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Up Against The Walls: A Comparison of Cross-Functional Capability in U.S. and Japanese Automobile Companies

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ABSTRACT

The competitive environment of the 1990s demands internal processes with highly evolved capability to coordinate and integrate across previously isolated functions-- the ability to breach the "walls" that exist within firms. A growing response to these demands by many companies has been the creation of cross-functional teams. Four models of cross-functional organization used in product development are presented and discussed based upon comparative case studies of two American and two Japanese automobile companies. Results suggest that U.S. and Japanese firms appear superficially similar but differ in subtle ways, involving tacit skills and behavioral routines. These capabilities appear to constitute a key resource in product development performance.

Large American industrial organizations in the recent past were typically organized as "chimneys"-- a collection of specialized, functional units managed vertically through formal systems aimed at cost control. Under this model, individuals were held accountable for producing specific results through a formal hierarchy and typically spent their entire careers working within the "walls" of one functional chimney. Managers' jobs were geared primarily toward monitoring and controlling employees in the interest of maximizing their function's performance. Indeed, functional units (e.g. R&D, engineering, manufacturing, marketing) often competed with one another for scarce resources (Galbraith, 1977; Kanter, 1983).

While "chimney"-based organizations facilitated the development of deep expertise and predictable results, they were also notoriously slow and cumbersome. Conflicts tended to rise through the functional units, requiring resolution by senior managers who were often ill-equiped to make such trade-offs. The result was that decision-making was based upon cost criteria using highly abstract data collected from the operations (Hayes and Abernathy, 1980; Johnson and Kaplan, 1987; Byrne, 1993).

The competitive environment of the 1990s, however, demands capability far beyond cost control-- it requires the ability to deliver *high-quality* products at *low cost* (Porter, 1980) in the least elapsed amount of *time* (Stalk and Hout, 1990), and with the least *waste and pollution* (Schmidheiny, 1992). Such capability appears to demand greatly improved coordination and integration across previously isolated functions within firms. Developing such capability requires wholesale redefinition of the roles of executives, middle managers, and line workers, particularly with respect to the development and production of new products and services.

A growing response by many companies to this competitive challenge has been the creation of cross-functional teams: working groups with linkages to multiple sub-units created as an overlay to the existing functional organization (Dumaine, 1990). Despite the rapid development of this new organizational form (Takeuchi and Nonaka, 1986), however, research on the topic has lagged. Noteworthy exceptions include the work of Ancona and Caldwell (1987), Donnellon (1990), Womack, Jones, and Roos (1990), and Clark and Fujimoto (1991).

Building upon this base of research, a comparative study was undertaken in four auto companies-- two based in the U.S. and two in Japan. The objective was to gain insight into the cross-functional structures and processes that are associated with the highest levels of effectiveness in product development. The research entailed interviews with key executives and managers in each company, and direct observation of development programs and the teams that comprise them.

This paper presents an overview of the results of this study. After outlining the strategic context of new product development capability, and developing a resource-based view of this skill, we describe the inductive research process used to identify the key differences between American and Japanese models of cross-functional management (Glaser and Strauss, 1967). The paper closes with a discussion of the managerial and strategic implications. Results suggest that even though the formal structures of American and Japanese product development are converging, there is still a wide discrepancy with regard to the more tacit process and behavioral aspects of cross-functional management.

STRATEGIC CONTEXT

In many industries, the basis for competitive advantage has been moving increasingly toward fast-cycle capability (Stalk, 1988) and environmental responsibility (Hart, 1993). This trend is particularly salient for original equipment manufacturers that produce complex products such as automobiles, computers, and electronics. While expertise in basic science and well-managed research programs are important in this regard, of particular concern is the ability to develop and commercialize products based upon that science and technology (Gomory, 1989). Evidence suggests that fast-cycle firms commercialize two times as many products and processes as do their competitors, incorporate twice as many technologies in their products, and bring their products to market in less than half the time of their competitors (Nevens, Summe and Uttal, 1990), while also minimizing emissions and effluents to the environment (Cairncross, 1992; Schmidheiny, 1992). This translates into more customer-focused products which incorporate the latest technology and produce the least waste. The performance implications of such cross-functional capability appear equally staggering: Fast-cycle companies with a strong customer focus not only grow three times faster than their competitors, but are also twice as profitable (Stalk and Hout, 1990, Stalk and Webber, 1993). The higher level of profitability stems from cost advantages attributable to speed such as lower overhead, higher asset and labor productivity, faster inventory turns, and lower raw material and energy costs (Schmenner, 1988).

Studies suggest that in most organizations, less than 5% of the time between receipt of an order and shipment of a product is spent actually adding value (Stalk and Hout, 1990). There are many reasons for this astonishing lack of efficiency: Functional experts have tight schedules resulting in delay, time is lost working between different locations, executives are busy perfecting the approval process, and people cycle in and out of projects, resulting in start-up costs and loss of experience

(Bower and Hout, 1988). Perhaps most significantly, specialists often work at cross purposes, cancelling each others' contributions. All this suggests that there is tremendous room for improvement-- but only if cross-functional processes are drastically redesigned to achieve higher levels of coordination and integration.

THE DYSFUNCTION OF THE FUNCTIONS

The problem of coordination and integration among disparate functions or sub-units of organizations has been a central concern of organizational theorists for decades (Taylor, 1911; Barnard, 1938; Trist and Bamforth, 1951; Lawrence and Lorsch, 1967; Mintzberg, 1979). Never before however, has this feature of organizational design received such attention as a critical factor in the capability of large organizations to develop new products (Takeuchi and Nonaka, 1986) and to achieve competitive success (Womack, Roos, and Jones, 1990). Indeed, the problem of sub-optimization-- achieving local efficiency to the detriment of the whole system-- as first posed by Simon (1947), has now returned to center stage for both scholars and practitioners.

