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**Using a Model of the Instructional Design Process
in a complex Socio-technical Organization:
A Description and Analysis of Problems Encountered**

Laurie L. Doroshenko

A Thesis Equivalent

in

The Department

of

Education

**Presented in Partial Fulfillment of the Requirements
for the Degree of Master of Arts at
Concordia University
Montréal, Québec, Canada**

December, 1985

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ISBN 0-315-30644-0

Abstract

Using a Model of the Instructional Design Process in a complex Socio-technical Organization: A Description and Analysis of Problems Encountered

Laurie L. Doroshenko

The primary purpose of this thesis is to describe and analyse an application of a standard model of the instructional design process to improve use of a specialized group of computerized information - processing systems. The thesis contains five main sections:

- 1) a model of the organization as it existed prior to project;
- 2) a discussion of solution alternatives and evaluation of the solution selection process which led to the decision to develop a training programme;
- 3) a detailed description and critical analysis of the instructional design process used to produce the training programme;
- 4) a discussion of the immediate results and longer range effects of this training programme;
- 5) a review of general problem areas encountered including recommended modifications to the model for instructional design used, to more adequately accommodate the many variables (affecting the establishment and maintenance of effective training programmes in rapidly changing complex socio-technical organizations.

Acknowledgements

To F.J. Artner who inspired me in the beginning,
to D.C. Bennett who encouraged me at the end,
and to T.C. and L.W. Doroshenko who supported me
throughout, many thanks.

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Introduction

This thesis equivalent is a description of a needs assessment and the subsequent design, development, production, delivery, evaluation, and outcomes of a training programme. The training programme was created to improve the use of a specialized group of computerized information-processing systems by managers in a nationwide socio-technical organization.

The computer systems that were the subjects of the training programme, had been being developed and used for the previous ten years and are still being developed and refined. The oldest of these systems was initially developed to help managers at central locations evaluate and improve the distribution of work forces by recording labour costs in each defined territory across the country.

By recording labour costs per location by activity and workforce, managers would be able to gather the information they needed to redistribute the work forces more equitably and efficiently. With labour fairly distributed it was felt that jobs could be cut and money saved, so the cost of the first computer system was justified.

Similarly, a materials reporting system was developed to help improve the distribution of material resources and thus save money. Then a work planning system was developed to help schedule major projects more efficiently so that

labour and material resources were available where and when necessary. Through efficient scheduling it was thought that the company could do more with less.

Initially these computer systems were used at central headquarters locations only to plan and analyse the nationwide distribution of resources. And the cost of development and maintenance was justified on the basis of the savings obtained through more efficient distribution of these resources.

Eventually, however, two new computer systems were developed to be used not only at the headquarters locations, but at field locations too. One was a plant inventory system which was to provide current and historical data on the condition of the plant. This information could be used locally to plan maintenance projects and centrally to analyse trends and create maintenance models. The other was a project estimating system which was to help in anticipating and prioritizing capital expenditures. Both of these systems were cost-justified on the basis of the savings expected when both operating (maintenance) and capital (new work) expenditures could be anticipated and prioritized nationwide through use of these systems. However, to be useful, both of these new systems required the active participation of managers in field locations.

This need prompted discussions about training. Training for managers in the field was needed on the two

new systems, and, although the older systems were designed for a different purpose, they did contain information that could be accessed in formats that would also be useful to managers in field locations. The systems were in place already, cost-justified and contained much useful information, but most managers did not know how to use them. This thinking led eventually to the needs assessment and development of the training programme which is the subject of this thesis equivalent.

Through this report, the standard processes and techniques used in assessment of needs and the design, development, delivery, and evaluation of the training programme are documented where applicable. However, in discussing the environmental factors that intervened in the process, especially the motives, ambitions, attitudes and goals of the various individuals, the report is more interpretive than purely descriptive. There being no objective criteria in place with which to judge these factors, those evaluations and interpretations are entirely subjective. The validity and reliability of these assessments remain untested.

Although specific methods are described within it, the thesis equivalent overall does not follow any standard research methodology. It is simply a broad description of one application of a model of instructional design in a complex and uncontrolled environment.

4

Following the description of the design, development, production, delivery, evaluation and outcomes of the training programme, an analysis of problems encountered is given. And two tools, meant to help adapt the standard model of instructional design to an industrial setting, are presented. It is hoped that these products will assist other educational technologists in similar environments to be adaptive and successfully effect change.

Background

Background

The organization in question is an engineering department in a large transportation company. As elsewhere today, this organization is experiencing an era of transition. Current rapid changes in human values, technology, and natural as well as economic environments are making it increasingly difficult for most organizations to anticipate, adapt, survive and evolve in these turbulent times (Roher, 1983). Of all the forces pressuring organizations to transform perhaps the most influential is technological change and advancement. Such is the case in the department which is the focus of this study.

From the beginning of time, technology has played an important role in our ability to adapt, survive and compete. In fact, technology is one defining characteristic of human beings (DeGreene, 1982). Now, when the evolution of human beings has slowed, technological evolution becomes increasingly important and the human-machine interface becomes a critical area of concern.

Of all technologies recently introduced to this department, the computer has probably had the most persuasive effect. Over the past five years, a group of computerized management information systems has been developed, implemented and is operating within the department. Accompanying the new technology were some largely unanticipated shifts in roles, structure, goals and power which have been demanding attention (Tapscott, 1981).

The aim of this particular department is to maintain the transportation company's fixed plant in satisfactory condition. It also conducts research and introduces innovations to improve the efficiency of maintenance and construction so that goods can be transported with minimal delay and hazard. The department is responsible for the maintenance of approximately 17,000 miles of roadway, \$10 million worth of buildings, and the signals necessary to control the traffic. There has always been great pride taken in its reputation for innovation while maintaining plant condition above standard. With cost as the limiting constraint, quality and efficiency in construction and maintenance of the company's fixed plant is the primary goal of the department.

The department's Computer Systems were developed primarily to help management to more efficiently distribute available resources and thus help them achieve their goal of quality maintenance at minimal cost. By providing timely, accurate and relevant information to management, the Computer Systems would help optimize the distribution of available resources and lead to dollar savings in the long run. In the process, the Computer Systems would also automate some office procedures, reduce clerical workload and speed up the processing of information from the field to management and back, while at the same time facilitating transfer of information across departments. In short, the Computer Systems were intended to provide a

service which would save time and money across the board, thus making the entire operation more efficient.

Objectively, it is clear that the aim of the department as a whole and that of this department's Computer Systems group, were truly complimentary. The Computer Systems would help the department maintain its high standards by better controlling resources, eliminating waste and redundancy and thereby improving efficiency. However, many people in the department viewed the Computer Systems group as separate and foreign, and saw the two sets of goals as conflicting. Some, quite justifiably, speculated that the introduction of the Computer Systems would lead to loss of autonomy, a loss of power and a loss of jobs. The Computer Systems were often seen as a threat, an imposition, an unwanted change, and were generally resisted or ignored upon introduction.

There had been, from inception, a pronounced difference between the actual and desired state of the overall departmental attitude with respect to the Computer Systems. This was, as we shall see, primarily due to a lack of communication and participation throughout their development and introduction.

The purpose in modelling this system as it existed is to pinpoint the causes of this difference between actual and desired states and to explain the subsequent recommendations made to bring the two closer together.

A Model of the Organization

A Model of the Organization

The Human Boundaries

This particular department is made up of various functional groups all reporting to the department Chief. Each group is headed by a Senior Manager at headquarters who reports directly to the Chief. In addition, there are five regionally located Senior Managers who also report directly to the Chief but who are solely responsible for the overall day to day operations on their own region. These Senior Managers from the regions and headquarters make up what is known as the department's Cabinet which, for the most part, directs the department's activities (see Figure 1).

The largest and most influential of the group reporting to the Chief is the Track and Roadway or T & R function. This group is responsible for 90% of the department's plant and resources, as it is their province to maintain and upgrade the company's roadway and track. On the other hand, the newest and least influential Cabinet position is that Senior Manager of Planning, who oversees a planning and analysis group as well as the Computer Systems development and operations teams. The status of this new position was upgraded during the course of this project.

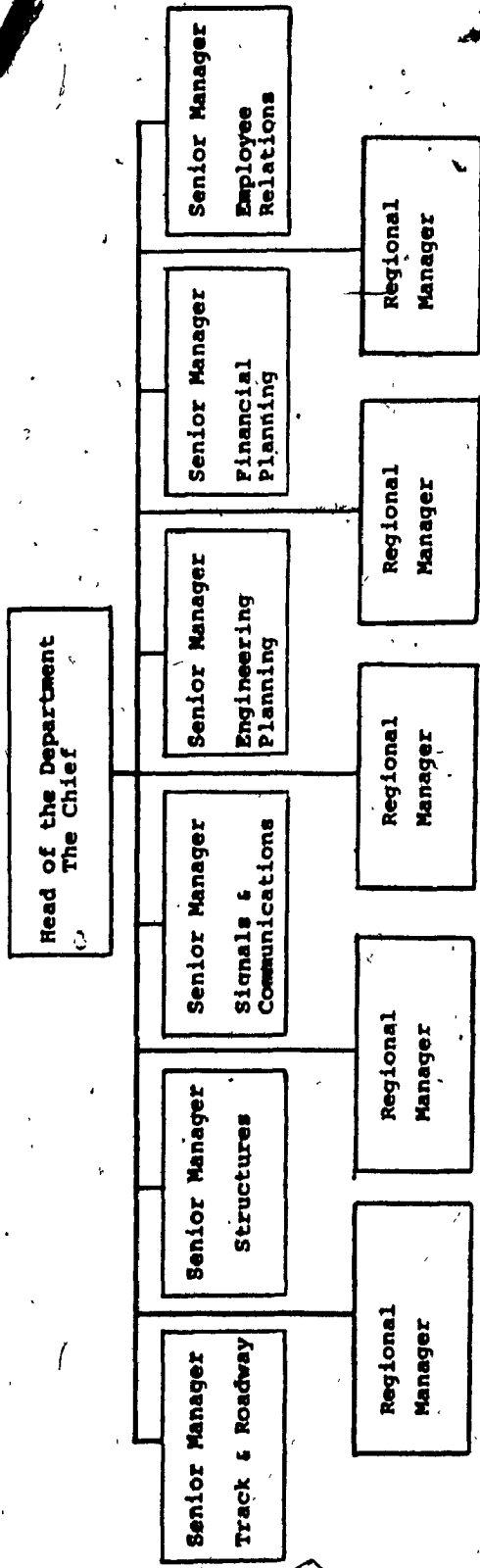


Figure 1: The departmental Cabinet

Although the organization to be described here is part of a much larger system by which it is influenced and upon which it exerts influence, for this model the boundaries will be defined quite narrowly. The organization will be bounded by the people directly involved in attempting to "improve effective use of the department's Computer Systems leading to more efficient management of plant and resources". It is also bounded by the limited time, space and money allotted to accomplish this objective. By describing just the groups which interact toward this end and by clarifying their individual and collective goals, the scope of this system will be delineated. Other people who are influenced by or exert influence upon this system will be considered part of the environment.

