3. Integration: The Essential Function of Project Management

Linn C. Stuckenbruck

INTRODUCTION

Project management has achieved almost universal recognition as the most effective way to ensure the success of large, complex, multidisciplinary tasks. The success of project management is based on the simple concept that the sole authority for the planning, the resource allocation, and the direction and control of a single time- and budget-limited enterprise is vested in a single individual. This single-point authority and responsibility constitutes the greatest strength of project management, but it also constitutes its greatest weakness. The pressures for the completion of an often almost impossible task must of necessity be focused on how effectively the project manager carries out his or her job (20).

Therefore, project management is not a panacea, and unfortunately it does not always work. Its use does not guarantee the success of a task; rather, it takes a great deal more. It takes great dedication and considerable effort on the part of an experienced and talented project manager leading an equally experienced and talented project team to ensure that a project will be a success. However, even these proven ingredients are not always enough—projects occasionally fail.

Determining the real or basic cause or causes of project failure can be a frustrating experience. It can be very difficult to pin down the basic causes because they are seldom simple or clear-cut. The problems will be numerous, extremely complex, very much interrelated, and often deeply hidden. It is all too easy to pick a scapegoat, and the project manager is usually the handiest person. Of course the project manager may not be at

* Dr. Linn C. Stuckenbruck is with the Institute of Safety and Systems Management at the University of Southern California where he teaches project management and other management courses. Prior to this he spent seventeen years with the Rocketdyne Division of Rockwell International where he held various management positions. He holds a Ph.D. from the State University of Iowa, and is the author of the book *The Implementation of Project Management—The Professional's Handbook*, published by Addison-Wesley Publishing Company
fault, but there are definitely any number of things that project managers can do wrong. Among the many pitfalls that the unwary or inexperienced project manager can fall into is a failure to completely understand some of the basic aspects of the job.

Project management can, of course, be perceived as just another job requiring an experienced and conscientious manager. But, is just any experienced manager prepared for the job of project management?

It is a management axiom that the overall job of every manager is to create within the organization an environment which will facilitate the accomplishment of its objectives (11).

Certainly the job of the project manager fits this role very well. In addition, all managers, including project managers, are responsible for the universally accepted managerial functions of planning, organizing, staffing, directing, and controlling. It can then be asked whether project management is really significantly different from management in general. An old management cliche states, "A manager is a manager," or putting it another way, "A good manager can manage anything." This statement implies that there is little real difference between the job of the project manager and that of any line or disciplinary manager. However, there is one extremely important, very real, and significantly different aspect of the job of the project manager which makes it different from general management.

By definition projects are complex and multidisciplinary tasks; therefore, project managers must of necessity be very much aware of or even in some cases completely preoccupied with the problem of integrating their projects. This problem, which is of major importance to all but the simplest projects, seldom confronts line managers. This chapter will discuss this essential function of project integration and indicate the various actions that are necessary to achieve a fully integrated project.

SYSTEMS INTEGRATION

The term systems integration is usually applicable to most projects because inevitably a project is a system. This term is used to indicate the process of integrating any system being utilized or developed, whether it is hardware, software, an organization, or some other type of system. This process of systems integration has been identified as an important management function which has been described by Lawrence and Lorch. They pointed out that with the rapid advances in technology and the increased complexity of systems to be managed, there is an increased need both for greater specialization (differentiation) and for tighter coordination (integration) (13). An effective manager has a need for both; however, since these two needs are essentially antagonistic, one can usu-
ally be achieved only at the expense of the other (14). It can be described as a trade-off between these two needs as shown in Figure 3-1.

Referring to Figure 3-1, it has been suggested that the ideal high-performance manager falls on the arrow midway between differentiation and integration, and probably is typical of high-performance top management. It is also true that line or discipline management usually falls closer to the differentiation arrow, and that the truly effective project manager falls closer to the integration arrow. This model emphasizes the importance of the project manager’s role as an integrator.

Systems integration is related to what Koontz and O’Donnell call “the essence of management-coordination, or the purpose of management is the achievement of harmony of individual effort toward the accomplishment of group goals” (12). However, doesn’t every manager have this function? Yes, but the project manager has to be preoccupied with it. The project manager’s major responsibility is assuring that a particular system or activity is assembled so that all of the components, parts, subsystems and organizational units, and people fit together as a functioning, integrated whole according to plan. Carrying out this responsibility comprises the function of systems integration.