Before beginning to describe models of cross-functional organization, it is worthwhile to briefly consider the prior question, "What is a function?" While many have been content to simply list the departmental names on an organizational chart (finance, marketing, production, etc.) the pursuit of sub-organization goals can in fact take on many forms (eastern sales region, the start-up team, department of quality control circles, etc.). A more basic approach seems to require that "functions" be defined as identity groups with specific sub-unit interests, which operate within a dynamic field of intergroup relations in an organizational context (Schein, 1965; Alderfer and Smith, 1982; Brown, 1983).

In addition to intergroup dynamics, several other types of forces help create the "functional" conflicts that cross-functional teams are created to resolve.

Although suboptimization has been treated primarily as a cognitive phenomenon (Simon, 1947; Dearborn and Simon, 1958), it is readily apparent that there are a number of other influences that reinforce functional behavior. Careers and internal labor markets (Rosenbaum, 1984) exert a strong coercive force on members of any function, as does the allocation of resources (Pfeffer and Salancik, 1978). For example, in one of the organizations that we studied, even the resources allocated to cross-functional teams were controlled by functions. In another part of the same organization, cross-functional product development teams controlled many of their own resources, but the cost analysis expertise necessary to make product decisions still resided in the engineering function.

In addition to these structural considerations, Donnellon (1990) and others have pointed to the individualistic nature of American business culture as a factor that limits coordination across functions: A strongly held belief "that competition produces better effort and outcomes" (Donnellon, 1990, p.2), that specialization is synonymous with expertise, and that innovation springs forth from individual genius, all encourage functional behavior and thought.

These cognitive, structural, and resource dynamics are often dysfunctional because they tend to create barriers to coordination. All of these influences tend to focus attention toward the suboptimal goals of the organizational sub-unit and away from the broader supraordinate goals of the firm. Several examples of functional thinking and behavior and their consequences stand out from our interviews and help to illustrate the nature and importance of this problem. The following story is a classic illustration of the consequences of inadequate coordination between the functions of product design, product engineering, manufacturing engineering, and production. This story was referred to by several different individuals within one of the organizations we studied as the "whistling car" story:

> On one new car platform, the chassis had been completely redesigned by the product engineers. When this design was given to the manufacturing function to build, it was discovered that the new chassis would not submerge in the paint vats. One manufacturing engineer discovered that a series of holes could be drilled in the chassis without weakening the structure, allowing it to sink in the paint. The problem was solved. Unfortunately, upon final assembly, it was discovered that the car made a high-pitched noise whenever it exceeded 60 MPH. The marketing organization, charged with the responsibility of selling this vehicle to customers, fecetiously dubbed it the "whistling" car.

This illustration demonstrates vividly the dysfunction of the functions: A decision (drilling holes in a chassis) was taken that reflected the goals, constraints, and viewpoints of one sub-unit of the organizational system. When compared to the needs of a final customer or the needs of the system as a whole, the decision was clearly sub-optimal, but, as the example illustrates, a functionally defined organization seldom makes these comparisons.

A RESOURCE-BASED VIEW OF CROSS-FUNCTIONAL CAPABILITY

In contrast to industrial organization economics, which adopts a largely static, "entry deterrence" philosophy to competition (Rumelt, Schendel, and Teece, 1991), the resource-based view conceives of the corporation as a unique and evolving set of resources and capabilities (Wernerfelt, 1984; Ulrich and Lake, 1990). Capabilities and skills, such as product development, manufacturing, or sales and service networks are best developed internally, because they are not readily available on fungible factor markets (Dierickx and Cool, 1989). The resource-based view thus holds that competitive advantage is gained through the accumulation of intangible assets with imperfect imitability and substitutability (Itami, 1987; Barney, 1991). Resources with a strong tacit dimension--social complexity or causal ambiguity-- provide effective protection from competitors (Rumelt, 1984; Teece, 1987). Would-be imitators are twarted by the difficulty of discovering and replicating the development process employed by the firm, and by the considerable time lag involved (Dierickx and Cool, 1989).

Powell (1992), for example, applied the resource-based view to examine whether formal strategic planning offered a basis for competitive advantage. Results indicated that formal planning provided economic value only in a context where it had not yet been fully disseminated among competitors. He therefore concluded that "strategic planning may provide economic value in many contexts, but it is not-- under the resource view-- a source of sustainable competitive advantage: it is imitable, it is substitutable, and it is no longer scarce" (p. 33).

While an interesting application of the resource-based view to strategy, Powell's (1992) study contained a curious inconsistency: wide dissemination of knowledge about the *structure* of formal planning systems on the part of competitors does not necessarily imply that all firms will demonstrate the same ability to actually *use* the systems effectively. In fact, the resource-based view would predict that it is the tacit, "capabilities in use" that would constitute the firm "resource" and not the knowledge of the structure per se. Hart and Banbury (1994), for example, presented empirical evidence that firms able to accumulate more complex resources and capabilities in strategy-making by deepening strategic involvement and fostering more interactive communication, outperformed firms with simpler, less inclusive strategic processes.

Accordingly, this study examines the linkage between formal, structural characteristics of product development (e.g. cross-functional team design) and the more subtle aspects of cross-functional capability (e.g. tacit skills and behavioral routines). Guided by the resource-based view, we would expect the tacit skills and capabilities to be important contributors to sustained success in new product development.

METHODS

A comparative study of four major corporations in the world automobile industry was adopted for this study. This design afforded the greatest likelihood of identifying the socially complex, team-embodied skills that we expected to characterize successful new product development. Two of these companies were based in the U.S. (Ford and Chrysler) while the other two were based in Japan (Honda and Mazda). The two Japanese firms had achieved sustained excellence in product development performance over the previous decade (1980s), while the two American firms achieved success on a more sporadic basis during this period, hitting the occasional "home run" in product development (e.g. Ford Taurus, Chrysler mini-van).

Ford was clearly the largest in size with sales of nearly $100 billion in 1992 compared to $20-30 billion in sales for the other three study firms. However, both Ford and Honda had significant positions in Europe, the U.S., and Japan. Honda and Mazda had significant positions in the U.S., while Ford was the only U.S. competitor with any real presence in the Japanese market. Chrysler was focused largely on the American market. Thus, the four study firms included large and small competitors, with global as well as domestic strategies.