The people interacting within this system and thus defining its boundaries were:

1. The Chief - head of the department
2. The Senior Manager - Planning - head of the Computer Systems and planning group
3. Manager of the Computer Systems operations team - reports to Senior Manager - Planning
4. Manager of the planning and Computer Systems development team - reports to Senior Manager - Planning
5. The Senior Manager - Track and Roadway (T & R) - head of the major intended user group
6. The other members of the department's Cabinet

7. The Planning and Computer Systems development team within the Planning group
8. The Computer Systems Operations team within the Planning group
9. The Programming and Computer services department
10. The Regional Representatives for the Computer Systems
11. The intended user groups

Describing the apparent goals of each of these individuals and/or groups will help focus attention on areas where conflicts existed, areas which were to be addressed if the system were ever to achieve its overall objective, "effective use of the Computer Systems for more efficient management of plant and resources".

Goals of the Organization's Human Elements

The Chief, head of the department:

Though not directly involved with the Computer Systems, this engineer directly influences their operation and acceptance through policy setting. Not the Chief when the Computer System development began, he has not always supported these Systems, but now acknowledges that they can be valuable if people know how to use them efficiently. He would like to see the Systems being used to save time and money and has recently become more vocal in encouraging their acceptance and future development. Coming from "the

old' school" to whom "good plant maintenance" was the ultimate end, it appears that the Chief has only recently accepted his broader role as manager and is beginning to acknowledge the value of computers in the department. His public goal for the Systems is now to have them be used, to survive and grow, though privately he may still doubt their true worth.

The Senior Manager-Planning, head of the Computer Systems and planning groups:

The history behind this position is important. The original position was created when Computer Systems development began and was held by the unpopular character who pushed the Systems into being. When the previous Chief, who has initiated Computer Systems development and who had supported this unpopular manager of the Computer Systems and his autocratic approach, was quickly promoted for his innovative work, suddenly the power structure shifted. The then new, and still current Chief, had not supported the Computer Systems, nor the way they were introduced. He now forced the arrogant head of the Computer Systems group into retirement and down-graded the level of the position.

The unpopular post was filled with a non-threatening outsider who appeared to have won the position by default. His mandate was to popularize the existing Computer Systems but, initially, he was given little support from the Chief.

Not a risk-taker, the man sought to keep the Systems and himself, alive, through various superficial public relations tactics such as personal visits to potential users and the encouragement of a "user friendly" approach. The effect of this action or lack of it, could be construed as positive in that the Computer Systems were beginning to be seen as non-threatening, but little was being done to build the image of them as useful management tools.

At approximately the same time, an in-house study of future trends indicated that the department should continue to computerize so that work could be redistributed and reorganized, becoming less labour-intensive. With this approach, it was thought that eventually, return on capital investment would be increased. It was becoming clear to all that the position as head of the Planning group was a potentially powerful and influential one.

Accordingly, the existing managerial position was retained, but, in addition, a more senior position was created. The status and the title of this new position were graded so that the person filling the new position would be on a par with the highest level people reporting directly to the Chief.

To lend credibility to this new position, it was first given to one of the brightest young managers in the department who was rapidly moving up in the company. The intent was to establish the importance of the new position by having it recognized as a stepping-stone in a desirable

career path which would lead to a regional Senior Management position and upward from there. With this man in charge, the Planning and Computer Systems group gained the direction and support it has previously lacked. Unfortunately for the group, an unexpected retirement took place and, within a few months, this dynamic new leader of the Computer Systems group was promoted to one of the regional Senior Management positions and the new position of Senior Manager - Planning, was open again.

Candidates were sought, but as the credibility and status of this new job had not yet been firmly established, there remained the stigma of unpopularity attached to it by the original leader. This negative perception and possibly fear of this relatively unfamiliar "Computer Systems" area combined, and there were no takers for the job.

Management was reluctant to break with tradition and look outside of the usual selection list. The final result was that this position was filled by default, by the same man who had defaulted into the previously existing management position. And so the man who had taken no risks as a manager was rewarded with upgraded position and status. He became the Senior Manager - Planning.

The second-in-command position which he left, was abolished. The goal of the new Senior Manager - Planning is basically the same as it was as systems manager. He does want to increase the use to the existing Computer Systems, develop others and gain credibility, status and

publicity for himself through his group, all without any personal or professional risk.

The manager of the Computer Systems operations team within the Planning group:

As one of the few non-engineers in the department this manager holds a precarious position, with much to gain if successful, but much to lose if he fails. His professional goal is to have the Systems operate smoothly, fulfilling their potential as a powerful management tool. His personal goals include gaining credibility, publicity, and status for the group and himself notwithstanding the shadow on the group by the non-directive new Senior Manager. With these goals in mind and with the co-operation of his counterpart, the Manager of the Computer Systems planning and development team within the group, this manager attempts to steer the Senior Manager into taking the risks necessary if the Computer Systems were to survive and grow.

The manager of, the planning and Computer Systems development team:

This engineer and his counterpart, the manager of the Computer Systems operating team, have not always been willing to co-operate. In fact, there was, until the

recent senior appointment, an ongoing competition between them. But with the appointment of the new Senior Manager - Planning these two young ambitious managers have begun to work together to achieve some common goals. This managing engineer, like his counterpart in operations, appears to believe in the Computer Systems and wants them to be used effectively by management to help them distribute scarce resources efficiently and increase their span of control. There also exists a personal goal, that of using the Computer Systems as a vehicle for advancement. Working together, this engineer and the manager of the Computer Systems operations group appear to be capable of overcoming the weak leadership of the new Senior Manager and even dispelling the entrenched negative attitude toward the Computer Systems.

The Senior Manager - Track and Roadway, head of a major intended user group:

This is a very influential position in the department, second only to the Chief. This engineer manages a group of engineers who work throughout the country and employ a major portion of the department's labour forces and budget. The Senior Manager - T. & R., wants these subordinate engineers to use whatever means to save time and money while still maintaining the plant in good condition. If the Computer Systems can help him accomplish this goal, he

wants this group to be able to make effective use of them. He also wants to have the content of the Computer Systems geared to the requirements of his people. His goals are to have his engineers function as efficiently as possible and thereby gain credibility and status for himself. He is aware that he can use the Computer Systems to achieve these goals.

The other members of the department's Cabinet:

Though there were still some vestiges of the doubt, mistrust and resistance which had characterized the Cabinet's attitude toward the Computer Systems and their proponents at the time of their creation, time and economics have all but displaced these out-dated attitudes. Most of the Cabinet would agree that computerization can help them achieve their goal of achieving maximum return on investment while maintaining the highest standards practicable. In addition, some of the more upwardly mobile members see their support of the Computer Systems as an indication that they are progressive and competitive. Finally when all the world is jumping on the computerization bandwagon it is difficult to resist the flow without appearing backward. If establishing a progressive and innovative image for the department is a goal of the Cabinet, then showing support for the Computer Systems might help achieve that, while at the same time improving efficiency of operation.

The Planning and Computer Systems development team within the Planning group:

This headquarters team develops, implements, and analyses statistics from the department's Computer Systems. They report to the manager of the Planning and Development team. With the help of a group of programmers, this team of engineers and technicians designs Computer Systems to the specifications of management and secondary users. The goal of this group is to provide an interface between end-users and programmers so that workable and useful Systems are developed within the time frame and budget allotted by upper management. Too often, time and money constraints take precedence over Systems useability standards, but usually decisions on the relative weights given these variables are made at higher levels. The goal of this group is to develop Systems which satisfy requirements given strict constraints.

The Computer Systems operations team within the Planning group:

This headquarters team is responsible for the daily operation of the Computer Systems. Trouble shooting, quality control, provisions for equipment, circuits etc., and minor enhancements to the existing Systems are all part of

this team's mandate. The goal of this team is to keep the Computer Systems running smoothly by providing an interface between end users and hardware and software producers. Within this young team there are some competitive and ambitious individuals who want to gain credibility, status and publicity for themselves through their work. Other team members appear satisfied with the status quo.

The Programming and Computer Services Group:

The Computer Services group is a separate department within the company which provides assistance in the form of programmers and system analysts when new systems are being developed. They also work on enhancements and modifications to existing systems, provide some technical writers and trainers for implementations, and coordinate computer processing across departments and systems.

The Computer Services people are supposed to serve as consultants to department developing computer systems but apparently have broader goals. They would like to have more control over computer system development, processing schedules and priorities. The departmental Computer System development group, on the other hand, struggles against this intrusion into what they see as their sphere of influence. Because both groups are ambitious and seek to extend their power, they tend to be critical of each other,

protective of their existing "territories" and eager to impose checks and balances on one another. The goals of both groups include survival and growth, partially through increased control of the other group.

The Regional Representatives of the Computer Systems:

Members of this group do not report directly to the Computer Systems group, but their role at the regional offices includes troubleshooting and ongoing training on the Computer Systems. They are supposed to be kept up to date with respect to Systems enhancements and to inform end users on the regions of any change in Systems content or procedures. They actually report to a different subgroup within the department which has no real connection to the department's Computer Systems group. As a result, their time and loyalty are divided between the regional demands and headquarters requirements.

Most of these representatives are genuinely interested in having the Systems operate efficiently but most of them have also grown cynical after experiencing years of the prevalent negative attitude. On the regions, they seemed to have concentrated most of their training effort at the clerical level and had provided little to management, who, as a result of this neglect, viewed them as inept or incompetent. There is little chance for advancement for this group without reorganization. Their goals are various.

Some simply seek to survive, others would like to escape and still other hope that the rapid expansion in computer use will benefit them professionally.

The intended user group:

The overall intended user group is ultimately comprised of anyone in the department who can make use of the Computer Systems to improve management of resources. Within this large population there are many groups with varying degrees of interest and to whom the Systems have varying levels of applicability.

For this study the intended user group is the group of engineers and supervisors reporting to the Senior Manager-Track and Roadway. These engineers function quite independently, maintaining and operating the major portion of the department's plant and inventory throughout the country. The group is made up of the first level senior managers and high-level middle managers. Among the group are both managers on the way up, and those who have reached their peak and settled. The goals of this group concerning the Computer Systems are diverse. Some are eager to use the Computer Systems to manage their territories as efficiently as possible and in the process, gain an edge on the competition. Others, for a variety of reasons, would rather avoid using the Computer Systems. Those engineers whose goal is merely to survive, seem to regard the Systems as a

necessary evil, while those who want to evolve and grow into positions of increased authority apparently see the Computer Systems as potentially valuable management tools.

Looking at the people and goals interacting within this organization, (see Figure 2) it is clear that conflicts and gaps exist. The more aggressive and progressive individuals and groups realize that using and promoting the Computer Systems is essential and could provide both professional and personal benefit. The force of this group is beginning to influence those who have been afraid to take risks, have clung to the old ways or have simply been satisfied with the status quo. The goals of the various groups have forced the whole organization to shift in favour of the Computer Systems, though there is still enough resistance to temper any real commitment at the higher levels until the actual value of such commitment has been more clearly ascertained.