INTEGRATING THE PROJECT

Every project is a system in that it consists of many interrelated and interconnected parts or elements which must function together as a “whole.” Projects vary greatly in size, complexity, and urgency; however, all but the simplest projects have a common element in that they

Figure 3-1. Measuring managerial performance.
must be integrated. Project integration can then be described as the process of ensuring that all elements of the project—its tasks, subsystems, components, parts, organizational units, and people—fit together as an integrated whole which functions according to plan. All levels of management ascribe to this goal, but project managers must be preoccupied with it since they have the direct responsibility to ensure that it occurs on every project. These project elements will not automatically come together; the project manager must make a concerted effort and take a number of specific actions to ensure that integration occurs.

The principal precaution that the project manager must take is to make certain that adequate attention is given to every element of the project system. It is easy to be trapped into thinking of the project as consisting entirely of the hardware or other system being designed, developed, or constructed. Many elements of the project may have little direct relationship to the system being worked on, but they may be critical to ultimate project success. Most projects involve a number of different organizational units, many only in a service or support capacity, and an infinite variety of people may be stakeholders in some aspect of the project. The total project system consists of everything and everyone that has anything to do with the project. The diversity of the project system is indicated in Figure 3-2.

![The total project system (Figure 3-2)](image-url)
INTEGRATION IN THE MATRIX

The job of project integration is most important and most difficult when the project is organized in the matrix mode. The matrix is a complex organizational form that can become extremely complicated in very large projects. The matrix is complex because it evolved to meet the needs of our increasingly complex society with its very large problems and resulting very large projects. The conventional hierarchical functional management structure usually finds itself in difficulty when dealing with large projects. The pure project organization is a solution when the project is very large, but it is not always applicable to smaller projects. Therefore, management, in an effort to obtain the advantages of both project and functional organizational forms, has evolved the matrix, which is actually a superimposition of project organizations upon a functional organization. The matrix is not for everyone (23). It should only be utilized if its advantages outweigh the resulting organizational complexity.

Why is systems integration difficult in the matrix organization? What is so different about the matrix? Since the matrix is such a complex organizational form, all decisions and actions of project managers become very difficult, primarily because they must constantly communicate and interact with many functional managers. The project manager discovers that the matrix organization is inherently a conflict situation. The matrix brings out the presence of conflicting project and functional goals and objectives. In addition, the project manager finds that many established functional managers who must contribute to the project feel threatened, and continual stresses and potential conflicts result.

The matrix organization has evolved to cope with the basic conflict inherent in any large organization—the needs of specialization versus the needs of coordination (18). These divergent needs in the hierarchical organizational structure lead to inevitable conflict between functional and top management, and often lead to nonoptimizing decisions. All major decisions must be made by top management who may have insufficient information. The matrix organization was a natural evolution growing out of the need for someone who could work problems through the experts and specialists. The project manager has assumed the role of “decision broker charged with the difficult job of solving problems through the experts” (18), all of whom know more about their particular field than he or she.

The role of the project manager in the matrix organization has been analyzed by Galbraith (8, 9), Lawrence and Lorsch (13, 14, 15, 16), and Davis and Lawrence (5). They point out that the horizontal communication in a matrix organization requires an open, problem-solving climate. However, as pointed out by Galbraith (8, 9), when the subtasks in an
organization are greatly differentiated a matrix structure may be required to achieve integration. The integrator coordinates the decision processes across the interfaces of differentiation. The project manager must function as an integrator to make the matrix work.

Problem solving and decision making are critical to the integration process since most project problems occur at subsystem or organizational interfaces. The project manager is the only person in the key position to solve such interface problems. The project manager provides “1. a single point of integrative responsibility, and 2. integrative planning and control” (2). The project manager is faced with three general types of problems and with the subsequent necessity for decision making:

1. Administrative problems involving the removal of roadblocks, the setting of priorities, or the resolution of organizational conflicts involving people, resources, or facilities.
2. Technical problems involving the making of decisions, and scope changes; making key trade-offs among cost, schedule, or performance; and selecting between technical alternatives.
3. Customer or client problems which involve interpretation of and conformance to specifications and regulatory agency documents.

Matrix organizations will not automatically work, and an endless number of things can go wrong. Recognizing that the matrix is a complex organizational form is the first step. The next step is getting this complex organization to function. Its successful operation, like that of any management function, depends almost entirely on the actions and activities of the various people involved. In a matrix, however, the important actions and activities are concentrated at the interfaces between the various organizational units. The most important of these interfaces are between the project manager and top management, and between the project manager and the functional managers supporting the project. Moreover, most matrix problems occur at the interfaces between the project manager and functional managers. Project managers must effectively work across these interfaces if they are going to accomplish their integrative function.

