MATRIX ORGANIZATION DESIGNS

How to combine functional and project forms

JAY R. GALBRAITH

Mr. Galbraith is a faculty member in the Alfred P. Sloan School of Management, M.I.T.

Each form of organizational design has its own set of advantages and disadvantages. If, for example, the functional structure is adopted, projects fall behind; if project organization is chosen, technologies are less well-developed. The matrix design attempts to achieve the benefits of both forms. The history of The Standard Products Co. illustrates the change from the functional form to a pure matrix form. Measures were taken that allowed Standard to achieve high levels of technical sophistication necessary to innovate products and simultaneously get these products to the market quickly to maintain competitive position. Since not all organizations need a pure matrix organization, the author describes the alternatives and lists some factors that help determine the choices.

Each era of management evolves new forms of organization as new problems are encountered. Earlier generations of managers invented the centralized functional form, the line-staff form, and the decentralized product division structure as a response to increasing size and complexity of tasks. The current generation of management has developed two new forms as a response to high technology. The first is the free-form conglomerate; the other is the matrix organization, which was developed primarily in the aerospace industry.

The matrix organization grows out of the organizational choice between project and functional forms, although it is not limited to those bases of the authority structure.[1] Research in the behavioral sciences now permits a detailing of the choices among the alternate intermediate forms between the project and functional extremes. Detailing such a choice is necessary since many businessmen see their organizations facing situations in the 1970's that are similar to those faced by the aerospace firms in the 1960's. As a result, a great many unanswered questions arise concerning the use of the matrix organization. For example, what are the various kinds of matrix designs, what is the difference

1. See John F. Mee, "Matrix Organization," *Business Horizons* (Summer, 1964), p. 70.

between the designs, how do they work, and how do I choose a design that is appropriate for my organization?

The problem of designing organizations arises from the choices available among alternative bases of the authority structure. The most common alternatives are to group together activities which bear on a common product, common customer, common geographic area, common business function (marketing, engineering, manufacturing, and so on), or common process (forging, stamping, machining, and so on). Each of these bases has various costs and economies associated with it. For example, the functional structure facilitates the acquisition of specialized inputs. It permits the hiring of an electromechanical and an electronics engineer rather than two electrical engineers. It minimizes the number necessary by pooling specialized resources and time sharing them across products or projects. It provides career paths for specialists. Therefore, the organization can hire, utilize, and retain specialists.

These capabilities are necessary if the organization is going to develop high technology products. However, the tasks that the organization must perform require varying amounts of the specialized resources applied in varying sequences. The problem of simultaneously completing all tasks on time, with appropriate quality and while fully utilizing all specialist resources, is all but impossible in the functional structure. It requires either fantastic amounts of information or long lead times for task completion.

The product or project form of organization has exactly the opposite set of benefits and costs. It facilitates coordination among specialties to achieve on-time completion and to meet budget targets. It allows a quick reaction capability to tackle problems that develop in one specialty, thereby reducing the impact on other specialties. However, if the organization has two projects, each requiring one half-time electronics engineer and one half-time electromechanical engineer, the pure project organization must either hire two electrical engineers—and reduce specialization—or hire four engineers (two electronics and two electromechanical)—and incur duplication costs. In addition, no one is responsible for long-run technical development of the specialties. Thus, each form of organization has its own set of advantages and disadvantages. A similar analysis could be applied to geographically or client-based structures.

The problem is that when one basis of organization is chosen, the benefits of the others are surrendered. If the functional structure is adopted, the technologies are developed but the projects fall behind schedule. If the project organization is chosen, there is better cost and schedule performance but the technologies are not developed as well. In the past, managers made a judgment as to whether technical development or schedule completion was more important and chose the appropriate form.