The Space Boundaries

This department Planning group is based at company headquarters, where Computer Systems development and operations are centralized. From headquarters the Computer Systems network extends to each of the five regional offices and to the 25 to 30 local Track and Roadway offices across the country. In all there are nearly 300 computer terminals across the country, some being used nearly constantly,

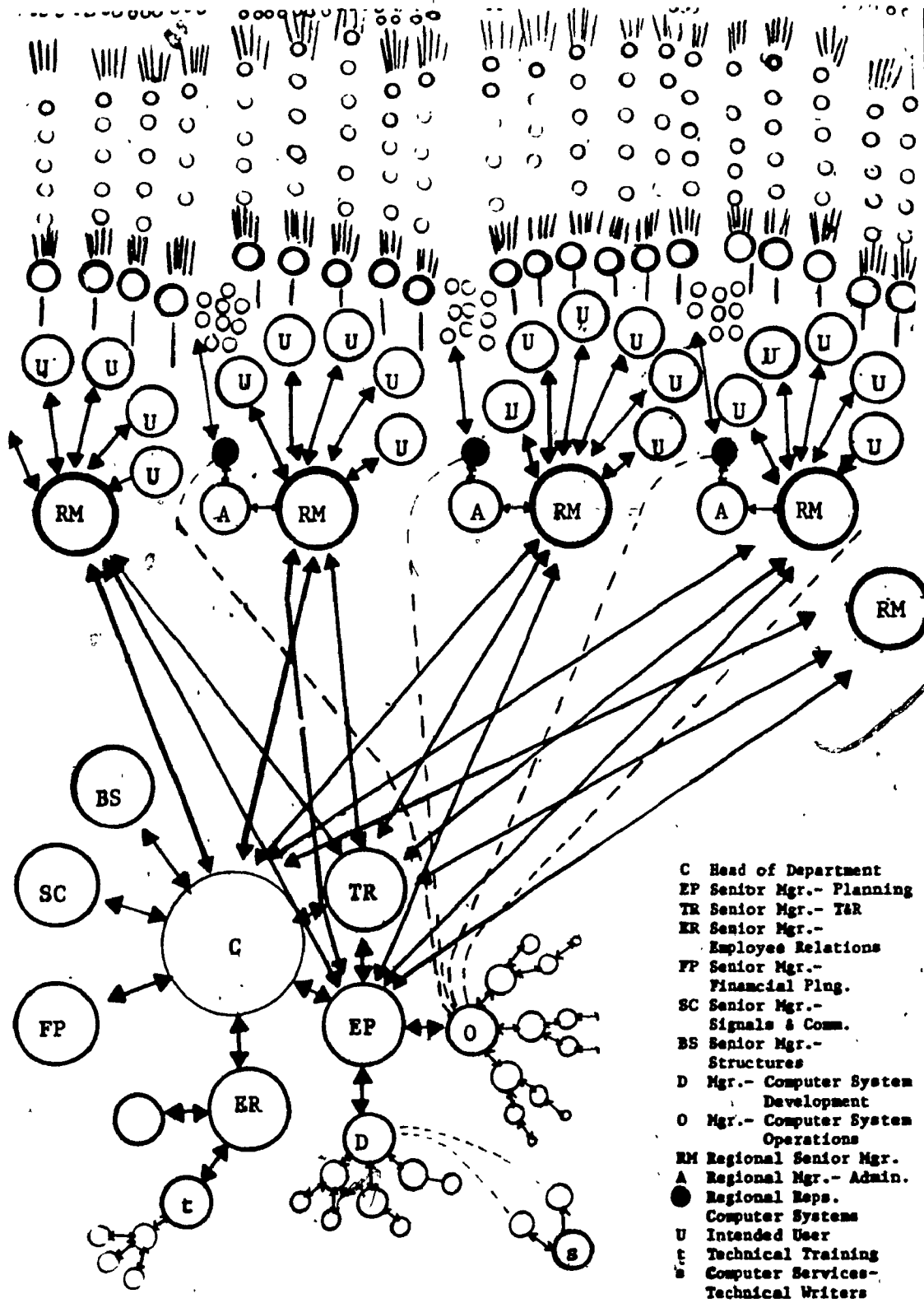


Figure 2: The human boundaries of the organization

others hardly ever touched.

Based at regional headquarters, each of the five Regional Representatives of the Computer Systems is supposed to cover that region, providing guidance and/or technical assistance to both clerical and non clerical users across the region.

If major problems occur or if users run into trouble when assistance is not available, they are encouraged to call the Computer Systems operations team at systems headquarters for immediate help over the phone.

This arrangement has provided adequate troubleshooting coverage for trained users, but training for new users and/or new systems has been neglected. To meet the perceived need for comprehensive training it appears that an alternative arrangement will have to be found to overcome the vast space problems.

To deal with the tremendous scope, various solutions could have been proposed. More regional trainers could be provided, users with similar interests and similar entry-levels could be brought together at central locations for training or tailored training packages could be developed for distribution to remote locations. The problems of space and user distribution were obvious, the best solutions were not.

The Time Boundaries

The Computer Systems have been a reality for approximately five years. During that time they have grown from the one original Labour Reporting System into seven diverse Systems, and continue to develop.

In the summer of their fifth year of operation, it was recognized that use of the Computer Systems could and should be greatly improved. An educational technologist was hired temporarily to study the situation. The educational technologist recommended that a needs assessment be performed, and was allotted a three-month time period in which to perform this analysis.

Based on that study and various other factors, a training programme was to be developed within six months. Based on the results of that training programme, a two year training strategy was developed. The time boundaries were thus not established at the outset but rather developed in response to needs identified and deadlines.

The Financial Boundaries

At the time of the initial development of a training strategy for Computer Systems, there was no real commitment to training as an ongoing function within the group. The educational technologist had been hired temporarily by the managers of the Computer Systems operations team within the

Planning group simply to do a study of training needs.

When the study led to a complete process of instructional design, development, delivery and evaluation, no additional funds were provided to the group. The cost of developing the instruction had to be covered within a typical operating budget. And the technologist was told to use the least expensive means available to produce materials. Most of the research and production had to be done in-house using available resources.

The Technical Boundaries

This organization was also bounded by technical constraints which were typically related to financial priorities as set by upper management. The Computer Systems had been developed by independent groups over the preceding five years and were, by no means, compatible, technologically or structurally. Methods of accessing information procedures, screen layouts, computer messages and key functions varied from System to System, making it difficult for even experienced users to feel comfortable in the many varied environments. These inconsistencies did damage to the image of the Computer Systems, but, rather than concentrating programming efforts on System integration, new, again inconsistent Systems continued to be built. The integration and standardization of the various existing and projected Computer Systems were planned for the future but

that constituted a monumental, and not highly visible task, for which resources had not yet been made available. The feasibility study concerning integration was being conducted as the training project began.

Technology changes quickly and the Computer Systems, which may have been state of the art a few years ago were, by today's standards, dated and more difficult to use than need be. Advancements in computer hardware, have accelerated processing times, added colour and graphics capabilities, and made equipment easier to operate. With the advent of data base technology, methods of storing data have become more efficient.

At the same time many system designers are now concerned with system useability as well as efficiency, and software is now being developed to be "user-friendly" so that the inexperienced can access information as required. Unfortunately, most of these advances in hardware and software had not been incorporated into this department's existing Computer Systems. Using them could be quite laborious and sometimes tedious or frustrating.

Standardizing, integrating and updating the technology of the Computer Systems was one logical goal of the operations and development teams within the Planning group but, to other influential groups, the development of new inventory systems and analytical models took precedence; while still others felt that the Computer Systems should be marketed as they were, avoiding the overwhelming task of

integration.

As a result of the conflict of interests and goals, and with no clear direction from the group's Senior Manager, most of the problems and inconsistencies of the Computer System were continuously being piled up and endured, waiting for a massive overhaul at some unspecified future date. Meanwhile, because of their awkwardness and the lack of communication between users and designers, the Computer Systems received less than optimal use. With no feedback coming in to force action, the inconsistencies remained and multiplied.

The Input

With these basic issues as yet unresolved and priorities not formally established, the marketing of the Computer Systems began within the department, spurred by the coming of the new Senior Manager - Planning. His goal was to publicize the Computer System and he wanted visible results as soon as possible. The Computer Systems began to be made more accessible and use was being encouraged by a variety of means.

It was a symptom, not the actual problem which was being addressed, but with the increased usage, the multitude of quirks and inconsistencies was increasingly being exposed. In the long run with increasing use, pressure from influential groups for standardization, integration

and 'friendlier' procedures might come to outweigh the demand for new development, and force priorities to be re-evaluated so that the underlying problems with the Systems could be addressed. In any case, the idea of exposing the Computer Systems to users for their critical evaluation and then acting on their suggestions, could only help to improve their useability and acceptance. By starting to work on the symptoms, the basic problem might eventually receive attention.

The useability of the department's Computer Systems was constrained by the technology which was used to construct them as well as the time, space, financial and human boundaries. However, improved communication between end-users and system designers and operators appeared to be one means of overcoming these limitations, either by teaching users to handle the awkwardness and/or by building enough pressure to force an overhaul.

System Goals

This complex organization can be partially described by its boundaries of time, space, financial and technological constraints and the varied goals of the human elements. However, it is the goals of the system which define it and these are more difficult to pinpoint. The lack of a universal system goal was one of the major problems with this organization.

All groups and sub systems within this organization shared the public goal of survival and most also aimed to grow and evolve. On a more private level, the ambitious individuals aimed to gain credibility, publicity and status for themselves by taking the necessary risks and backing the "winning" side. Across groups, however, these common individual goals may produce dissimilar results for the organization as a whole.

There were, as has been seen, a variety of conflicting and complimentary goals existing amongst the sub systems of this organization, but, for this system as a whole, no single goal with respect to the Computer Systems had been clearly established. There were groups and individuals in the system who supported the continuing evolution of the Computer Systems because they perceived they would realize some benefit from achievement of this goal. Membership in this group, however, had not yet reached the critical mass necessary to sway the whole organization in support of Computer System evolution. There were still a significant number of influential system members who, for a variety of reasons, remained disinterested, refused to accept, or even promoted hostility toward the Computer System and their advocates. Whether this negative stance was due to the historically almost adversarial relationship which had existed between headquarters and the regional offices, or was possibly a carried-over reaction to the autocratic manner in which the first Computer System had been imposed, or

was simply a matter of inadequate training, or had developed as a response to fear of the unknown, was unclear. However, this hostility and avoidance had to be recognized as at least a subconscious goal of some groups, and constituted a major obstacle in the evolutionary path of the Computer Systems.

With no effective communications network, the goals for the whole system had not been negotiated and the secondary, potentially destructive goals had been allowed to gain credence and to influence the behaviour of the organization as a whole. The system was being divided into satellite groups moving in opposing directions. Without a holistic goal, it was difficult to direct and control the behaviour of the system and nearly impossible to predict how it would react to change.