Unlike previous studies of the auto industry (e.g. Womack, Jones, and Roos, 1990; Clark and Fujimoto, 1991), our research took a closer look inside the organizations, with an eye toward uncovering the more subtle processes and practices that are less visible in larger scale, survey studies (Glaser and Strauss, 1967). In each organization, we interviewed members of top management, as well as managers in product development and manufacturing. Several working engineers and product development team members were also interviewed in each of the four firms. In one of our study firms (Ford), we also spent considerable time observing product development teams in action. Data on the U.S. firms were collected over a three year period (1991-93), whereas the Japanese portion of the study was conducted through an intensive field study during the summer of 1992. The results reported here comprise our initial efforts to coalesce these data into a set of overall findings with regard to cross-functional capability.

A specific set of questions guided the interviews (see Appendix), but the interviewer(s) resisted the approach of asking the same questions each time and aggregating responses. Instead, each successive interview was used to expand our understanding of the organization. In every case, however, we were careful to obtain multiple responses to a common core of questions pertaining to the product development process and cross-functional management. This effort was enhanced by the fact that many of our interviews were conducted in group settings, allowing us to explore the difference in perspective that existed among participants to the process.

Whenever possible, interviews were recorded, and then later reviewed and re-analyzed. When a professional Japanese translator was used, the Japanese co-author later reviewed the tapes to compare the responses and the translation to ensure accuracy. For all interviews, there were at least two people present from the study team. Extensive notes were taken during each interview and debriefing following each interview allowed for cross-checking of data and interpretations. This facilitated the identification of integrative themes within specific cases and later, between cases.

RESULTS

This section first presents descriptive findings about formal structure before delving into the analysis of tacit capability. Specifically, we begin by presenting four models of cross-functional organization that emerged from the field research, using the work of Hayes, Wheelwright, and Clark (1988) as a point of departure. We then assess the position of each of the study firms with respect to these models. The section closes with a detailed analysis of four subtle differences among the firms which were not captured by the structural models.

Cross-Functional Structures

In their study of the world auto industry, Hayes, Wheelwright, and Clark (1988) described four distinct types of cross-functional organizations, with special emphasis upon product development: functional structures, "light-weight" project manager, "heavy-weight" program manager, and product team. Our research confirmed these models, but also identified a new type of product development organization-- the Platform Team (instituted at Chrysler over the past four years). Since all of the companies we studied had moved beyond a purely functional structure, the comparative analysis suggested four models of cross-functional organization: Project Teams, Program Teams, Dedicated Teams, and Platform Teams. Figure 1 provides a graphic summary of each of these structures.

Following the conventions set by Hayes, Wheelright, and Clark (1988), the rectangular boxes represent functional subunits, and the horizontal relations represent various kinds of project or program coordination. Functional organizations (e.g. departments in Engineering, Manufacturing, and Marketing) are supervised by functional managers (FMs). Personnel at the working level are shown as large circles; the smaller dots are "liason" people (L) who represent the functional unit. A program or project manager (PM) coordinates efforts across functional units. The dotted ovals represent the areas in which the PM exercises strong influence. The area of influence may be limited to engineering or extend to production, marketing, or even the market itself.

<Insert Figure 1 About Here>

Project Teams. The first approach to cross-functional structure (upper-left corner of the figure) takes a small step toward solving the problems of coordination and sub-optimization associated with the traditional functional design. Here, people still reside in the functions, but each functional organization selects people to represent it in a project team. These "liaisons" are expected to speak for and "deliver" their home functional organizations; that is, they should be able to commit their functions to performing specific tasks on a set time schedule. They work with a project manager who has responsibility for coordinating the activities of the different functions but has little authority to accomplish this end. In fact, under this model, the project manager often reports to one of the FM's. Furthermore, the project manager's responsibility is often limited to the product and process engineering aspects of the program. The PM's ability to influence outcomes is further limited by two factors: First, the person is usually junior in status and therefore wields little influence in the organization. Second, while the PM is responsible for coordinating project activity, the key people involved in the effort are "liaisons" who remain under the control of their respective functional managers--they are assigned to projects only on a part time basis and continue to be evaluated and rewarded by their "home organizations." Thus, while the project manager may have some influence over *what* gets done, functional managers still exercise primary control over *who* is involved, *when* they get involved, and *how* they do their work.

Program Teams. The second cross-functional structure, Program Teams, is represented in the upper-right portion of the figure. In contrast to the Project Team approach, Program Teams are headed by more senior-level people with extensive experience and visibility within the company. In some cases, they may be at the same level, or even outrank the functional managers. In short, they wield significant organizational "clout" enabling them to work as peers with key functional managers in the interest of the program effort. Quite frequently, members of such program teams will have dual reporting relationships-- they are evaluated both by the program and by their home function. The PM thus has more direct control over the people working on the team since they supervise and evaluate work on the team. However, career tracks are still defined by the functions, since team members are not assigned on a full-time basis. Program managers thus serve as "champions," exercising considerable influence over the selection, level of involvement, and supervision of program members. The program takes on more of the character of a "temporary" organization with the program manager assuming the primary leadership and coordination role. In addition to the engineering aspects, PMs are usually responsible for coordinating concept development, product planning, and manufacturing ramp-up as well.

The Program Team model is roughly analogous to a "matrix" organizational structure (Davis and Lawrence, 1977). It constitutes a significant departure from the functional model of "one-man--one-boss" in favor of a "two-boss" or multiple command system. There are three key roles associated with this approach: top leadership, matrix management, and subordinate (two-boss) management. Top leadership is literally atop, or outside of, the matrix. Executives must oversee and guarantee the balance of power in the matrix, resolve conflicts, and set the overall direction and standards for the programs. In this sense, top leadership constitutes the ultimate "tie-breaker." In contrast, the "matrix" managers-- functional and program managers-- share subordinates in common with one another. Functional managers must balance the needs of their particular area of responsibility against the overall needs of the programs. Program managers, in contrast, have all the same responsibilities as a senior executive, but do not have the same clear authority. Thus, they are left with the job of influencing with limited formal authority. They must use their knowledge, relationships, clout, and skills to get people to do what is necessary for program or business success. Two-boss managers are those individuals based within specific functional organizations who are also involved in programs. Effective two-boss managers must be able to deal with ambiguity and help resolve the inevitable conflicts which will arise between program and functional management.

