Technological revolution in international project management

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Technological Revolution in International Project Management

Révolution technologique dans la gestion de projets internationaux

Technologische Revolution bei der Leitung internationaler Projekte

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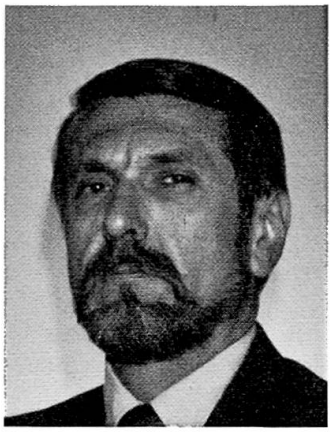

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SUMMARY

The complexities of major international projects have created a need for more powerful and versatile project planning and control tools. Development of these tools is well underway. This paper explores the potential of computers, electronic conferencing, interactive graphics ans the automated office to provide project managers with the tools they need for the challenges of the not too distant future.

RÉSUMÉ

La complexité des grands projets internationaux nécessite des moyens de planification et de contrôle du projet plus puissants et plus souples. Le développement de ces moyens est en cours. L'article considère les possibilités offertes par l'ordinateur, la téléconférence, l'infographique active et la bureautique. Ces moyens devraient permettre aux directions des projets de mieux résoudre les tâches difficiles qui les attendront prochainement.

ZUSAMMENFASSUNG

Die Komplexität grosser internationaler Projekte verlangt leistungsfähigere und beweglichere Planungs- und Kontrollinstrumente. Die Instrumente sind heute in voller Entwicklung begriffen. Dieser Beitrag untersucht die Möglichkeiten des Einsatzes von Computern, Konferenzen mit elektronischen Hilfsmitteln, interaktiver Graphik und Büroautomatisierung. Die Projektleiter und ihre Stäbe werden diese Mittel brauchen, um die Herausforderungen einer nicht allzu fernen Zukunft zu bewältigen.

1. INTRODUCTION

The way major corporations manage their international projects is going to change dramatically over the next decade. These changes are coming as a result of significant advances in communications and information processing technologies and the need to find better ways to manage major undertakings in highly competitive, complex and everchanging social and political environments. Only those organizations which successfully adapt the new technologies and develop the management techniques which can effectively utilize these technologies are going to survive in the international arena of the 1990's.

2. OBJECTIVES

The basic theme of this paper is that technological advances in information processing and communication systems are creating new and more powerful planning and control tools for project management. This coupled with the increasing complexity and risk involved in major international projects will substantially alter the way corporations organize, plan and control these undertakings. More significantly, the character and nature of the people who become project management professionals in the international environment will be different. Thus, this paper will focus on: 1) a brief review of the fundamental planning and control problems of the international project manager; 2) examine technological advancements in communications information processing and decision support systems to identify their potential for helping project management; and 3) discuss the changes that will be brought about by these technological advancements on the project management organizations and their people.

3. THE ENVIRONMENT FOR INTERNATIONAL PROJECT MANAGEMENT

International Project Management basically involves the organizing, planning, directing, controlling and reporting on organizations, resources and activities required to accomplish a major technological undertaking in another country or region by a certain date, for a specified amount of money. The more demanding of these projects may require the contributions of many multi-national project participants and it would not be unusual to see firms from the Far East, Western Europe and the United States working to design, construct and make operational some major technological undertaking in South America, the Near East or some other region of the world. For these multi-national project participants, the diversity of their languages, customs and values are linked by their understanding of the technology they are working on and their desire to successfully complete the project in order to make a profit. The management and technical challenges of the project, together with today's economic and social problems all combine to create a complex environment in which the international project manager must work.(1) Thus, the project managers primary goal is to understand the environment he must work in and apply the planning and control tools which will enable him to be successful.

4. WORKING IN THE INTERNATIONAL PROJECT MANAGEMENT ENVIRONMENT

In the simplest of terms, the job of the international project manager and his team is to define the work to be done and establish the detailed plans, schedules and budgets for the economic expenditures of resources to accomplish this work. In addition, the Project Manager must organize and direct the activities of all the project participants to accomplish the required work. Having devised and implemented the project plans, the Project Manager must collect and evaluate a myriad of detailed facts to determine how the work is progressing against the plan. This basic responsibility becomes extremely complex because it is necessary to address a bewildering array of facts. The permutations and combinations of things to be planned and done require the efforts of hundreds if not thousands of people. In a complex technical undertaking, there is a high degree of interdependency among participants, which means that an iterative process must be used between many of the disciplines and functions before the right answers or perhaps even the right questions can be formulated. Add to this the difference of languages, customs and

management systems and techniques of the participants and we can appreciate that any major international project will be forced to develop a complicated infrastructure to accomplish its basic responsibilities. More important, however, is the fact that the project success is determined to a large degree by the management decision making process which controls project events. The whole process of building this infrastructure and using it to accomplish the project objectives is a demanding and time consuming communication and information processing task. Thus, it seems clear that considerable opportunities for improving overall project management effectiveness in planning and control rest with tools or systems which enhance the project's communication, information processing, and decision making functions. In addition, it seems equally clear that the real benefits of any new tool or system can only be realized if we have the people who are appropriately suited to utilizing these tools and systems.

5. THE NEED FOR BETTER PROJECT MANAGEMENT TOOLS

In addition to planning how to accomplish the normal cost, schedule, technical objectives of the project, the international project manager must plan for the environmental factors or outside influences which may affect the success of the project. This is especially important if the project is located in some volatile area of the world. Furthermore, for the experienced project manager, it is obvious that the more complex the project, the higher the risk; thus, greater is the need for detailed integrated planning. Fundamental to successful planning is the need to communicate with and receive information from all those involved on the project. The need for effective, efficient communications is especially critical for large or multiple projects with diverse geographic operations. Likewise, the more volatile the project environment, the higher the risk of failure; thus, the greater the need for effective project control. The main ingredients for effective project control are timely information and sound management action. As we know from experience, most project managers, especially those on large complex projects, spend the largest percentage of their time on communication and information processing tasks. The tremendous amount of travel, endless meetings, reports and correspondence burdening these managers is testimony enough to that fact. Unfortunately, experience indicates that the time expended on these activities far exceeds the benefits derived from the effort.