Such was the state of this system when the latest Senior Manager - Planning arrived with the mandate to "improve effective use of the Computer Systems". To a large extent his apparent goal of personal and professional publicity and his penchant for visible results directed the evolution of the organization and its goals.

Chapter 1: Beginning of Instructional Design Process

Chapter 1: Beginning the Instructional Design Process

1.1 Background

In the fall of 1982 an education technologist entered this organization. This 'training consultant' was actually hired in the spring of 1982 by the manager of the Computer Systems operations team within the Planning group and given a temporary internship assignment to begin in the fall of the same year. The assignment would be to determine what training was needed on the department's Computer Systems. In the interim, between the time when the consultant had been hired in the spring and when she began work in fall, the major change in management and powershift within the department had occurred.

The Chief, who had been the head of the department for a number of years and who had motivated the development of the Computer Systems had been promoted. His successor was a man whose support for the Computer Systems had been grudging at best. Though he did accept that the Computer Systems had potential value, he knew them to be flawed and underused. His attention was focussed primarily on the traditional departmental functions of maintaining the plant to standard in a time when money was tight. In fact, his only decisive action concerning the department's Computer Systems during the first few months of his administration was to force a change of management within the group. As

soon as the new Chief took power, he arranged for the former head of Planning to retire, devalued the position, and placed in it, an engineer from outside the group who had the reputation of being reliable, non-threatening, loyal and definitely not a risktaker. The new head of the Planning group was given the vaguely defined mandate of "improving effective use of the Computer Systems".

Then, with this potentially powerful and threatening group thus diffused, the Chief turned his attention to other matters and left the Planning group alone to reassess and re-establish its role within the department. This is the point at which the educational technologist arrived to begin the previously determined task of establishing what training was needed with respect to the department's Computer Systems.

The new Manager of Planning had not committed himself to this needs assessment project but neither did he oppose it at this point. With support from the manager of the Computer Systems operations team and ambivalence from the Senior Manager of the group, the educational technologist started work.

See Figure 3 for the structure of the Planning group when the educational technologist joined the organization.

The position of 'training consultant' had been created for the educational technologist. Formerly, training has been the responsibility of one of the middle level managers under Administration, but had been neglected for three

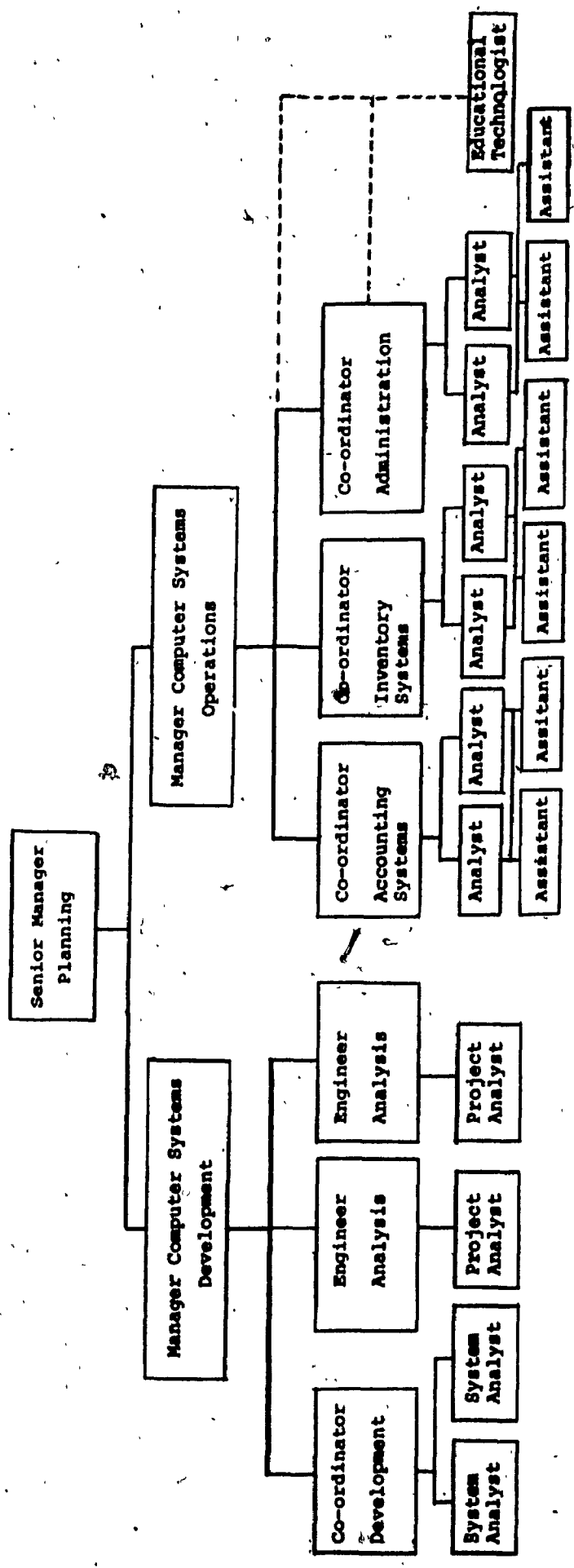


Figure 3: Structure of the department's Planning and Computer Systems group

years due to lack of resources and motivation. In the previous few years the budget for training on the Computer Systems had been cut drastically, consequently, the person responsible for it had shifted attention to other aspects of his job. At the time when the educational technologist arrived to start work on the study, training on the Computer Systems was at a standstill.

Everyone appeared relieved to pass the whole messy problem over to the educational technologist.

In theory, the educational technologist was to report through this middle level manager to the manager of the Computer Systems operations team and through him to the new group manager, but in practice, if this chain of reporting was used, the message usually stopped at the middle management level. This middle level manager was not willing to commit effort to training from the outset, blocked communication, and was therefore eventually by-passed. The educational technologist soon began to report directly to the manager of the Computer Systems operations team and/or the Senior Manager for Planning.

On arrival, the first step taken by the educational technologist was to become familiar with the subject matter, the department's mainframe Computer Systems themselves. The educational technologist was given a yard-deep stack of 'procedure manuals' to read and absorb. This information alone was inadequate and the 'training consultant' eventually got permission to consult with

subject matter experts and received some of "hands-on" experience with the Computer Systems. After approximately a month of research and some discussion about the Computer Systems, the educational technologist had gained only a superficial knowledge of what kind of information was stored by the Computer Systems and how it could be assessed. At this point, the primary task of determining what training was needed on the department's Computer Systems was to begin.

1.2 The Needs Assessment

Having thus briefly investigated the functioning of the department's Computer Systems, the educational technologist was aware that inadequate training of some user groups was just one of many problems. Before prescribing solution, the educational technologist recommended the problems be analysed, clarified and prioritized so that the solution procedure eventually chosen would provide maximum benefit to the organization.

In order to solve problems, establish goals and/or make decisions, the first step is to clarify the situation by determining how the existing state differs from a model situation. Kaufman's term for this first phase in a total process of problem identification and resolution is "needs assessment", (Kaufman, 1976; 1979) but similar processes

are known by a variety of names in the literature. Needs analyses, diagnosis, front end analysis and performance analysis are some of the titles used by various authors to describe this phase of the problem identification and resolution process within a system approach to goal clarification and/or decision making (Coffing, 1977; Elerington, 1980; Gilbert, 1967; Harless, 1975; Mager & Pipe, 1970; Witkin, 1977).

A formal needs assessment requires a systematic approach and the collection and analysis of empirical data to determine the cause of any difference between the actual and desired system states. Harless, the developer of the Front-End Analysis process, classifies problems into three types by their causes:

1. skill/knowledge causes
2. environmental causes
3. motivation/incentive causes (Harless, 1975).

The goals of a needs assessment or front-end analysis process are to:

1. isolate the root cause of a problem rather than focusing on its symptoms or effects,
2. clarify and isolate problems which have high worth,
3. increase the probability that the solution to a given problem is effective by matching the cause of the problem to the appropriate type of remedy,

4. increase the probability that the type of solution selected is feasible and cost effective (Harless, 1975).

After investigating various models of needs assessment, the educational technologist recommended that Kaufman's system approach to problem identification and resolution be followed, with the additional step of cost/benefit analysis, (see Figure 4).

This proposal was accepted by the two managers of operations and development and by the Senior Manager of Planning. The next step was to perform the needs assessment, to collect sufficient data to accurately describe the problems which were causing less than optimal use of department's Computer Systems.

Decisions about the scope of the assessment and methods of data collection were made. The educational technologist recommended that the assessment cover not only skill and knowledge needs, but also needs developing from environmental and/or motivational causes (Harless, 1975). The plan included data collection to describe needs at all levels within the department, from labourers to top management. With these extensive data requirements and because of their lower cost relative to other data collection methods, questionnaires were to be used (Berdie and Anderson, 1980). This method would be supplemented with interviews, observations and record searches where possible.

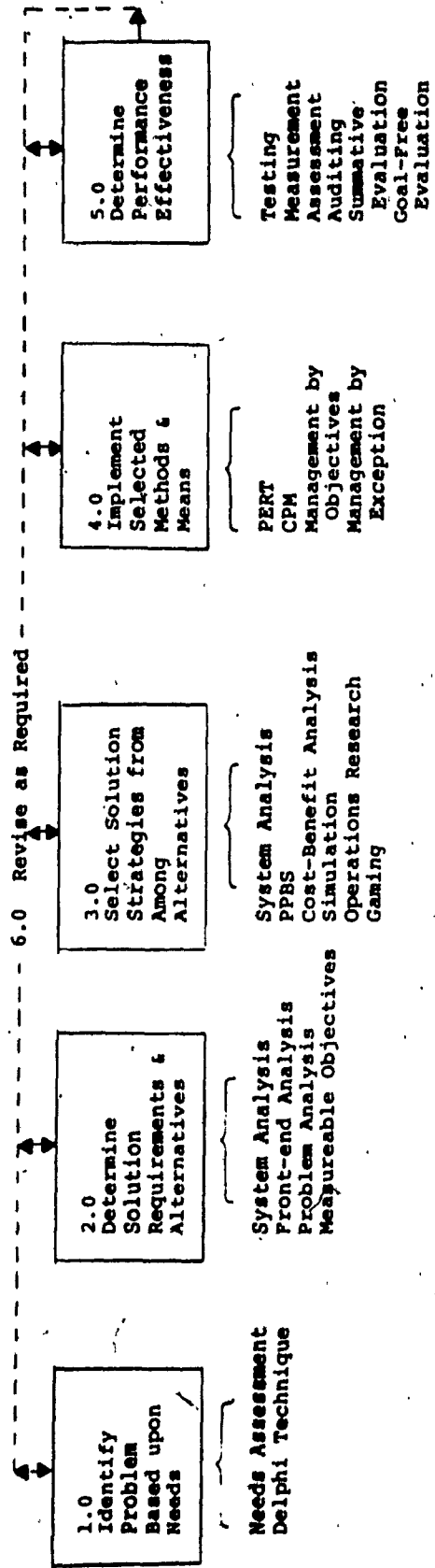


Figure 4: Kaufman's model for Problem-solving

Note: From Needs Assessment: Concept and Application by R.A. Kaufman, 1979, Englewood Cliffs, N.J.: Educational Technology Pub. Copyright 1979 by Educational Technology Publications. Reprinted.