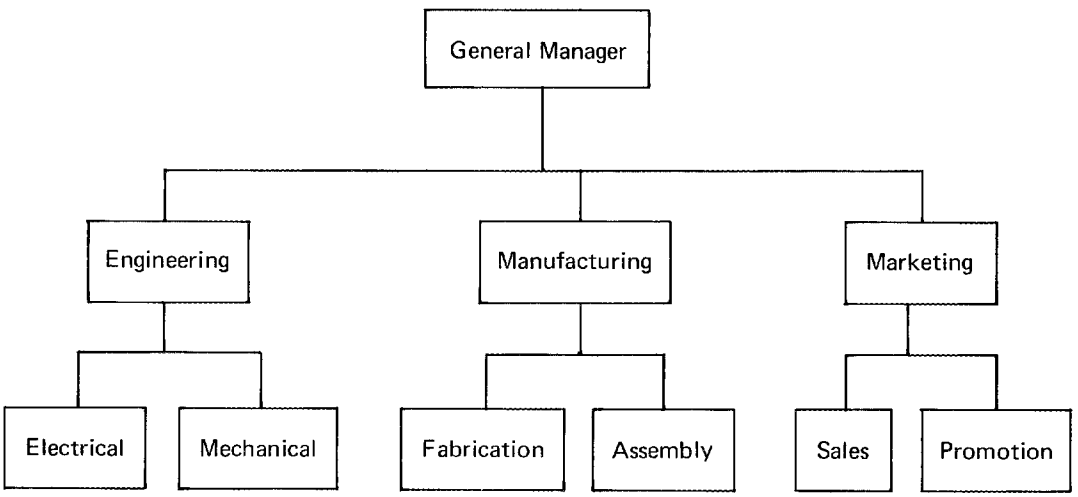
However, in the 1960's with a space race and missile gap, the aerospace firms were faced with a situation where both technical performance and coordination were important. The result was the matrix design, which attempts to achieve the benefits of both forms. However, the matrix carries some costs of its own. A study of the development of a matrix design is contained in the history of The Standard Products Co., a hypothetical company that has changed its form of organization from a functional structure to a matrix.

A COMPANY CHANGES FORMS

The Standard Products Co. has competed effectively for a number of years by offering a varied line of products that were sold to other organizations. Standard produced and sold its products through a functional organization like the one represented in Figure 1. A moderate number of changes in the product line and production processes were made each

FIGURE 1

Standard's Functional Organization



year. Therefore, a major management problem was to coordinate the flow of work from engineering through marketing. The coordination was achieved through several integrating mechanisms:

Rules and procedures—One of the ways to constrain behavior in order to achieve an integrated pattern is to specify rules and procedures. If all personnel follow the rules, the resultant behavior is integrated without having to maintain on-going communication. Rules are used for the most predictable and repetitive activities.

Planning processes—For less repetitive activities, Standard does not specify the procedure to be used but specifies a goal or target to be achieved, and lets the individual choose the procedure appropriate to the goal. Therefore, processes are undertaken to elaborate schedules and budgets. The usefulness of plans and rules is that they reduce the need for on-going communication between specialized subunits.

Hierarchical referral—When situations are encountered for which there are no rules or when problems cause the goals to be exceeded, these situations are referred upward in the hierarchy for resolution. This is the standard management-by-exception principle. This resolves the nonroutine and unpredictable events that all organizations encounter.

Direct contact—In order to prevent top executives from becoming overloaded with problems, as many problems as possible are resolved by the affected managers at low levels by informal contacts. These remove small problems from the upward referral process.

Liaison departments—In some cases, where there is a large volume of contacts between two departments, a liaison department evolves to handle the transactions. This typically occurs between engineering and manufacturing in order to handle engineering changes and design problems.[2]

The Standard Products Co. utilized these mechanisms to integrate the functionally organized specialties. They were effective in the sense that Standard could respond to changes in the market with new products on a timely basis, the new products were completed on schedule and within budget, and the executives had sufficient time to devote to long-range planning.

Matrix Begins Evolution

A few years ago, a significant change occurred in the market for one of Standard's major

2. For a more detailed explanation, see Jay R. Galbraith, *Organization Design* (Reading, Mass.: Addison-Wesley Publishing Co., Inc., 1971).

product lines. A competitor came out with a new design utilizing an entirely new raw material. The initial success caused Standard to react by developing one of their own incorporating the new material. They hired some specialists in the area and began their normal new product introduction activities. However, this time the product began to fall behind schedule, and it appeared that the product would arrive on the market at a time later than planned. In response, the general manager called a meeting to analyze the situation.