The fundamental problem faced by most international project managers is that they don't have the tools or systems suited to the demands of the environment or project. There are many reasons for this problem and a detailed analysis is well beyond the scope of this paper. However, it is worthwhile to point out some obvious facts.

In general; most project managers must manage using the systems and procedures made available by their firm.(2) For the most part these systems and procedures were designed to meet the general business needs of the firm. In most cases these systems are woefully inadequate in addressing the unique management requirements of a project.

The problem is further complicated when the project manager attempts to integrate several other firms, each with its own equally unsuited systems, into a single project team.(3) Another part of this problem, and certainly a much more difficult one, lies in the reluctance of many senior project managers to use technological tools to help plan and manage their projects.

Even in today's highly computerized world there is still a very wide gap in understanding and cooperation between the decision makers (the project managers) and the information processing practitioners (the project planning and control groups). Part of the problem is that we still have not developed systems which present only the information needed; the other part is the bias against computerized systems by managers who have accomplished major undertakings relying primarily on their skill, experience and good intuitive judgments. The question we face now is, "Will these qualities be sufficient in a world growing more complex every day?" I think that the answer is an obvious no!

6. THE COMMUNICATION/INFORMATION REVOLUTION

The need to increase management productivity and effectiveness in all areas of business has caused a dramatic increase in the use of sophisticated communication and information processing devices of all types. We have seen how the large computer has significantly altered our traditional business procedures. We are beginning to see the emergence of the automated office, or the electronic office, with its integrated communications, information processing and data filing capabilities. Couple this with the widening use of mini-computers, micro-computers, interactive graphics, satellite communications, and a host of other sophisticated systems and we can speculate as to how these technological advancements will aid the international project manager. In order to put these new advances in their proper perspective, we need to take a brief look at the systems which offer significant opportunity to increase the planning and control effectiveness of project management. In addition, we need to understand the impact that this technology will have on the traditional organization and the people that make up these organizations. Most important we need to determine now the type of people and skills that will be needed to fully utilize the potential offered by these emerging technologies.

7. NEW TECHNOLOGIES FOR INTERNATIONAL PROJECT MANAGEMENT

For ease of discussion, we can categorize the new technological developments simply as: 1) communication tools, 2) information processing tools, and 3) decision support tools (see Figure 1). These tools offer an interesting potential for those who understand and know how to apply them.(4)

7.1 Communication Tools

The essence of any communication system is to send information from one place to another in a cost effective manner to permit people to accomplish their jobs. Communication is conducted people to people, people to machine, machine to machine or machine to people.(5) The information to be moved can take many forms and use many different mediums. Messages can be inputted to a computer and made available as printed output, displayed output, microfilm or microfiche. Messages can be typed and transmitted to

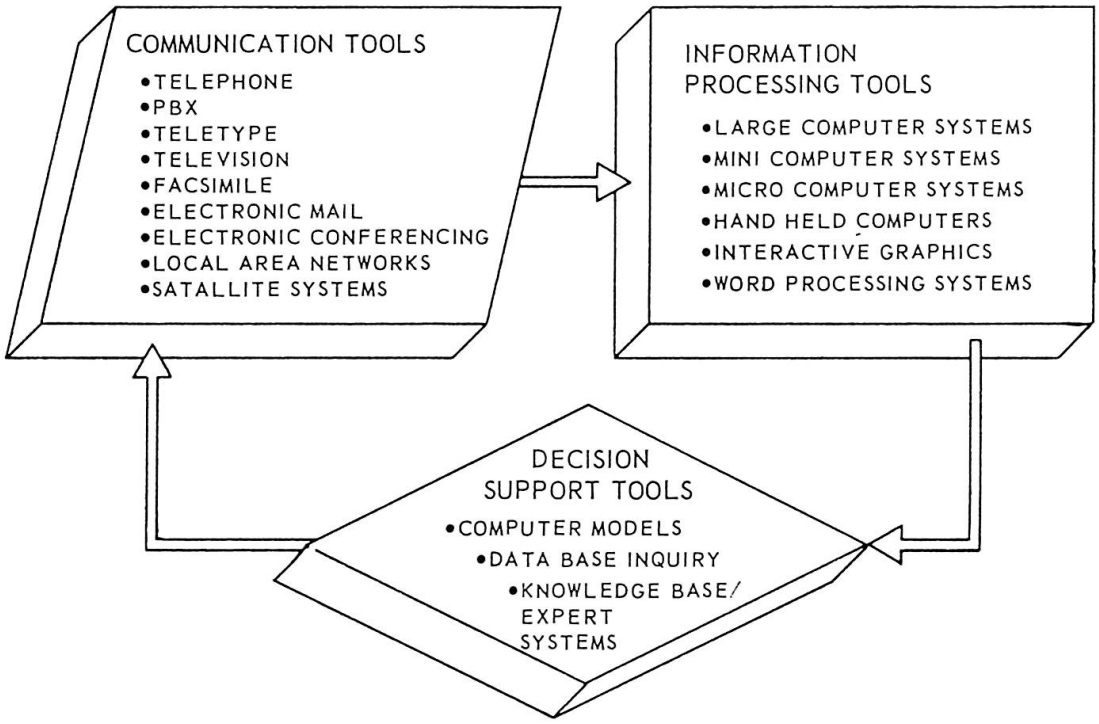


FIGURE 1. TECHNOLOGIES FOR PLANNING AND CONTROL

remote locations by facsimile, terminals, communicating word processing or electronic mail. Graphic information can be relayed by facsimile, intelligent copies or computer. Most of this information can be transmitted by ordinary telephone lines, wire cable, microwave radio, satellite channels or optical cable. The variety of communication devices available is extensive. However, there are three communication modes available to project managers and in each mode there are communication tools and techniques particularly suited to the needs of this unique management environment. We can identify these communication modes as: 1) the participatory interactive mode, 2) the active exchange mode, and 3) the on demand mode.