Development of the questionnaire went through a multiple-step process. First the educational technologist conducted a series of relatively unstructured interviews with clerical, middle and upper management personnel in the department at system headquarters. Having thus established the perceived general problem areas and concerns, a further series of more structured interviews as conducted with actual users and potential users of the Computer Systems at regional headquarters offices. Again interviewees came from practically all levels within the department, with only labourers and foremen, who report to, but do not directly interact with the Systems, being missed. In all, approximately 20 people were interviewed, the interviews ranging in duration from half an hour up to two hours. The educational technologist would have continued these interviews, covering representative personnel from all five regions and all levels but at this point the new Senior Manager of the Planning group decided that no more interviews were necessary. He wanted visible action to begin.

Having gained some insight into what end-users saw as their needs, the educational technologist's second step in data collection was the construction of an extensive questionnaire which would help evaluate the actual versus desired states of the problems exposed. This long questionnaire was to be completed by the Regional Representatives of the Computer Systems. This group was selected for

extensive questioning because they could be assumed to be aware of the needs of all users at regional and more remote areas, seeing as it was part of their job to provide those users with on-going training as required. They were seen as a valuable source of information. Another reason for focusing on this ten-person group was purely practical. The group would be having one of its tri-annual meetings with the Computer Systems operations team at headquarters in the near future and so would be readily accessible. Accordingly, an extensive opinion survey would be taken using a questionnaire and informal discussions.

The survey of needs was developed and administered to this group at their next meeting. Reaction to this new training-related effort was generally positive, though the enthusiasm was tempered with some cynicism. Those representatives had seen other programmes planned and then cancelled. Results obtained from all data collection were analysed and summarized. In a report to Computer Systems management, an attempt was made to prioritize the expressed needs and recommend solutions based on a purely subjective cost/benefit analysis by the educational technologist.

1.3 Determining Solution Requirements and Alternatives

The report summarized the reason for conducting the needs assessment; primarily, the study was an investigation of the needs of several levels of users (foremen, field

supervisors, clerks and management) with respect to the Computer Systems in general. The assessment covered a variety of needs, related to training, logistics, environment, motivation and attitude. The needs expressed and evaluated in this survey were prioritized and solutions recommended. The following listing has been excerpted from the summary section of that December 1982 report:

To identify precisely where and what the needs were, a needs assessment survey was developed and administered to Regional Analysts and H.Q. personnel. The results of the surveys and discussions indicated that effective participation is less than optimal within each functional group and, as a result, the system as a whole is not accomplishing its function as effectively as it could. To achieve more effective system function the priority needs of its component parts (each functional group and computer hardware & software) should be resolved.

Priority and secondary needs and recommendations drawn from the preceding assessments are presented in this report.

Summary of Conclusions and Recommendations

1. Managers

A. The priority need of managers and supervisors is EDUCATION. By educating them as to what information is available from the system and how it can be used by them, and by training them in how to access and interpret required information, both managers and the system will benefit.

Recommended Solutions:

- i) Research, design, develop, implement and evaluate a program of education and training to meet the needs of managers.
- ii) Provide adequate on-going training and communication with managers to facilitate effective use.

- B. A second need of managers is simplification of system operation so that required information can be more easily accessed and interpreted.

Recommended Solutions: (see page for detail)

- C. Another need of managers is for integration of the information systems so in-depth analyses can be accessed if needed.

Recommended Solutions: (see page for detail)

2. Clerical Staff

- A. The priority need of clerks is for TECHNICAL EXPERTISE which will involve both SIMPLIFICATION of system operation and TRAINING. Resolving this need will benefit the clerks as a group and the system as a whole.

Recommended Solutions:

- i) Simplify and integrate system operation so technical expertise necessary is reduced. The development of "help" keys on-line, interfacing, easy-to-use screens etc. would make the clerk's job less time-consuming and his/her work more accurate
- ii) Develop a complete and concise training manual on-line or in print for initial training and for reference.
- iii) Develop a system of on-going training so that problems are solved before accuracy becomes questionable.

- B. A second need of clerks is for better COMMUNICATION with foremen and their field supervisors to clarify the accuracy of the data received.

Recommended solutions:

This problem would be eliminated if foremen reported orally and field supervisors were accountable for the validity, accuracy and completeness of foremen's reporting. Contact between clerk and field supervisors would be increased and accuracy and validity improved.

C. Another need of clerks is MOTIVATION. At present some clerks do not have the incentive to input data accurately.

Recommended Solutions:

- i) Make clerks aware that the data they input is valuable and useful by routing feedback to field supervisors and managers through them.
- ii) Make the clerk's job less cumbersome by providing them with technical expertise, and simplified system operation, field supervisors with accountability for data accuracy, and foremen with simplification of reporting procedures.

3. Field Supervisors

A. The number one need is for involvement in the computer systems. Resolving this need will require the development of training, feedback and accountability for field supervisors.

Recommended Solutions:

- i) Provide feedback to roadmasters and B & B masters on the data reported by their foremen, before and after input by clerks.
- ii) Make them accountable for the validity, accuracy and completeness of the data reported by their men.
- iii) Train the field supervisors so they can supervise and provide help to their men in reporting and so they can use the report and enquiry facilities available to them.

4. Foremen

A. The number one need is for SIMPLIFICATION of reporting procedures. Resolving this need will bring the most benefit to the group and to the system as a whole.

Recommended Solutions:

Simplify the reporting procedures for foremen by having them make their report orally on phone or radio, daily to a clerk or their field supervisor instead of using forms.

- B. A second need is for MOTIVATION. There is now a general lack of incentive to report properly to the computer systems.

Recommended Solutions:

Involve the field supervisors in the reporting process in order to motivate and/or supervise the work of their foremen as effects the computer systems. Also, develop reports from the systems which can be of use to the foremen while illustrating to them the results of their reporting efforts.

- C. Another need of foremen in TRAINING.

Recommended Solutions:

Develop a complete training package for new hires covering all systems. Provide updated training when changes or additions are made. Provide on-going and remedial training with involvement of the field supervisors.

The function of the department's management information systems is to provide useful information to managers and supervisors to aid them in the efficient and effective management of resources and plant. But to have an effectively functioning system its component parts - the functional groups involved and the computer hardware and software - must be able to interact successfully.

At present the computer systems are functioning, but the level of effectiveness could be improved. The ways to achieve this goal have been indicated in the results of a needs assessment of the various functional groups involved with the system. By resolving the priority needs of the functional groups, the system as a whole will benefit.

The report gave detailed descriptions of an instructional design process for the recommended management

training, through which 'tailor-made' training could be provided. It also suggested some ways in which Computer System design and operation could be simplified, standardized and/or updated to make the human-computer interface more user-friendly for managers, clerks, field supervisors, foremen and other department personnel.

Before any action could be taken in response to this needs assessment and prioritization, an opportunity arose for further data collection. Two people from the development team within the Planning group were preparing to make a tour of all regional locations to introduce the latest enhancement to one of the newer Computer Systems to management personnel. The Senior Manager of the Planning group persuaded them to take along a one-page questionnaire on training needs, if it could be developed before they were to leave, one week later.

Drawing on the results of the previous survey, this short questionnaire was developed quickly using a format developed by the Manitoba Institute of Management (Holmes & Trump, 1981). Since the previous data collection had indicated that training was a major need of management, this short questionnaire concentrated on training-related issues, basically asking middle and senior management people which content areas needed the most work and which methods of training they felt to be most useful.

The second questionnaire was given to approximately 50 people of middle and senior management levels during the

road trip. Out of the 50, 45 responses were received. The results were surprising. The only item of the ten on which there was almost unanimous agreement was that training was needed. These managers were not sufficiently aware of the kinds of information which were available from the Computer Systems to discriminate between subject areas. There was no agreement as to which of the Systems should receive the most attention or how the selected content should be taught, presumably because of this low level of awareness.

These results supported the priority listing in the previous report. Based on these brief opinion surveys and questionnaires and on the resources available, the number one priority appeared to be to provide tailored training to management. Effective training would not only benefit those who received it, by giving them access to useful information, it also had the potential to benefit the Computer Systems group. Improving communications and promoting a positive attitude as well as providing training for management personnel, especially those on the way up, could be a great boon to the Computer Systems group. With the active support of this influential group, the Computer Systems organization would have a much better chance for growth and evolution.

The prioritization of needs was crude but probably as accurate as possible given the resources. It was clear that of the groups assessed, management knew the least about the Computer Systems and therefore had the most to

gain if a solution were implemented. The various needs identified and solutions recommended included training, simplification, integration, accuracy, communication and motivation regarding the Computer Systems. Of these, the one which could be implemented most quickly with the least involvement required from outside groups, the least visible cost, and least commitment by the group's hesitant Senior Manager, was training. Training could also have the beneficial side-effect of increasing communications and motivation amongst managers.

As the Senior Manager - Planning was not a risk-taker, he was not willing to commit himself to any long term plan or strategy for dealing with the basic, problem areas. Given the available resources, namely, one educational technologist, and no real budget for training, he opted for a short term solution. The basic organizational and technological problems were left untouched and it appeared that a one-shot training programme would be chosen as an interim solution. Though it should have been done at this point, no cost/benefit analysis of solution recommendations was performed.

1.4 Solution Selection

Having requested and been denied the resources for further research, needs assessment and cost/benefit analysis, the educational technologist was asked to write

and submit a report detailing her recommendations. The report was written and recommendations were made based solely on subjective evaluations of available resources, costs and benefits. Unfortunately, at this time, the Senior Manager - Planning was not willing to take decisive action regarding these recommendations. Perhaps the problems appeared too extensive to tackle on a limited budget. Perhaps there was some fear of the unfamiliar involved. Maybe the Senior Manager did not feel that the training team could be held accountable for results. Or perhaps being unable or unwilling to precisely measure all benefits of resolving the expressed needs and thus improving use of the Systems, against the cost of ongoing inadequate use and negative attitude, this Senior Manager did not feel that the risk was justified. In any case, no decisive action was taken.

On the positive side, this characteristic hesitation, indecision and risk-avoidance behaviour had given the educational technologist the time to conduct the initial needs assessment; but on the negative side, it forbade any further research or any radical change in past procedures. Rather than commit himself to any long-term comprehensive plan of action which would eventually improve effective use of the Computer Systems, this Senior Manager took the safe course and chose from among the recommendations, the least risky, the most unobtrusive, the one most similar to past methods, the cheapest and the most disposable.