Task Force After a briefing, it was obvious to the general manager and the directors of the three functions what was happening. Standard's lack of experience with the new material had caused them to underestimate the number and kinds of problems. The uncertainty led to a deterioration in usefulness of plans and schedules. The problems affected all functions, which meant that informal contacts and liaison processes were cumbersome; therefore, the majority of the problems were referred upward. This led to overloads on the directors of the functions and the general manager, which in turn added to the delays. Thus, the new situation required more decision making and more information processing than the current organization could provide.

The directors of engineering and manufacturing suggested that the cause of the problem was an overly ambitious schedule. More time should have been allowed for the new product; if realistic schedules were set, the current coordination processes would be adequate. They proposed that the schedules be adjusted by adding three to six months to the current due dates, which would allow more time to make the necessary decisions.

The director of marketing objected, reporting that the company would lose a good percentage of the market if the introduction was delayed. A number of big customers were waiting for Standard's version of the new product, and a delay would cost the company some of these customers. The general manager agreed with the marketing director. He proposed that they should not change the schedule to fit their current coordination processes, but that they should introduce some new coordination mechanisms to meet the scheduled due dates.

The group agreed with the general manager's position and began to search for alternative solutions. One of the solution requirements suggested was to reduce the distance between the sources of information and the points of decision. At this point the manufacturing director cautioned them about decentralizing decisions. He reminded them of previous experiences when decisions were made at low levels of the engineering organization. The data the decision makers had were current but they were also local in scope; severe problems in the manufacturing process resulted. When these decisions were centralized, the global perspective prevented these problems from developing. Therefore, they had to increase decision-making power at lower levels without losing the inputs of all affected units. The alternative that met both requirements was a group with representation from all the major departments to enter into joint decisions.

The group was appointed and named the "new product task force." It was to last as long as cross-functional problems occurred on the new product introduction. The group was to meet and solve joint problems within the budget limits set by the general manager and the directors; problems requiring more budget went to the top management group. The purpose was to make as many decisions as possible at low levels with the people most knowledgeable. This should reduce the delays and yet ensure that all the information inputs were considered.

The task force consisted of nine people; three, one from each function, were full-time and the others were part-time. They met at least every other day to discuss and resolve

joint problems. Several difficulties caused them to shift membership. First, the engineering representatives were too high in the organization and, therefore, not knowledgeable about the technical alternatives and consequences. They were replaced with lower level people. The opposite occurred with respect to the manufacturing representatives. Quite often they did not have either information or the authority to commit the production organization to joint decisions made by the task force. They were replaced by higher level people. Eventually, the group had both the information and the authority to make good group decisions. The result was effective coordination: coordination = f (authority × information).

Creation of the task force was the correct solution. Decision delays were reduced, and collective action was achieved by the joint decisions. The product arrived on time, and the task force members returned to their regular duties.

Teams—No sooner had the product been introduced than salesmen began to bring back stories about new competitors. One was introducing a second-generation design based on improvements in the raw material. Since the customers were excited by its potential and the technical people thought it was feasible, Standard started a second-generation redesign across all its product lines. This time, they set up the task force structure in advance and committed themselves to an ambitious schedule.

Again the general manager became concerned. This time the product was not falling behind schedule, but in order to meet target dates the top management was drawn into day-to-day decisions on a continual basis. This was leaving very little time to think about the third-generation product line. Already Standard had to respond twice to changes initiated by others. It was time for a thorough strategy formulation. Indeed, the more rapid the change in technology and markets, the greater the amount of strategic decision making that is necessary. However, these are the same changes that pull top management into day-to-day decisions. The general manager again called a meeting to discuss and resolve the problem.

The solution requirements to the problem were the same as before. They had to find a way to push a greater number of decisions down to lower levels. At the same time, they had to guarantee that all interdependent subunits would be considered in the decision so that coordination would be maintained. The result was a more extensive use of joint decision making and shared responsibility.

The joint decision making was to take place through a team structure. The teams consisted of representatives of all functions and were formed around major product lines. There were two levels of teams, one at lower levels and another at the middle-management level. Each level had defined discretionary limits; problems that the lower level could not solve were referred to the middle-level team. If the middle level could not solve the problem, it went to top management. A greater number of day-to-day operating problems were thereby solved at lower levels of the hierarchy, freeing top management for long-range decisions.