7.1.2 Participatory Interactive Mode

Perhaps the most widely used mode of communication is the participatory interactive mode. This mode includes one to one discussion (as in a telephone conversation) as well as group participation in a meeting. For project managers, meetings are a way of life. A meeting is an excellent way of encouraging project participants to make known their problems, requirements or ideas and share these with other project participants. More important, meetings provide project participants the opportunity to develop a common understanding of the project purpose and thus make a firm commitment to the undertaking. The team building benefits of this participatory interaction are extensive and very valuable; hence, there will probably never be a good substitute for the interaction obtained in a well orchestrated meeting. However, as most project professionals will testify, there are far too many meetings; travel time and expense make it more important than ever to reduce meetings to an absolute minimum. Some of the new communication tools available which make this possible, utilizing a voice plus visual media to transfer information between widely separated groups of people. Electronic conferencing techniques (see Figure 2) use standard voice transmission media coupled with electronic blackboard or CRT displays of data, documents or drawings.(6) Video capabilities utilizing still frame, slow

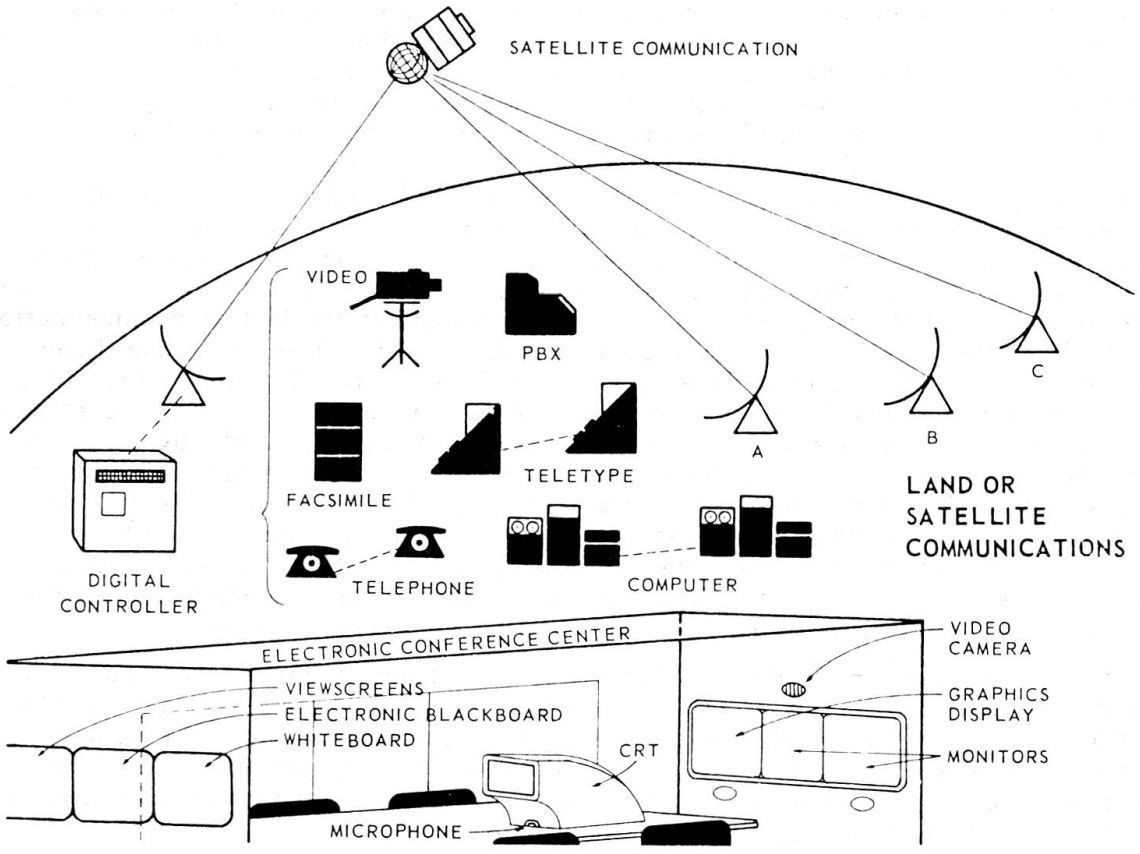


FIGURE 2. COMMUNICATION TOOLS

scan or real time visual transmission may also be used. It is anticipated that electronic conferencing will do much to save time and money and require less travel on the part of the project participants. Even though professionals will have to travel to their conference centers, the time and cost involved will be significantly reduced. More important, however, it will be possible for more project participants to actively contribute to the meetings. Another important fringe benefit of electronic conferencing is that there will be improvements in the quality of the communicating and decision making of the participants as a result of eliminating the effects of jet lag and travel fatigue.

Obviously, it is necessary to overcome a number of problems to fully realize the benefits of electronic conferencing. We must learn to use the system, that is, become familiar and comfortable with it. We must then address the time and language differences between the participants. Finally, we must develop standards and procedures which make it easy to implement these systems on a worldwide basis.

7.1.3 Active Exchange Mode

The active exchange mode of communication recognizes all the advances made in the dedicated work station, or desk top input/output devices which make it possible for the user to originate, format, edit, transmit and receive information. These so called electronic mail systems make it possible for users to communicate with a large group of specific individuals.(7) Information can be left even if the recipient is not there. The real strength of these systems is that they dramatically reduce communication time and eliminate redundancy. All the appropriate project participants can share information. The most important advantage of these systems for the project manager is that direct access to project information makes it possible to deal more effectively with daily crises.

