Information Technology Management

A Framework for Planning and Controlling
New Information Technology Investments

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Abstract

New information technologies offer opportunities to improve
organizational productivity and competitive position; however,
these opportunities raise significant management issues that must
be addressed if our investments in these technologies are to be
profitable.

In the next few years the management of all businesses will be
called on to make significant investment decisions in office-
based equipment, communications facilities, software and
training. This paper was developed to help provide management
with a framework for making these investment decisions. It
raises issues for management consideration and suggests possible
paths for their resolution.

INTRODUCTION

Every month articles appear in the business and popular press
proclaiming the importance of "Office Automation". They usually
begin with a lengthy justification of the issue as a cause for
management attention. So much has been written and spoken on the
subject that is unproductive to reproduce the efforts. Instead,
we begin by identifying the conclusions which appear to be
universally accepted.

For example, the U.S. work force continues to shift from one that
is blue collar (agricultural and manufacturing) dominated towards
one that is white collar (information and service) dominated.
Figure 1 shows the trend graphically. Automation on the farm and
in the factory has so significantly improved productivity that we
need no longer deploy as much of our labor force in these areas.
Not only are new information- and service-based industries
growing, but the white-collar cost component of manufactured goods
is also increasing.

The continuing decline in unit costs and increase in functional
capabilities of electronic, storage, printing, communication and
software technologies will offer management significant new
opportunities to deploy these technologies within the business
processes.

Figure 2 graphically depicts trends in the technology-cost versus
labor-cost trade-offs. Tasks which could not be automated
yesterday because of function or cost now must be automated if one
is to remain competitive. In the future, this trend will enable
automation of processes that today are not perceived as attractive
opportunities.

These technological advances can and must be deployed to produce
significant gains in productivity in the management and
professional segments of the white collar work force. Booz-Allen
& Hamilton, Inc. has stated, "Firms actively pursuing new
technologies will be the winners while those that do not will be
the losers...Losing will be disastrous from a competitive and
financial viewpoint." Studies have consistently indicated
productivity improvement potential in the 10- to 25-percent
range. Today's technologies are capable of delivering this level
of improvement. However, organizationally we are not necessarily
ready to absorb these technologies.

THE INFORMATION ECONOMY

PERCENT

INFORMATION

SERVICE

INDUSTRY

AGRICULTURE

Source: Dept. of Labor   DISTRIBUTION OF U.S. WORK FORCE

Figure 1

TECHNOLOGY VS. MANPOWER COSTS

UNIT COSTS

PEOPLE UP 8 – 12 % PER YEAR

COMMUNICATIONS
DOWN 11 % PER YEAR

COMPUTER LOGIC
DOWN 25 % PER YEAR

COMPUTER MEMORY
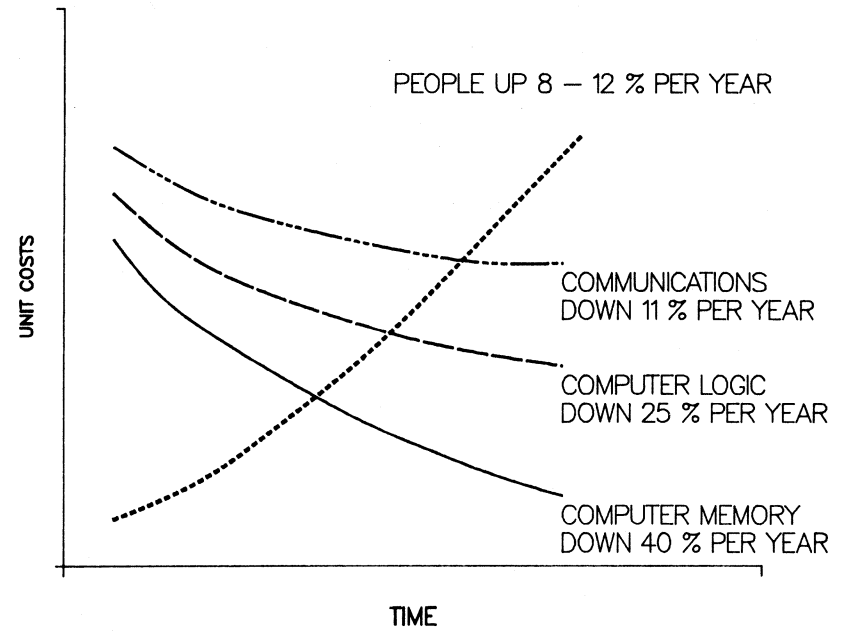DOWN 40 % PER YEAR

TIME

Figure 2

Why has the actual deployment of these technologies lagged behind all previous predictions. There are several significant factors that contribute to this delay making the introduction of these technologies truly a management issue:

