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MANUFACTURING-BASED RELATEDNESS, SYNERGY, AND COORDINATION

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This paper explores the basic question of whether manufacturing-based relatedness between business units within a multibusiness firm serves as a basis for a competitive advantage at the business unit level. We developed a system for describing manufacturing relatedness that combines the study of value chain activities with 4-digit SIC codes, then we assessed presence of manufacturing synergies. We found no evidence that, on average, organizations involved in manufacturing-related businesses are reaping financial benefits from shared resources in manufacturing. However, some firms, through explicit commitment to coordination, do realize performance benefits from such involvement.

INTRODUCTION

Some leading scholars have argued that synergy creation is the only justification for a multibusiness corporation (Kanter, 1989; Porter, 1985). Efforts to achieve synergies, however, have been largely unsuccessful (Chatterjee, 1986; Ramanujam and Varadarajan, 1989; Reed and Luffman, 1986). The purpose of our work is to pursue the basic question: Can manufacturing-based relatedness between business units within a multibusiness firm create synergies that provide a basis for a competitive advantage at the business unit level? We approach this question by integrating and extending four streams of research on manufacturing strategy, related diversification, and synergy creation: (1) the role manufacturing plays in creating competitive advantage through its influence on the cost and uniqueness drivers that underlie competitive strategies (Abernathy and Utterback, 1975; Hayes and Wheelwright, 1984; Porter, 1980; 1985); (2) the use of elements of the resource-based view to explain the impetus and direction of firm diversification efforts (Brush, 1996; Mahoney and Pandian, 1992; Markides and Williamson, 1994, 1996; Peteraf, 1993; Robins and Wiersema, 1995); (3) the use of interindustry resource profiles, rather than SIC codes, to explain sources of relatedness and synergy (Brush, 1996; Lemelin, 1982; Robins and Wiersema, 1995; Slusky and Caves, 1991); (4) realizing actual benefits from intended strategies through effective implementation (Hill, Hitt and Hoskisson, 1992) and coordination (Galbraith, 1973, 1994; Govindarajan, 1988; Gupta and Govindarajan; 1991; Martinez and Jarillo, 1989). We develop an approach for describing manufacturing relatedness, then measure performance and coordination efforts at the business unit level. Our purpose is to explore manufacturing interrelationships and synergy between specific businesses within a corporate portfolio rather than the overall diversification strategy of the corporation, using the corporation as the unit of analysis.

Key words: corporate strategy; manufacturing; synergy; coordination; competitive advantage
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THEORETICAL BACKGROUND

Relatedness, resources, and synergy

Although the empirical research results are inconclusive (Hoskisson and Hitt, 1990; Markides and Williamson, 1996; Ramanujam and Varadarajan, 1989; Rumelt, 1974), there are persuasive theoretical arguments for the benefits of relatedness among the businesses in multibusiness corporations. Relatedness, when managed properly, should result in tangible and intangible synergies that make the corporate strategy more than the sum of the individual business unit strategies (Kanter, 1989; Porter, 1985). Slack resources that might not be used otherwise may be put to good use (Penrose, 1959; Teece, 1980) and scarce resources may be bargained for by a larger, more powerful organization (Porter, 1985). The firm's performance may be superior to its single business competitors when the combination of businesses allows preferential access to the types of strategic assets that underpin the firm's cost or differentiation advantage (Markides and Williamson, 1996).

The resource-based view provides a foundation for understanding why and how firms diversify, and helps clarify the types of resources and capabilities that will have value and lead to strategic advantage in diversified firms (Barney, 1991; Chatterjee and Wernerfelt, 1991; Mahoney and Pandian, 1992). Firms tend to diversify over time in order to make use of underutilized resources such as excess capacity, idle workers, underchallenged engineers, and excess capital, systems and infrastructure (Mahoney and Pandian, 1992; Penrose, 1959). The more specialized the resources, the more diversification that may be needed to sustain growth over time and fully utilize capabilities (Penrose, 1959). Furthermore, with growth, pools of productive resources and specialized knowledge are created within firms through the routinization of activities (Brush, 1996; Penrose, 1959). Those resources and knowledge are often worth more within the firm than if sold in the open market (Rubin, 1973), and must be maintained if the firm is to sustain its competitive position. Therefore, a firm will tend to expand or diversify as a means of using the *most valuable* of these resources as fully as possible (Brush, 1996; Penrose, 1959). Experience gained in one business can be used to reduce the friction of building resources in a new business (Markides and Williamson, 1996). Therefore, the resource profile of a diversifying firm is critical in predicting the resource characteristics of the industry into which the firm will diversify (Lemelin, 1982; Montgomery and Hariharan, 1991; Stewart, Harris and Carleton, 1984).

The resource-based view of the firm also provides insight into the role resources and capabilities can play in providing a source of *competitive advantage* at the business unit level, and a *distinctive competence* at the corporate level. For resources and capabilities to provide a competitive advantage, they must be valuable and nonsubstitutable, from a customer's point of view, and unique and inimitable, from a competitor's point of view (Barney, 1991; Grant, 1991). Extending these concepts to the domain of multibusiness firms, the types of combined resources and capabilities that have real value are those that contribute to sources of cost or differentiation advantages (Markides and Williamson, 1996), and cannot be imitated by competitors through normal market mechanisms (Mahoney and Pandian, 1992; Peteraf, 1993). If a firm can deploy its pool of experience, knowledge, and systems from one business to another business, such that the costs and time required to create and expand assets and resources are less than that of competitors, it is said to have a corporate-level distinctive competence (Markides and Williamson, 1996). Furthermore, the combination must be properly coordinated so that the value is realized and isolating mechanisms are created to prevent imitation by competitors and substitution by customers (Rumelt, 1984). Such conditions result in the industry heterogeneity and limits to competition that are the cornerstone of distinctive competence and competitive advantage within the resource-based view (Petaraf, 1993).