7.1.4 On Demand Mode

The "on demand" mode of communication literally means that information is made available to the user only when he wants it. This mode of communication includes all the interactive systems that interface with the traditional computer based transaction processing system (i.e., inventory, payroll, accounting, etc.), as well as information data bases and computer aided index and retrieval systems. The value of these systems lies in the ability to quickly assemble information ranging from the general to the highly specialized. Scientific data, corporate financial data, currency exchange rates, legal information and a host of other information can be obtained from internally and externally maintained data bases.(8) In addition, the need for rapid retrieval of physical documents is always a major problem in any project and most likely will continue to be a problem as long as information is recorded on paper. Therefore, computerized index and retrieval systems can be employed to direct the user to the appropriate conventional file cabinet for specific documents, reports, contracts, purchase orders or other written materials which may not be routinely fed to the computer. A particularly intriguing method of communication in this mode is the so called computer conferencing (CC).(9) This technique differs from electronic mail or electronic conferencing in that it is not totally interactive. Data base files are established and made accessible to selected users around the world. Certain users can update files, others cannot; selected information can be made available only to designated individuals, such as senior management; other information is available to specific functions or disciplines. The advantage of the CC approach is that it is relatively inexpensive to set up and use (far less than video conferencing for example) and it is not time zone constrained. More important, it can be made available at an individual's work station or desk top. Thus, the user can avail himself of a tremendous reservoir of information without having to travel or interface with many contributors.

From this discussion it is obvious that these new communication tools make possible information accessibility to a very wide range of project participants regardless of location. Also, this accessibility can be accomplsihed quickly and efficiently via the electronic medium. The net result is that time will be saved and the need for extensive and costly travel will be reduced considerably. Hence, we expect to plan and control project activities more rapidly and more effectively.

7.2 Information Processing Tools

For our purpose we will define information processing tools as those systems, procedures or software which are used for the receipt, storage, manipulation, organization and presentation of information to a user. The primary function of these information tools is to provide the right information at the right time in the right format so the user can accomplish his planning and control responsibilities. To support the planning and control activities of the project management environment, we can define three categories or three levels of information processing tools. These include: 1) supportive transaction processing, 2) personal processing, and 3) proactive information processing.

7.2.1 Supportive Transaction Processing

Supportive transaction processing includes the traditional corporate Management Information Systems (MIS) processing functions which provide information to support normal business operations (i.e., payroll, general accounting, personnel, etc.) as well as the normal project planning and control support systems (planning, scheduling, CPM, estimating, etc.) which are available to support most large projects. The project planning and control systems which have been developed over the past two decades have done much to aid in the task of planning and controlling complex projects. Such things as network planning using CPM and PERT and their accompanying computer software programs make it possible to use the speed of the computer to evaluate the interrelationships of thousands of project activities. Despite the advances made possible by the large computer, data files, CPM, PERT and related software packages, these tools have some serious shortcomings. Generally, these information processing functions require a relatively large staff of experienced specialists to set up, operate and maintain; furthermore, they cannot respond quickly to changing requirements or specialized needs. Thus, most project managers complain that they cannot get the specific information they need without pouring through reams of computer printouts and making their own analyses. The problem is that most traditional MIS systems and even those designated to support projects are designed to promote efficiency in generating data; as a result these systems have limited flexibility to respond to changes or a diversity of requirements. However, this situation is changing as computer processing and data storage resources become increasingly interactive. It has become easier for information users at all levels to retrieve specific information from existing MIS resources without going through intermediate functions or organizations. Thus, we see increasingly widespread use of remote terminals by project management personnel.

7.2.2 Personal Processing

When an information user can go directly to an information source and quickly and easily perform the manipulation necessary to find the specific data he needs, then we have made a quantum jump in our ability to plan and control complex undertakings. This is exactly what is happening today. Considerable technological advances have been made in computer hardware and software. The speed and processing capability of the computer has increased dramatically and data base management systems have been developed which make it easier than ever for multidisciplined functions to share information.(10) Couple this with intelligent terminals, desk top micro-computing systems, interactive graphic systems such as CAD/CAM, and the communication systems which can link together all the users in a worldwide network, and we have finally begun to develop tools suited to the demands of the international project management environment.

The schematic given in Figure 3 depicts how these new personal processing tools can fit into a major project planning and control system. The fundamental power of this scheme is that the detailed planning, control and decision making is accomplished at the level where the work is actually performed and that the individuals responsible for these functions have real time access to information on all other functions that affect their operations. This capability is a reality because we can now generate drawings, graphs, sketches, specifications, calculations, reports and many more things electronically and instantly disseminate the information to all who need it without intermediate paper steps. By

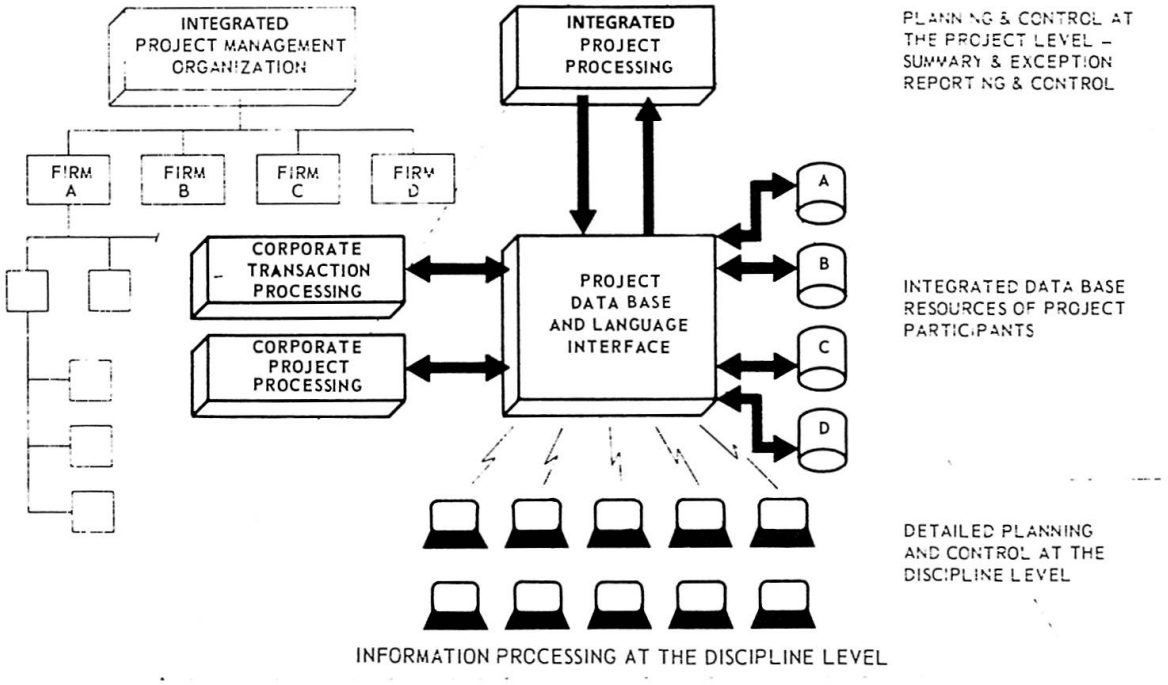


FIGURE 3. INTEGRATED PLANNING AND CONTROL SYSTEM

combining the technological advances in computer hardware, software and information transfer and retrieval tools it is now possible to create another quasi form of information processing (proactive processing) which has some interesting potentials for the complex project environment.