- The term "office automation" itself is much too restrictive and leads many senior managers to believe that word-processing or personal-computer decisions are relatively minor. We prefer the term "information technology" and include all new technologies which improve the collection, analysis and communication of information. No single definition may be sufficiently comprehensive for these new and dynamic fields. In general, however, by office automation we mean,

   A business strategy aimed at improving business results through an integrated plan to improve the quantity, quality and timeliness of business information and of the decisions drawn from this information. These improvements are achieved through deployment of new tools made available by advanced electronic, printing, storage and communications technologies and through complementary plans for organizational change.

- The methodologies for evaluating and justifying the promised productivity benefits in the white collar work force are not mature and are sometimes viewed as "soft" and intangible.

- Although some of the benefits of automation can be achieved in the initial phases of introduction, some of the most significant benefits are achieved only after a critical mass of the organization has been affected.

- To achieve these benefits management must consider basic changes in business processes. These changes involve organization, structure, skill levels and information flow, and they often meet with organzational resistance. In the case of factory automation, management changes the work environment of others; in the case of office automation, management may be required to change their own work environment and that of their staff.

In spite of these impediments, it is certain that the senior management of all businesses will be asked to make significant investment decisions in office-based equipment, communications facilities, software and training in the next few years. This paper is intended to help provide management with a framework for making these investment decisions. It raises issues for management consideration and suggests possible paths for their resolution.

How should personal computers, departmental computers, local computing facilities or large shared computing facilities be deployed? What kind of local communication network should be utilized? What vendor strategy should be developed? These questions will be answered differently in each business depending on the vision of future requirements of the senior management, on the current investments in equipment, networks and training, and on individual management style. The management of each unit needs to develop a vision of future requirements and a broad awareness of the issues before they are asked to make these major investment decisions that will have a significant impact, positive or negative, on the future productivity of their business.

Most of the technologies and applications associated with office automation can be placed in the overall architectural framework of the concept of the professional work station. This concept suggests that within a decade over 50 percent of the white-collar work force will have available to them the information, the processing tools, the presentation media and the communications capabilities to significantly improve their productivity and, perhaps even more importantly, their decision making ability.

These facilities will be provided through a work station located within the professional's own office. It will give them access to information and processing capabilities located within the work station itself, in departmental systems, in plant (local) computing facilities, in corporate computing centers and in external facilities offering access to data from many independent information providers.

These capabilities will be available not only in the professional's office but also from other locations in the company, from the home and even from the traveler's hotel room. They will be made available not only to our employees, but also to our customers and suppliers when appropriate.

The concept today includes a large number of applications that can be made available to any professional and assumes that each white-collar worker, or class of worker, would have a work station tailored to meet individual (or group) requirements. The applications most often identified with office automation and the professional work station include:

> Word processing
> List processing
> Electronic mail
> Electronic filing
> Time management
> Business graphics

Presentation preparation
Source data entry
Information retrieval (company data)
Information retrieval (industry data)
Spread-sheet analysis
Decision support (modeling) systems
Voice mail
Telephone management

Although many authors do not include the current timesharing and transaction processing applications (order processing, circuit design, etc.) as office-systems applications, these current applications must be considered in planning the future office environment.

INFORMATION AUTOMATION - A TIME PHASE MODEL

A time phase model, such as Figure 3, has been used by several authors to identify the issues involved in the introduction of change into an organization. Product life cycles and organizational growth and maturity have been described in this way. Figure 4 identifies four phases in the introduction of information technology that help identify the changing management issues during this process.