Project managers carry out their function of project integration primarily by carefully managing all of the many diverse interfaces within their projects. Archibald indicates that “the basic concept of interface management is that the project manager plans and controls (manages) the points of interaction between various elements of the project, the product, and
the organizations involved” (1). He defines interface management as consisting of identifying, documenting, scheduling, communicating, and monitoring interfaces related to both the product and the project (1).

The complexity that results from the use of a matrix organization gives the project manager even more organizational and project interfaces to manage. These interfaces are a problem for the project manager, since whatever obstacles he or she encounters, they are usually the result of two organizational units going in different directions. An old management cliche says that all the really difficult problems occur at organizational interfaces. The problem is complicated by the fact that the organizational units are usually not under the direct management of the project manager, and some of the most important interfaces may even be completely outside of the company or enterprise.

Types of Interfaces

There are many kinds of project interfaces. Archibald divides them into two types—product and project—and then further divides them into subgroups, of which management interfaces are a major division (2). The problem of the overall project/functional interface is thoroughly discussed by Cleland and King, who point out the complementary nature of the project and the functional or discipline-oriented organization. “They are inseparable and one cannot survive without the other” (3).

Another way of describing the various interfaces that the project manager must continually monitor for potential problems is (a) personal or people interfaces, (b) organizational interfaces, and (c) system interfaces (2). In other words, project management is more than just management interfaces; it involves all three of the above types.

1. Personal Interfaces—These are the “people” interfaces within the organization whether the people are on the project team or outside it. Whenever two people are working on the same project there is a potential for personal problems and even for conflict. If the people are both within the same line or discipline organization, the project manager may have very limited authority over them, but he or she can demand that the line supervision resolve the personal problem or conflict. If the people are not in the same line or discipline organization, the project manager must play the role of mediator, with the ultimate alternative of insisting that line management resolve the problem or remove one or both of the individuals from the project team. Personal interface problems become even more troublesome and difficult to solve when they involve two or more managers.
2. Organizational Interfaces—Organizational interfaces are the most troublesome since they involve not only people but also varied organizational goals, and conflicting managerial styles and aspirations. Each organizational unit has its own objectives, its own disciplines or specialties, and its own functions. As a result of these differences, each organizational unit has its own jargon, often difficult for other groups to understand or appreciate. It is thus apparent that misunderstandings and conflict can easily occur at the interfaces. These interfaces are more than purely management interfaces since much day-to-day contact is at the working level. Purely management interfaces exist whenever important management decisions, approvals, or other actions that will affect the project must be made. Organizational interfaces also involve units outside the immediate company or project organization such as the customer, subcontractors, or other contractors on the same or related systems.

3. System Interfaces—System interfaces are the product, hardware, facility, construction, or other types of nonpeople interfaces inherent in the system being developed or constructed by the project. These will be interfaces between the various subsystems in the project. The problem is intensified because the various subsystems will usually be developed by different organizational units. As pointed out by Archibald (1), these system interfaces can be actual physical interfaces existing between interconnecting parts of the system, or performance interfaces existing between various subsystems or components of the system. System interfaces may actually be scheduled milestones involving the transmission of information developed in one task to another task by a specific time, or the completion of a subsystem on schedule.

Management Interfaces

Each of the three types of interfaces that have been described pose important problems. Problems become particularly troublesome when personal and organizational interfaces are combined into what may best be called management interfaces (17). Management interfaces have personal aspects because normally two individuals are concerned, such as a project manager and a particular functional manager. Management interfaces, however, also have organizational aspects because the respective managers lead organizations which probably have conflicting goals and aspirations.

There is a great difference between the conventional organization chart (whether it be hierarchical or matrix) and the actual operation of a real-
world organization. The conventional hierarchical organization charts or matrix organization charts clearly show many of the management interfaces, such as superior/subordinate and project management/worker relationships. However, conventional management charts only suggest some of the other really important interfaces. These important interfaces, as shown by the double-ended arrows in Figure 3-3, consist of project manager/functional manager interfaces, project manager/top management interfaces, functional manager/functional manager interfaces, and sometimes even project manager/project manager interfaces.

Most important are the interfaces between the project managers and the various functional managers supporting the project. These relationships are almost inevitably adversary since they involve a constantly shifting balance of power between two managers on essentially the same reporting level.