7.2.3 Proactive Information Processing

Planning and control of project requirements must be accomplished quickly and must continue throughout the life of the project. Furthermore, this activity must be orchestrated carefully with all the participants fulfilling their part as needed so that all project participants perform as an integrated whole. The systems of hardware and software now available can be used to orchestrate many of the project's routine tasks. By employing time and task triggers these systems can be used to issue instructions to project participants as key dates are reached or specific tasks are accomplished.(11) The function of these proactive aids is to automatically generate information which causes or forces action to be taken in a systematic manner. As a result of messages from these systems, project participants initiate work tasks, generate information or interact with other project participants in some manner. Some examples of the tasks that could be accomplished are: 1) Time Management Aid - A project calendar could be developed and entered into the project data base. As project participants need to establish meetings, make trips, or interface with other project participants, they would enter this information into the system. The time management system would then identify conflicts, establish priorities, alert participants to the requirements and even send out reminders at specified intervals. 2) Activity Management Aid - Specific project activities can be initiated and

directed automatically by systems which are programmed to respond to certain events. For example, a project manager can automatically authorize work through his data base system by keying work authorization releases to the completion of CPM task or schedule milestone dates. Also, the system can be triggered to generate alerts to remind project participants that drawings, specifications, contracts or reports are needed to support an upcoming project activity. Or the system can generate red flag reports when required inputs have not been submitted by a certain date. Sub-tiering of information from one system to another is also possible to aid in integrating activities. For example, in one system a CPM schedule may identify that a vital piece of equipment will be needed by a certain date to support a critical test. The engineering computer based system can identify the engineering drawing, specifications, purchase orders and vendors involved. This same system can directly interrogate the specific vendor's computers to check the status of the vendor's drawings releases, purchase orders and manufacturing schedules. If the vendor has not met his commitments, the system will issue a warning report. The dependent relationships between project participants are always difficult to manage; but now, proactive information processing should do much to simplify this task. However, it should be obvious that unless these tools are properly managed, they have the potential to become an irritant and a constraint on initiative and creativity.

7.3 Decision Support Tools

It is generally assumed that if managers are given the right information at the right time in the right format they will make sound decisions. However, as we become involved in increasingly complex technological undertakings which must be accomplished in equally complex social and economic environments we create a situation in which the amount of information that must be assimilated in order to make a decision can be overwhelming. In addition, the time available from the initial identification of a problem or a requirement to the need to take action tends to be very short. Most project managers spend a good deal of their energies on addressing one crisis after another. The net result is that very often the right decision is not made. We know from experience poor decisions or wrong decisions are generally the result of not enough of the right (quality) information, not enough time to assess the information, or errors in analysis or judgment generally as a result of lack of experience or expertise in a particular area. Even when a satisfactory decision is made in a timely manner, we often find out later that it was not the best or optimum approach to the situation. Here again, experience shows that this is generally a result of not having a broad enough understanding of the situation or a sufficient range of knowledge of alternative approaches to the problem. In order to significantly improve our decision making ability, we need tools which can quickly provide us with a wide range of pertinent information, help us to evaluate the myriad of facts and figures and help point the way toward the optimum solution or the most desirable alternatives. Technology is now developing just such tools.

At the present time we can identify three types of systems that are of particular interest to the International Project Manager as decision support tools. These include: 1) computer models, 2) data base inquiry systems and 3) knowledge base/expert systems.

7.3.1 Computer Models

Computer models have been used by managers for a number of years to support decision making on a variety of topics. Computer models have been developed for marketing, financial planning, transportation and distribution and inventory management, to name a few.(12) In the project environment we model the project when we use CPM and PERT network techniques to depict the interrelationships between project activities, events or tasks. Computer models aid the manager's decision making process by pointing out the result of various courses of action. Alternatives to a requirement or a problem can be evaluated by employing "what if" reasoning with the computer model. For example, project managers can use CPM or PERT software programs to evaluate such questions as "What is the schedule impact of a certain component being delivered two months late?" or "What happens if a certain labor craft resource is reduced by 12 percent?" Computer models can provide answers to this type of question quickly and efficiently. However, models are limited by their ability to represent all the parameters of the project and by the

quality of the data made available to the model. Therefore, project managers must be careful to use intuitive judgments and assign appropriate values to the different outcomes given by the model. Even with their obvious shortcomings, computer models, because of their speed and large data handling capability, are an invaluable tool for charting the way through a complicated problem.

In the international project environment, we can anticipate wider use of computer models to aid management decision making. In addition to modeling the usual work task related activities of the project, we can expect to see models which attempt to represent the economic, social, political, cultural and infrastructural dimensions of a major international project. In view of the enormous cost and risk involved in these types of projects, it will be a worthwhile investment to develop models which will not only aid project managers in addressing the day to day problems of their project, but which will also help them to anticipate situations and thus formulate decisions which may not be strictly required but which would improve the project or help to avoid a problem in the future. Certainly, a prime goal of every project manager should be problem avoidance. Computer models can be an important tool in helping to achieve this goal.

