3

ORGANIZING THE HIGH-TECHNOLOGY ENTERPRISE

GM'S ADVANCED VEHICLE DEVELOPMENT—REDUCING TIME TO MARKET WITH STREAMLINED ORGANIZATIONAL PROCESSES

After getting beaten to the punch year after year by Toyota and Honda, General Motors has stepped up its efforts dramatically to reduce the time to launch new products and to react to market changes. While Toyota and Honda are still faster, GM and the other U.S. Big Two are getting more competitive. "Most of GM's new product programs are on a 24-month schedule," says Rick Spina, executive director, program management, GM North America. He adds, "We are continuing to cut it down, but 24 months is pretty much our norm now. We know, we can do it, but the world doesn't stand still." Most critics agree. U.S. auto makers have come a long way from the 1970s, when government safety and emissions standards turned the company bureaucracy into an organizational albatross, and it took 18 months or more to bring a new car model to market. Today, thanks to management's determination and leadership, and to the enormous advances in design technology and processes, from CAD/CAM to simultaneous engineering, product development cycles continue to shrink. U.S. car makers have new products in the market after 18 months, with some specialty cars, such as the Hummer H2 and Ford GT, being done as

quickly as 16 or 14 months. However, time-to-market performance takes more than just technology and project management process templates. It is achieved through improved productivity, elimination of bureaucracy, and focused decision making, as explained by Mark Hogan, GM group vice president, advanced vehicle development: "The new approach is possible because the overall product development organization has continued to increase productivity and become more focused under the *Vehicle Line Executive (VLE) System.* The up-front work that has to be done to determine if the program is viable and profitable is very complex and includes many different variables. It starts with portfolio planning. Our teams orchestrate the work and resources associated with the development of a new product idea, and then see it through to the point where we know the product can be executed as a sound business case." "We are making sure, we have all the stakeholders involved," adds Ron Pniewski, GM North America vice president of planning. "The previous sequential approach, using a lot of hand-offs, is time-consuming and invites communication breakdowns." The current Advanced Vehicle Development process starts off with a core team that includes all the line functions that have been established at GM for decades, such as engineering, design, planning, purchasing, manufacturing, quality, and marketing. Once the new product team and its support groups have been organized, the work integration through the various product development stages is virtually seamless. Yet, managing this process is not a trivial matter, as echoed by Mark Hogan: "In essence, we're managing a virtual organization. Most of the critical players associated with the up-front work are also part of the bigger product development organization. It's our role to ensure the directions and desires of GM's senior product leadership are being effectively applied in creating new products. This requires aligning some of industry's best talents and resources, and to make the right decisions faster through streamlined decision making and better organizational focus."

Source: GMC Press Releases, 2002–2004, *www.prdomain.com/companies/g/gm/news.*

3.1 TODAY'S BUSINESS PROCESSES REQUIRE FLEXIBILITY, SPEED, AND EFFICIENCY

Effective organizational structures are fundamental to business success. This is not only true for General Motors, but also applies to NASA, dot.coms, and community hospitals. As technology changed the competitive landscape, organizations too had to change, to keep up with the demand for greater flexibility, speed, and efficiency. New administrative tools, product development techniques, and project management tools have evolved, especially over the past 20 years. These tools offer better capabilities for executing operations more integrated with the business process, and with

greater emphasis on supply chain integration, horizontal decision making, and work/technology transfer. This in turn leads to flatter, leaner, and more change-responsive organizations that can deliver enterprise objectives, such as new product development, by integrating resources effectively across multifunctional organizational segments.

Very noticeably over the past 20 years, activities within the enterprise have become increasingly business-oriented. That is, each functional component of the enterprise is being measured increasingly by its contribution to specific enterprise objectives, rather than by its ability to provide superior functional services in its specialty, such as R&D, marketing, engineering, or manufacturing. This drive toward broader business accountability combined with the pressures for faster, more effective market response have led to many new and innovative organizational designs, such as *simultaneous engineering, concurrent project management, design-build,* and *Stage-Gate processes*. However, none of these new organizational forms can function as a business by itself. They become *overlays to the traditional functional organization*, the baseline of any enterprise, from our ancient beginnings to modern times.

This presents major challenges. The drive toward greater cross-functional efficiency and agility also requires large degrees of *resource and power sharing*, hence diluting central decision making and control toward unified enterprise objectives. It also diminishes the autonomy of functional resource groups to develop and maintain the best functional capabilities needed by the enterprise. When GM's group vice president for advanced vehicle development, Mark Hogan, talked about the new approach to product development under the *Vehicle Line Executive (VLE) System,* he also pointed at the importance of resource alignment, supply chain integration, central organizational focus, and senior leadership. GM's emphasis on central direction and control is very clear when you look at GM's Advanced Vehicle Development Center in Warren, Michigan. The reality is that even GM, with its enormous pressure for agility and speed, is not too eager to give up central control and to empower management at the operational level. However, organizations are continuously evolving to adapt to the changing business environment. In spite of the challenges that flatter, leaner, and faster organizations are presenting, the trends of restructuring toward better cross-functional, horizontal integration are continuing. Let's take a more formal look at the organizational options that exist for today's enterprises.