Manufacturing-based relatedness, competitive advantage, and synergies

Within traditional manufacturing firms, operations are the site of a large pool of organizational resources that usually account for the preponderance of a firm's physical and human capital (Hayes and Wheelwright, 1984). With successful pursuit of efficiencies, manufacturing can create extra physical capacity, which must then be utilized in order to sustain the efficiencies (Hayes and Wheelwright, 1984). Also, process improve-

ment activities create a foundation of human capabilities and organizational routines that will also experience underutilization as efficiencies are gained. Since manufacturing often represents a type of lumpy, indivisible asset, management may pursue manufacturing-based diversification as a vehicle for more fully utilizing those skills, resources, and capabilities (Brush, 1996; Penrose, 1959).

Although underutilized manufacturing operations may provide an impetus for a manufacturing-based diversification move, *can the related manufacturing operations serve as the foundation for a multibusiness distinctive competence?* To address that issue, we must first discuss the role manufacturing operations can play in creating a single business competitive advantage, then extend those arguments to a discussion of multibusiness synergies.

Manufacturing and competitive advantage

Organizations usually attempt to achieve a competitive advantage by pursuing a form of either cost leadership or differentiation that, when properly matched to industry conditions, can provide value to customers and protection from competitor imitation (Porter, 1980). The key to effective pursuit of a low-cost leadership strategy is management of cost drivers. Porter (1980) identified 10 major cost drivers that are linked to low-cost strategies, virtually all of which are linked directly or indirectly to the resources and management of manufacturing operations. Table 1 provides illustrative examples of the linkages between Porter's cost drivers and manufacturing resources and capabilities.

Manufacturing may also serve as a source of competitive advantage with a differentiation strategy. The ability of a firm to differentiate its products or services is determined, in whole or in part, by the skills of employees, the capabilities of processes and technologies, and the routines enacted by manufacturing management (Hayes and Wheelwright, 1984; Kotha and Orne, 1989). Illustrative examples of the linkages between Porter's sources of uniqueness and manufacturing resources and capabilities are also shown in Table 1.

To sustain a competitive advantage, the resources and capabilities should be difficult for competitors to imitate. In general, the internal workings of a manufacturing plant are not readily observable, and, in many cases, manufacturing management uses extreme procedures to maintain the secrecy of operations. Custom-designed process equipment, worker experience, and the accumulation of incremental process improvements made over time can create a store of manufacturing capability that is difficult to observe or imitate (Abernathy and Utterback, 1975; Hayes and Wheelwright, 1984). Whereas a competitor's engineers can disassemble a product to uncover the details about what it is and why it works, they rarely know for sure how it was produced or the sources of and degree of efficiency and effectiveness with which it was produced. This *causal ambiguity* makes imitation difficult (Barney, 1991; Rumelt, 1984).

Manufacturing and multibusiness synergies

For a firm to leverage a single-business competitive advantage into multibusiness synergies it must achieve benefits that transcend the cost of coordination (Govindarajan and Fisher, 1990; Gupta and Govindarajan, 1986; Porter, 1985). Resource sharing may increase power and leverage in accessing and managing the drivers of cost and uniqueness within each business unit (Markides and Williamson, 1996; Porter, 1985). If the cost of an activity represents a large percent of total costs and is driven by economies of scale, learning effects, or the pattern of capacity utilization, then sharing of that activity between businesses is likely to offer cost savings, as long as the costs of coordination do not outweigh the benefits (Porter, 1985). Sharing of uniqueness drivers can potentially improve access, speed up development time, and reduce the costs of achieving uniqueness. To the degree that the pool of knowledge and experience in one system can be deployed to reduce the cost or time required to create new strategic assets or expand the stock of an existing one (Markides and Williamson, 1996), the overall effect can be synergistic cost reduction or uniqueness. Empirical assessments of these effects, however, have been inconclusive. Lang and Stulz (1994) found no evidence that diversification provided firms with a valuable intangible asset. Although the study was not specifically focused on manufacturing relatedness, Brush (1996) found performance benefits (market share) from operational relatedness. Davis *et al.*

Table 1. Drivers of competitive advantage and manufacturing capabilities

	Manufacturing application	Manufacturing capabilities contributing to advantage
Cost driver		
Economies of scale	Factory, equipment, and logistics scale	Cost minimizing factory size, effective facility design, management of overhead and indirect activities.
Learning	Direct labor learning	Continuous improvement of work methods, training of employees, incentives to learn and to incorporate that learning into routine work methods
		Efficiencies leading to deferred capacity investments
	Indirect labor learning	Process improvements leading to improved quality, cost reductions, and faster, more cost-effective product launches
Capacity utilization	Factory utilization	Ability to plan and manage capacity effectively to avoid high cost of underutilized facilities (technology choices, workforce policies, scheduling procedures, use of stop-gap measures)
Linkages	Linkages with suppliers and distributors	Systems view of cost interdependencies: higher-quality raw material may increase input costs, but decrease overall costs from reduced rework. JIT is an example of improved linkages between suppliers, distributors, and the internal production stages
	Linkages with marketing and product development	Early involvement with product design leading to lower-cost manufacturing processes: stability linked to better customer information from marketing
Integration	Backward into supplies, forward into distribution	Ownership, rather than management, of linkages can lead to cost advantage if there is system-wide capacity balancing, and maintenance of quality and innovation standards
Timing	Timing of new capacity, new facility, and new technology investments	Management understanding of technology choices, market demand, facility size, and contingent competitor actions
Location	Location of plants, warehouses	Lower fixed costs, and lower transportation costs
Discretionary policies that affect costs	Factory focus	Number and variety of products produced within a plant influence cost structure
		Number and variety of customer groups served by a plant influence cost structure
	Process technology	In addition to affecting scale, influences labor skills needed, production efficiencies, and costs of changeover, all of which underlie costs
	Raw material specifications	Quality and price of raw materials influence product costs
	Human resource policies	Recruiting and training of skilled labor, evaluation of capabilities, and rewards, all of which influence productivity and cost structures
	Production scheduling	Scheduling procedures including lot sizing, inventory holding, run lengths, and frequency of schedule changes influence cost structures
	Delivery policies	Flexible delivery promises allow manufacturing to manage a more stable, efficient system