7.3.2 Date Base Inquiry Systems

In order to effectively support management decision making in the project environment, it is frequently necessary to obtain data items that are not in a published report or included in a routing data file. It may be necessary to review a wide range of data elements on a variety of topics in order to begin to structure a solution to a problem. Recent developments in so called "natural language systems" now make it possible to interrogate a data base on a much more generalized basis.(13) These new systems utilize the results of development work in the field of Artificial Intelligence (AI) and Cybernetics. The net results are that we are beginning to see information/decision support systems which are user friendly, that is, they can be readily used by the non-computer specialist. The value of these retrieval/query systems is that they bring the power of computer based information resources (processing, storage and retrieval) directly to the user without having to rely on intermediate support functions. Thus, project participants in widely separated locations can work together using these systems to formulate answers to complex problems. This integrated approach to problem solving, using the capabilities of data base inquiry systems and the creative power of the human mind, can produce solutions which can be documented in data base systems for future use. The net result is that we are building a more effective decision support tool for future projects.

7.3.3 Knowledge Base/Expert Systems

Systems which are designed to hold human expertise in some form are called knowledge base systems or expert systems.(14) These systems differ from traditional data base management systems in that they attempt to compile an extremely factual taxonomy of a specialized field and make this knowledge available to the user by way of structured human reasoning patterns. These systems use the techniques developed by AI which relies to a large extent on heuristic procedures to guide the user to the desired information.

Heuristic procedures generally involve judgement rules, inference techniques, intuitions or even personal theories that act on a body of factual knowledge of a particulate subject. The whole essence of knowledge base/expert systems is the integration of heuristic procedures and factual knowledge into a practical systems which can extend the capabilities of the user (see Figure 4).

At the present time so called 'expert systems' are beginning to be used with varying success in such widely diversified fields as medical diagnosis, very large system integration (VLSI) design, printed-circuit board layout, computer software design and several other specialized areas.

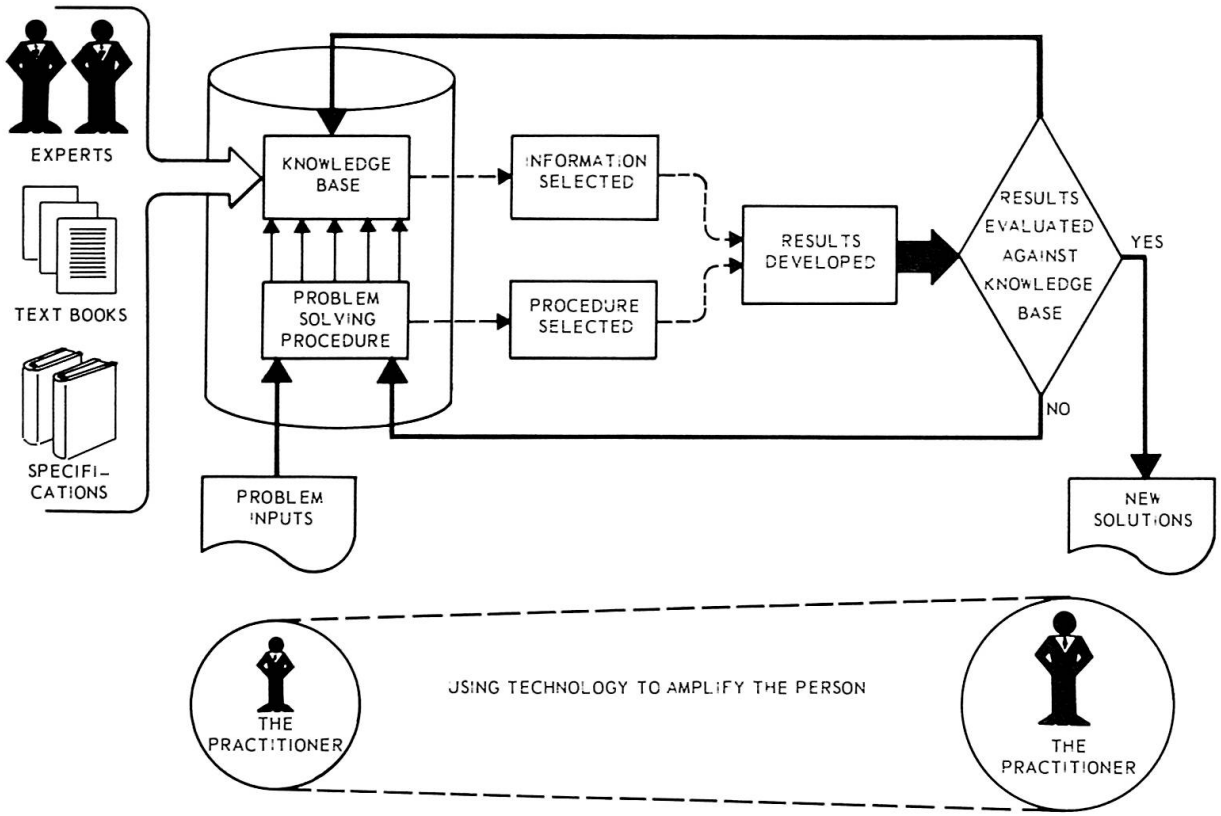


FIGURE 4 KNOWLEDGE BASE/EXPERT SYSTEMS

It can be anticipated that as knowledge bases are developed, and as the thinking and reasoning procedures of experts are more closely studied, we will begin to develop the software and hardware which will provide a capability quite distinct from anything available at the present time. These knowledge base/expert systems will give us the capability to address problems and situations well beyond our range of knowledge and experience. Thus, these tools will act as amplifiers of our capabilities and give us the potential for improving the speed and quality of our decision making. In addition, these systems offer the potential of increasing the capabilities and productivity of the total organization because they will enable the novice or less experienced member of the group to address problems beyond their level of expertise or experience. Obviously, as the members of the organization increase their knowlege and experience, this information will be used to update the knowledge base/expert systems and we will continue to evolve tools with increased power and capabilities to aid our decision making ability for a wide range of issues and situations.