3.2 ORGANIZATION DESIGNS FOR TECHNOLOGY-BASED ENTERPRISES

How can a company be organized to conduct its business most effectively and yield the greatest value to its stakeholders? Different times in history produced different answers. In 1600 the British East India Company was formed by a group of independent people, joining together for a single business mission: a trading mission to the East Indies. Although the company became one of the most powerful commercial enterprises of its time, and took part in the creation of British India, Hong

Kong, and Singapore, *its stakeholders disbanded each time a mission was completed,* at least for the first fifty years of the company's existence. Three hundred years later, Henry Ford created quite a different organizational model. He demonstrated that a successful company must be both vertically and horizontally integrated, owning virtually all stages in the supply chain and having strong central control. How does this compare to an Internet startup company, or an Intel or General Morors, today? Is there a "norm" of an organizational structure today? Fitting an organizational approach to a company is like fitting cloth to a person, says Alan Glasser.[1] It's a matter of style, personal taste, and circumstances.

How can the activities and functional support systems of an enterprise be organized most effectively to optimize desired results? In today's environment, where companies struggle with issues of complexity, agility, resource efficiency, and interdependence, the need exists for both centralized control *and* decentralized decision making, functional autonomy *and* cross-functional integration. This is a tricky balancing act and a great challenge. Consider the internal work environment of a typical high-tech company. Management has to deal with a broad spectrum of contemporary challenges. Such challenges include time-to-market pressures, accelerating technologies, innovation, resource limitations, technical complexities, social and ethical issues, operational dynamics, risk, and uncertainty, as summarized in Table 3.1. Facing such a dynamic environment often makes it difficult to manage activities through traditional, linear work processes or top-down controls. In response to these challenges, many companies and their management have moved from reliance on hierarchy and central control to flatter, more dynamic, and more cross-functionally transparent organizations. Their managements are trying to attend to both dimensions of vertical and horizontal integration. This creates a classic dilemma: how to organize to ensure unified mission control of the enterprise while providing autonomy and flexibility for horizontal integration and delivery. The answer to this dilemma is a delicate power balance between functional resource units and cross-functional business processes that results in some form of a matrix structure.

Table 3.1 High-Tech Business Environment: Today's Characteristics and Challenges

- Changing business models and structures
- Complex business performance measurements
- Complex joint ventures, alliances, and partnerships
- Complex projects
- Complex success criteria
- Different organizational cultures and values
- Global markets
- High risks and uncertainties
- Integrating across functions

[1]See *Research and Development Management*, p. 244, by Alan Glassser (1982).

Table 3.1 (Continued)

- Integrating broad spectrum of functions and support services
- Integrating many business processes
- Many stakeholders
- Multifunctional buy-in and commitment
- Need for continuous improvement
- Need for sophisticated people skills
- Organizational conflict, power and politics
- Resource constraints
- Self-directed teams
- Tight, end-date-driven schedules
- Tough performance requirements
- Virtual organizations, markets, and support systems

3.3 ORGANIZATIONAL LAYERS AND SUBSYSTEMS

The business areas of an enterprise do not operate in a vacuum, but are integrated within the functional support system of the company, which is part of the institutional framework of the enterprise. The three fundamental organizational layers are shown in Figure 3.1:

1. *Institutional Framework.* This is the area of "immortality," providing strategic directions, long-range survival and growth plans, policies, and procedures. This layer is staffed with senior management, corporate officers, and directors, who provide broad guidelines and resource allocations for the enterprise.
2. *Functional System.* This is the traditional organizational framework of the firm. It is an area of slow change and the provider of stability. It is the functional system that positions the enterprise for competitive advantage, growth, and profitability by advancing methods of operation, markets, and supply lines, and by integrating new technologies into the operating areas of the organization. Typical resource groups of the functional system include R&D, engineering, development, manufacturing, marketing, human resources, legal, quality control, and purchasing, just to name a few of the more common functional subsystems.
3. *Operational Areas.* This is the contemporary part of the enterprise that expands and shrinks as needed by the business. The operational areas of the firm are often organized as programs and projects, such as new product developments, contracts, off-the-shelf deliverables, internal maintenance, and field support operations. It is the functional system that provides the needed resources to the operational areas, which leads in most cases to a

matrix organization. In the extreme, the operational areas expand to absorb the entire functional system, creating a pure product organization or projectized or aggregated organization. In this approach the combined functional-operational system exists for the sole purpose of supporting one operation, such as the development of a new car model at GM, a new commercial airliner at Boeing, or a Mars Rover at the Jet Propulsion Laboratory (JPL). It is these operational areas that are most directly responsible for business results to the enterprise. It is also these operational areas that are most visible to the market and customer, and are held most accountable for business results by top management.

Each of the three organizational layers exists in every firm. These layers often overlap significantly and occupy different amounts of space relative to each other. Consider, for example, a high-tech, but relatively undifferentiated, computer assembly plant or a newspaper publisher. These firms can be expected to have a relatively large part of their resources organized along functional lines. Conversely, a consulting firm or aerospace company would be organized with two strong axes of functional and project/operational responsibilities. Yet, another situation exists for companies, such as Boeing, that most likely organize the whole company around product lines, such as 747, 767, 777, etc., hence integrating both functional and operational areas with focus on a particular product or project.