The interface with top management is important because it represents the project manager's source of authority and responsibility. The project manager must not only have the real and unqualified support of top management, but must also have a clear and readily accessible communication link with them. The project manager must be able to get the "ear" of top management whenever necessary.

The interfaces between the various functional managers are important because they are the least visible to project managers who might not be immediately aware of trouble spots.

Figure 3-3. The multiple management interfaces in the matrix.
The Balance of Power

Having implemented project management, top management must recognize that they have placed a new player in the management game—the project manager. Problems are to be expected, particularly in a matrix organization where a new situation has been created with natural conflict or adversary roles between the project managers and the functional managers who support the projects. This managerial relationship can best be described as a balance of power between the two managers involved as illustrated by Figure 3-4. This relationship has also been described as a balance of interest and a sharing of power (6). But this does not imply that the shared power is ever truly balanced, because in reality the balance of power is a dynamic, constantly changing condition that cannot be static even if so desired.

There is no way to assure a balance of power at every managerial interface. Theoretically, it should be possible to divide the authority and responsibility more or less equally between the project and functional managers, which implies a very clear balance of power between the two managers. This is not only very difficult, but it doesn’t happen very often. Various authors have attempted to clearly delineate the authority and responsibilities of both project and functional management so as to assure a balance of power (3). Certainly such a delineation can indicate where

Figure 3-4. The balanced matrix.
major responsibilities lie, but cannot guarantee a balance of power. In fact, there are many reasons why it is almost impossible to have a true balance of power between functional and project management. Not the least of these reasons is the fact that a matrix consists of people, and all people—including managers—are different from each other. Managers have differing personalities and differing management styles. Some management styles depend on the persuasive abilities of the manager, while others depend on or tend to fall back on strong support from top management.

Since projects, programs, or products are usually the most important of all of a company’s activities, project managers are very important persons. They are the persons who put the company in a position where it can lose money or make a profit. Therefore, in terms of the balance of power, it would seem that projects would always have the scale of power tipped in their direction, particularly with the firm support of top management. Not necessarily so! In fact, not usually so, at least in a matrix organization. In a pure project organization, there is no question as to who holds the power. But in a matrix organization the functional managers have powerful forces on their side. The functional manager is normally perceived by project personnel to be the real boss. This is inevitable since functional management is part of the management ladder in the hierarchy which goes directly up to the president of the company, and it is therefore perceived to be “permanent” by the employees. After all, the functional organization represents the “home base” to which project personnel expect to return after the completion of the project.

Very strong top management support for the project manager is necessary to get the matrix to work, and even very strong support will not guarantee project success. However, the matrix will not work without it. Project managers must get the job done by any means at their disposal even though they may not be perceived as the real boss.

The Project/Functional Interface

The secret of the successfully functioning matrix can thus be seen to be not just a pure balance of power, but more a function of the interface or interface relationships between the project and individual functional managers. Every project decision and action must be negotiated across this interface. This interface is a natural conflict situation since many of the goals and objectives of project and functional management are so very different. Depending on the personality and dedication of the respective managers, this interface relationship can be one of smooth-working cooperation or bitter conflict. A domineering personality or power play usuall
is not the answer. The overpowering manager may win the local skirmish, but usually manages sooner or later to alienate everyone working on the project. Cooperation and negotiation are the keys to successful decision making across the project/functional interface. Arbitrary and one-sided decisions by either the project or functional manager can only lead to or intensify the potential for conflict. Unfortunately for project managers, they can accomplish little by themselves, they must depend on the cooperation and support of the functional manager. The old definition of successful management—'getting things done by working through others'—is essential for successful project management in the matrix organization.

The most important interface that the project manager has in a matrix organization is with the functional managers. The conventional matrix two-boss model does not adequately emphasize this most important relationship. Obviously, neither the project manager nor the functional manager can simply sit in his or her office and give orders. The two managers must be communicating with each other on at least a daily basis, and usually more often. The organizational model shown in Figure 3-4 shows the managerial relationship as a double-ended arrow indicating that the relationship is a two-way street. Consultation, cooperation, and constant support are necessary on the part of both the project and functional managers. This is a very important relationship, key to the success of any matrix organization, and one which must be carefully nurtured and actively promoted by both project and functional management.

**Strong Versus Weak Matrices**

Achieving an equal balance of power between project and functional management may be a desirable goal; certainly it should be a way of minimizing potential power struggles and possible conflicts. There is no certain way to assure that there is an "equal" balance of power, and it is probably seldom really achieved. However, it can be approached by assuming that the project managers have the full support of top management and that they report at a high enough level in the management hierarchy. In fact top management can, whenever desirable, tilt the scales of power in either direction.