This structure raises interesting questions about measurement and reward systems. With the Project Team approach, rewards are clearly administered through the functions, with obvious negative implications for speed and program effectiveness. The Program Team model, however, is more ambiguous. It sets up a matrix system with dual reporting relationships: Employees are evaluated for both their *individual* contributions to the function and their *team* contributions to product development efforts. While manageable in theory, this dual reporting approach is exceedingly difficult to implement in practice. In companies where individual performance management systems pervade the culture and team-based performance assessments are overlayed, the former often dominates the latter. For example, efforts to encourage productive teamwork are effectively nullified when the individuals are later evaluated individually and "forced ranked" for the purposes of allocating merit pay or determining promotional opportunities within the function.

Dedicated Teams. The third form of cross-functional structure, in the lower-left portion of the figure, is the Dedicated Team. Unlike either of the other two previous models, individuals from the different functions are formally assigned or "dedicated" to a program team on a full-time basis. Usually, such teams are also "co-located"-- people work together at a separate location for the duration of the program. This stands in sharp contrast to the Program Team model where work literally moves from one function or location to another as it reaches different stages of development. With Dedicated Teams, the PM is usually a "heavy-weight" in the company and has full control over the resources-- human, financial, and physical-- needed to execute the effort. In addition to coordinating the functions in product development, the PMs of dedicated teams are often in charge of concept creation and maintain direct contact with customers. Given its centrality, the program management track becomes one of the most highly desireable career paths when this model is widely used in a company. And while team members do periodically return to home functional organizations to replenish and update themselves technically, functional managers are seen more as program facilitators and husbanders of special expertise.

The use of such "dedicated, co-located" teams has significant implications for the organization of work. In order to be dedicated to a program on a full-time basis, specialists will often have to broaden their area of expertise. For example, a door handle engineer who was able to work on five or more car programs on a part-time basis under the Program Team model, may have to learn to design the entire door if he or she is to be dedicated to a single program. Consequently, it is possible to staff programs with significantly fewer people through the Dedicated Team model than either of the previous two. Indeed, data from the work of Clark, Chew, and Fujimoto (1987) on the world auto industry indicates that dedicated teams require only about half the number of people (person-hours) as the Project Team approach and less than one-quarter the number of the traditional functional organization. Furthermore, the use of program managers and dedicated teams appears to shorten the product development cycle significantly, with gains being particularly important in the concept study, product planning and design stages of the development process.

With dedicated teams, team members must also return periodically to a "functional" base to "recharge their batteries" and update on the state of the art. It is through this mechanism that new products developed with dedicated teams continue to deploy the latest technology as quickly as possible.

Platform Teams. The final form of cross-functional organization, in the lower-right corner of the figure is that of Platform Teams. While similar in most respects to dedicated teams, platform teams go one step further: The functional organizations, which provided the "home base" for employees in the previous models, are abolished in favor of lateral organizations organized by car platforms. Program managers effectively become general managers of business units since all the necessary functions and responsibilities have now been assigned to each car platform. There are no conflicting priorities with this model: All platform team members work on the platform and on the platform only.

As a mirror image to the functional organization, a key challenge to the platform teams becomes coordination *within* functions, since functional specialists are now deployed to separate platform organizations. Coordinating mechanisms such as "technology clubs" and other informal gatherings are employed to facilitate communication and transfer of ideas within functional specialties across platforms. Whether the Platform Team model can sustain functional excellence over the long run remains to be seen since the repositories of core competence (the functions) no longer exist.

The four models of cross-functional structure described above go a long way in capturing the range of approaches utilized by the companies in our study. Table 1 captures the significant design differences associated with each of the four structures and shows where the four study companies fit into this framework. While some of the nearly-completed U.S. car programs were organized as Project Teams, none of the newer product development efforts in any of the four study companies employed this structure. At the other extreme, only Chrysler had made the move to the Platform Team structure. All of the other product development programs we studied in the four firms were organized using some form of "matrix"-- either as Program or Dedicated Teams.

<Insert Table 1 About Here>

Analysis

While the four study firms evidenced only minor variations in formal structure, we uncovered several significant, but more subtle differences among the firms in product development process. As we had expected, these differences, while difficult to observe, appeared to account for product development capability more than did the structures employed (Dierickx and Cool, 1989; Barney, 1991). Four areas of subtle difference, identified through field study, are discussed below: 1. Stability of Structure; 2. Program Friendly Functions; 3. Cross-Program Coordination; and 4. Behavior versus Structure.

Stability of Structure. Since the four structures described above are static representations of dynamic processes, it is instructive to examine how our four study companies have changed over the past decade with respect to cross-functional product development structure. Given that fast cycle capability has been so important to strategic success over the past decade, we would expect significant and in some cases, radical structural changes in our study firms. Figure 2 provides a snapshot of what we found with respect to structural change over the past decade in Ford, Chrysler, Honda, and Mazda.

<Insert Figure 2 About Here>

Surprisingly, in the two Japanese companies we studied, what stood out was the *stability* of cross-functional structure. In both Honda and Mazda there was a well-established way to produce a car that had not changed significantly for at least 10-15 years, although Honda appeared to be moving from a dedicated team approach back to more of a matrix model (Program Teams). This change was a manifestation of corporate restructuring that was occuring in the early 1990s, following the death of the company's founder, Soichiro Honda.

At both Honda and Mazda, there were a relatively small number of people in each company recognized as Program Managers (Shusa). The Shusas were generally mid-career people (around 40 years old) who played this role for 8-10 years before returning to line operations (Womack, Jones and Roos, 1990). Thus, the Shusa role was a long-term, developmental position, usually leading to executive management. In contrast, Ford, and to some degree, Chrysler tended to staff new product programs with less experienced managers, rotating them more frequently.