Table 1. Continued

	Manufacturing application	Manufacturing capabilities contributing to advantage
Uniqueness drivers		
Policy choices associated with 'availability'	Capacity or inventory available to provide delivery as requested	Sizing of capacity, timing of capacity additions to 'lead' demand, choice of flexible process equipment, training of flexible workforce, effective product scheduling, supplier management to assure available materials, end-item inventory holding policies, locating facilities close to customers
Policy choices associated with 'quality'	Quality specifications and tolerances, with ability to improve over time	Supplier management to assure quality materials, workforce training, equipment tolerances and reliability, maintenance programs, process control systems
Policy choices associated with 'rapid new product introduction'	Product–process development	Flexible equipment, flexible workforce, available capacity, early involvement with product design to avoid delays
Product uniqueness	Process support for product uniqueness	Linkages with suppliers, maintenance of standards, cost reduction efforts that allow the form of product uniqueness to be realized at reasonable cost
Responsiveness to special customer requests	System-wide flexibility and responsiveness to schedule changes	Flexible equipment, employees, raw material ordering, and scheduling to support rapid schedule change
Custom designs	System-wide flexibility and responsiveness to design changes	Flexible equipment, employees, raw material ordering, and scheduling to support custom product offerings

(1992) found manufacturing relatedness was associated with improved profitability, but Chatterjee (1986) found little support for synergy created from production-related resources.

The sheer size of the manufacturing resource base, the opportunities for shared cost and uniqueness drivers, and the relative invisibility to competitors may provide manufacturing-related multibusiness firms with more potential than other multibusiness firms to develop synergies that cannot be imitated by competitors through alternative market mechanisms. Furthermore, if the benefits are realized, then the individual business units should have advantages that are not available to their single-business competitors.

Hypothesis 1: Business units within diversified firms with a pattern of manufacturing-based relatedness will outperform same-industry business units within firms exhibiting other forms of diversification.

Hypothesis 2: Business units within diversified firms with a pattern of manufacturing-based relatedness will outperform same-industry single-business firms.

Mechanisms for achieving synergy

The potential for synergy can be measured by the closeness of the activities of the two enterprises (Slusky and Caves, 1991), but actual synergy does not exist until after the administrative coordination has yielded the cost savings, market gains, or innovations leading to improved profitability (Hill, Hitt, and Hoskisson, 1992). Poor implementation and coordination may interfere with realizing actual synergies (Harrison, Hall, and Nargundkar, 1993; Hill *et al.*, 1992).

There is a considerable research literature on the use of administrative mechanisms for achieving commitment and coordinated action in the implementation of strategies (Galbraith, 1973, 1994; Govindarajan, 1988; Gupta and Govindarajan, 1991; Martinez and Jarillo, 1989; St. John and Rue, 1991). The general theory of coordination that is emerging in the research literature suggests that environmental conditions and the

firm's own strategy–structure choices determine the complexity of the coordination task. The chosen system of coordinating mechanisms should then reflect that complexity. More complex coordinating systems generally employ a combination of top-down controls, formal bureaucratic controls, structural changes to achieve interaction, and socialization methods to create a common culture and shared vision (Galbraith and Nathanson, 1978; Govindarajan, 1988; Gupta and Govindarajan, 1991; Martinez and Jarillo, 1989; St. John and Rue, 1991).

For a multibusiness firm to achieve the high level of coordination necessary to achieve synergy, we would expect extensive use of many of the mechanisms suggested by the coordination literature. We would expect firms to *express commitment* to synergy creation, show evidence of *resource and activity sharing*, and then *employ mechanisms* to create the coordination necessary to achieve ongoing synergy. On the other hand, those firms that do not employ the coordinating mechanisms may participate in businesses that exhibit manufacturing relatedness and may intend to create synergy, but may be unable to muster the coordination necessary to realize synergies. These views may be summarized in the following research hypotheses:

Hypothesis 3: High-performing manufacturing-related diversified firms are more likely to exhibit a strong commitment to synergy creation *than low-performing manufacturing-related diversified firms.*

Hypothesis 4: High-performing manufacturing-related diversified firms are more likely to exhibit evidence of resource and activity sharing *than low-performing manufacturing-related diversified firms.*

Hypothesis 5: High-performing manufacturing-related diversified firms are more likely to exhibit use of administrative mechanisms *for achieving coordination between business units than low-performing manufacturing-related diversified firms.*

METHOD

Following the suggestion of Seth (1990), we were interested in assessing manufacturing relatedness, synergy, and coordination at the level of business units. The specifics about our variables, data, and analysis methods are set forth in the following paragraphs.

Measuring manufacturing relatedness

In the corporate diversification literature, decisions about relatedness are usually made using one of two systems: (1) subjective classification from company documents (Rumelt, 1974), or (2) SIC codes (Montgomery, 1982; Jacquemin and Berry, 1979). Subjective classifications are often criticized as time-consuming and subject to researcher error and bias. Commonly used SIC code approaches, however, apply the assumption that two businesses within the same 2-digit code are related, and two businesses with two different 2-digit codes are unrelated. This assumption may have limitations for strategy research in general (Davis and Duhaime, 1992; Hall and St. John, 1994) and is certainly too liberal for an assessment of manufacturing-based relatedness.[1] Furthermore, as noted by Hoskisson *et al*. (1993), continuous and categorical measures are measures of diversification type rather than relatedness, and do not make a clear distinction between extent of diversification and relatedness among businesses (Robins and Wiersema, 1995). As Robins and Wiersema (1995) and Brush (1996) demonstrated, however, it is possible to develop measures of relatedness from SIC categories without relying on the hierarchies implied