In many situations it may not be desirable to have an equal balance of power. For instance, a project may be so important to the company, or the budget and schedule so tight that top management feels that the project manager must be in a very strong position. Or perhaps the project managers feel that they must tilt the organizational balance of power in their favor to obtain better project performance. On the other hand, top
management may feel that functional management needs more backing. In either case, the balance of power can be tilted in either direction by changing any one or any combination of the following three factors:

1. The Administrative Relationship—The levels at which the project and involved functional managers report, and the backing which they receive from top management.
2. The Physical Relationship—The physical distances between the various people involved in the project.
3. The Time Spent on the Project—The amount of time spent on the project by the respective managers.

These three factors can be used to describe whether the matrix is strong or weak. The strong matrix is one in which the balance of power is definitely on the side of project management. This can be shown by the model in Figure 3-5. A weak matrix has been described by project managers as one in which the balance of power tilts decisively in the direction of line or functional management.

The managerial alternatives have been described as a continuum ranging from pure project to functional as shown in Figure 3-6 (7). The matrix falls in the middle of the continuum, and can range from very weak to very strong depending on the relative balance of power.

![Diagram](image)

Figure 3-5. The balance of power in a strong matrix.
THE INTEGRATION PROCESS

As previously indicated, project integration doesn't just happen, it must be made to happen. It is more than just fitting components together; the system has to function as a whole. The integration process consists of all of the specific actions that project managers must initiate to ensure that their projects are integrated. Integration cannot be an afterthought, and it does not consist only of actions that can be accomplished after the sub-systems have been completed. Therefore, the critical actions leading to integration must take place very early in the life cycle of the project, particularly during the implementation phase, to ensure that integration takes place. In "pure" project organizations there is no question as to who initiates these actions, project managers run their own empires. In matrix organizations, however, project managers encounter particular difficulties and problems in carrying out their integrative functions.

THE CRITICAL ACTIONS OF INTEGRATION

The integration process is difficult to separate from general good management practice; however, there are a number of critical actions which are uniquely important to the job of project management. These actions must be initiated and continually monitored by project managers if project integration is to occur. The project manager is the single point of integrative responsibility, and is the only person who can initiate these actions. These critical actions are of two types: (a) those which are essentially just

![Figure 3-6. The balance of power in weak and strong matrices.](image)
good project management practice and which must extend over the entire life of the project, and (b) specific one-time actions which must be taken by some member of management (usually the project manager or a member of top management) to ensure that the project is integrated. The most important of these actions are as follows (22):

1. Getting started on the right foot.
2. Planning for project integration.
3. Developing an integrated Work Breakdown Structure, schedule, and budget.
4. Developing integrated project control.
6. Removing roadblocks.
7. Setting priorities.
8. Facilitating project transfer.
9. Establishing communication links.

**Getting Started on the Right Foot**

To achieve successful project integration, it is of course very important that the project get started on the right foot. There are a number of specific things that must be done, both by top management and by the project manager (22). The secret of project success is dependent on making these critical actions very early in the project life cycle. For the most part these actions are inseparable from the normal actions that must be taken to implement any successful project; however, they must be made during the project implementation phase. If the right decisions are made at this time, the project can be expected to run smoothly and the integration process will proceed as planned.

The most important decisions and resulting actions are those taken by top management, and many of these actions must be taken well before the project is actually started. Not all of these actions are directly concerned with the integration function, but they are all necessary for the successful implementation of project management. The most critical of the actions which must be taken by top management are the following:

1. Completely selling the project management concept to the entire organization.
2. Choosing the type or form of project organization to be utilized.
3. Issuing a **project charter to completely delineate all project and functional authority and responsibilities**.
4. Choosing the project manager or project managers.
5. Choosing the right functional managers to participate in the project and/or matrix organization.

6. Supplying adequate resources to the project organization such as finances, equipment, personnel, computer support, etc.

7. Continuing strong support for the project and for the project manager.

The above list of actions is more or less in the order that the actions must be taken, and most of them must be taken prior to the actual implementation of the project.