One of our Japanese informants described the product development process at his company as being like a "car wash"-- once you go in, a set series of events occur, and a new product comes out the other end. Alterations, if they are needed, occur in parallel and are not allowed to disrupt the product development process itself. This stability extended to suppliers as well, and formed the basis for long-term relationships, black-box sourcing, and just-in-time delivery. There was little discussion of shortening the process, or changing it drastically; the focus was on how to make it work with as few resources and as little waste as possible. Rather than striving to reduce cycle time, several of our Japanese informants saw product development time remaining stable with model cycles lengthening in the next several years due to slowing customer demand and environmental contraints. In fact, when we asked what factor they saw as most important in creating competitive advantage in the coming decade, many of our Japanese informants responded that pressures for environmental responsibility and sustainable development would drive product innnovation in the coming decade.

This stood in stark contrast to the two American companies we studied. At each U.S. company, the structure of product development had been changed dramatically, often several times, in the past 10 years. In one case (Ford), an approach to product development was deployed in the 1987-88 time frame (Program Teams) and was then replaced two years later by a dramatically different approach (Dedicated Teams) designed to cut cycle time. Chrysler, on the other hand, made a radical shift from a largely Functional structure in the mid 1980's to the Platform Team structure in 1992. In general, the American auto companies were preoccupied with cutting product development and model cycle times. This is understandable given the competitively disadvantaged position these companies started from in the early 1980's (cycle times of 5-6 years versus 3-4 years for their Japanese competitors). The general atmosphere of confusion and lack of role clarity in the American companies, however, stood in sharp contrast to the consistency and stability of the Japanese companies. If Japanese product development was like a car wash then American product development was more like refurbishing antique homes-- each new project is full of surprises and no two experiences are ever alike.

Program-Friendly Functions. Despite all the turmoil and change over the past decade, the American companies we studied appeared structurally to be quite similar to the Japanese companies by 1992. Most used some aspect of Program Management or Dedicated Teams staffed by members of functional organizations. The exception was Chrysler, which had moved all the way to Platform Teams in an effort to shore up its sagging competitive position. For the other three companies, however, an analysis of formal organization charts would produce familiar-looking matrix structures with the products as rows and the functions as columns. On the surface, one might conclude that the American companies had successfully imitated or matched the Japanese model of lean design and production. A closer look, however, yielded some subtle yet significant differences.

For example, despite the close relationship between Ford and Mazda, including extensive benchmarking of the latter by the former, Mazda's "functions" were organized very differently from those in Ford. Indeed, American functions were typically organized around "chunks" of the vehicle (e.g. body engineering, transmission, chassis, powertrain, etc.) and processes that represented particular points in the value chain (e.g. design, purchasing, assembly). The Japanese companies, however, organized their functions almost exclusively around around steps in the value chain (e.g. research, styling, design, engineering, and production). A comparison of the teams working on car programs yielded similar configurational differences: both Chrysler's and Ford's program teams separated the vehicle into "chunks" or "modules" (i.e. components) whereas Mazda's program teams were composed of different steps in the value delivery chain, with all components of the vehicle represented at each stage. Figure 3 represents this difference graphically.

<Insert Figure 3 About Here>

Within each "function" of Mazda, the entire vehicle was represented. For example, at the engineering stage, all component engineers for a given vehicle sat together and were coordinated by an engineer within the function. The engineering function thus took on a total systems (vehicle) perspective. This arrangement was duplicated in each of the other functions (e.g. design, production, etc.). In contrast, at Ford, teams were composed of individuals working on particular car components (e.g. chassis) throughout the entire product development process. Thus, the American companies reflected the componentry within the *program*, whereas the Japanese companies reflected componentry within the *functions* that contribute members to the product development teams. This seemed to make it much easier for team members to "deliver" their functions, since the functions themselves were designed in a "program-friendly" manner.

The impact of this subtle difference in structure on behavior appeared to be quite significant. For example, when we asked "who has responsibility for the integrity of the whole vehicle" in Ford, the answer was often "nobody" or, at best, the "Program Manager" or "Steering Team" that directed the program. In Mazda, however, when we asked the same question, the answer was "everybody."

Cross-Program Coordination. Beyond the issue of coordination *within* a given car program is the issue of coordination and technology transfer *between* programs. Cusumano and Nobeoka (1991), for example, have shown the importance of interproject relationships: Both development time and replacement rate of new product programs appear to be enhanced by the transfer of information and technology *across* programs. In the automobile industry, the slowest companies were characterized by little communication across programs. Existing models were replaced after a period of time by engineers working on that particular program. Speed was enhanced when companies transferred knowledge gained from one completed program to another that was just getting underway (sequential transfer). However, the fastest companies demonstrated an ability to transfer information and design ideas across different programs while they were at various stages of completion (concurrent transfer).

Cross-program coordination is best accomplished through active, real-time exchange of ideas. This concept seemed best captured by the the Japanese term "Ba" which means "place" in both the physical and psychological sense (Itami, 1991). As one example of Ba, Itami describes Akihabara, a consumer electronics district in Tokyo, where hundreds of merchants sell the latest technology, all within a few square city blocks. Such close proximity fosters rapid communication of innovation. Ba is thus a sense of belonging or identity with a marketplace of ideas.

Ba was vividly displayed at Honda: When we asked where program managers were physically located (vis a vis team members), we learned that all product development took place under *one roof*-- a warehouse-like facility approximately 250 meters long and 100 meters wide. By housing *all* car programs in one location, the ultimate in cross-platform transfer had been achieved. With their new Corporate Technology Center, Chrysler has also co-located all product development within a single structure. However, programs are located on different floors at Chrysler and it remains to be seen whether the same effect will be achieved.