[1] It is very common for businesses within the same 2-digit code to be vertically integrated rather than related (Davis and Duhaime, 1992) and many forms of relatedness span multiple 2-digit codes. Maytag participates in the following businesses as represented by 4-digit codes:

Household Laundry Equipment	3633
Household Cooking Equipment	3631
Household Vacuum Cleaners	3635
Household Refrigerators and Freezers	3635
Automatic Vending Machines	3581
Blowers and Fans	3564

Using the typical 2-digit scheme for classifying relatedness, the Maytag home appliances business, regardless of type (refrigerator, washers and dryers, stoves, and vacuum cleaners), are related to each other (2-digit code 36), while the vending machine business and blowers and vans would be classified as related to each other (2-digit code 35) but unrelated to any of the household equipment classifications. In reality, their vending machine business (refrigerated beverage can dispensers) is closely related to their household refrigerator business, and fans and blowers are a form of vertical integration with many of the other items.

by the SIC system. It is not the use of an SIC code to define an industry segment that creates the problem, but rather the hierarchical logic implied by the SIC classification system.

Markides and Williamson (1994) measured the potential for sharing knowledge and systems across business units. Their model was based on the potential for sharing of resources at the corporate level as opposed to interrelationships across business units per se. Markides and Williamson (1994) measured the extent to which businesses in a corporation's portfolio were similar, based on such things as whether few or many customers were served and the degree of third-party channel dependence. In contrast, we approached relatedness as a judgement of similarity in activities and resources between pairs of industries. Our approach is similar to that used by Robins and Wiersema (1995) and Brush (1996) in that we identified interindustry similarities by collecting information about the characteristics of industries that may have strategic importance. Like Robins and Wiersema (1995) and Brush (1996), our approach does not depend on the hierarchical scheme of the SIC system, but uses SIC codes to define a particular industry segment. Robins and Wiersema (1995) and Brush (1996) used patterns of technology imports derived from input–output tables and the Scherer technology flow matrix (Scherer, 1982) as an indicator of the underlying strategic similarities between industries and, therefore, the potential for synergies from shared capabilities and knowhow. Our approach differs from both Robins and Wiersema (1995) and Brush (1996) in that we focused on a different set of resource similarities in determining the potential for synergy, as described in the following paragraphs.

According to Porter (1985), the primary value activities of a firm are those involved in incoming logistics, operations, outbound logistics, market and sales, and service, with technology development, procurement, human resource management, and administration providing support to those primary activities. Two business units may develop interrelationships that lead to synergy at any point in the value chain (Hax and Majluf, 1991; Porter, 1985). Since the focus of our study was on manufacturing-based related diversification strategies, we ignored the sources of marketing relatedness. The remaining categories of value activities may be summarized as:

1. *raw materials* (type of and processes for acquiring raw materials);
2. *product and process science/technology* (the theoretical principles underlying the design and manufacture of products); and
3. *resource conversion processes* (the equipment, processes, and procedures used to apply the technical and scientific principles to the conversion of raw materials into end products).

We defined two industries as *loosely linked* if one of the three categories of activities was the same. Two industries were described as *tightly linked* if two or three categories of activities were the same. If none of the categories of activities were the same, then we described those two industries as *manufacturing-unrelated.*

The next step was the creation of a classification matrix that identified which 4-digit SICs were tightly and loosely linked with one another. Based on the descriptions and product listings found in the SIC manual, two researchers made independent classification decisions concerning whether one 4-digit industry was loosely or tightly linked with all other classifications (manufacturing industries representing codes 2011–3999 only). Tightly linked industries shared at least two of the following characteristics: common raw materials (e.g., steel, plastic, milled wood), common science (e.g., organic polymer science), or common processing technologies. Loosely linked industries shared one of these characteristics. For example, bread (SIC 2051), cookies (SIC 2052) and baked products (SIC 2053) use similar raw materials (e.g., flour, sugar), similar science (e.g., sterile preparation, cooking, flavoring) and similar resource conversion process technologies (e.g., mixing, baking, packaging); therefore, they would be described as tightly linked related manufacturing industries. On the other hand, all types of dairy products (SIC 2021–2026), would be classified as unrelated to either bread, cookies or baked products because the science, raw materials, and conversion processes of dairy farms are completely different from those of bakeries. All forms of vertical integration were eliminated from the classifications, as were many of the 'not elsewhere classified' industries that were too broad to make an intelligent classification decision. The independent classifications were then compared. This process resulted in 99.4 percent agreement

concerning classifications. The two researchers were easily able to resolve disagreements concerning the remaining classifications through discussion.

Defining and measuring synergy

Research into relatedness and synergistic gains is of two general types: (1) studies in which synergy is defined as stockholder wealth creation, measured as cumulative abnormal returns (CAR), usually associated with the announcement of a merger or acquisition (Chatterjee, 1986; Davis and Thomas, 1993; Lubatkin, 1987; Lubatkin and Shrieves, 1986; Nayyar, 1993; Niden, 1993; Seth, 1990; Slusky and Caves, 1991); and (2) studies that attempt to demonstrate a relationship between relatedness and some measure of organizational financial performance, such as return on assets or return on investment (Bettis, 1981; Christensen and Montgomery, 1981; Grant and Jammine, 1988; Montgomery, 1985; Rumelt, 1974). Although both types of studies draw conclusions about synergistic gains, they are defining slightly different constructs and may be introducing biases in measurement and interpretation that are obscuring rather than clarifying our understanding of relatedness and synergy. The CAR approach assumes that the capital market forms unbiased estimates of the potential for value creation in acquisitions and mergers (Seth, 1990). These estimates are reflected in the abnormal (above and beyond general market movements) returns to the acquiring firm's stock surrounding a particular merger transaction (Slusky and Caves, 1991). Seth (1990: 107) criticizes this approach, noting, 'The operationalization of synergy necessarily involves, as the unit of analysis, the combined entity . . . [rather than defining synergy as] . . . the property of the bidding or target firm.' Event studies are oriented toward the announcement 'event' rather than development of sustained advantage. It is inherently an *estimate of potential synergy* that may or may not be realized in subsequent years.