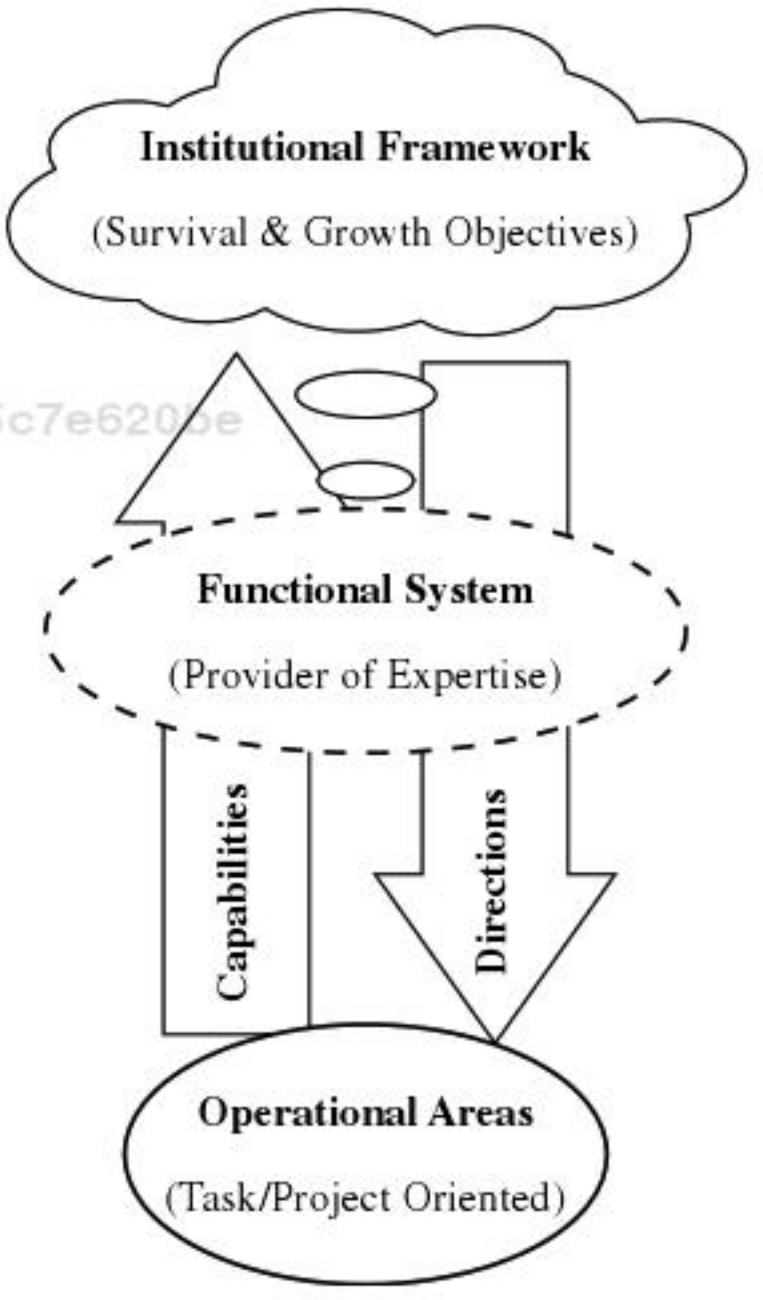

Figure 3.1 The three principal organizational layers.

With the great variety of products, services, markets, and supply chain scenarios, it is not surprising to find a large number of organizational structures and processes in today's world of business. While the resulting organizational structures are often bewildering and confusing, they can be broken down into a few basic components that can be explained in a simple model, such as that shown in Figure 3.2. In virtually every enterprise, responsibilities can be divided into two overlapping categories or axes: (1) responsibilities related to the *management of resources* that provide the traditional *functional organization*, such as engineering, manufacturing, and marketing, and (2) responsibilities related to the *management of the business, its projects, and its operations*, hence providing mission-oriented results of product rollout or project deliverables. As shown in Figure 3.2, the operations axis is an overlay to the functional axis, well positioned to contract with the functional organization for services needed for the integration of specific projects or programs. This is the essence of matrix management. Every enterprise has these two organizational axes to some degree. However, the organizational construct and managerial process vary a great deal, depending on the nature of the business, which will be discussed in the next section of this chapter.

3.4 ORGANIZATIONAL CHOICES

Fundamentally, companies have two choices for structuring their business operations:

- *Functionally Organized.* Resources are grouped by "functional" capabilities and managed via a hierarchical chain of command and control processes.
- *Project Organized.* Resources are allocated to specific projects that are managed autonomous and independently.

However, virtually no company works as a *pure functional* or *pure project* structure. Every company has some functional components that provide support services

Figure 3.2 Two organizational axes: project operations and resource functions.

and infrastructure, and every company has some project activity. As soon as a functionally organized business engages in some project activities, or a project organized business creates some overhead functions, it operates as a matrix organization.

3.4.1 Matrix Organized

This is a hybrid between the functional and the project organization that relies on resource sharing among functional units for producing specific project deliverables. Real-world businesses operate as hybrids. However, the degree of projectized versus functional structure varies a great deal, not only among companies, but also within each company. The matrix provides an effective and convenient framework for structuring any business, because its design depends less on the physical restructuring of organizational components than the management style, policies, procedures, and budgeting processes that determine the sharing of power and responsibilities. Figure 3.3 shows graphically the matrix as part of an organizational continuum, somewhere between the two extremes of pure functional and pure projectized. Further, the "strength" of the matrix, and therefore its location between the two extremes, depends to a large degree on the management style and interaction of people within the organization, as will be discussed next.