Phase 1 - Conception

In the first phase, Conception, creative employees identify opportunities to improve their own individual (or departmental) productivity by introducing one or a few relatively simple applications. These applications might involve word processing, list maintenance, retrieval from a small data base or use of minor computational aids. Since the typical MIS organization has a large backlog of major development projects, small applications such as these have low priority and the data processing organization may be viewed as unresponsive. However, new technolgies and the computer literacy they have created permit creative employees to satisfy their own requirements by acquiring a word processor, a time sharing terminal or a personal computer. Since the capital requirement is relatively small and the perceived benefits very attractive, the individual finds a way to acquire the investment capital required to satisfy the objectives. Such projects serve as successful visible showcases for the rest of the organization.

Phase 2 - Expansion

As other individuals or departments begin to identify such opportunities, the Expansion phase begins. In this phase, technical management, normally with either an administrative or information systems background, identifies these uncontrolled
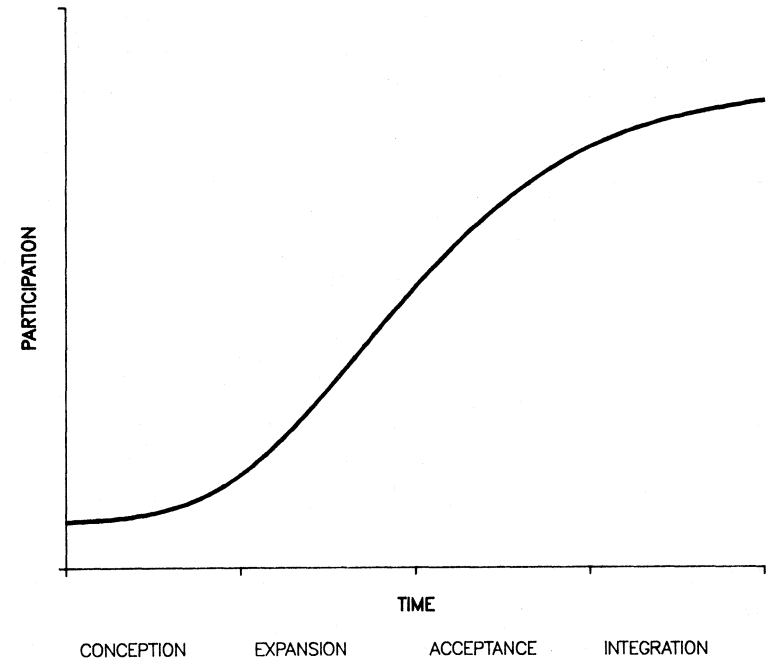
INFORMATION TECHNOLOGY INTRODUCTION

Figure 3

INFORMATION TECHNOLOGY INTRODUCTION

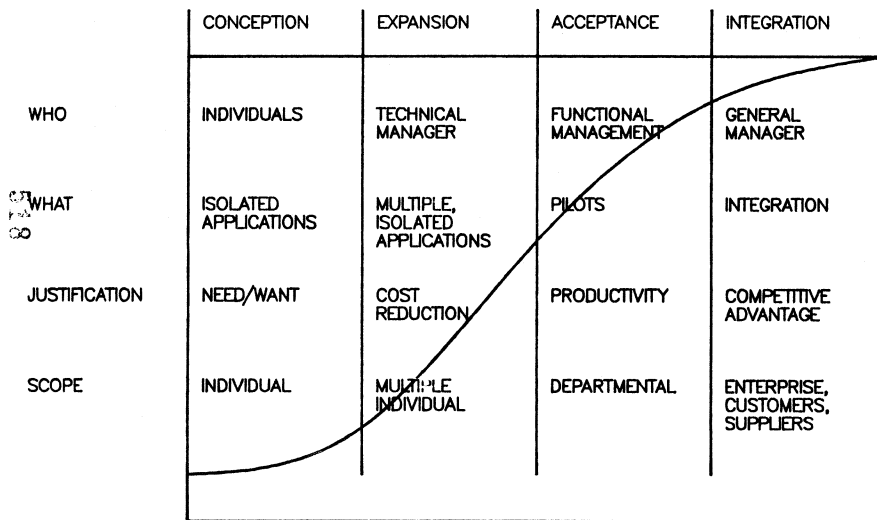|	CONCEPTION	EXPANSION	ACCEPTANCE	INTEGRATION
WHO	INDIVIDUALS	TECHNICAL MANAGER	FUNCTIONAL MANAGEMENT	GENERAL MANAGER
WHAT	ISOLATED APPLICATIONS	MULTIPLE, ISOLATED APPLICATIONS	PILOTS	INTEGRATION
JUSTIFICATION	NEED/WANT	COST REDUCTION	PRODUCTIVITY	COMPETITIVE ADVANTAGE
SCOPE	INDIVIDUAL	MULTIPLE INDIVIDUAL	DEPARTMENTAL	ENTERPRISE, CUSTOMERS, SUPPLIERS