Some of the diversification–performance literature has attempted to assess *actual, rather than potential, synergistic gains* by comparing the longer-term financial performance of single and diversified organizations. In most of these studies, synergistic gains were measured as corporate-level return on assets or return on investment. These measures, although used often, may fail to tease out the specific cost savings and market advantages of particular combinations of businesses within the portfolio. In addition, aggregate measures of return on assets are contaminated by methods of asset valuation, tax considerations, and one-time write-offs. Suppressed levels of investment and depreciated assets may show higher returns, but may not be tapping operating synergies.

We were interested in a measure of actual synergy, not estimated or potential synergy. In our view, synergy is realized when two business units are more profitable or more competitive together than they would have been alone. The benefits derived from the combination must be greater than the capabilities of each unit alone, plus the cost of the deal (if an acquisition was involved), plus the ongoing costs of coordination, plus any opportunity costs incurred. Synergy is value creation over the long term, reflected in *superior operating profitability that is sustained over a multiyear period*. Given our hypotheses and research focus, we needed to measure profitability at the business unit level. We chose to measure performance as operating-level return on sales (ROS) over a 5-year period. ROS is a measure of operating profitability that should capture effectively any cost savings and competitive benefits of coordinated multibusiness manufacturing. Also, operating-level ROS is not contaminated by tax considerations.

Measuring implementation and coordination

In assessing coordination, we gathered information in three areas: (1) evidence of managerial intent to create synergies (INTENT); (2) evidence of actual resource and activity sharing (ACTION); and (3) evidence of use of administrative mechanisms to coordinate between the two related manufacturing organizations (MECHANISMS). We developed our list of administrative coordinating mechanisms by adapting previous research findings to the specifics of manufacturing-relatedness. Galbraith (1973), building on the work of Lawrence and Lorsch (1967), created a hierarchy of coordinating mechanisms for integrating interdependent groups that included goal-setting and planning processes, committees and teams, liaisons, and permanent integrating roles and departments. Subsequent

research on coordination has offered additional mechanisms: (1) human resource management practices that link rewards to coordination; (2) career paths that encourage a broadened perspective; and (3) socialization activities that encourage communication and shared vision (Galbraith and Nathanson, 1978; Govindarajan, 1988; Gupta and Govindarajan, 1991; Martinez and Jarillo, 1989; St. John and Rue, 1991).

In measuring coordination, we used a formal case research protocol (Yin, 1989), with data collection from public sources and structured interview. As Romanelli and Tushman (1994) have noted, business press articles, 10-K forms, and annual reports provide a rich base of stories about organizational activities. First, we collected and independently reviewed public documents including annual reports, 10-Ks, and all published articles for all the years of the study (1987–92). The coding sheet shown in the Appendix shows how we defined the domain and organized observations and events within each firm. Since public documents are likely to have a positive bias in their representation of organization activities, we also conducted selected telephone interviews with manufacturing vice-presidents and directors in those high- and low-performing organizations that would agree to participate (Appendix). We then compiled our findings and drew conclusions about patterns within firms.

Data analysis

Information on business units (BUs) was drawn from the Compustat Industry Segment File, which contains data on over 6000 companies reporting as many as 10 business segments.[2] The objective was to determine whether a single organization was involved in multiple BUs that were either tightly or loosely linked with one another. Within a firm portfolio, each BU was compared to every other BU, using both the primary and secondary SIC code.[3] If two BUs showed SICs that were loosely or tightly linked, based on our previous classification of pairs of industries, then the operating profit and sales for the two units were combined to calculate a weighted measure of ROS. To calculate ROS, we made use of as many years of data as were available from COMPUSTAT. ROS was the average for the combined units during the period 1986–92. The middle year, 1989, was selected as the basis for determining linkages across business units. Combined units with fewer than three years of data were excluded from the study.

Hypothesis testing

Our first two hypotheses required that we compare the BUs of manufacturing-related firms to two control groups: (1) same-industry BUs within other diversified firms (using two methods); and (2) same-industry single-business firms. For each case, we first analyzed loosely linked BUs, then repeated the analysis with tightly linked BUs separately. Paired comparison *t*-tests were used to determine the significance of the differences between BUs and their comparison groups, while controlling for industry effects.

1. *BUs in diversified firms, method one.* We reviewed the entire data base of business segments and formed two groups: (1) the BUs from manufacturing-related portfolios (loose and tight linkages); and (2) the control group,

[2] Some researchers will want to know why we chose to use COMPUSTAT data rather than FTC data for our classifications. As described by Roquebert, Phillips, and Westfall (1996), the COMPUSTAT data base (1) is more recent (FTC represents mid–late 1970s) and represents more years of data, (2) is broader in scope (746 manufacturing SICs compared to 260 for FTC), (3) includes a larger sample of lines-of-business, and (4) includes a more diverse sample (FTC is biased toward larger, successful firms).

[3] Scherer (1979) and Bentsen (1979) have noted that interpretations of line-of-business segment definitions and the data reported for them can vary widely from corporation to corporation. Corporations may apply looser or tighter definitions of business activities when drawing the boundaries around a BU, which may result in inaccurate business descriptions and invalid segment performance data. As Scherer notes, however, segment data are widely used in industry, which suggests that the data are viewed, for the most part, as reliable and valid. We attempted a small test of the degree to which BUs included product categories that were unaccounted for in the SIC descriptions. Moody's Industrial and OTC Industrial Manuals contain detailed product listings for many of the companies found in the BU data base. In some cases, those product listings are separated by BUs. We randomly selected 38 pairs of BUs, 20 of which were thoroughly profiled by Moody's with detailed product listings grouped by BU. In none of the 20 cases would our classification (no-links, loose-links, or tight-links) have changed, which suggests there are no serious, glaring problems underlying our reliance on segment reporting. Of course, if a company were intent on concealing a product or small business, it could hide it from Moody's as well.

which included business units that were part of diversified portfolios with *no* loose or tight manufacturing linkages. We found 170 tightly linked BUs and 296 loosely linked BUs that had sufficient financial information for the comparison to control groups. To form the control group, we sorted the BUs by 4-digit SIC code, then calculated average industry ROS across the 5-year time period.