3.4.1.1 The Functional Organization

This is the traditional and most fundamental form of organization and management. It has been successfully used since ancient times by governments, military organizations, churches, and commercial enterprises. The trademark characteristics of the functional organization are the separation of "functional responsibilities," such as R&D, engineering, product development, marketing, finance, human resources, and so forth, and its hierarchical structure, which leads to clearly defined chains of command, controls, and communication channels. As summarized in Table 3.2, the *strength* of this organizational form is in effectively utilizing its resources, taking advantage of economies of scale, developing areas of specialization and expertise, and providing the institutional framework for long-range enterprise planning and

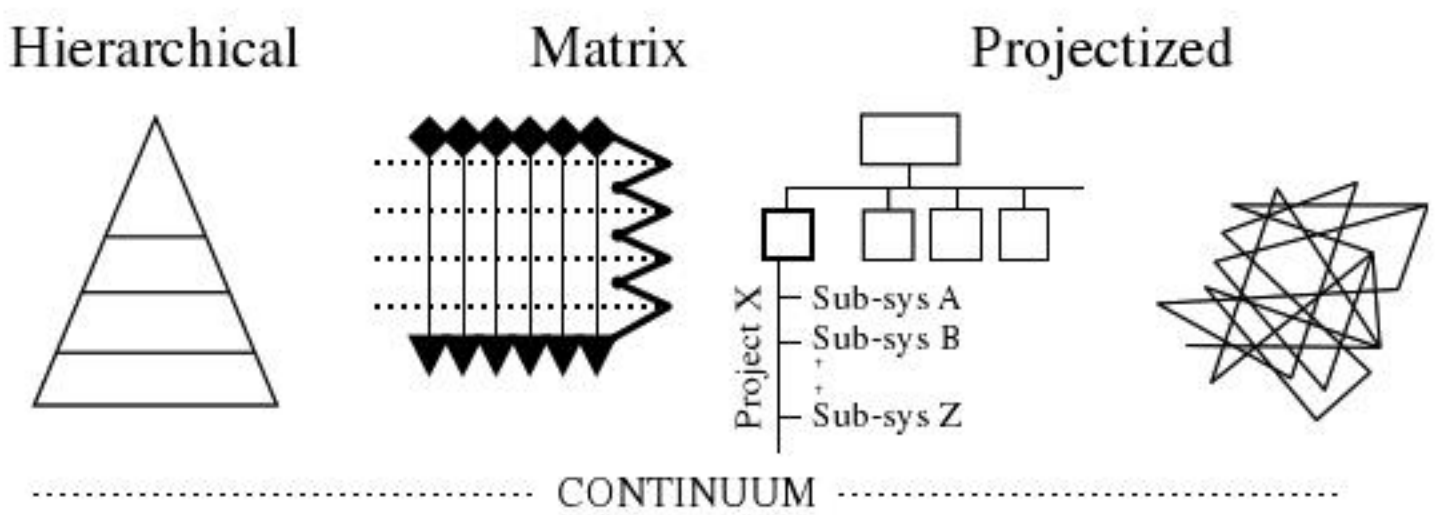

Figure 3.3 The organizational continuum of the matrix.

Table 3.2 Characteristics of the Functional Organization

Strength
• Institutional framework for planning, control, and stability
• Efficient use of collective experiences and facilities
• Concentration of expertise, benefiting most advanced developments
• Long-range preparation for survival and growth
• Effective utilization of operational facilities and systems
• Career continuity and advancement potential
• Well suited for mass production and standardized operations
Weaknesses
• Difficult cross-functional communications and controls
• Limited ability of technology transfer and multidisciplinary integration
• Slow and ineffective decision making at enterprise level
• Limited flexibility in responding to changes in business environment
• Risk adverse, limited entrepreneurial capacity
• Functional structure interferes with business process

control. Still, today, the functional organization provides the basic platform of operation for any enterprise, regardless of its business or environment. This concept of organizational structure has been the backbone for companies that are in a single business, especially those whose products and services come out of a single operational facility and are marketed through a single distribution and sales network. If decentralization of the enterprise is sought, regional or product divisions can be formed, as is typical for the automobile and aircraft industries (i.e., General Motors, Ford, and Boeing). Or, the company can operate in a number of unrelated conglomerated businesses, such as General Electric, Verizon, and ITT. Each of these decentralized businesses has its own organizational systems for development, manufacturing, sales, marketing, and so forth, hence operating its own "functional" business according to its product or regional charters.

Yet, in spite of its robustness and economic benefits, the functional organization has its *limitations and weaknesses*, especially in the dynamic, fast-changing, and market-focused business environment that we have been experiencing for several decades. In fact, the traditional functional organization is most challenged in *complex and technology-intensive environments*, characterized by high speed, great change, and great uncertainty (Shim and Lee 2001, Thamhain 2004, Zhang, Keil, Rai, and Mann 2003). Critical success factors (CSF) span a wide spectrum of cross-functional areas, involving technological, organizational, and interpersonal issues, including gaining and maintaining cohesiveness, commitment, technology transfer, self-direction, rapidly changing technology and requirements, resource limitations, innovation and demands for flexibility, and speedy implementation. In these contemporary business environments, traditional models of organization and management are often not

effective. As a result, these traditional hierarchical organizations are augmented with contemporary systems, tools, and techniques that lead to the matrix and projectized organization. However, regardless of these limitations and extensions into other organizational forms, the functional structure provides one of the most fundamental and stabilizing layers in any organization, and is the backbone of any company or institution.

3.4.1.2 *The Projectized Organization*

The *projectized* (also called *aggregated* or *monolithic*) structure essentially organizes the business activities of an enterprise into project groups. In its purest form, the *projectized* organization is the most extreme departure from the functional organization. The enterprise is partitioned into project units (or programs), with resources allocated to specific projects, managed autonomously and independently. Often each project is run as a profit center, like a business unit in a conglomerate or a division of a large company. In fact, the projectized form of organization and management is *similar to the divisionalized structure*. It offers a contemporary approach to building an organization for the purpose of executing a single project. Hence, the organization has a limited life. It builds up with the project and terminates with it! As summarized in Table 3.3, the projectized organization represents the strongest form of project authority. Each project manager has complete control over all support functions needed, people, facilities, and functions necessary to execute the project, start to finish. That is, the projectized business unit contains not only the technical functions, but also the operational and administrative support functions, such as marketing, quality, finance, human resources, and legal.