Figure 4

equipment and software investments as a management issue and recommends the establishment of either an Office Systems or Information Center organization (or both), depending on the background of the individual or the initial application thrust in the Conception phase. The Office Systems organization, with its administrative systems background, may begin with a word-processing emphasis out typically expands into list processing, information access and financial spread-sheet applications. The Information Center focuses its attention on the introduction of "user friendly", "fourth generation" languages and applications that can be used directly, in either a time-sharing or personal-computer environment, by end users. Unlike the traditional MIS mission, the Information Center organization views itself as an end-user support organization rather then an application-development organization.

In the Expansion phase management is asked to make many small, apparently unrelated, investment decisions. Although each decision involves a relatively small investment, the management requires formal cost benefit analysis usually focused on cost reduction or cost avoidance for each application. This approach, although necessary at this stage of development, tends to isolate further these investments and the individual productivity benefits they generate.

Phase 3 - Acceptance

Eventually, a senior functional manager (a vice president of Marketing, Engineering, Manufacturing, or Finance, for example) will identify an opportunity to improve the productivity, not of an individual or single department but of the entire organization. This introduces the Acceptance phase. In this phase the functional manager accepts the concept that, by improving communication, improving information flow, providing more, better, and more timely information, the productivity of the entire organization can be significantly improved. In this phase the functional manager provides leadership and direction, and project members include members of his or her staff as well as representatives from support organizations (Administrative Systems, Information Management and Industrial Relations). In this phase the application focus shifts from mechanization of a single task to automation of an entire business process. For example, electronic mail, voice mail, organizational and industry data bases are used and the quality and flow of information within the organization is improved.

Figure 5 makes this point graphically. As an organization matures and as the cost of technology decreases, management identifies opportunities to mechanize and reduce costs. This process follows the standard learning curve. By contrast, substantial productivity increases come about not by mechanizing

MECHANIZATION VS. AUTOMATION

Mechanization ⟶ Cost Reduction

Automation
↓
Productivity

Technology
Organization
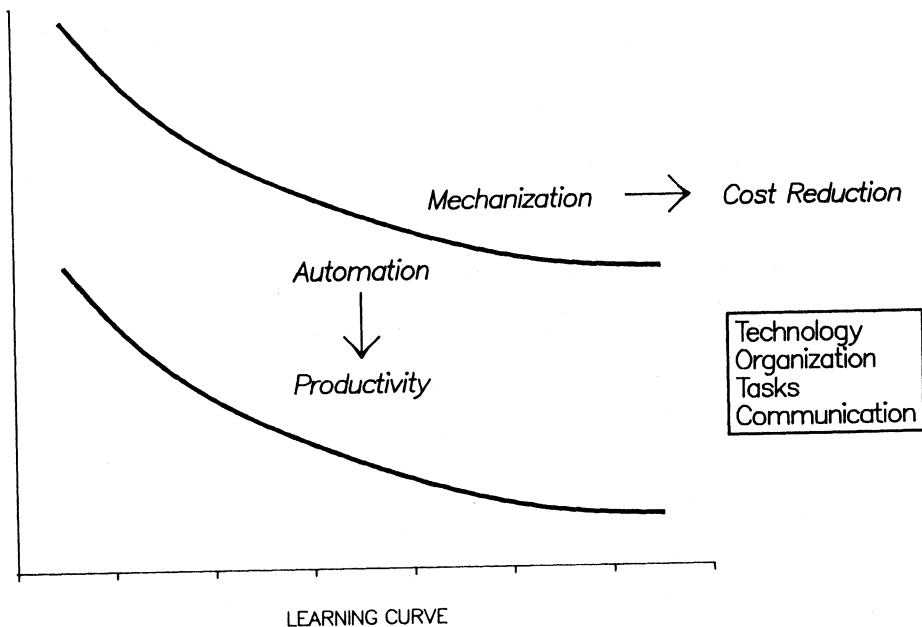Tasks
Communication