The final comparison figure for this analysis was a weighted industry average based on the amount of sales of each firm in each of the two 4-digit industries. For example, if a corporation had sales of $10 million in BU 1, which was tightly linked to BU 2 with sales of $20 million, the comparison figure would be calculated by multiplying the 4-digit industry ROS for the primary SIC of BU 1 by 10/30 and the 4-digit industry ROS for the primary SIC of BU 2 by 20/30 and then summing the two figures.

2. *Diversified firms, method 2.* We also ran a test based on degree of relatedness of the control group. According to Palepu (1985) and consistent with the widely used entropy measures of diversification, two businesses are related if they operate within the same 2-digit SIC industry. We compared all of the business units within a firm based on their primary SIC codes. The related BUs were placed into one control group, while the unrelated BUs were placed into the other. We then compared the performance of our tightly linked and loosely linked businesses with each of the control groups.
3. *Single-business firms.* Using the single-business unit firms, we calculated average ROS and made the matched industry comparisons with our tightly linked and loosely linked manufacturing BUs. One hundred fifty three tightly linked BUs and 263 loosely linked BUs had complete financial information for the single business comparisons.

Next, we used the qualitative data collected from public sources and selected interviews to profile the related firms within two groups: (1) those that showed performance that was significantly higher ($p < 0.05$) than their industry mean ($n = 15$); and (2) those that showed performance that was significantly lower than their industry mean ($n = 16$). The qualitative data on intent to create synergy, resource and activity sharing, and use of administrative coordinating mechanisms was analyzed by recording observed incidents and then categorizing the firm as '+, 0, or −' on each dimension. For example, a firm could receive a '+' score for 'intent to create synergy,' indicating that there was evidence in the public documents that synergy was valued and encouraged. However, the same firm could receive a '0' score on resource and activity sharing because there was insufficient evidence to make a classification. A score of '−' was assigned if there was evidence that they did not believe in synergy creation or clearly did not share resources. Interval scaling of these dimensions was not attempted because the data were too subjective to force further accuracy.

We reviewed the public documents for the 31 firms first, then contacted manufacturing management about participating in a structured interview. Thirteen firms agreed to participate in the interview process. When a firm had been assigned a score of '0', the interview response was used to adjust the score to '+' or '−.' In two cases, the interview data contradicted the previous classification from public documents. We chose to use the direct interview responses as the basis for a new classification.

RESULTS

Our first hypothesis predicted that business units in firms exhibiting a pattern of manufacturing-based relatedness would outperform same-industry business units in firms exhibiting other forms of diversification. We did not find support for our hypothesis, using either of the two methods for forming control groups, whether manufacturing links were loose or tight. In essence, manufacturing-based relatedness and other forms of diversification did not yield differences in 5-year operating margins, on average. The result of the paired comparison *t*-tests are shown in Table 2. The findings suggest that, on average, across the full sample of firms, manufacturing relatedness was not providing a source of competitive advantage within diversified firms.

Our second hypothesis proposed that firms exhibiting a pattern of manufacturing-based relatedness would outperform single-business competitors in the same industry. We did not

Table 2. Results of paired comparison *t*-tests

	N	Mean of group differences in 5-year operating margin (dependent variable)	Standard error	*P*-value
SERIES OF TWO GROUP COMPARISONS				
Diversified BUs (Method 1)				
Tightly linked vs. BUs in diversified firms	170	–0.013	0.007	0.065
Loosely linked vs. BUs in diversified firms	296	–0.010	0.005	0.057
Diversified BUs (Method 2: Palepu)				
Tightly linked vs. related BUs	108	0.007	0.005	0.151
Tightly linked vs. unrelated BUs	130	0.007	0.006	0.265
Loosely linked vs. related BUs	196	–0.003	0.005	0.549
Loosely linked vs. unrelated BUs	232	0.007	0.005	0.151
Single-business comparisons				
Tightly linked vs. single businesses	153	–0.007	0.009	0.454
Loosely linked vs. single businesses	263	–0.009	0.006	0.163

Note: Samples sizes vary by method and form of coupling because of our requirement for same-industry BU matching.

find statistical support for this hypothesis either, which indicated that, on average, manufacturing-related firms were not deriving 5-year average operating income performance advantages from their combinations. The test of Hypothesis 2 is also shown in Table 2.

At this point, our research shifted from a focus on large-sample hypothesis testing and quantitative data analysis to a focus on qualitative differences between those firms that seemed to have created synergies and those that definitely had not. The summary comparison of intent, action, and administrative mechanisms within high- and low-performing firms is shown in Table 3.

As the results show, we found evidence to support that 67 percent of high-performing firms intended to create synergy (INTENT) and shared some resources and activities (ACTION), such as purchasing and engineering. We found evidence that 80 percent of those high-performing firms that had indicated they were seeking synergy employed various administrative mechanisms for achieving coordination (MECHANISMS), such as technology review committees, task forces, and combined strategic planning processes.

Only two of the 15 high-performing firms clearly did not value synergy and were aggressively promoting separation and autonomy. The public documents on three high-performing firms were insufficient to make a classification and their manufacturing directors did not agree to participate in the interview process.

In our profiles of low-performing firms, we found evidence that 37 percent valued synergy and were attempting to share resources and activities such as some overhead functions. Only one firm (16% of synergy-seeking low performers) employed any administrative mechanisms for achieving ongoing coordination. Of the six low-performing firms that participated in the structured interview process, all indicated no use of administrative mechanisms to achieve coordination between business units. Many of the low-performing firms indicated efforts to coordinate between functions (marketing and manufacturing, or marketing and R&D) *within* businesses, but coordination *across* businesses was virtually nonexistent.