Table 3.3 Characteristics of the Projectized Organization

Strengths
• Strong control over all project activities by single authority
• Rapid reaction time, time to market
• Schedule, resource, and performance trade-offs
• Large project integration capability
• Personnel loyalty to project, one boss
• Well-defined interfaces to contractors and customers
• Well suited to large, long-term projects
Weaknesses
• Inefficient use of production facilities and capital equipment
• Difficulty of balancing work loads during technology transfers
• Costly project start-up and phase-out
• Limited technology development
• Little opportunity for sharing experiences among projects
• Limited career ladders

The principal advantage of the projectized organization is the high degree of control over each project, its resources, and its interfaces by a single authority, the project manager. For larger projects this translates into (1) more rapid reaction time to market/customer changes, (2) faster time to market, (3) schedule, resource, and performance trade-offs within each project, and (4) the capability to integrate larger projects in comparison to any other organization. Because of the full line of authority, similar to the functional organization, trade-off decisions between performance, cost, and schedule can be made rapidly and effectively with a focus on the end objectives. All people assigned to the project are loyal to the project and its mission objectives. By definition, there are no competing projects or dual accountabilities, and there is only one boss. This type of project organization is often preferred by the customer, because it can mirror the customer's organization, therefore providing one-to-one people interfaces between customer and contractor.

The principal disadvantages of the projectized organization, especially visible for smaller project and projects with shorter life cycles, are (1) considerable start-up cost and time requirement, (2) limited opportunity to share experiences and production elements, and (3) limited opportunity to use economies of scale and to balance workloads.

Because of these disadvantages and limitations, even companies in project-oriented businesses seldom projectize completely, unless their projects are large enough to utlize the dedicated resources, and long enough in duration to justify the organizational setup and phase-out efforts. What is more common, especially in technology-based companies, is a partially projectized organization. That is, project managers may fully control *some resources* that are particularly critical to the project, and can be fully utilized over the project life cycle (resource leveling), while other resources remain under the control of functional managers who share them among many projects as needed. Such resource sharing especially prevails in administrative support functions such as human resources, accounting, and legal. Thus, many enterprises that at first glance look projectized are really hybrids of several organizational types and layers. The matrix organization is in fact such a hybrid organization that operates across a whole spectrum of organizational entities. Stretched in one direction, it behaves very much like a functional organization, and stretched in the other direction, it becomes projectized.

3.4.1.3 The Matrix Organization

The matrix approach offers a compromise solution for project-oriented businesses that cannot dedicate resources over the life cycle of their projects, but must share them among many or all projects. Matrix organizations are overlaid on the functional structure of the firm which, when designed right, combines the strength of both the functional and the projectized organization. The matrix is a relatively straightforward and simple concept. Yet, it has been surrounded by much mystique and confusion.

Here is how it works: When a functionally organized enterprise has to perform several tasks, missions, or programs simultaneously, it automatically operates as a matrix. The matrix is essentially an overlay of contemporary project organizations on the functional resource departments of a company, as symbolically shown in Figures 3.2 and 3.4.

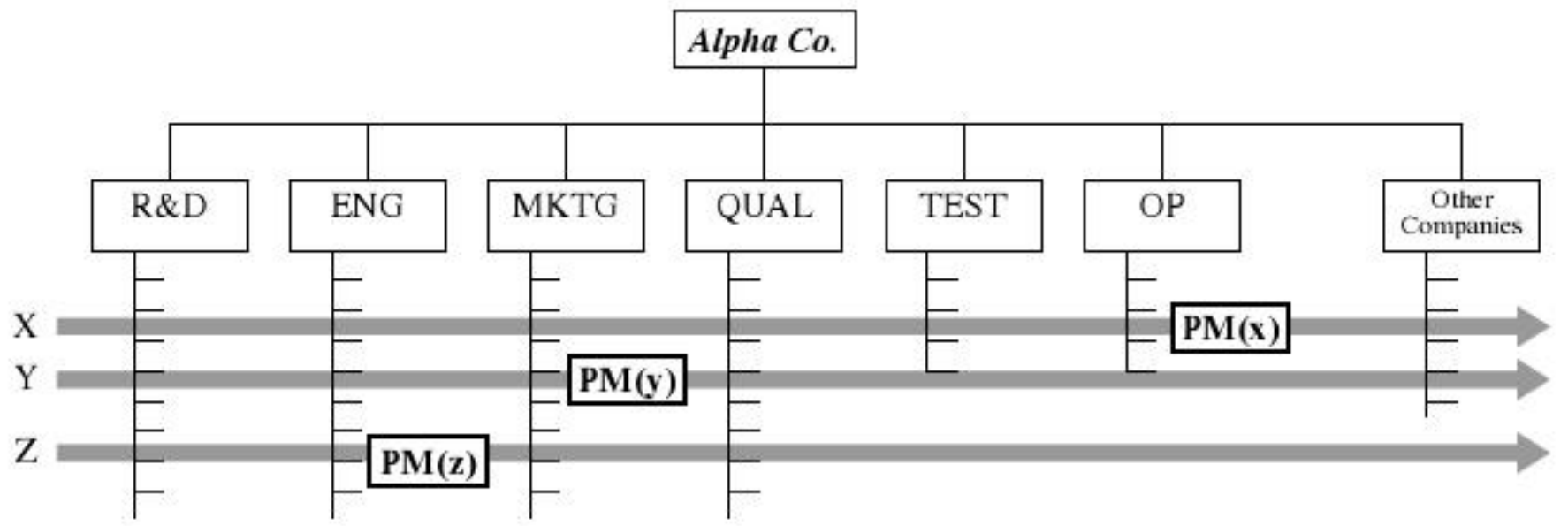

Figure 3.4 The matrix: schematic structure.