LEARNING CURVE

Figure 5

existing tasks but rather by utilizing technology to stimulate changes in the organization, structure, tasks and information flows; that is, to change the basic business process itself. These innovative introductions of technology truly automate a process and can dramatically move the organization to an improved learning curve. In these cases, management is looking to technology to improve the flow of information within the organization in order to facilitate faster and more informed decisions. Specific cost reductions may not be immediately identifiable.

Phase 4 - Integration

In the final phase, Integration, the general management of the organization recognizes the real potential of the available technologies. They consider not only the productivity of one functional area, but the potential impact of information technology on the business as a whole. In this phase, management identifies its critical success factors and asks how information technologies and applications might help achieve them. They seek to identify, for example, how information technology can be used to improve:

        Customer service
        Customer loyalty
        Time to market
        Supplier performance
        Employee quality
        Employee relations
        Company image

Today, some businesses are encouraging their customers to access their information systems directly to determine order status; others are issuing their purchase orders electronically; others are providing information services as an added value to their customers. For some, existing communication networks provide a vehicle for keeping employees better informed; for others, it provides a way to utilize a remote (perhaps home-bound) labor market. These systems are being applied to the most significant business issues, the critical success factors of the business as identified by its senior management.

In the Integration phase, management also recognizes the significant challenges it faces in utilizing information technology effectively:

1. How can the information available in factory systems, engineering design systems, traditional data processing systems and the new office systems be integrated into an effective information network for use by the professional and managerial staff of the entire enterprise?

MANAGEMENT RESPONSE

With the time phase model as a framework, what should be management's response? Given the problems identified, what steps should management take today to ensure that opportunities are identified as early as possible and that today's investments reflect both short- and long-term analysis?

Responsibility

Even though office technologies have been introduced at a rate slower than previously predicted, introductions are occurring in most organizations today on a broad front, and recent trends indicate an explosion of interest in these areas. The introduction of the personal computer, the availability of "user-friendly" software targeted at the end-user marketplace, and increasing functional capabilities on the word-processing and timesharing facilities already in place are all signficant factors in this process. Management must focus responsibility for planning and control of this area and the investments we will make in it. Strategically, identifying a single responsible person may be appropriate; however, in many organizations the appointment of a single person or organization may not be immediately feasible or practical. In these cases a management committee, with all its flaws, may be necessary. In either case, those responsible must be able to balance between the strategic and tactical objectives of the organization and between the technical and organizational disciplines required for success.

In the next few years every organization will be making difficult investment decisions. They will be difficult because the justification methodologies will not identify solid cost reduction/avoidance benefits and difficult because the best short-term, tactical investments may not integrate well in the organization's long-range, strategic plans. Every organization will face these difficult decisions and should be prepared with appropriate organizational structures and procedures for these decision processes.

Focus

Today, most businesses find themselves in the Expansion phase of the model. Attention is being given to end-user computing and isolated office systems applications. Although the trend to broaden the availability of information technology is clearly positive, management must focus this effort on areas and issues that have the greatest potential for contribution. Today, some organizations are focusing on the easy applications rather than the important ones. The growth in demand for both capital and for scarce technical skills requires identification of the

2. How can previous investments in equipment, software and training be integrated in a way that will permit a single, multifunction work station to access the wealth of information now available?

3. How can the planning and control of this distributed information environment be integrated to ensure that information vital to the business' long-term success is securely protected?

The ever increasing impact of information technology on all business functions, the growing computer literacy and the increase in specialization in all aspects of business, are accompanied by a growing trend towards decentralized responsibility for information collection, processing and reporting. Yet without some overall planning-and-control focus, organizations may not be able to achieve the full benefits of their investments, may be paying too much for the benefits they are achieving, and may lose control of vital business information.