The teams, unlike the task force, were permanent. New products were regarded as a fact of life, and the teams met on a continual basis to solve recurring interfunctional problems. Task forces were still used to solve temporary problems. In fact, all the coordination mechanisms of rules, plans, upward referral, direct contact, liaison men, and task forces were used, in addition to the teams.

Product Managers The team structure achieved interfunctional coordination and permitted top management to step out of day-to-day decision making. However, the teams were not uniformly effective. Standard's strategy required the addition of highly skilled, highly educated technical people to

continue to innovate and compete in the high technology industry. Sometimes these specialists would dominate a team because of their superior technical knowledge. That is, the team could not distinguish between providing technical information and supplying managerial judgment after all the facts were identified. In addition, the specialists' personalities were different from the personalities of the other team members, which made the problem of conflict resolution much more difficult.[3]

Reports of these problems began to reach the general manager, who realized that a great number of decisions of consequence were being made at lower and middle levels of management. He also knew that they should be made with a general manager's perspective. This depends on having the necessary information and a reasonable balance of power among the joint decision makers. Now the technical people were upsetting the power balance because others could not challenge them on technical matters. As a result, the general manager chose three technically qualified men and made them product managers in charge of the three major product lines.[4] They were to act as chairmen of the product team meetings and generally facilitate the interfunctional decision making.

Since these men had no formal authority, they had to resort to their technical competence and their interpersonal skills in order to be effective. The fact that they reported to the general manager gave them some additional power. These men were successful in bringing the global, general manager perspective lower in the organization to improve the joint decision-making process.

The need for this role was necessitated by the increasing differences in attitudes and goals among the technical, production, and marketing team participants. These differences are necessary for successful subtask performance but interfere with team collaboration. The product manager allows collaboration without reducing these necessary differences. The cost is the additional overhead for the product management salaries.

Product Management Departments Standard Products was now successfully following a strategy of new product innovation and introduction. It was leading the industry in changes in technology and products. As the number of new products increased, so did the amount of decision making around product considerations. The frequent needs for tradeoffs across engineering, production, and marketing lines increased the influence of the product managers. It was not that the functional managers lost influence; rather, it was the increase in decisions relating to products.

The increase in the influence of the product managers was revealed in several ways. First, their salaries became substantial. Second, they began to have a greater voice in the budgeting process, starting with approval of functional budgets relating to their products. The next change was an accumulation of staff around the products, which became product departments with considerable influence.

At Standard this came about with the increase in new product introductions. A lack of information developed concerning product costs and revenues for addition, deletion, modification, and pricing decisions. The general manager instituted a new information system that reported costs and revenues by product as well as by function. This gave product managers the need for a staff and a basis for more effective interfunctional collaboration.

In establishing the product departments, the general manager resisted requests from the product managers to reorganize around product divisions. While he agreed with their analysis that better coordination was needed across functions and for more effective product decision making, he was unwilling to take

3. See Paul R. Lawrence and Jay Lorsch, "Differentiation and Integration in Complex Organizations," *Administrative Science Quarterly* (June, 1967).

4. Paul R. Lawrence and Jay Lorsch, "New Management Job: the Integration," *Harvard Business Review* (November-December, 1967).

the chance that this move might reduce specialization in the technical areas or perhaps lose the economies of scale in production. He felt that a modification of the information system to report on a product and a functional basis along with a product staff group would provide the means for more coordination. He still needed the effective technical group to drive the innovative process. The general manager also maintained a climate where collaboration across product lines and functions was encouraged and rewarded.

The Matrix Completed

By now Standard Products was a high technology company; its products were undergoing constant change. The uncertainty brought about by the new technology and the new products required an enormous amount of decision making to plan-replan all the schedules, budgets, designs, and so on. As a result, the number of decisions and the number of consequential decisions made at low levels increased considerably. This brought on two concerns for the general manager and top management.

The first was the old concern for the quality of decisions made at low levels of the organization. The product managers helped solve this at middle and top levels, but their influence did not reach low into the organization where a considerable number of decisions were made jointly. They were not always made in the best interest of the firm as a whole. The product managers again recommended a move to product divisions to give these low-level decisions the proper product orientation.