The overall picture of high-performing firms shows they were more likely than low-performing firms to value synergy creation, share resources and activities, and employ administrative mechanisms for coordination. Furthermore, of those high-performing firms that valued synergy creation and worked to share resources and activities, 80 percent employed ongoing administrative mechanisms for coordination. In contrast, only 16 percent of the synergy-seeking low performers employed ongoing mechanisms for coordination. Although chi-square tests of the association between performance category and INTENT and ACTION were not significant, a chi-square test of the association between performance category and use of administrative mechanisms was sig-

Table 3. Results of qualitative analysis of high and low performers

	High Performers (n = 15)	Low Performers (n = 16)
Intent	**67%** of high performers (10 of 15) expressed synergy intent	**37%** of low performers (6 of 16) expressed synergy intent
Action	**67%** of high performers (10 of 15) initiated sharing action	**37%** of low performers (6 of 16) initiated sharing action
	All of the high performers that expressed synergy intent initiated sharing action	**All** of the low performers that expressed synergy intent initiated sharing action
Mechanisms[a]	**53%** of high performers (8 of 15) employed coordinating mechanisms	**6%** of low performers (1 of 15) employed coordinating mechanisms
	80% of the high performers that expressed intent and initiated sharing also employed coordinating mechanisms	**16%** of the low performers that expressed intent and initiated sharing also employed coordinating mechanisms

[a]Chi-square test of the association between performance and use of administrative mechanisms significant at $p = 0.002$

nificant at $p = 0.002$. High-performing firms made significantly more use of administrative mechanisms for achieving coordination than did low-performing firms. Table 4 provides a full description of the qualitative data.

DISCUSSION

The purpose of this work was to add to the existing diversification–performance literature on three fronts. First, following the logic of the resource-based theory of the firm and the lead of some recent researchers (Brush, 1996; Robins and Wiersema, 1995; Shelton, 1988; Slusky and Caves, 1991), we identified resource and activity similarities between industries as a way of capturing relatedness and synergy potential. By profiling resource similarities, rather than proximal SIC codes, we hoped to capture real sources of technological and operating synergies. Second, by moving away from the 'event' orientation of much of the synergy research (Chatterjee, 1986; Nayyar, 1993; Niden, 1993), we hoped to capture sustained performance differences rather than the stress of high debt or the speculative abnormal gain from a recent acquisition.

Third, we examined the next link in the process: implementation. Previous research has examined the relationship between organization performance and relatedness among businesses within a corporate portfolio, with conflicting results. The ambiguous results about the diversification–performance link may be partly explained by differences in implementation. In this study, we attempted to profile commitment, actual resource and activity sharing, and use of administrative mechanisms to achieve coordination between business units. By exploring implementation differences that exist between the outlier high and low performers, we hoped to offer normative conclusions about the role of implementation in achieving synergy with manufacturing-related diversification strategies.

The methodology we used in this study represents a departure from much of the empirical diversification literature. Much of the early work was based on Rumelt's (1974) pioneering study and made use of part or all of his classification system (Hoskisson and Hitt, 1990). Limitations associated with this approach led researchers to develop and improve continuous measures of diversification. The most commonly used of these measures, the entropy index (e.g., Jacquemin and Berry, 1979) and the concentric index (e.g., Montgomery and Hariharan, 1991), are both based on the hierarchical scheme implied by the SIC system. As Robins and Wiersema point out, 'The SIC system is a weak source of information on substantive relationships among industries' (1995: 281). They argue convincingly that measures such as the entropy or concentric indices

Table 4. Profiles of high and low performers

Company ID	Intent	Action	Mechanism
High performers			
A	$-_{DI}$	$-_{DI}$	$-_{DI}$
B	$+_{DI}$	$+_{DI}$	$+_{DI}$
C	$+_{DI}$	$+_{DI}$	$+_{I}$
D	0_{D}	0_{D}	0_{D}
E	0_{D}	0_{D}	0_{D}
F	$+_{DI}$	$+_{DI}$	$+_{DI}$
G	$+_{DI}$	$+_{DI}$	$+_{DI}$
H	$+_{DI}$	$+_{DI}$	$+_{DI}$
I	$+_{D}$	$+_{D}$	$+_{D}$
J	$+_{D}$	$+_{D}$	$+_{D}$
K	$+_{I}$	$+_{I}$	$+_{I}$
L	0_{D}	0_{D}	0_{D}
M	$+_{D}$	$+_{D}$	$+_{D}$
N	$-_{D}$	$-_{D}$	0_{D}
O	$+_{DI}$	$+_{DI}$	$-_{I}$
Low performers			
AA	0_{D}	0_{D}	0_{D}
BB	$-_{I}$	$-_{I}$	$-_{I}$
CC	$-_{I}$	$-_{I}$	$-_{I}$
DD	$-_{D}$	$-_{D}$	$-_{D}$
EE	$+_{D}$	$+_{D}$	0_{D}
FF	$-_{DI}$	$-_{DI}$	$-_{DI}$
GG	$-_{I}$	$-_{I}$	$-_{I}$
HH	0_{D}	0_{D}	0_{D}
II	$+_{D}$	$+_{D}$	$-_{D}$
JJ	0_{D}	0_{D}	0_{D}
KK	0_{D}	0_{D}	0_{D}
LL	$+_{I}$	$+_{I}$	$-_{I}$
MM	$+_{D}$	$+_{D}$	0_{D}
NN	$+_{D}$	$+_{D}$	$+_{D}$
OO	$+_{I}$	$+_{I}$	$-_{I}$
PP	0_{D}	0_{D}	0_{D}

+ indicates evidence that the firm has demonstrated this factor (intent, action, or mechanisms)
0 indicates evidence was insufficient to make a classification decision.
– indicates evidence that the firm does not support or use this factor.
D designates a classification made with public documents.
I designates a classification based on interview.
DI designates a classification based on both public documents and interview.

lack content validity; that is, they are inadequate measures of the construct of relatedness.