After top management has successfully implemented project management and has given it full support, the action passes to the newly appointed project managers. There are a number of specific actions that the project managers must now initiate to start their projects on the road to success, and to ensure project integration. The project manager is the single point of integrative responsibility, and is the only person who can initiate and monitor these actions. The most critical of these actions are as follows:

1. Issuance of the Project Implementation Plan.
2. Creation of the project Work Breakdown Structure (WBS).
3. Development of the project organization.
4. Issuance of the Project Procedures Guide.
5. Issuance of a Project Material Procurement Forecast.

These actions are more or less sequential, although they are strongly interrelated and must be worked on at the same time. The most important consideration is that documentation implementing the above actions be issued as early in the project life cycle as possible. Much of this effort should have been accomplished prior to the initiation of the project, such as during proposal preparation. Even so, a great deal of effort is required during the "front end" of a project to accomplish these actions, and to ensure that project integration takes place.

Planning for Project Integration

Integration doesn't just happen—it must be planned. The project manager must develop a detailed planning document that can be used to get the project initiated, and to assure that all project participants understand their roles and responsibilities in the project organization.

The project manager is the only person in the key position of having an
overview of the entire project system, preferably from its inception, and therefore can best foresee potential interface or other integration problems. After identifying these key interfaces, the project manager can keep a close surveillance on them to catch and correct any integration problems when they first occur. Particularly important in the project plan is a clear delineation of the project requirements for reporting, hardware delivery, completion of tests, facility construction, and other important milestones.

An important part of the project plan should be the integration plan. This plan is a subset of the project plan and may even be a separate document if a single department or even a separate contractor is responsible for system or project integration. In any case, the integration plan should define and identify all interface events, interrelationships between tasks and hardware subsystems, and potential interface problems. The integration plan should then analyze the interrelationships between tasks and the scheduled sequence of events in the project.

Project managers must continually review and update both the administration and technical portions of their project plans to provide for changes in scope and direction of their projects. They must assure that budget and resource requirements are continually reviewed and revised so that project resources are utilized in the most effective manner to produce an integrated system.

The most complete and well integrated project plan is worthless if no one uses it. Only the project manager can ensure that all task managers are aware of their roles and responsibilities in the attainment of project success. But continuous follow-up by the project manager is necessary to assure adherence to the project plan, and awareness of any necessary revision.

Developing an Integrated Work Breakdown Structure, Schedule, and Budget

Solving the project manager's problems starts with the fact that every project must be broken down into subdivisions or tasks which are capable of accomplishment. Creating this Work Breakdown Structure (WBS) is the most difficult part of preparing a project plan because the project manager must ensure that all of the tasks fit together in a manner that will result in the development of an integrated workable system. The WBS can be considered to be the "heart" of the project integration effort. Too often a WBS is prepared by breaking up the project along easily differentiated organizational lines with very little thought as to how the final system fits together. However, the WBS is the system "organization chart"
which schematically portrays the products (hardware, software, services, and other work tasks) that completely define the system (4). Therefore, it is best to prepare the WBS by breaking down the project first into subsystems and then into components and finally into tasks that can readily be accomplished. These lower-level tasks or "work packages" can be most effectively estimated and carried out if they are within single organizational units.

This process of breaking down a project into tasks or work packages, that is, creating a WBS, is just the first step. The WBS must then be carefully integrated with the schedule and budget if the project is to succeed. Each work package must have an integrated cost, scheduled start, and scheduled completion point. The WBS serves as the project framework for preparing detailed project plans, network schedules, detailed costing, and job responsibilities. A realistic WBS assures that project integration can truly be achieved.

Developing Integrated Project Control

The most prolific project planning is useless if project control is ineffective. Whatever type of planning and control technique is used, all the important interfaces and interface events must be identified. Interface events such as hardware or facility completions will be important project milestones. The project network plan must be based on the interface events in order to facilitate analysis of the entire project on an integrated basis. Resource allocation and reporting periods can then be coordinated with interface events, and schedules and budgets can be designed on an integrated basis.

Managing Conflict

Project managers have been described as conflict managers (10). This does not mean that they should constantly be fire fighters; however, they cannot avoid this role in resolving conflicts, particularly when the conflict involves project resources such as project personnel. Conflicts are very likely to occur in the temporary project environment where the project manager is often the new player who has not had time to develop good working relationships with project team members or with supporting functional managers. The conflict potential is also increased by the great differences between project and functional goals and objectives, and by the unavoidable competition between projects for resources.

It is inevitable that problems occur at organizational and subsystem interfaces. These problems may or may not result in actual open conflict
between individuals or organizations. A common situation is personal conflict between the two managers involved at an interface. Conflict situations result primarily from the concerned groups or managers losing sight of the overall project goals or having differing interpretations of how to get the job accomplished. Project managers must continually be on the lookout for real and potential conflict situations and resolve them immediately if they expect to have an integrated project.