The director of engineering objected, using the second problem to back up his objection. He said the move to product divisions would reduce the influence of the technical people at a time when they were having morale and turnover problems with these employees. The increase in joint decisions at low levels meant that these technical people were spending a lot of time in meetings. Their technical input was not always needed, and they preferred to work on technical problems, not product problems. Their dissatisfaction would only be aggravated by a change to product divisions.

The top management group recognized both of these problems. They needed more product orientation at low levels, and they needed to improve the morale of the technical people whose inputs were needed for product innovations. Their solution involved the creation of a new role—that of subproduct manager.[5] The subproduct manager would be chosen from the functional organization and would represent the product line within the function. He would report to both the functional manager and the product manager, thereby creating a dual authority structure. The addition of a reporting relation on the product side increases the amount of product influence at lower levels.

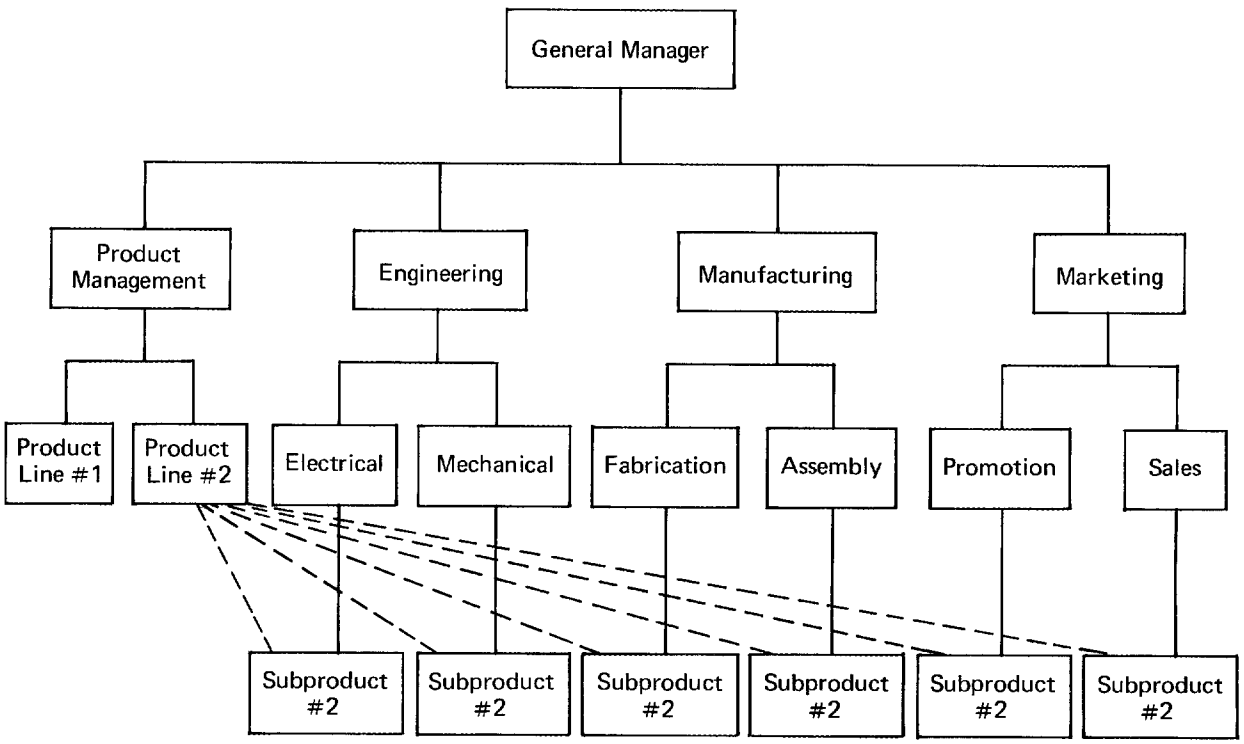
The addition of the subproduct manager was intended to solve the morale problem also. Because he would participate in the product team meetings, the technical people did not need to be present. The subproduct manager would participate on the teams but would call on the technical experts within his department as they were needed. This permitted the functional department to be represented by the subproduct manager, and the technical people to concentrate on strictly technical matters.