All departments and support units retain their functional, hierarchical characteristics. A clear chain of command and control exists for all units within the enterprise. At the operational level of the enterprise, task leaders or project engineers direct and coordinate the work. They are responsible for the implementation of plans that are directed either from the top down or horizontally via project managers, such as PM(x), PM(y), or PM(z) in Figure 3.4. These task leaders essentially have two bosses, upward to their department managers for effective resource utilization and review of work quality, and horizontally to project leaders for the timely and resource-effective implementation of specific projects according to established plans. Similar *dual accountabilities* often exist at the next level. Department managers share with their task leaders responsibilities along the horizontal axis of the organization for resource-effective implementation of projects plans, while vertically they are responsible to senior management for the maintenance and advancement of personnel, facilities, and support technologies. Project managers, such as PM(x), can either report to a functional manager, as shown in Figure 3.4, or into a *Program Management Office (PMO),* led by a *director of programs,* responsible for all projects conducted within the enterprise. Further up the organizational hierarchy, senior management is responsible for overall capability coordination and resource allocation, strategic planning, overall corporate direction, and leadership, very similar to top-level responsibilities in traditional hierarchical organizations.

The advantages of the matrix organization, summarized in Table 3.4, are similar to both the functional and the projectized organization combined: reasonable reaction time to emerging business opportunities, customer requirements, and changes; effective integration of multidisciplinary activities; and efficient resource utilization. The matrix also enjoys a high concentration of specialized resources, positioning the company for creating the best support technologies and most advanced products. The task leaders and project managers within the organization provide effective interface points to other organizational units and externally to the customer, contractor, and supplier communities. Perhaps one of the most important features of the matrix is its ability to start up and phase out projects quickly and economically, which results in greater agility and flexibility of the enterprise in pursuing emerging business opportunities and in dealing effectively with a mixture of projects that vary in size, duration, and scope.

Table 3.4 Characteristics of the Matrix Organization

Strengths

- Effective resource utilization
- Quick formation of project teams
- High quality of resources and skill sets
- Ability to handle complex projects
- Ability to work on many projects concurrently
- Quick response to business/market needs
- Organizational agility
- Standardized business processes
- Unified business strategy across many operations
- Career development and growth opportunities

Weaknesses

- Power and resource sharing
- Dual accountability
- Leading without authority
- Organizational ambiguity
- Complex organizational interfaces and work transfers
- Priority conflict and interruptions
- Complex cost accounting
- Difficulty of project control
- Resource multiplexing leads to organizational conflict and inefficiency
- Career uncertainty, risk, and anxieties

The weaknesses and limitations of the matrix organization relate to its unconventional structure that relies on resource and power sharing, often a source of organizational conflict, and always a challenge to managerial accountability and control. Furthermore, the additional organizational overlay (two axes) is likely to increase cost overhead, and together with the power and resource sharing, requires a more sophisticated management style than either the traditional functional or the projectized organization.

Yet, in spite of its limitations, the *matrix, when designed properly, combines some of the best features of both the functional and the projectized organization.* Therefore, it is not surprising to find the matrix structure in virtually every enterprise that executes projects or has to deal with multidisciplinary task integration. Technology management is to a large degree synonymous with matrix management!

Four Matrix Categories. Matrix organizations come in many forms and shapes depending on the specific business processes and operational needs within

each company. Formally, matrix organizations are classified into *four specific categories*[2] according to their primary purpose and mission objectives:

1. *Project-Function Matrix.* This represents an overlay of the project structure to the functional resource organization. It is the most common type of matrix organization, used for executing a wide variety of projects, ranging from development to service and training. The project or program manager is responsible for the business results, including project acquisition, planning, organizing, integration, and customer interfacing. Resource managers are responsible for the functionality and quality of the project components, and the management of their departmental resources, including the development and effective utilization of personnel, facilities, and technologies.
2. *Product-Function Matrix.* This matrix emphasizes product-oriented businesses. It is an overlay of the product organization on the functional or resource organization. Project or product-line managers are responsible for business results. Typically, they have to work across functional lines to achieve the integration of product design, prototyping, fabrication, sales, and marketing. Resource managers are responsible for the development and effective utilization of company resources and the technical implementation of project components, including their functionality and quality.
3. *Product-Regional Matrix.* This matrix is an overlay of the product organization on the regional network of a company's operation. This is often a sales-oriented structure where product managers are responsible for business results cutting across geographic-regional lines. This type of business operation also leads to multidimensional matrices with multiple layers of business operations.
4. *Multidimensional Matrix.* This organizational structure combines several matrix types, resulting in many layers, such as an overlay of the product organization on the functional organization, within a business division or regional network. Therefore project managers must cross functional lines in various divisions and geographic regions to achieve the desired business results. Similar to other matrix organizations, resource managers are responsible for the development and effective utilization of company resources and the technical implementation of project components.