Removing Roadblocks

Roadblocks are inevitable whenever there are separate organizational units which must support project efforts, particularly if the projects are matrixed. Roadblocks are inevitable in such a complex organization, and are the inevitable result of conflict situations. Resolving the conflict will eliminate many roadblocks, but there are always other roadblocks set up intentionally or unintentionally by managers and other personnel not directly involved with the project. These roadblocks may be the result of conflicting needs for resources and personnel, or conflicting priorities for the use of facilities and equipment. Administrative roadblocks often occur because managers outside the project do not understand or sympathize with the project urgency. Such roadblocks are difficult to deal with, and the project manager may be forced to go to top management to get a satisfactory resolution.

Setting Priorities

In order to resolve or prevent conflict situations, the project manager is continually faced with the problem of setting priorities. There are two types of priorities that are of major concern to project managers:

1. The overall company or organizational priorities which relate project needs to the needs of other projects within the organization, and to overall organizational needs.
2. The priorities within projects for the utilization of personnel, equipment, and facilities.

The first type of priority may be beyond the control of project managers, but it is a problem with which they must be continually concerned. Pity the poor project manager who is so busy getting the job done that he or she forgets to cement a working and personal relationship with members of top management. The result may be a low project priority that dooms the project to failure. The second type of priority is within the project.
organization and therefore completely within the control of the project manager. These priority problems must be handled on a day-to-day basis, but in a manner that will promote the integration of the project system.

Facilitating Project Transfer

Project transfer is the movement of a project through the company organizations from the conceptual phase to final delivery to the customer. Project transfer doesn’t just happen, it must be carefully planned and provided for in the scheduling and budgeting of the project. The project manager has the responsibility of ensuring that project transfer takes place without wasteful effort and on schedule. The steps in a typical project transfer are shown in Figure 3-7.

If the product or system is to be delivered to the customer on schedule, it must move from block to block as indicated in Figure 3-7, which involves crossing a number of organizational interfaces. This transfer process must be expedited or even forced by the project manager if it is to be completed on schedule. The basic problem is that of making certain that the project is transferred quickly, without organizational conflict, without unnecessary redesign or rework, and without loss of relevant technology or other information. Experience has shown that the best method of ensuring effective project transfer is to utilize people who can move with the project across organizational interfaces. The project manager has two alternatives to facilitate project transfer: (a) the designation of suitable qualified personnel who can move forward with the project, that is, change their role as indicated by the left to right dashed arrows in Figure 3-7, (b) the utilization of personnel who can move backward in the organization and serve as consultants or active working members of the project team. When the project moves forward they serve as transfer agents in moving the project forward in the organization (22). Various possible personnel transfers are shown by the right to left solid arrows in Figure 3-
7. Great importance must be placed on having customer, manufacturing, and/or construction representatives take part in the design phase of the project.

Establishing Communication Links

The last of the integration actions, that of constantly maintaining communication links, is perhaps the most difficult and troublesome because it involves the necessity for considerable "people" skills on the part of project managers. Most project managers find that they spend at least half of their time talking to people—getting information, delegating, clarifying directives, and resolving conflicts and misunderstandings. Much of this time is involved with project managers' critical responsibilities for maintaining all communication links within and outside their projects in order to ensure project integration. Internal communication links must be maintained between each subdivision of the project, and the project managers must make sure that all project team members talk with each other. In addition, the project manager is personally responsible for maintaining communication linkages outside of the project. Many of the external communication links can be personally expedited by the project manager, and in most cases the communication consists of written documents.

Communication linkages internal to the project, however, must function continuously, with or without documentation, and whether the project manager is personally involved or not. These internal communication linkages are most important to the health of the project since they involve the technical integration of the subsystems of the product or project. However, there are usually very real barriers to effective communications across any two such subsystem interfaces. In order to assure that problems don't accumulate and build up at these interfaces, the project manager must act as a transfer agent or a communications expediter. The model shown in Figure 3-8 illustrates the interface problem.

The project manager must serve as the bridge to make sure that the communication barriers do not occur. Communication barriers can be caused by a variety of circumstances and occurrences which the project manager must watch for. A communication barrier may or may not result in actual conflict depending upon the individuals involved, but the possibility always exists.