The 'solution' chosen was the development of simplified "user guides" or "how-to-use handbooks" for the oldest two of the existing Computer Systems. When these first systems had been developed, the details of how to use them and of which information was contained in them had been recorded in a series of procedure manuals. These technical manuals gave screen by screen details of which codes could be input, listed all options available, showed each level of any hierarchy and explained all possible error or computer messages. This documentation became quite extensive, eventually growing to eight binders, each about 4 inches thick. The manuals had been developed primarily for use by system analysts who are to keep the Systems running smoothly, and by clerical people whose responsibility it is to update the information in the Systems as reports come in. Because of the sheer volume and the awkward style in indexing, even the intended users scarcely took these manuals off the shelf.

Though the manuals were seldom used, this original cumbersome style had been preserved for the sake of standardization as additions and revisions to the Computer Systems were made. Soon it became an annoyance for users even to keep their manuals up to date. Many revisions were not filed and the out of date manuals quickly became useless. Also, because these manuals gave every detail about System operation and because the Systems were constantly being modified, it became a major task for the operations

team at Computer Systems headquarters to keep informed of all changes and additions, document them in the format required and distribute them to all manual users, before they too, were out of date. It became a frustrating and demanding task with no guarantee that revisions sent were not being thrown out at the other end. Eventually, with the budget cuts for "training" within the Computer Systems group, the updating process had been dropped. No revisions were being sent out. The procedure manuals were at least two years out of date.

In addition to being cumbersome and out of date, the manuals were not designed for use by management. The documentation gave detailed step by step procedures for operating the Computer Systems but did not attempt to include any concepts or realistic examples. They showed in minute detail, exactly what information was contained in the Systems but said nothing about why that information was collected or how it might be used. For some clerical people the manuals may have been useful in clarifying some complex input or enquiry procedures, but as tools for management the procedure manuals were useless.

Because users and producers of these procedure manuals had become aware of their inadequacies, the budget for their maintenance had been cut and the manager of the development team had begun to use a new simplified format for the more recently developed Computer Systems. A technical writing team from the Computer Services depart-

ment had traditionally been responsible for the development of training materials for new Computer Systems. They had been responsible for the now defunct procedure manuals and were willing to try something different. As in the past, after the initial development, the responsibility for maintenance of the new "support" material was to be assumed by the operations team of the Computer Systems group.

The result of this set of circumstances had been the development of a relatively small and self-contained "update and enquiry guide" for each of the two newer Computer Systems. The objective of these guides was to explain the more commonly used update and enquiry procedures in a System, using a question and answer format; stating a problem, then directing the user to "discover" the answer step by step. This logical and concise approach had been well-liked and widely accepted as a viable alternative to the maintenance of procedure manuals for all new Computer Systems. In some quarters there was concern that there should be additional documentation in the form of procedure manuals to back up the small guides, this to be kept only at headquarters and the regional offices. Though a legitimate concern, it was dismissed because the resources were not available to develop and maintain both guides and manuals. Only small guides were being developed.

There were four major Computer Systems in operation in

the department and some smaller Systems. The older two major Systems had no user guides, just extensive, but out-of-date procedure manuals. The newer two had the easier-to-use and concise user guides but no procedure manuals. Development of similar small, user-friendly guides for the two older Systems had been one minor recommendation of the educational technologist, along with the on-line upkeep of the old procedure manuals. Avoiding commitment to an overall training strategy, the Senior Manager-Planning decided that developing user-friendly guides for the two older Computer Systems was a useful, easy, safe and short-term means of acting on the recommendations made by the educational technologist.

This project was definitely justified, even if it had not the highest priority on the list. It was also relatively inexpensive and the precedent for the development of such guides had previously been set by the manager of the development team. Choosing to take no risks and make minimal commitment to an overall training strategy for the Computer Systems, the Senior Manager of the group played it safe and gave the educational technologist a mandate to develop these two user guides geared to the department's management. With this general direction, but no system goals, no budget and no demands for accountability, the educational technologist began the process of designing instructional text.

Chapter 2: The Instructional Design Process

Chapter 2: The Instructional Design Process

2.1 Designing Instructional Text

Though chosen as the solution alternative for the wrong reasons, the project was justified and eventually provided a valuable jumping off point in the development of other instructional materials. Beyond the general mandate "to produce user guides for management", the educational technologist was given no direction and no restrictions save that a prototype guide for each of the two systems was to be ready for approval and testing in two months and that the production work must be done in-house by company's reproduction service. The design process used, the content and format of the text was left to the discretion of the educational technologist.

To design the instructional text, the technologist consulted various models of instructional design (Dick & Carey, 1978; Gammuto, 1980).

The Dick and Carey model for the systematic design of instruction was chosen as the basis for development of the text because of its simplicity and flexibility and because it was the model with which the educational technologist was most familiar. An adapted version of this model would be used in the design of the user guides (see Figure 5).

Following Dick and Carey's model, the first step in designing instruction is to identify the instructional

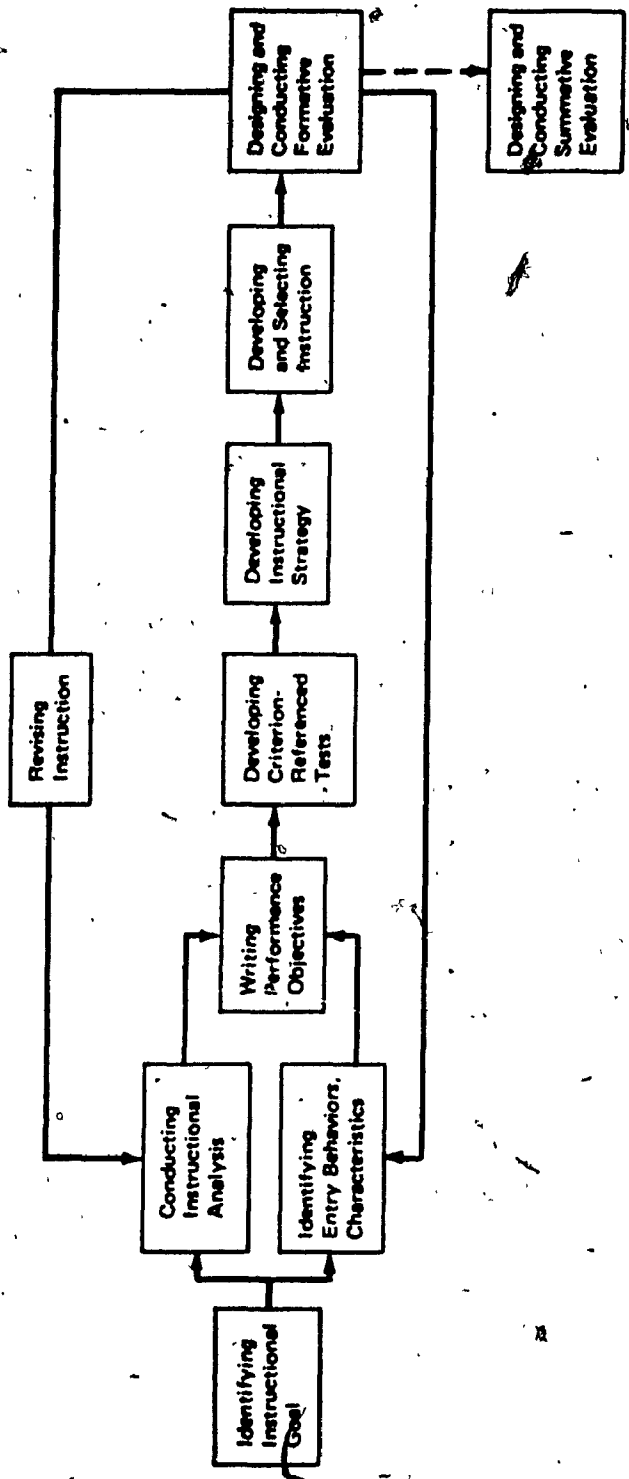


Figure 5: Dick & Carey's model for the Systematic Design Instruction

Note : From the Systematic Design of Instruction by W. Dick and L. Carey, 1978, Glenview, Illinois: Scott, Foresman and Co. Copyright 1978 by Scott, Foresman and Co. Reprinted.

goal. In this situation the instructional goal had been identified through the earlier needs assessment and was clarified during the solution selection phase. With the planned new guides, the department's management was to be able to find out what kind of information was available from the Computer Systems and easily access the information which would be valuable in managing resources. In short, each booklet was to provide a stand-alone guide to specialized use of a particular management information system.

To achieve the broad instructional goal, "effective use of a Computer System", a thorough instructional analysis was the next step. The extensive task had to be broken down into a sequence of logical steps. First an advance organizer would be built into the guide, giving the user an overview of what would be covered within (Jonassen, 1982). Next the essential idiosyncratic terminology used within a particular Computer System and that common to all the department's Computer Systems would be defined. Thirdly, for the novice user, the basics about the department's standard computer terminal, its keyboard, key functions and programmed keys would be explained. Then, in the more comprehensive procedures section of the booklet, the types of information available would be listed and the user would be guided step-by-step through relevant "hands on" examples showing what the System could do and how to access the required information on the terminal

screen and/or in report form. Finally, each guide would also contain a section listing all the codes necessary for using that Computer System.

Conducting the instructional analysis was one of the most time-consuming and difficult steps of the instructional design process. The scope of each Computer System and the procedural steps required to use it had to be thoroughly understood before any logical breakdown into subordinate skills could be accomplished. The educational technologist, in essence had to become a subject matter expert. Relying heavily on the old procedure manuals, each Computer System was researched, studied and tested, until a logical sequence of skills and steps required for effective use, emerged.

With the instructional analysis completed it was apparent that it would be impossible to completely explain all the ways in which a Computer System could be used, without writing volumes. The purpose of developing these new guides was not to rewrite the old procedure manuals, rather the guides were intended to condense the awkward procedures into a concise and useable format with which the department's management would make selective use of the Computer Systems. To accomplish this purpose it was decided that content would be determined by the interests of the intended user group. From the extensive information available from a System, only that of interest to particular homogenous group would be selected and described.

within a guide. The explanations of what the System could do and standard procedures for accessing information would be explained through the use of a few relevant examples. The guides would not overwhelm the user with detail as the old procedure manuals had done, instead they would be tailored to the informational requirements of a homogeneous functional group within the department and the applications selected for explanation within the guide would be directly related to these users' jobs. Future plans would include the development of interest-specific guides for other homogeneous functional groups within the department.

For these prototypes guides, the user group chosen as the target had been identified as one with high priority needs in the earlier needs assessment and rough cost/benefit analyses. This group's position within the department was pivotal. Members of the largest and most influential of the major functional group in the department, the Track and Roadway section, these engineers were typically poised on the bottom rung of the senior management ladder..

Located across the country, each of the approximately 30 Track and Roadway engineers is directly responsible for the maintenance and operation of fixed territories of plant and, collectively, the group has direct authority regarding the work and work habits of the major portion of the department's employees. In addition, at that time within the department, turnover and retirements had created an abun-

dance of these young ambitious engineers and the competition was tough. Engineers attaining the position of Track and Roadway engineer or the comparable but more junior position of Maintenance Engineer are considered some of the most upwardly mobile within the department.