Behavior versus Structure. The combined effect of structural stability, program-friendly functions and cross-program coordination in the Japanese firms described above appeared to produce important differences in mindset and behavior, compared to the American companies we studied. Whereas the American companies (especially Ford) tended to experience significant conflict between the functions and the programs, such conflicts-- long thought to be an inevitable consequence of "matrix management"-- did not seem to exist in the Japanese companies. For example, when we asked Japanese functional managers "what happens when someone is having a problem balancing the demands of the program with their responsibilities in the function," most had the same response-- they smiled, looked at each other, exchanged a few remarks, and then said simply, "that never happens." In the Japanese companies, the functional managers saw their jobs as facilitating total vehicle development. In contrast, the American functional managers still tended to see their jobs as optimizing a given component or chunk of the vehicle.

In this sense, the American companies (both of which had spent considerable time and energy benchmarking their Japanese competitors' processes) have been quite successful at mimicking the general structure and approach to cross-functional organization used by Japanese competitors. However, in both cases, the U.S. companies had largely failed to either recognize or internalize the more subtle, behavioral aspects of the Japanese organizations. These subtle capabilities appear to have evolved over time as the Japanese have worked to continuously improve and perfect their approaches.

The American companies had internalized some of the formal, codified aspects of the Japanese systems, but missed the subtleties-- they adopted the "hardware" but not the "software." In some cases, the U.S. companies even appear to have "overadopted" Japanese structures (see Figure 4). For example, Chrysler initiated the Platform Team approach citing their benchmarking of Japanese competition (as well as their partner Mitsubishi) as the impetus for the change. In our study, however, we could identify no Japanese competitor that practiced the Platform Team model: All used some variation of the Program Team or Dedicated Team models. The American firms, particularly those under intense competitive pressure, appear to have "over-adopted" structural innovation in order to compensate for their "under-adoption" of the more subtle behavioral aspects.

<Insert Figure 4 About Here>

DISCUSSION AND CONCLUSIONS

Few dispute the importance of cross-functional coordination to competitive success in the coming decade. Our study of two U.S. and two Japanese auto companies suggests that while the range of structural approaches is converging (the purely Functional model has been all but abandoned and even the Project Team model is becoming hard to find) there is still a wide discrepancy with regard to the *process* and *behavioral* aspects of cross-functional management. The resource-base view stresses the importance of tacit skills and capabilities to sustainable competitive advantage (e.g. Barney, 1991). Since the four structures are highly formal representations of the product development process (and hence easy to observe and copy), it should come as little surprise that the tacit skills developed over years of trial, error, and experience in Japanese firms are not easily or quickly duplicated by their American competitors.

It is our conclusion that the two Japanese firms we studied have largely perfected the subtleties of cross-functional management (having evolved their systems over the past two decades) and now see the basis for competitive advantage moving on to new frontiers, such as the development of environmentally sustainable products. The American companies, in contrast, are still racing to acquire cross-functional management capability. Indeed, most internal initiatives in the U.S. companies we studied were focused upon speeding product development and lean production capabilities. Resource-based theory would predict that this capability will be slow to develop since tacit, team-embodied, and socially-complex skills are not quickly copied or duplicated.

Given the U.S. firms' preoccupation with product development, there was comparatively little investment or initiative in the technologies or products that might form the basis for competitive advantage in the next century. Despite deep recession and flagging profits, however, the Japanese appeared to be focusing management attention on the next generation of product technology. From a strategic perspective, it appears that cross-functional management in product development will soon become a *prerequisite* for continued existence and will not serve to differentiate some competitors from others. If this prediction proves to be the case, then the American companies in our study are truly "up against the walls"--they will have to focus simultaneously at absorbing the processes and subtle behaviors required for cross-functional coordination and fast cycle capability while also investing in the technologies and products that will create competitive advantage into the next century. This represents a formidable strategic challenge indeed.

Appendix
Sample Interview Questions

1. How is product development organized?
   a. Is there a "hierarchy" of development programs (e.g. large car, long-term programs, near-term programs)
   b. For specific car programs, does the company use "dedicated teams", whose members work only on a particular program?
   c. Are car programs structured using a "matrix" organization in which individual engineers hold primary membership in a "functional" organization and work on several programs?

2. What is the internal structure of the programs?
   a. Are there "sub-organizations" that have particular responsibility for different "modules" of the vehicle?
   b. If there are such smaller groups, how is integration among these sub-organizations achieved?
   c. How many people are directly involved in a typical car product development program?
   d. What organizational factors are most important in reducing the amount of time required to develop a new product?

3. What are the "reporting relationships" within product development?
   a. Which individuals report to the "program manager" and which ones report to functional managers?
   b. How is the performance of individuals and teams evaluated?
   c. Who evaluates performance, program managers or functional managers?
   d. What mechanisms are used to ensure cooperation between programs and functions?

4. How has the method of organizing product development evolved?
   a. How long has the current approach been used?
   b. How was product development organized five years ago?

5. Some have argued that the automotive industry is moving toward technologies designed to produce the "batch of one"-- uniquely customized products produced with minimimum lead time.
   a. How have these ideas influenced product development in your company?
   b. Do future planning volumes assume that the market will continue to segment into smaller and smaller niches?
   c. Will cycle times continue to grow shorter?

6. For several years now, "lean production"-- producing more models with fewer people in less time-- has been a key factor in competitive advantage.
   a. Do you think this capability will continue to confer sustainable competitive advantage?
   b. What will the next frontier of competitive advantage be?
   c. Will responding to environmental factors (e.g. global warming, waste reduction) play an increasing role in your company's competitive advantage?
   d. How would you describe the best car company in the world in the year 2020?

