harvard Business Review*, May–June 1969, pp. 156–167.
Skinner, Wickham. 'The focused factory', *Harvard Business Review*, May–June 1974, pp. 113–122.
Talaysum, Adil T. and Joel D. Goldhar. 'An overview of CIM's impact on business strategy, CASA-SME Technical Paper, CIMCOM Conference, 1985.
Thompson, J. D. *Organizations in Action*. McGraw-Hill, New York, 1967.
Tosi, H. L. and J. W. Slocum. 'Contingency theory: some directions', *Journal of Management*, **10**(1), 1984, pp. 9–26.
Utterback, J. M. and W. J. Abernathy. 'A dynamic model of process and process innovation', *OMEGA*, **3**, 1975, pp. 639–656.
Uyterhoeven, H. E. R., R. W. Ackerman and J. W. Rosenblum. *Strategy and Organization: Text and Cases in General Management*. Irwin, Homewood, Illinois, 1973.
Venkatraman, N. and John H. Grant. 'Construct measurement in organizational strategy research: a critique and proposal', *Academy of Management Review*, **11**(1), 1986, pp. 71–87.
Wheelwright, Steven C. 'Reflecting corporate strategy

in manufacturing decisions', *Business Horizons*, **21**(1), February 1978, pp. 57–72.
Wheelwright, Steven C. 'Manufacturing strategy: defining the missing link', *Strategic Management Journal*, **5**, 1984a, pp. 77–91.
Wheelwright, Steven C. 'Strategy, management and strategic planning approaches', *Interfaces*, **14**, January–February 1984b, pp. 19–33.
Wheelwright, Steven C. 'Productions operations: liability or asset?' In G. E. Germane (ed.), *The Executive Course*, Addison Wesley, Reading, Massachusetts, 1986.
White, Roderick E. 'Generic business strategies, organizational context and performance: an empirical investigation', *Strategic Management Journal*, **7**, 1986, pp. 217–231.
Williams, Jeffery R. 'Effects of divergent rates of learning on competitive strategy and industry structure'. Working Paper, Graduate School of Industrial Administration, Carnegie-Mellon University, August 1985.
Wissema, J. G., H. W. Van der Pol and H. M. Messer. 'Strategic management archtypes', *Strategic Management Journal*, **1**, 1980, pp. 37–47.
Woodward, Joan. *Management and Technology. Problems of Progress in Industry*. Series No. 3. Her Majesty's Stationery Office, London, 1958.
Woodward, Joan. *Industrial Organizations*. Oxford University Press, Oxford, 1965.
Zwerman, W. L. *New Perspectives on Organization Theory*, Greenwood Publishing, Westport, Connecticut, 1970.