Known as T & R engineers, they appeared to be ideal first group for which user guides would be developed because of their critical position and their ability to influence use of the Computer Systems by people both above and below their level. If the T & R engineers could be successfully trained and 'sold' on the Computer Systems, everyone stood to benefit. The Computer Systems group would gain powerful allies and much needed feedback, along with increased publicity, status and credibility. On the other side, the T & R engineers would gain a valuable management tool along with a progressive image in a competitive market.

These characteristics also made this group ideal for the development of a comprehensive training package. However, because of their potential influence, the Senior Manager-Planning was not willing to risk a possible failure without further backing. At this point, the entry behaviours and characteristics of this group were to be studied solely for the purpose of developing concise and relevant user guides.

Consequently, the time spent on this crucial research step in the design process was probably less than adequate.

Though the educational technologist was not permitted any travel expense in connection with the development of these guides, some information on the entry level and characteristics was obtained through interviews at headquarters. The technologist was able to discuss the project with two French-speaking T & R engineers, two supervisors who had worked closely with T & R engineers and with the five Regional representatives of the Computer Systems, who had some understanding of the needs of typical T & R engineers.

These interviews revealed that T & R engineers' group, though homogenous as to function, was definitely not homogenous with respect to their knowledge of the Computer Systems. The two T & R engineers interviewed did not know what kind of information was available from the Systems and therefore could not assist in selecting relevant examples. The two supervisors were enthusiastic about the project but also had insufficient knowledge of the Computer Systems to be selective. The Regional representatives were more helpful. They were aware that some of the T & R engineers were making requests for particular types of information through their clerical staff and were able to describe these apparent interests to the educational technologist. Though the information thus collected was minimal, it did indicate that there were widely varying levels of knowledge about the Computer Systems across the group and that, though some interest did exist, in general the level of knowledge was

quite low. These findings led to the conclusion that the guides should be as simple and easy-to-use as possible, stimulating interest with relevant applications without intimidating the user with too much detail. With this scant information and a job description for a T & R engineer, the education technologist began to develop examples which would eventually be evaluated for relevance, accuracy and difficulty before being included in the final version.

From the instructional analysis and the survey of entry characteristics, the objectives of the instructional text followed naturally. Using the text as a guide and/or reference, T & R engineers would find out what kinds of information were available from each Computer System, access relevant information by following the step by step instructions on a terminal, and finally, be able to access similar types of information on their own, using the guide as a reference.

The achievement of these objectives would be tested by having novice users utilize the guides and go through the examples, accessing the information required in the examples. They would then be evaluated on-the-job by being asked to do examples to access similar information, using the guide as a reference. Each guide would thus be used as its own assessment instrument. If new users could successfully do the examples and if the examples were found accurate and relevant by subject matter experts, the guides

would be produced and distributed to T & R engineers.

Having defined the objectives of the instructional text and decided on a method of testing their achievement, the next step in the instructional design process was to develop the instructional strategy. The scarcity of resources and of commitment to training as well as the ongoing changeability of the Computer Systems had dictated that the medium of instruction was to be text. The instructional analysis and the characteristics of the target audience had determined the sequence in which the instruction would be presented and the activities which would accomplish the objectives. Each booklet would consist of an overview of the System to serve as an advance organizer and motivator, three pre-instructional sections through which the user can become familiar with the Computer Systems terminology and the basic operation of a terminal, and finally, the instructional procedures section in which practice and feedback would be embedded.

Once the strategy had been established one of the last steps in the instructional design process was to actually develop and/or select the materials. Because the concept of replacing the cumbersome procedure manuals with small guides was new, the previously existing materials could be used only as references. The new booklets would require a new format and new content. The idea was to make the guides as different from the old manuals as possible while adhering to principles of sound textual design. Where the

old procedure manuals were massive in size, the new guides would be compact. Where the old procedure manuals were awkwardly indexed, the new guides would be self-indexed and self-explanatory. Where the old manuals had made no consistent use of white spaces or visual cues, in the new guides, spacing would have meaning. Using Hartley's book on designing instructional text as the primary reference and incorporating ideas found in other tests and procedure manuals, a workable new format was designed for the guides (Jonassen, 1982; Hartley, 1978).

The next major task was to organize the selected content into the newly devised format, have it reviewed, edited and produced in a presentable form at minimal cost in order that the total package could be evaluated for effectiveness. The writing and formatting was done by the educational technologist. The content was reviewed by two subject matter experts and revisions were made. For the test version, the books were to be typed in the appropriate format. The typist found the format difficult to follow but eventually the task, which, except for the cost, would better have been done by a typesetter, was complete. Then the tedious task of cutting, collating and binding the pages as required was done by the clerical staff of the Computer Systems group for this initial version, with help from the company's Reproduction Center. This labour-intensive first effort was very time consuming but the test versions of two guides were ready for formative

evaluation on schedule.

This first, homemade edition of both booklets was tested by three novice users who followed the instructions and performed the exercises with no difficulty. Minor errors were found as a result of this small group formative evaluation but no major changes in format or content were required. The guides were then given to the three managers of the Computer Systems group, namely, the manager of operations, the manager of planning and development and the Senior Manager of the group, for final approval before going into production.

At this point, the Senior Manager-Planning decided that his counterpart, the Senior Manager-Track and Roadway should also be given a chance to review the new guides before production seeing as they were intended for engineers working under his jurisdiction. At the subsequent meeting, a number of events occurred to change the course of instructional development.

2.2 Designing Instructional Package

2.2.1 Background

There is a training group within the department and their primary responsibility is to provide training on track maintenance procedures for foremen and first line supervisors. A second priority of this group is to provide

assistance in developing and producing training materials for other specialized groups or individuals within the department. The group consists of a manager, a training development officer, a coordinator, a graphic artist, an illustrator and a typist.

Because of budget cuts over the past few years, the traditional track training for foremen and first line supervisors, who number upwards of 2000 people in all, had been eliminated for the year. To say nothing of its effect on the plant, this decision had drastically reduced the work load of the department's training group and had left the regionally located facilities nearly idle. The Senior Manager-Track and Roadway was aware of this situation and, rather than lament it, decided to take advantage of this unexpected availability of resources.

It is the approximately 30 Track and Roadway engineers who report through the Regional Senior Managers and to the Senior Manager-Track and Roadway who are ultimately responsible for the maintenance of track on their territories. These men are expected to be thoroughly familiar with standard maintenance practices and cognizant of the latest advances in this field.

To assist them in achieving and maintaining a thorough knowledge of maintenance procedures they are issued the handbook known as the Standard Practice Circulars (SPC's) which details industry-wide track specifications and maintenance methods. Outside of this handbook, any

training on these topics was done regionally or locally. Though some thought it essential, no formal, scheduled training programme of this subject matter had existed.

Having the training group available to work on developing the materials, training facilities available, a relatively small number of prospective trainees and a perceived need, the Senior Manager-Track and Roadway was considering having a training programme on selected SPC's developed and given to the T & R engineers in late fall of the year. At approximately the same time, the results from a recent administration study began to be made public. The long range study asserted that productivity could be improved in the future if managers increased their span of control through use of computerized information systems. It predicted that the future held further computerization and, ultimately, reduced work forces and/or forces doing more with less. For managers at mid-level and higher, the ability to use the Computer Systems would be a valuable asset, eventually a necessity.

At spring meeting between the Senior Manager-Track and Roadway and the Senior Manager-Planning, the need for various types of training and the availability of resources to provide it was discussed. The discussion focused on the T & R engineers as the group to be trained because their need for knowledge of the Computer Systems had been recognized as a priority by both the Computer Systems in-house needs assessment and by the broader administration study.

The Senior Manager-Track and Roadway also felt that this group could benefit through expert and formalized training on the SPC's. The idea of combining the two topics, Computer Systems and track maintenance standards, in order to make the Computer Systems appear to be an acceptable part of a T & R engineer's sphere of knowledge, came from the Senior Manager-Track and Roadway and was enthusiastically supported by the Senior Manager-Planning who was eager to promote the Computer Systems once he had acquired influential backing.

At the same meeting, the new guides, just developed for T & R engineers, were presented for review and approval. This led to a discussion of who would participate in the design, development and delivery of the training package.

The Senior Manager-Track and Roadway volunteered his training group as to logical training development team. They would be available to develop the necessary materials with the close co-operation of subject matter experts. The training programme would be held at one of the department's available training centers in the late fall after the hectic summer major production period had ended. Because the T & R engineers are of senior management level and quite knowledgeable, the instructors for the track maintenance subjects were to be the highest authorities available on the chosen topics, three senior engineers reporting directly to this Senior Manager - T & R at headquarters.

Each of these subject matter experts would be responsible for the development and presentation of his own materials, with assistance and production work by the department's technical training group.

This having been proposed, the Senior Manager - Planning responded by offering the resources he had available. He decided that the educational technologist in the Computer Systems group could work closely with the department's training group to provide technical and subject matter expertise on the Computer Systems. In addition, liking the idea of tying the Computer Systems to the more traditional subject of track maintenance, the Planning chief suggested that a case study approach be used, in which the Computer Systems would be used to solve track related problems and/or to plan maintenance programs.

This meeting ended not only with the new guide books being approved for production, but with a commitment to an intensive training programme for the T & R engineers. The project was to be directed by a steering committee consisting of the two Senior Managers, the selected instructors and the manager of the department's training group. Details of scheduling and the precise subject matter to be included were to be confirmed at a later date.

Within the Computer Systems group, reaction to this new project was mixed. The educational technologist was enthusiastic about having the opportunity to participate in the development of the training package which had been

suggested as a first priority need by the earlier needs assessment. However, the lack of participation in goal negotiation was not agreeable. The Senior Manager's willingness to please, along with his confusion about the role of educational technology had led to the technologist being designated as the technical rather than the instructional development specialist. The managers of operations and of development, who had not been consulted before being volunteered as instructors, were also unhappy about having their roles arbitrarily expanded to include training.

Though everyone agreed that this training was desirable, the motives for its initiation and manner in which it had been forced upon the selected team without their participation made the plan appear unacceptable initially. Had the development team been asked to participate in the goal setting, more enthusiasm could have been mustered at the outset. The Computer Systems team did not respect the manner in which the Senior Manager - Planning had so eagerly committed scarce resources to this project simply to please a more influential party, especially when a similar plan, previously recommended as a result of an assessment performed by this team, had been ignored. Change is often resisted if imposed (EDP Analyzer, 1982), and until the team was given the opportunity to participate in the decision making process, they were not totally supportive of the project.