In many cases, our current skills and organizational structures cannot satisfy the necessary planning, coordinating and control responsibilities. The information systems, administrative systems and engineering organizations are technical skill centers and, in some cases, focused narrowly on a few selected technologies, tools or applications.

The specialization required by the complexity of the current information environment has made it much more difficult to train broadly based systems analysts. In many cases, today, management can accurately predict the solution recommended by an analyst based on his or her area of technical specialization rather than on the business requirements. Word processors, personal computers, timesharing can all satisfy many common problems. The tool selected is often a matter of individual style rather than thoughtful analysis. Even if these organizations broadened their base of technical expertise, they may be lacking the human-factors, behaviorial-science and organizational-planning skills that will be necessary.

Forward thinking organizations should begin to plan for an eventual integration of their technology investments. Unfortunately, there is no single architecture, vendor or even technology that will guarantee timely and cost-effective solutions for today's large variety of problems and that will, at the same time, provide for a smooth integration in the future. On the other hand, we cannot afford to wait until the direction is clear before making any investments. The opportunities are here today; certain risks are inevitable.

critical success factors or strategic issues of the business. This focus should include addressing professional and managerial productivity issues; improving the management decision processes; improving the flow of consistent, timely information throughout the organization; and providing competitive product and service advantages.

Plan

A wise man once said, "If you don't know where you're going, any road will take you there." If we are to make profitable investments we need to have some view of the future environment. In particular, it is important to consider, now, certain key issues that will affect short-term decisions:

(1) What is the architectural structure of our future information environment? That is, How should we distribute the storage and processing of our business information (personal computers, department computers, local computing facilities, corporate shared facilities, external facilities) and how will we provide access to this information by employees, customers and suppliers from our offices, from our homes and from other remote sites?

(2) What vendors, products, applications or standards should we identify as strategic, today, in order to move towards this future environment?

(3) What policies and procedures should be in place to ensure protection of our business information in this new distributed environment?

(4) What significant organizational impacts will accompany this technology introduction? What education and training processes should we develop now to smooth the transitions?

These questions do not have unique answers and certainly, in today's changing environment, they do not have precise answers. Yet it is important to develop a plan that addresses these kinds of issues and that is discussed, reviewed and accepted by the entire organization.

Justification Methodology

Perhaps the most difficult issue to deal with today is the determination of an appropriate justification methodology for these technology investments. Our traditional methodologies do not seem to apply; yet to do nothing may risk the competitive position of the business. There are no simple solutions but there are some reasonable approaches. If an organization has identified Responsibility, Focus and Long-Range Plan, then projects can be categorized as either tactical or strategic.

Tactical projects address today's productivity problems. They must be justified using traditional cost/benefit analysis and must provide a rapid and high return on investment. In particular, one should assume that today's investments in equipment will have a relatively short (3- to 5-year) life. Although consideration of longer range integration issues should be made, it will often be necessary to minimize this issue in order to achieve the short-term benefits of these tactical projects.

On the other hand, we need to establish an ongoing commitment of resources (capital and manpower) to develop more strategic projects. Strategic projects are those that offer the organization the more significant, but perhaps longer term and higher-risk payoffs. It is important that each organization take some of these risks in order to protect its future; however, we must assure ourselves that we're taking the right risk and minimizing the chance and impact of failure. Such projects must clearly identify their objectives in terms of the focus of management direction previously identified. They should contain an initial pilot phase to test the concepts. Even though we cannot yet measure the true productivity of our professional and management work force, we should insist, in each project, on the measurement of productivity indicators. By productivity indicators we mean factors which by themselves do not guarantee improved, bottom-line performance, but that can give management a sense that their investments do have positive, even if indirect and non-quantifiable impact. Examples could include time through approval cycles, time savings on individual tasks, organizational response times and measures of employee satisfaction. For strategic projects we must should insist on a clear understanding of the longer-term integration issues and on the organizational impacts if the project is successful.

SUMMARY

Even though information technology offers an enormous potential, its full benefits cannot be achieved without the awareness, direction and support provided by management. Without this involvement the process of introducing new technologies will still undoubtedly take place. However, its impact will be bottom up and tactical. With an awareness of its true potential, these technologies can become an important component in the organization's strategic planning for the future.