8. THE FUTURE DIRECTION OF INTERNATIONAL PROJECT MANAGEMENT

The technological advancements in communications and computer based systems are providing tools that have the ring of space age fiction. Satellite communications and electronic conferencing will take the designer from the drawing board (computer terminal) to the project site thousand of miles away. Data base files and computer based management systems will automatically talk to each other to determine inventor status, vendor status, or construction status and routinely advise the project manager of potential problem areas. Project participants located in widely separated geographic areas will have their management systems integrated so that everyone, at every management level, will function as one single organization. These and many more changes are coming but, what does it mean for the organization and people who work in the international project environment? Let us briefly examine the impact of technology on the international project management organization and the project personnel who will be part of these organizations.

9. THE COMING INTERNATIONAL MANAGEMENT ORGANIZATIONS

Having technology and applying it are two different things. The firms that invest in the new technologies and learn how to successfully employ them will have a definite edge over their competition. More significantly, only those companies who are geared up to use these technologies will be the ones qualified to participate in the international project arena. The benefits of the new technologies can only be fully realized if the project participants integrate their systems so that these systems can interact with each other. Companies who have not made the investments will not be able to play the game; hence projects of the future will go only to those who have mastered the management tools of the future.

Since these firms will have to make some considerable investments in the new technologies, it is expected that they will have to also invest in the people who will use these systems. It can be reasonably assumed that these firms will develop core project management teams which are highly skilled in various specialized areas. These core teams will be called upon to link up with other teams, probably from other companies, to form a total project organization for a particular undertaking. Thus, it would not be unusual to find firms located in widely separated geographic areas, contributing some specialized service or product, to the total effort of a project located in some other region or country. These project organizations would be pulled together, operated, and dismantled as quickly as it takes to make a satellite communication link up with their electronic office and computer based management systems (see Figure 5).

In addition to a large number of changing project management organizations, we would also expect to see project organizational structures which are much wider and have very few levels of supervision. First of all, the extensive communication systems will greatly facilitate the span of control of the project manager. Second, the increased use of knowledge base/expert systems will enable more planning and decision making to be accomplished by those who do the actual work. In addition, the integration of all project data resulting from extensive use of natural language data base systems will make it possible to tie together the dependent relationship between the participating functions such as marketing, engineering, procurement, manufacturing and so on. Many of the detailed tasks of monitoring and prodding the various organizations to release drawings, specifications, purchase orders, etc. in accordance with the overall schedule will be performed automatically by the computer based systems. Hence, the international project manager will be able to exert a wide range of influence over many of the project's activities without actually taking a personal hand in the effort. The net result of all this is that the project management organizations of the future are going to be more concerned with building the project infrastructure which will enable the project participants to actually do the work. This means that project management personnel will be primarily concerned with project strategy and with creating the environment and providing the tools so that the actual workers can develop the plans and control events to accomplish the project objectives within the available resources.

10. THE PERSONAL CHARACTERISTICS OF FUTURE PROJECT PERSONNEL

As in today's project management environment, individuals who are comfortable in an atmosphere of change and challenge will be needed for the future. More significantly, however, future project personnel at all levels will have to be well disciplined, self-starters and self-motivators since they will be working in less formalized organizational structures. In fact, if the potential of the new management technologies (automated office, electronic conferencing, etc.) is realized, we can expect to see a very flat organizational structure with very few management levels, where individuals enjoy a wide range of responsibilities. In this setting we must have strong, self-confident, capable people who do not need the security of the rigid organizational structure.

Likewise, we will need individuals who can work effectively as integrators with many diverse technical and management disciplines. This means that we will need people who are able to plan and carry out their tasks as part of a total system. Which in turn means that we will need people who can visualize and understand the total project undertaking, see how their specific responsibility fits within this total structure, and effectively interface with all the other functions that relate to their own. Thus, in addition to being flexible and comfortable in a dynamic environment we need people who are capable of building and maintaining the communication and information processing interface needed to carry out the complex undertaking of future projects. Obviously, by virtue of our premise, we believe that future project personnel are going to have to do much more than just worry about the cost, schedule and performance objectives of their immediate project.

11. THE PRIMARY FOCUS OF FUTURE PROJECT ORGANIZATIONS

The most significant change, that we see for future international project management personnel, is that they will probably spend more of their effort in organizing and planning the project than in actually managing the job.

As international projects become larger, more costly, and more complex, they will require the combined resources and contribution of many participants. Many of these participants will be located over widely separated geographic areas. Some of the project participants will directly contribute to the project undertaking (i.e., finance, engineering, manufacturing, etc.). Other project participants will indirectly affect or constrain project activities (i.e., government regulations, political preferences, social/cultural issues, etc.) but all of these will have to be accounted for in the total project undertaking. Because of these and many other considerations, future project professionals will spend most of their time on the design, construction, maintenance, operations and day-to-day management of the project infrastructure (see Figure 6).

Since the probability of project failure rises dramatically with the increase in project complexity, the number of participants, and the number of interfaces involved, it would not be unreasonable to expect to see future international project personnel devote a great deal of their attention to building the framework for such things as: project policy and procedures; communication and information processing systems; organizational structure, responsibility and accountabilities; and the objectives, plans, schedules, budgets and control mechanism for the total undertaking. In fact, it is also conceivable that these future project professionals would be more concerned with the building and maintaining of infrastructure than the actual management of project activities. As was stated before, if the new management technologies prove fruitful, much of the actual work of the project will be spread over a very broad organization which has only a few management levels. Responsibilities and project accomplishments will be closely monitored by the project's communication/information processing systems and many of the deviations from project plan will be addressed automatically by the projects proactive information processing and decision support tools (knowledge base/expert systems).

Obviously, in order to realize the benefits of the new management technologies, a considerable amount of work will have to be done to get these systems in place before the start of the project. Future project personnel will probably spend most of their time doing this type of work. In addition, they will also spend considerable time dismantling this infrastructure and transferring the project results into knowledge base/expert systems for use in planning and controlling future projects.