Standard Products has now moved to a pure matrix organization as indicated in Figure 2. The pure matrix organization is distinguished from the previous cross-functional forms by two features. *First,* the pure matrix has a dual authority relationship somewhere in the organization. *Second,* there is a power balance between the product management and functional sides. While equal power is an unachievable razor's edge, a

5. Jay Lorsch, "Matrix Organization and Technical Innovations" in Jay Galbraith, ed., *Matrix Organizations: Organization Design for High Technology* (Cambridge, Mass.: The M.I.T. Press, 1971).

FIGURE 2

Standard's Pure Matrix Organization



– – – = Technical authority over the product
——— = Formal authority over the product (in product organization, these relationships may be reversed)

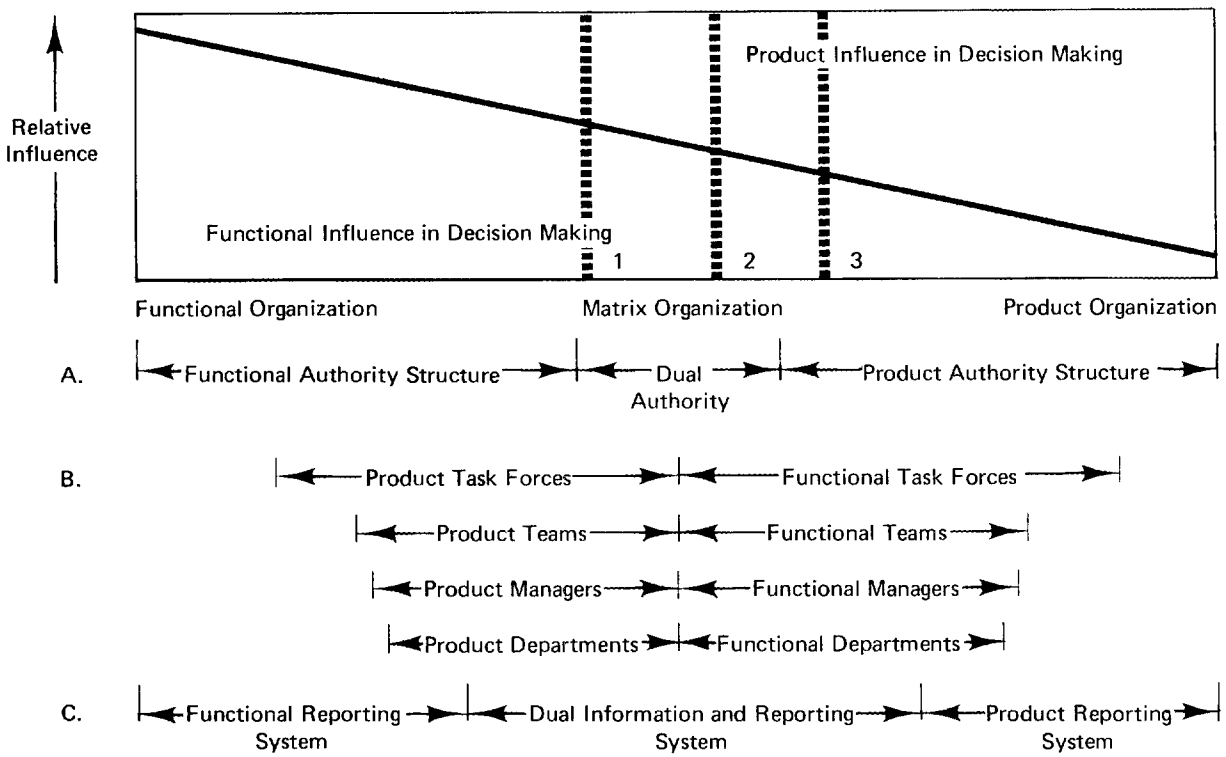
reasonable balance can be obtained through enforced collaboration on budgets, salaries, dual information and reporting systems, and dual authority relations. Such a balance is required because the problems that the organization faces are uncertain and must be solved on their own merits—not on any predetermined power structure.

Thus over a period of time, the Standard Products Co. has changed from a functional organization to a pure matrix organization using dual authority relationships, product management departments, product teams at several levels, and temporary task forces. These additional decision-making mechanisms were added to cope with the change in products and technologies. The changes caused a good deal of uncertainty concerning resource allocations, budgets, and schedules. In the process of task execution, more was learned about the problem causing a need for rescheduling and rebudgeting. This required the processing of information and the making of decisions.