Additional Matrix Axes. The relatively simple structure of the project-function matrix, with its two basic axes, as shown in Figures 3.2 and 3.4, can be expanded to reflect the realities of more complex business environments, as shown for the multidimensional matrix. The concept can be expanded even

[2]Classifications of matrix organizations date back more than 30 years. One of the earlier summary descriptions of different matrix types was published by the Conference Board, New York, in 1979, *Matrix Organizations of Complex Businesses.*

further. Companies that work across geographic, cultural, technological, and industrial boundaries, typical for multinational ventures or large programs, might establish additional matrix axes, which overlap the functional organization. Project charters, management directives, policy directives, and process flow diagrams provide the tools for defining these multidimensional matrices operationally. In addition, personal discussions and interactions, such as team sessions, workshops, focus group meetings, and managerial involvement with the project teams, can help in effectively communicating the matrix process and in clarifying the way the organization actually functions.

3.5 REAL-WORLD HYBRIDS

For real-world technology companies, the choice among functional, divisionalized, projectized, or matrix organization is not simple. A multibusiness company such as General Electric operates many unrelated businesses, largely on a high-technology platform, bound together by a common operating system. Top down the firm looks like a conglomerate, divided into operating companies. However, each of GE's 13 businesses consists of dozens of related, yet highly diversified enterprises with very different organizational needs and structures. Take, for example, GE's Transportation Business, comprising Aircraft Engines and Rail, two industry-leading business units with products and services ranging from jet engines to locomotives, mining trucks, and gas turbines, serving many different markets worldwide. Because these operations involve very large, long-term programs, most of these businesses have a projectized structure to concentrate resources and control on single projects or programs with dedicated customer and vendor interfaces, and specialized technology developments and field services. Yet, internally many resource departments, while dedicated to a single-project profit center, operate along matrix lines, executing subprojects that are eventually integrated with the larger program. In addition, there is a layer of traditionally structured administrative and strategic units that provide services and share resources across several businesses. Furthermore, to deal effectively with customers, suppliers, and regulators, each business must cross geographic, cultural, technological, and industrial boundaries, establishing additional organizational layers or axes that overlap the core business.

Not every company is as big as General Electric. Yet, many companies a lot smaller than GE also deal with a mixture of large and small programs, short range and long term, in different markets and multinational environments. These companies not only have the challenge of choosing the right organizational structure, but also must institutionalize this structure, that is, make it congruent with established business processes, cultures, and value systems.

3.5.1 Managerial Perspective

Choosing an appropriate organizational structure is difficult for any company. It is especially tough for firms that are involved with a mixture of functional and project-related

activities varying in size, duration, and markets. Since many technology-based companies fall into this category, it is not surprising that most of these enterprises operate, by design or default, as organizational hybrids. The core of these companies is often organized along matrix lines with hierarchically structured core functions, such as R&D, engineering, testing, manufacturing, marketing, field services, legal, and human resources. These resource functions are shared among the various project operations, providing a relatively high degree of organizational versatility and flexibility. In addition to the basic matrix, we find other organizational layers of *projectized clusters, mini-matrices, individual project organizations,*[3] *staff-project,*[4] and *intermix organizations.*[5] These hybrid structures help management to accommodate the widest possible range of business activities with great flexibility, while retaining much of the traditional functional stability and resource effectiveness.

3.6 UNDERSTANDING THE WORKING ENVIRONMENT

Real-world technology organizations are complex, both on paper and in practice. They must be carefully designed to accommodate the needed infrastructure and support systems for the business process while maintaining effective resource utilization. In many cases, even the managers who "designed" these organizational structures are unable to classify or describe their creations in simple terms, but speak of organizational system overlays, resource sharing, and joint responsibilities.

In fact, if we look at the organizational description of a typical high-technology company, such as given in an annual report or on a company Web site, we find that most high-tech businesses are very complex in terms of their internal operations and outside interfaces. Many of these companies conduct project-related businesses, and their core structure is some form of a matrix with an unconventional array of interfaces and reporting relationships.

To work effectively, people must understand where they fit into the enterprise and what their responsibilities are. Especially with the complex workings and intricacies of modern technology companies, it is important to define the management process together with the command and control structure, which includes responsibilities,

[3]An *individual project organization* is a one-person program office, chartered with the coordination of a single project across functional lines, according to established plans and objectives. It is simple, efficient, and quick to establish and to dissolve. It often exists as an overlay on other major organizational structures, such as the matrix or projectized organization.

[4]A *staff-project organization* is a mini-matrix, similar in characteristics to the *individual project organization*, but broader in terms of resources and responsibilities. As the name implies, the staff-project organization consists of a project leader with a small number of staff people directly reporting to him or her.

[5]Intermix organizations are created by splitting off resources from functional departments, such as individuals, teams, or complete operational groups, including facilities. These resources are temporarily transferred to the new project organization (intermix), to perform specific, usually short-range assignments, such as working on bid proposals, mergers, or feasibility assessments. The unique feature of the intermix organization is that it can be "created instantaneously"—but at the expense of other ongoing activities within the enterprise.

reporting relations, and interfaces for all organizational components. The tools come from conventional management practices. They provide the basis for managerial direction, communication, and control, as well as the informational infrastructure for teamwork, technology transfer and decision making at the operating level of the company. The principal tools are:

Policy Directive. This top-level document describes the overall philosophy and principles of managing the business within a particular organizational unit. A sample policy directive is shown in Appendix 1.1 on page 357 for managing the *engineering activities* within a company.

Procedure. This operational guideline describes the various components of the business process, including how specific work and projects are to be executed, and how supporting activities, such as cost estimating, scheduling, testing, and training, are to be conducted.