The project manager is the one person always in a position to expedite communication linkages. He or she can be considered to be a transfer agent who expedites the completion of the communication link by personally transferring information and project requirements across the interface. Considering the number of interfaces in a complex, multidisciplinary
matrix-organized project, this process becomes a major effort for the project manager. The only saving grace is that many of these interfaces will be trouble free, and communication problems will not all occur at the same time.

Communication barriers may be caused by a variety of circumstances and occurrences. Some of the causes of communication barriers are as follows (19, 21):

1. Differing perceptions as to the goals and objectives of the overall company or organizational system can cause problems. In addition, a lack of understanding of project objectives is one of the most frequent and troublesome causes of misunderstanding. It can be directly attributed to insufficient action on the part of the project manager, since he or she has the major responsibility for defining project objectives. Even when these objectives are clearly stated by the project manager, they may be perceived differently by various project team members.

2. Differing perceptions of the scope and goals of the individual subsystem organizations can likewise restrict communications. Again it is the responsibility of the project managers to clarify these problems, at least as to how they impact their projects.

3. Competition for facilities, equipment, materials, manpower, and other resources can not only clog communication routes but can also lead to conflict.

4. Personal antagonisms or actual personality conflicts between managers and/or other personnel will block communication flow. There may also be antagonism toward project managers by line managers who perceive them as a threat to their authority or their empire.
5. Resistance to change or the NIH (not invented here) attitude may also detrimentally affect communication links between organizational units.

As indicated in Figure 3-9, the project manager has four important communication links: (a) upward to top management, (b) downward to the people working on the project, (c) outward to line managers and other projects at the same managerial level, and (d) outward to the customer or client. The project manager has a major responsibility for maintaining communications with the chief executives in the organization who must be provided with timely, up-to-date progress reports on the technical and financial status of the project. Similar reports must be provided to the client or customer, particularly if the customer is outside of the company, such as a governmental agency.

The other important communication link is with the people working on the project. The project manager must keep them informed by means of project directives and personal communications. In addition, there is a continual stream of reports from the discipline/line-organization managers and specialists who are working on the project.

Many of these reports concern project and administrative details and can be evaluated by administrators and assistant project managers. How-

![Figure 3-9. The project manager's communication links.](image-url)
ever, the ultimate decision as to the worth of a report, and as to whether it should be included in progress reports to the customer and/or top management, is in the hands of the project manager. His or her communicative skills, therefore, must include the ability to accurately and rapidly evaluate, condense, and act on information from many sources.

Attenuation in these communication links at the organizational interfaces must be minimized. This means that project managers must have an open line to top management. Conversely, they cannot have too many line managers interpreting their instructions and project objectives to the people working on the project. Without open communication links, project managers will surely fail. There are also a number of important communication links outside the immediate scope of the project. The four most important such links are shown by the dashed arrows in Figure 3-9. For instance, the customer will at times talk directly to top management without going through the project manager. Project managers have to recognize the existence and the necessity for these sometimes bothersome communication links; and rather than fight them, they should endeavor to make use of them.

CONCLUSIONS

Project integration consists of ensuring that the pieces of the project come together as a "whole" at the right time and that the project functions as an integrated unit according to plan. In other words, the project must be treated as a system. Project managers carry out their job of project integration in spite of project and system complexity, and of course their job is the most difficult in a matrix organization.

To accomplish the integration process, project managers must take a number of positive actions to ensure that integration takes place. The most important of these actions is that of maintaining communication links across the organizational interfaces and between all members of the project team. Project managers must be continually expediting communication links throughout their projects. Of almost equal importance is the need for the project manager to develop a Work Breakdown Structure, which ensures project integration by providing a "framework" on which to build the total project. These integrative actions are every bit as important as the project manager's other principal function of acting as a catalyst to motivate the project team.

Project integration is just another way of saying interface management since it involves continually monitoring and controlling (i.e., managing) a large number of project interfaces. The number of interfaces can increase exponentially as the number of organizational units increases; and the life
of a project manager in a matrix organization can become very complex indeed. Interfaces usually involve a balance of power between the two managers involved. This balance of power can be tilted in favor of either manager, depending on the desires of top management. Project managers must continually keep their eyes on the various managerial interfaces affecting their projects. They must take prompt action to ensure that power struggles don't degenerate into actual conflict. It takes very little foot dragging to sabotage even the best project. Integration doesn't just automatically occur. The project manager must put forth great effort to ensure that it happens.

REFERENCES

2. Ibid., p. 5.
4. Ibid., p. 343.
12. Ibid., p. 50.