In order to increase its capacity to make product relevant decisions, Standard lowered the level at which decisions were made. Coordination was achieved by making joint decisions across functions. Product managers and subproduct managers were added to bring a general manager's perspective to bear on the joint decision-making processes. In addition, the information and reporting system was changed in order to provide reports by func-

FIGURE 3

The Range of Alternatives



tion and by product. Combined, these measures allowed Standard to achieve the high levels of technical sophistication necessary to innovate products and simultaneously to get these products to the market quickly to maintain competitive position.

HOW DO I CHOOSE A DESIGN?

Not all organizations need a pure matrix organization with a dual authority relationship. Many, however, can benefit from some cross-functional forms to relieve top decision makers from day-to-day operations. If this is so, how does one choose the degree to which his organization should pursue these lateral forms? To begin to answer this question, let us first lay out the alternatives, then list the choice determining factors.

The choice, shown in Figure 3, is indicated by the wide range of alternatives between a pure functional organization and a pure product organization with the matrix being half-way between. The Standard Products Co. could have evolved into a matrix from a product organization by adding functional teams and managers. Thus there is a continuum of organization designs between the functional and product forms. The design is specified by the choice among the authority structure; integrating mechanisms such as task forces, teams and so on; and by the formal information system. The way these are combined is illustrated in Figure 3. These design variables help regulate the relative

distribution of influence between the product and functional considerations in the firm's operations.

The remaining factors determining influence are such things as roles in budget approvals, design changes, location and size of offices, salary, and so on. Thus there is a choice of integrating devices, authority structure, information system, and influence distribution. The factors that determine choice are diversity of the product line, the rate of change of the product line, interdependencies among subunits, level of technology, presence of economies of scale, and organization size.

Product Lines

The greater the diversity among product lines and the greater the rate of change of products in the line the greater the pressure to move toward product structures.[6] When product lines become diverse, it becomes difficult for general managers and functional managers to maintain knowledge in all areas; the amount of information they must handle exceeds their capacity to absorb it. Similarly, the faster the rate of new product introduction, the more unfamiliar are the tasks being performed.

Managers are, therefore, less able to make precise estimates concerning resource allocations, schedules, and priorities. During the process of new product introduction, these same decisions are made repeatedly. The decisions concern trade-offs among engineering, manufacturing, and marketing. This means there must be greater product influence in the decision process. The effect of diversity and change is to create a force to locate the organization farther to the right in Figure 3.

6. For product line diversity, see Alfred Chandler, *Strategy and Structure* (Cambridge, Mass.: The M.I.T. Press, 1962); for product change rate, see Tom Burns and G. M. Stalker, *Management and Innovation* (London: Tavistock Publications, 1958).

Interdependence

The functional division of labor in organizations creates interdependencies among the specialized subunits. That is, a problem of action in one unit has a direct impact on the goal accomplishment of the other units. Organizations usually devise mechanisms that uncouple the subunits, such as in-process-inventory and order backlogs. The degree to which inventories and backlogs develop is a function of how tight the schedule is. If there is a little slack in the schedule, then the functional departments can resolve their own problems. However, if rapid response to market changes is a basis of competition, then schedules are squeezed and activities run in parallel rather than series.[7] This means that problems in one unit directly affect another. The effect is a greater number of joint decisions involving engineering, manufacturing, and production. A greater need for product influence in these decisions arises due to the tight schedule. Thus the tighter the schedule, the greater the force to move to the right in Figure 3.

Although the tightness of the schedule is the most obvious source of interdependence, tight couplings can arise from reliability requirements and other design specifications. If the specifications require a more precise fit and operation of parts, then the groups designing and manufacturing the parts must also "fit and operate" more closely. This requires more coordination in the form of communication and decision making.

Level of Technology

If tight schedules and new products were the only forces operating, every organization

7. For a case study of this effect, see Jay Galbraith, "Environmental and Technological Determinants of Organization Design" in Jay Lorsch and Paul R. Lawrence, eds., *Studies in Organization Design* (Homewood, Ill.: Richard D. Irwin, Inc., 1970).

would be organized around product lines. The level of technology or degree to which new technology is being used is a counteracting force. The use of new technologies requires expertise in the technical specialties in engineering, in production engineering, in manufacturing, and market research in marketing. Some of the expertise may be purchased outside the organization.