Charter of Key Positions. This policy document defines the operational framework for a particular department, business unit, or program office. It clearly describes its mission, scope, broad responsibilities, authority, organizational structure, interfaces, and reporting relations. Charters should be revised if the scope or mission of the position changes, as is the case for positions such as program offices or new product development organizations. Sample charters are provided for a *product design manager* and an *engineering team leader* in Appendix 1.2 and 1.3 on page 360.

Organization Chart. Regardless of the intricacies of the organization, its structure, and its terminology, a simple organization chart of the core organization defines the major reporting and authority relations, interfaces, and communication channels. In spite of its static nature, the organization chart provides a useful bird's eye view of principal organizational structure.

Responsibility Matrix. This chart is especially useful for defining the interfunctional responsibilities and multiple accountabilities for project-related activities. The chart shows who is responsible for what. Its application can be expanded from covering a particular department to the whole company, and even go beyond, to reach into supplier and customer environments.

Job Description. Similar to the charter, but more detailed and specifically for an individual position (or class of positions), the job description defines (1) principal duties, (2) qualifications, (3) responsibilities, (4) reporting relations, and (5) basic authorities. Job descriptions should be developed for all key personnel, such as managers, lead engineers, scientists, and project managers. Job descriptions are modular and portable among similar positions. Once established, job descriptions become building blocks for staffing, professional development, and performance evaluation and rewards. A sample job description for an R&D project manager is provided in Appendix 1.4 on page 361.

While the Exhibits in Appendix 1 provide examples of policy and procedural tools for defining complex organizations, it should be emphasized that these tools must be modified to fit the specific organizational needs, specs, cultures, and business processes. The objective of showing these samples in Appendix 1 is to provide a framework for managers for developing their own tools.

3.6.1 Make Interdisciplinary Relations Work for You

Technology-intensive organizations are, by and large, interdisciplinary, that is matrix-based with shared power and resources. When functional resource personnel are assigned to specific projects, team members are likely to maintain strong ties to their home functions. These ties are very normal and predictable as part of the existing cultural network. They are also desirable and necessary for broad conceptual thinking and ultimately cross-functional integration of the work. Yet, these functional ties are often seen by the project team leaders as "disloyalty" and lack of full commitment to the project effort they are assigned to. However, research shows that fighting these ties of team members to the home office is counterproductive. It leads to personal anxieties and mistrust. Project team members realize that their job security and career advancement come to a large degree via their home office and its management. At the same time, these home office connections are valuable linkages from the project office to the functional resource organization that should be carefully cultivated and maintained.

Commitment of assigned personnel to the project is a separate issue. Research shows that project ownership has little to do with team member alliance with home offices, but depends instead on the personal involvement and pride team members have in the project, and the professional excitement they experience in the team environment. These are dimensions that can be influenced by the project team leader via recognition, project visibility, and management involvement. Further, making accomplishments visible and providing feedback to functional managers will influence the reward process administered though the functional organization. This will build a strong team member commitment to the project, with the realization that many of the elements that contribute to their professional excitement and career advancement come through the project organization. These are the influences that help in building and sustaining commitment and ownership to a project and its mission objectives.

3.7 SUMMARY OF KEY POINTS AND CONCLUSIONS

The key points that have been made in this chapter include:

- The need for broader business accountability and pressures for faster, more effective market response led to many new and innovative organizational designs, such as *simultaneous engineering, concurrent project management, design-build*, and *Stage-Gate processes.*

- Three fundamental organizational layers exist in every enterprise: (1) institutional framework, (2) functional system, and (3) operational areas.
- Companies have two choices for structuring their business operations: *functionally and project organized.* However, virtually no company works in a *pure* mode. Real-world businesses operate as hybrids between functional and project organization, relying on resource sharing among functional units for producing specific project deliverables,. This is known as the matrix organizational structure.
- The matrix structure exists within an organizational continuum, somewhere between the two extremes of pure functional and pure projectized structures. Its exact operational location between the two extremes depends on the management style and interaction of people within the organization.
- The projectized form of organization is *similar to the divisionalized structure.* It represents the strongest form of project authority and an effective approach to executing large project. It requires considerable start-up cost and time, and offers limited opportunity for sharing experiences and resources.
- Matrix organizations offer a compromise solution for project-oriented businesses. The matrix is an overlay on the functional structure of the firm, combining the strength of both the functional and the projectized organization.
- Matrix organizations rely on resource and power sharing, often a source of organizational conflict, and always a challenge to managerial accountability and control, requiring a more sophisticated management style.
- It is important to define the management process, together with its command-and-control structure, including responsibilities, reporting relations, and organization. The principal tools are policy directives, procedures, the charter of key positions, the organization chart, the responsibility matrix, and job descriptions.
- Commitment of assigned personnel to a project is crucial to team performance. Commitment and project ownership can be enhanced through personal involvement, generating professional excitement and encouraging pride in the project activities.

3.8 CRITICAL THINKING: QUESTIONS FOR DISCUSSION

1. Describe a business environment that would benefit from a predominately projectized internal organization.
2. What advice would you give to your project managers in a matrix organization to minimize "matrix conflict"?
3. How do you build and sustain project ownership among the team members assigned from other resource departments?
4. Many managers see the matrix as a messy, sloppy organizational structure that is unworkable. Assuming that you cannot projectize, what alternatives do you see to matrix management?

5. Develop a list of dos and don'ts for effective matrix management.
6. Develop a policy or operational guideline for conducting project activities in your company.
7. Project leaders must often step across functional lines and deal with personnel over whom they have little or no formal authority. How can these leaders "earn" the authority they need to function effectively in a matrix environment?
8. How could senior management help project leaders to manage effectively in a matrix environment?

3.9 REFERENCES AND ADDITIONAL READINGS

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