The Future Corporate Structure

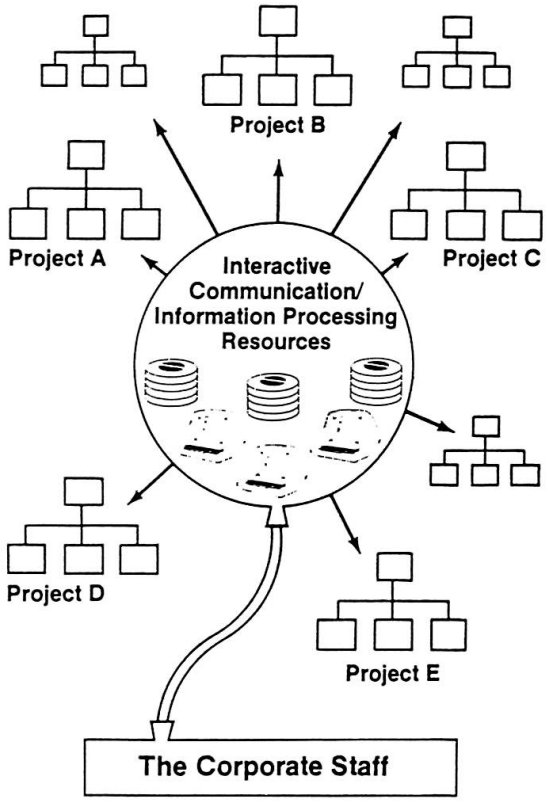
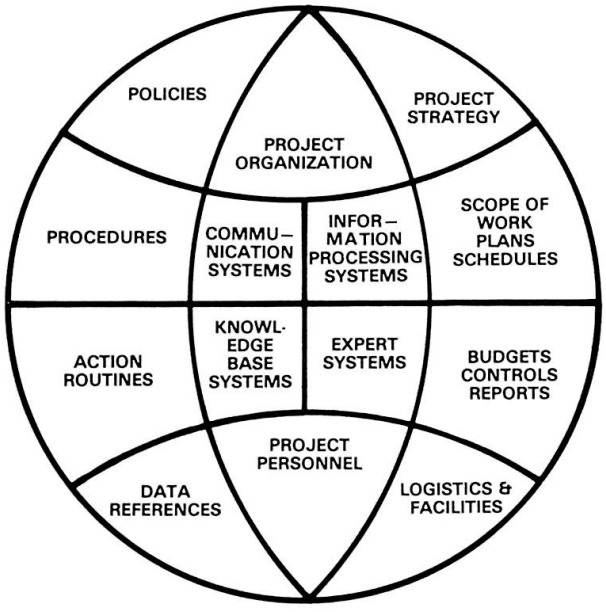


Figure 5



PROJECT MANAGEMENT WILL:

1. Build the infrastructure
2. Maintain and operate the infrastructure
3. Manage activities within the infrastructure
4. Dismantle the infrastructure
5. Document experience
6. Build data base for future projects

FIGURE 6. THE PROJECT INFRASTRUCTURE

If our premise about future project task is correct, then it is obvious that project personnel will need a much wider range of knowledge, experience and skill than they now have. The question is, "What are the specific needs, and how will we develop the people who have the right skills?"

12. FUTURE SKILL REQUIREMENTS

The project management personnel who will be involved in designing and implementing the complex project infrastructure of the future will have to have a wide range of very specialized skills. Certainly at a minimum these individuals will have to be trained in the state-of-the-art of communication systems, information processing and decision support systems.

As organizers for and integrators of all the project participants, the project management staff will have to know how to apply the technologies of satellite communications, electronic conferencing, the dedicated work station, mini and micro-computers, word processing, interactive graphics, data base management systems and a host of other sophisticated tools, which will enable knowledgeable workers at all levels to carry out their responsibilities in a highly integrated environment.

In addition, these same individuals will need an extensive background which will enable them to understand how organizations accomplish work and how specialized fields of knowledge contribute to the overall accomplishment of a major undertaking. These individuals must not only understand the workings of the organizations they seek to integrate into their project but they must also have a good working knowledge of the policies, procedures and routines that enable these entities to function efficiently. It must be expected that future project personnel will have a very wide range of business, government, social and cultural experience in order to qualify for the type of project management professionals envisioned for the future. In summary, we expect future project personnel to have the training and experience that will enable them to build the project organizational structures; develop and implement appropriate policy and procedures; set up and maintain an effective communication/information processing system; implement the project plans and then control all activities appropriate to the economic accomplishment of a complex, high risk, major technological or social undertaking. This uniquely skilled project professional will be the renaissance-systems man of the future.

13. THE CHALLENGES OF THE FUTURE

The international projects of the future will continue to grow in size and complexity and will have to be accomplished in a highly volatile economic, political and social environment. This means that only those organizations that have invested in the management technologies and the people needed to deal with these complexities will be best suited for the challenges of the future. However, by the very nature of the international project environment, these firms will also have to develop a cooperative attitude for sharing the development of their management technologies as well as the training and development of their project management personnel.

Since it will be in the best interest for international firms to have the ability to interface their management systems and organizations with that of other firms, we would expect to see a serious effort to develop international standards for the management technologies of the future. Also, because of the enormous cost and time required to develop and implement these technologies it may be worthwhile for these international organizations to combine their resources to create a framework of a permanent international project management organization.

A consortium of some sort could support a core group of project management specialists who would devote their attention to the development of standards and procedures for international communications, information processing and integration of management systems. Furthermore, this consortium would be responsible for establishing the standards for training and development of project personnel. A permanent international project management organization, supported by a number of international corporations, could

provide the environment and opportunity necessary to the development of the renaissance-system managers of the future. Also, such an organization could do much to create the understanding needed to improve our ability to better manage those activities which consume the world's scarce resources and effect the delicate balance of its environment.

14. CONCLUSION

We can reasonably expect that future projects will continue to grow in size and complexity and will have to be accomplished in a highly volatile economic and social environment. However, as we have shown, technological advancements in communications and information processing are providing sophisticated tools which can be used to better plan, organize and control projects. These new tools will do much to improve communications between project participants, provide more effective ways for making the right information available to the user and enable sound decision making in spite of the difficulties and uncertainties of the project environment. Thus, future project personnel must be highly skilled in the application and utilization of these tools. The work to develop these project professionals must begin now.

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