As noted earlier, our study is similar to Robins and Wiersema (1995) and Brush (1996) in some respects. Most importantly, all three studies used SIC-coded data but did not rely on the hierarchical relationships found in these data. Instead, the studies incorporated a broader base of information to study interrelationships that exist among industries. Robins and Wiersema (1995) and Brush (1996) used information on technology inflows and outflows estimated by Scherer (1982) as indirect indicators of strategic similarity between industries. Our system was developed around several manufacturing-based factors which provided more direct evidence of the strategic similarities that might influence the potential for synergistic relationships. Robins and Wiersema (1995) take the position that conceptualizing relatedness in terms of shared strategic assets rather than operational linkages is particularly important to advancing research on related diversification. Our measures are consistent with their logic. Since the business units we studied, by definition, are operated separately and report their own sales and profits, the greatest potential for synergy exists in the sharing of the intangible rather than the tangible. Two business units with similar raw materials, science, technology, and resource conversion processes, have the potential to share knowledge and skills that can enhance both units. However, we recognize that the potential for tangible relatedness also exists to the extent that, for example, two units might cooperate in the purchase of common assets or transfer work amongst themselves. A major difference and advantage of our approach is that we followed up with what amounted to a second study on the outliers (high and low performers). In this second phase, we measured specific synergy-creating behaviors.

Our research results are important for what we *did* and *did not* find. Although conventional economic and strategy theories suggest that relatedness should provide opportunities for synergies, we found no evidence to suggest that, *on average*, potential manufacturing synergies were converted into superior cost savings or improved competitive position, both of which should lead to improved profitability. If manufacturing synergy had been realized from the sharing or coordination between two related organizations, then the operating profit of the combined organizations should be superior to that of single businesses competing within the same industry. To the degree profits are not better, then synergy has not been realized. Performance benefits are not accruing preferentially to multibusiness firms.

This result is not that surprising, however. Porter (1985) has argued that few organizations have succeeded in achieving coordination and

synergy among multiple business units. While widespread gains from relatedness were not observed, certainly some firms had achieved synergies from their multibusiness strategies, and were the subject of our second stage of data collection and analysis. We found that most high-performing, manufacturing-related firms did value synergy creation. They aggressively pursued resource sharing and employed administrative mechanisms to achieve coordination. Seemingly, relatedness in human and physical capital resources is a necessary but not sufficient condition for creating the synergies. Instead, organization capital resources such as planning, controlling, and coordinating systems (Barney, 1991) must be employed in synergy creation as well.

In the public documents of some of the high performers, there was evidence of more than a general interest in achieving synergy—there was a passion for the value of efficient coordinated manufacturing. These firms exhibited a dominant manufacturing logic (Grant, 1988; Prahalad and Bettis, 1986). They knew their core resources and capabilities were in manufacturing and technology management and emphasized preservation of those capabilities through a strong manufacturing and technology focus. In discussing its diversification growth strategy of the previous several years, one company reported the following in its 1988 annual report:

> More importantly, the operations that make up Magnetek today were selected because they have much in common . . . Whether they build a/c motors or repair utility transformers, they are engaged in electrical design and engineering, and they utilize the same or similar materials, components, and processes. In short, they fit well together.

The majority of the low-performing manufacturing-related firms did not seek coordination and synergy at all. Follow-up interviews within six of these firms suggested that even when synergy-seeking was talked about, it was not pursued in a systematic fashion. The causal relationship is very unclear, however. We do not know if synergy-seeking was ignored because the organization's performance problems required that other matters be given a higher priority, or if failure to exploit synergies is an indicator of other implementation problems. Clearly there is a need for further study of synergy and coordination drawing from larger samples and capturing longer time frames. Although the firms we studied had been involved in their multibusiness strategies for many years preceding our analysis, the possibility exists that some firms had realized synergies in the past or would realize them in the future. Another limitation of our work may be our exclusive focus on related *manufacturing* resources and activities. We did not explore other forms of relatedness that could be exploited to achieve advantages. There is a possibility that some of the performance differences in our high and low groups may be partly explained by synergies derived from marketing relatedness, which may result in an overestimate of the benefits of manufacturing relatedness.

Development of synergies across related business units is the key to development of a corporate-level manufacturing-based distinctive competence. Development of a corporate-level manufacturing strategy that establishes horizontal linkages and exploits manufacturing commonalities or relatedness would seem to be an avenue to improved competitive performance. Further study is needed of the organizational barriers to manufacturing synergies, implementation mechanisms for achieving synergies, and measurement systems for evaluating the costs and benefits of synergies at the business unit and corporate levels. These and related topics should provide fruitful avenues for future research.

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APPENDIX: QUALITATIVE DATA COLLECTION INSTRUMENTS

Synergy worksheet: Public documents

I. Intent
   a. Managers value synergy creation
   b. Announcements of *plans* to share
      1. facilities
      2. technologies
      3. personnel
      4. programs
      5. research
      6. supplies

II. Actions
   a. Evidence of *existing* shared
      1. facilities
      2. technologies
      3. personnel
      4. programs
      5. research
      6. supplies

III. Coordinating mechanisms

a. top management commitment
b. joint (between business units) planning sessions
c. joint planning documents
d. committees and task forces (with representatives from both units)
e. standing task forces and teams (reps from both units)
f. use of common or linked information systems to coordinate production schedules, supply arrangements, and shared warehouses and facilities
g. business, department, and individual performance evaluation and rewards that encourage cooperation/sharing between business units
h. special liaisons between units whose jobs are to ensure coordination
i. career paths that encourage movement between groups.
j. informal gatherings and socialization efforts

IV. Other events that can explain performance
V. Other evidence that supports notions of efficiency, cost reduction, focus, diversification, etc.