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Table 1
CROSS-FUNCTIONAL STRUCTURES: CHARACTERISTICS

	Structural Type			
Dimensions	**Project**	**Program**	**Dedicated**	**Platform**
Program Manager				
•Level	Junior	Senior	Senior	Senior
•Reports to	FM	VP-PM	VP-Function	COO
•Accountability	Reports	Budget/Timing	Targets	Product
•Authority	None	Clout	Partial	Complete
Team Members				
•Selection	FM	Joint	PM	PM
•Job Definition	Part Time	Part Time	Full Time	Full Time
•Head Count	Function	Function	Function	Platform
•Communication	Periodic	Regular	Co-located	Co-located
•Scope	Engineering	Eng & Mktg	All Functions	All Functions
•Performance Review	FM	PM Input	Joint	PM
Example	None	Mazda-626	Honda-Civic Ford-Mustang	Chrysler-LH

Figure 1
MODELS OF CROSS-FUNCTIONAL STRUCTURE

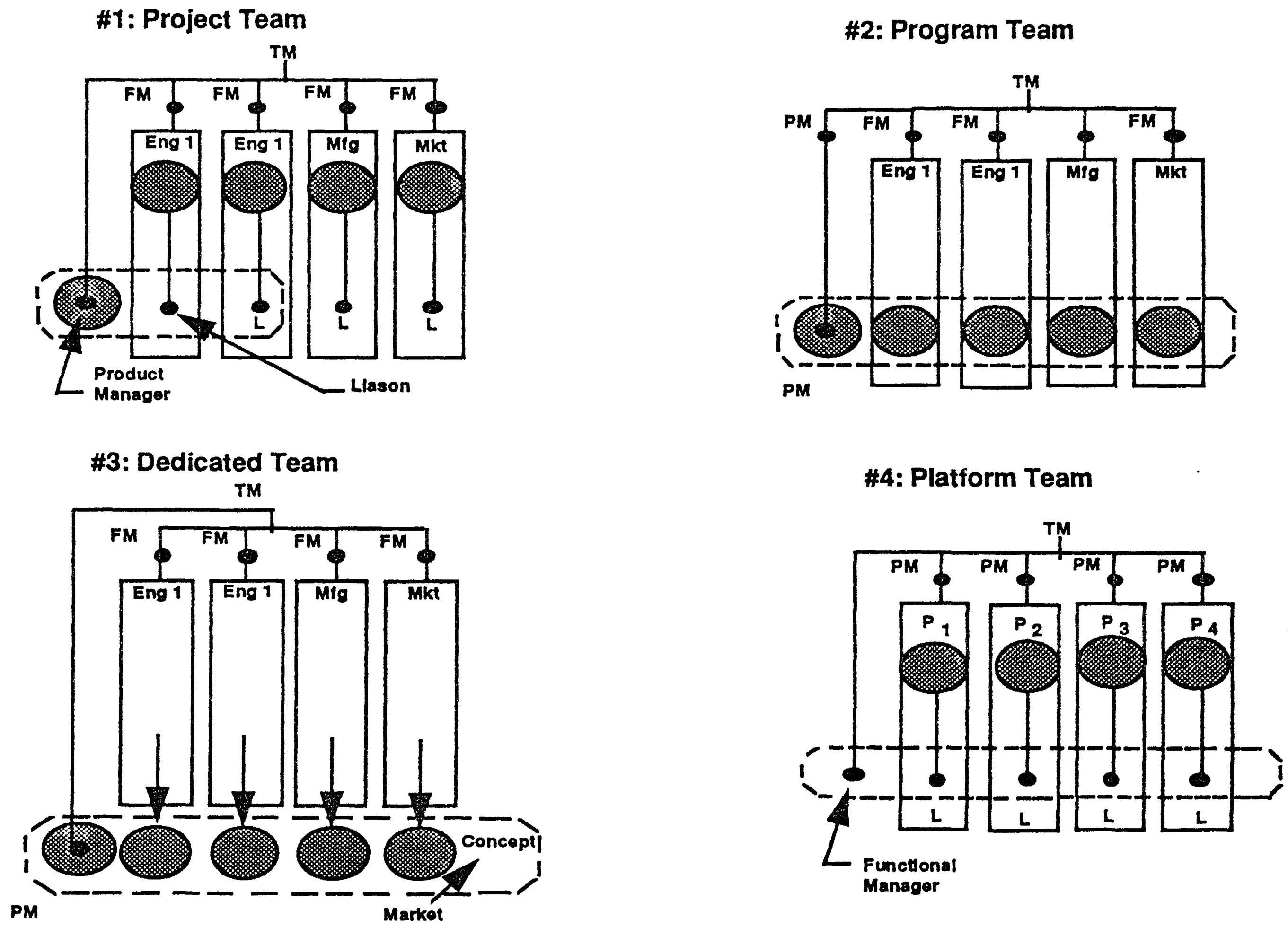


Figure 2
STABILITY OF STRUCTURE: 1982-1992

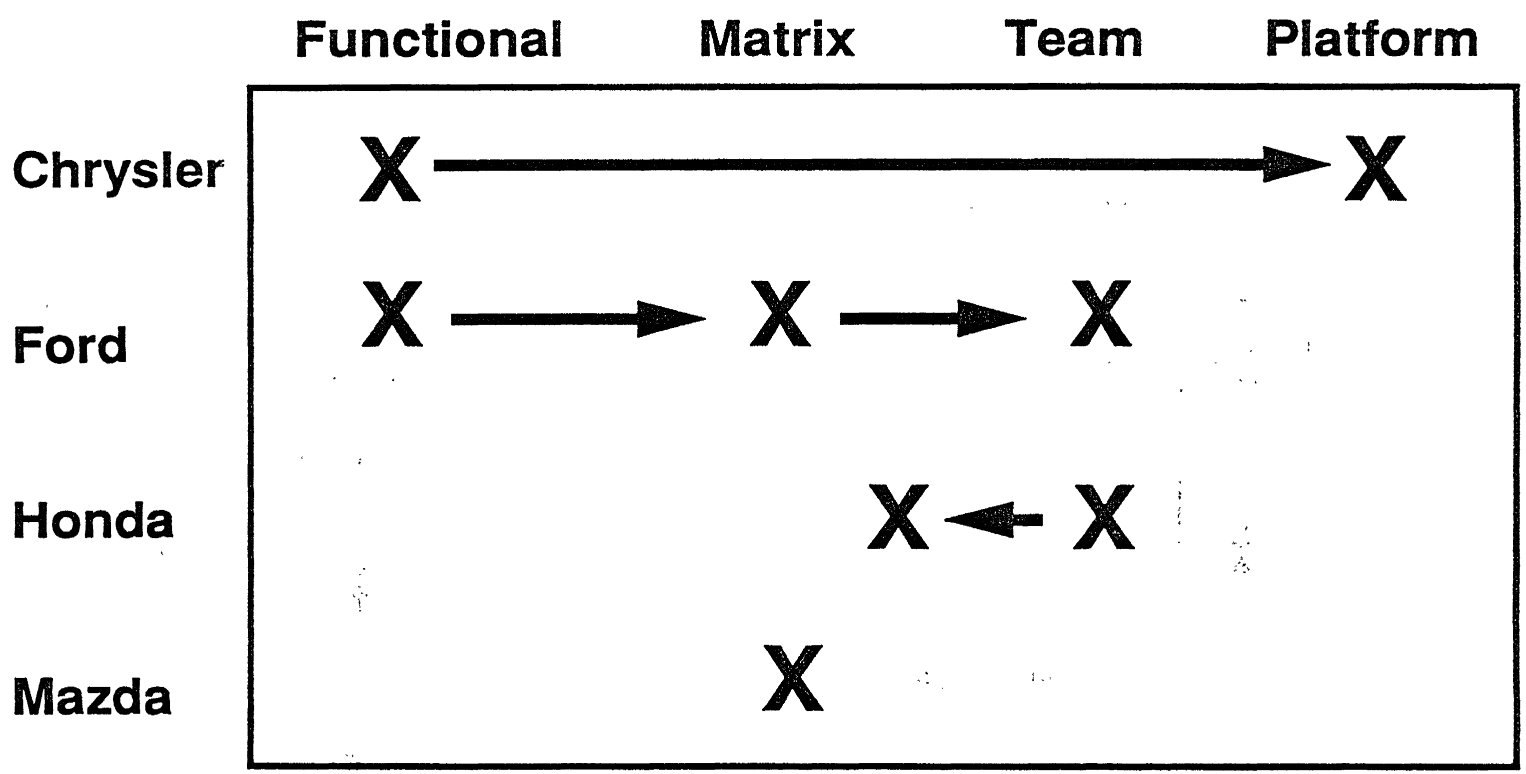
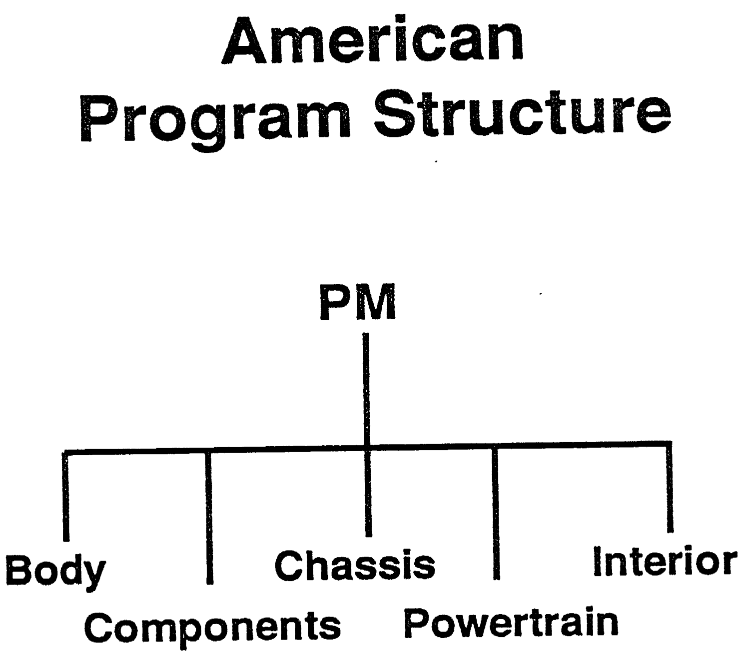


Figure 3
PROGRAM-FRIENDLY FUNCTIONS



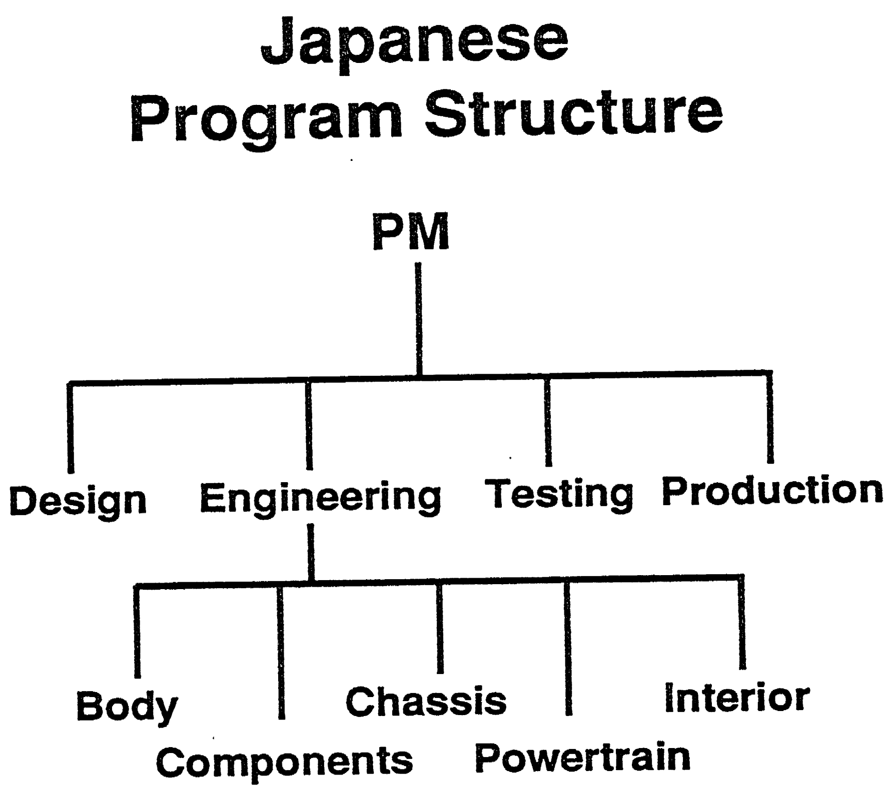


Figure 4
STRUCTURAL BIAS