However, if the expertise is critical to competitive effectiveness, the organization must acquire it internally. If the organization is to make effective use of the expertise, the functional form of organization is superior, as described earlier in the article. Therefore the greater the need for expertise, the greater the force to move to the left in Figure 3.

Economies of Scale and Size

The other factor favoring a functional form is the degree to which expensive equipment in manufacturing, test facilities in engineering, and warehousing facilities in marketing are used in producing and selling the product. (Warehousing introduces another dimension of organization structure, for example, geographical divisions. For our purposes, we will be concerned only with product and function dimensions.) It is usually more expensive to buy small facilities for product divisions than a few large ones for functional departments. The greater the economies of scale, the greater the force to move to the left in Figure 3. Mixed structures are always possible. That is, the capital intensive fabrication operation can organize along functional process lines, and the labor intensive assembly operation can organize along product lines.

The size of the organization is important in that it modifies the effect of expertise and economies of scale. That is, the greater the size of the organization the smaller the costs of lost specialization and lost economies of scale when the product form is adopted. Thus while size by itself has little effect on organization structure, it does moderate the effects of the previously mentioned factors.

The Choice

While research on organizations has not achieved a sophistication that would allow us to compute the results of the above factors and locate a point in Figure 3, we can still make our subjective weightings. In addition, we can locate our present position and make changes in the appropriate directions as product lines, schedules, technologies, and size change during the normal course of business. The framework provides some basis for planning the organization along with planning the strategy and resource allocations.

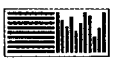
If the organization's present structure is on the left side of the figure, many of the symptoms occurring in the Standard Products example signal a need for change. To what degree are communication overloads occurring? Are top executives being drawn into day-to-day decisions to the detriment of strategy development? How long does it take to get top level decisions made in order to continue work on new products? If the answers to these questions indicate an overload, then some movement toward a matrix is appropriate. Probably a sequence of moves until the bottlenecks disappear is the best strategy; this will allow for the proper attitudinal and behavioral changes to keep pace.

If the organization is product organized, then movements to the left toward a matrix are more subtle. They must be triggered by monitoring the respective technological environments.

An example from the aerospace industry may help. In the late fifties and early sixties the environment was characterized by the space race and missile gap. In this environment, technical performance and technology development were primary, and most firms

adopted organizations characterized by the dotted line at "1" in Figure 3. The functional departments had the greatest influence on the decision-making process. During the McNamara era, they moved to point "2." The environment shifted to incentive contracts, PERT-cost systems, and increased importance of cost and schedule considerations.

Currently, the shift has continued toward point "3." Now the environment is characterized by tight budgets, a cost overrun on the C-5 project, and Proxmire hearings in the Senate. The result is greater influence by the project managers. All these have taken place in response to the changing character of the market. A few firms recently moved back toward point "2" in response to the decreasing size of some firms. The reduction in defense spending has resulted in cutbacks in projects and employment. In order to maintain technical capabilities with reduced size, these firms have formed functional departments under functional managers with line responsibility. These changes show how changes in need for expertise, goals, and size affect the organization design choice.



Many organizations are experiencing pressures that force them to consider various forms of matrix designs. The most common pressure is increased volume of new products. Organizations facing this situation must either adopt some form of matrix organization, change to product forms of organization, or increase the time between start and introduction of the new product process.

For most organizations, the matrix design is the most effective alternative. Managers must be aware of the different kinds of matrix designs and develop some basis for choosing among them.

In a dynamic context the control system tends to break down where the organization is split up into rigidly segregated specialist components, as it is in most medium and large firms. We find one set of control signals in the production department, a quite separate one in the accounting department, and still others in the sales and personnel departments. . . . The virile progressive firm works as a flexible system in which the work of each part is closely integrated with the work of all the rest. A company-wide control system not only reflects this integration, but stimulates and reinforces it.

Yet even where the control is company-wide, changing work-flow, new equipment, or transfers of staff can throw up points of friction. It follows . . . that the control system has ideally not only to measure the performance of the various components and of the system as a whole; it has also to assess the evolving relationships between the components, that is, to measure the disharmonies as they arise and before they do damage.

—Arthur E. Mills
Management Control Systems