2.2 Designing the Instructional Package

2.2.2 Clarifying the Instructional Goal

Approximately one month passed in the heated discussion and informal goal negotiation between the Senior Manager on one hand, and the two managers with the educational technologist on the other. Both instructional content and approach were contentious topics. The Senior Manager wanted the training programme to follow his suggestion and employ a case study approach, combining the two subject areas in exercises in problem solving and decision making. Though this appeared to be an excellent means by which to tie computer use to actual job tasks, the educational technologist and managers argued that it was too ambitious a scheme for an initial computer course. The previous needs assessment had indicated that many in the target audience had little or no experience with the Computer Systems. The duration of the "course" had been fixed at the departmental "standard" of five days. To expect them to gain sufficient grasp of the types of information available, and learn how to access it, and then be able to apply this knowledge to solve job-related problems, all in the span of a week, was unrealistic.

Another problem in developing a comprehensive case study was that no expert could be found who had a thorough understanding of the scope and function of the Computer

Systems as well as the prerequisite knowledge of the detailed standards of plant maintenance. To develop a case study approach, a generalist who was able to explain and demonstrate how the two subjects are related, was essential. None existed and there was no time to develop the required subject matter expertise. Because of these limitations, the team argued that the instruction be geared to the identified entry level of the group and that only the basics be taught during this session, leaving the more demanding case study approach for a subsequent course.

Another problem receiving attention during this month of discussion concerned the role of the educational technologist in the instructional design and development. The Senior Manager - Planning, again trying to follow the wishes of his influential counterpart in Track and Roadway and not understanding the role of the educational technologist in the instructional development process, assumed that the Computer Systems sections of the course could be designed and developed by the departmental training group, with technical and subject matter expertise supplied by the technologist. This confusion with respect to the role of training specialists and educational technology in industry is not unique (Denova, 1971). Though the role is being more clearly defined as a more technologists enter the labour force, it will likely be some time before it becomes generally well-understood. The role and processes must be clarified if instruction is to be

produced efficiently.

In this case, the fuzzy definition of the role of the educational technologist caused time problems. The departmental training group had no knowledge or work experience with the Computer Systems and could not begin to gain the required expertise, and then design effective instruction within the time frame. Also, the educational technologist, having been with the team for only six months had acquired some experience with the Computer Systems and had established some rapport with the subject matter experts, but was certainly not a technical or subject expert herself. Consequently, trying to work within the Senior Manager - Planning's role assignments for the month, very little was accomplished.

After approximately one month of conflict, argument and negotiation on these issues, with very little being done in the way of instructional design, the Senior Manager-Planning appeared to lose interest in the project. Control of instructional design and development for the Computer Systems sections of the course was unofficially passed to the educational technologist and the two team managers. This team took responsibility for selecting the goals, objectives, content, instructional strategy, media, and evaluation procedures for the proposed training programme.

The departmental training group, grateful to have the responsibility for an unknown subject lifted from them,

agreed that the educational technologist was in a better position to design effective instruction for the Computer Systems. Though the manager of that group did want to maintain some measure of control through periodic progress reports, the task of designing the instruction and co-ordinating all production and development was given to the educational technologist in the Computer Systems group. The training group would provide the required illustrations, graphics and some production work for slides and overhead transparencies. The departmental training group co-ordinator would also handle most of the administrative details, arranging for a classroom, accomodations, meals, meetings, participant selection and communications for the entire course. The technical training group would also be responsible for developing or adapting materials to be used in the plant maintenance sections of the course. Finally, with the respective roles, responsibilities and goals clarified, the actual design process began.

Again, in designing the instruction for this training programme, the educational technologist chose to use Dick and Carey's model for the systematic design of instruction because its simplicity, its flexibility and its familiarity.

The first step in the process was to identify the instructional goal. Broadly speaking, the goal was "effective use of the Computer Systems by T & R engineers".

The breadth of this goal would be reduced to a workable size and more clearly defined as the subsequent steps in the design process were followed.

2.2 Designing the Instructional Package

2.2.3 Task Analysis, Instructional Analysis and Analysis of Learner Characteristics

The next step in process was to analyze the broad instructional goal, breaking it down into a logical sequence of subordinate skills which respected the group's entry level and characteristics. The depth to which the overall goal would be analysed depended on the skill level and characteristics of the intended audience. To effectively match the materials to the students without over or underestimating their abilities, an effort had to be made to identify the general characteristics of the target group and consider these during the instructional analysis.

The target group consisted of the 30 Track and Roadway engineers who manage territories across the country. Although, because of their common function, this group had been thought to be homogenous, it was found that about the only characteristics they had in common were their responsibilities and the fact that they were all professional engineers.

From the personnel department it was learned that

their ages ranged from 28 to 60 with a mean of 41. Some had just started in their position as T & R engineers while others had been on the same territory for 20 years. Records about previous training courses, seniority standing, career paths etc. were not available. Subjective reports revealed that some of these engineers were ambitious, eager to move ahead, while others were quite content in their present positions. It was also apparent that some were enthusiastic supporters of the Computer Systems and of computerization in general, having terminals or personal computers of their own. Others were still hoping that the computers would somehow disappear, and preferred to and generally ignore or avoid them. In some, it appeared that this negative attitude was often accompanied with the feeling that using computers was a clerical, not a managerial activity. Rather than regarding the Computer Systems as a management tool, this negative group associated computer terminals with the tedious and time-consuming task of inputting data and with the often punishing experience of data extraction. Dealing effectively with the extremes in age, attitude, motivation and level of computer literacy, as well as with the quieter majority between these poles, would be a severe challenge for one instructional package. The training programme would have to be directed to the "middle of the road" majority, but also be flexible enough to handle these who were very reluctant or very eager to acquire the new skills.

Keeping the heterogeneity of this target group in mind, the educational technologist, with the help of the two managers and some co-operation from other subject matter experts, began a preliminary task analysis. Concepts were analyzed first (Foshay, 1983). In order to be able to use the Computer Systems effectively, the participants would first have to recognize the types of information contained in each management information system, know the source of that information and how it is processed by the System. Then, with these prerequisite concepts clarified, the T & R engineers would have to learn to distinguish and extract the information that was of use to them. Finally, the psychomotor typing skills themselves might have to be learned. Members of this group would have to be able to use the terminal keyboard and read the terminal screen, supplying information as required to select and retrieve the desired informations. These general chunks were then broken down into sequence of skills to be mastered in order that the overall goal, "effective use of the Computer Systems", could be reached.

The fact that neither a thorough needs analysis nor a thorough assessment of audience characteristics had been possible began to influence the development of the instruction. In order to be successful, a change effort should encourage participation. When a group is not sufficiently involved, resistance is more common (EDP Analyzer, 1982). Advance work would have let people know that their needs

were being respected and that the training had been designed specifically for them. However, the Senior Manager took a rather defensive stance on research of this type. The educational technologist was told to assume that "we know more about what they need than they do, so that there is no need to consult with them". This defensive attitude forced many assumptions about the real and felt needs of the target group to be made (Coffing, 1977; Kaufman, 1979).

The limited information gathered on the characteristics on the audience suggested great variation in the levels of computer literacy and associated anxiety levels. Learners with no typing experience would definitely be at a disadvantage. If some felt threatened by the possibility that increasing automation may cause shifts in traditional functions, they would probably not be receptive until the benefits were explored (MacBeth, 1983). Fear of technology was also likely to be a factor to be controlled. Explanations of how the computer works and minimal use of buzz words without adequate reference were planned to help alleviate this potential problem (Ramsey, 1984). Advance measures of these factors and others would have helped in tailoring the instruction and grouping the classes more effectively. Such measures, however, were not permitted.

To circumvent the anticipated diversity in entry-level as much as possible, 'knowledge of basic key functions and use of the keyboard' were made prerequisite skills for the

course. Description of key functions and computer terms were provided as job-aids and a brief introductory presentation on 'how the computer works' was developed. Taking these equalizing measures was a rather simplistic means of handling the undefined heterogeneity of group needs and characteristics. Ideally, needs should have been more thoroughly analysed and trainee entry-level behaviors and characteristics should have been assessed. An analysis of work environment would also have been desirable at this stage. These analyses should have been followed by task analysis and instructional analysis (Hoffman & Medsker, 1983) before the writing objectives began. However, time constraints and management's aversion to preliminary research precluded these steps.

The next step in the design process involved writing the instructional objectives.

2.2 Designing the Instructional Package

2.2.4 Writing Objectives

With the instructional sequence established and the target group's characteristics defined as thoroughly as possible, the performance objectives of the course could be identified in full. This step was conducted by the educational technologist in preparation for the development of an instructional strategy, selection of media, and design of

appropriate evaluation procedures.

The terminal objective was: given a job-related problem statement, the T & R engineers would be able to use a computer terminal to locate and access the required information in any of the department's Computer Systems. For each of the subordinate skills needed to reach this final performance objective, a series of related objectives were drawn up.

In general for each of the Computer Systems, the following performance objectives were included:

Information Objectives

- following an initial information presentation the T & R engineers will gain a knowledge of:
 - the projected and perceived objectives, scope and benefits of that Computer System; for themselves, for the department, and for the company as a whole
 - how the Computer System works, including:
 - what kinds of information are available and which are likely to be relevant at the T & R level
 - how and why those data are collected
 - who supplies the data
 - role of the field forces, field offices, regional offices, headquarters and the computer in the gathering and storing of information
 - how data are processed by the Computer System
 - how the Computer Systems can be used, including:

- which options are relevant at the T & R level
- where and when information will be received:
 - on screen or as printed output
 - immediate access or length of delay
 - regionally or locally
 - etc.

Operating Objectives

- given the prerequisite knowledge of basic key functions and following instruction, demonstration and "hands-on" guided practice, the trainees will be able to:
 - operate a computer terminal to access the required Computer System, including:
 - power-on
 - sign-on
 - use appropriate keys to move the cursor, select data fields and provide data
 - use appropriate programmed keys to move within the Computer System(s)
 - distinguish between operating problems which are user-related, immediately solvable, and those which are equipment - or system-related and will require assistance to be rectified.
- find the required information in a Computer System given a work-related problem statement, including:
 - read the information in computer screen format, and determine which data are required to be input in

order to proceed

- select appropriate options
- use the job aids provided to find codes and other required data
- supply the required data and codes in the appropriate data fields
- use the appropriate programmed key to move forward or backward through the system
- read computer screen formats and output reports, selectively, in order to locate the information of interest.

For the course as a whole the goals were more global and included some attitudinal objectives as well as the informational and operating, as follows:

Informational Objectives

- following instruction, the T & R engineers will be able to:
 - distinguish amongst the Computer Systems to determine from which of them a particular type of information is available
 - discuss how and why the Computer Systems differ in structure, scope and content
 - recognize at which points in the reporting and processing of information, they may be able to exert direct influence to improve its accuracy and reliability
 - see how the Computer Systems do or could relate to one another

- discuss ways which the Computer Systems could help them in their jobs

Operating Objectives

- following instruction and guided "hands-on" practice, the trainee will be able to:
 - operate a computer terminal
 - use any of the Computer Systems to find specified information, choosing the appropriate Computer System, sub-system, options, data field etc., as required

Attitudinal Objectives

- following instruction, the T & R engineers will display a more positive attitude toward the Computer Systems, by demonstrating increased interest and acceptance of them as valuable management tools. This interest and acceptance will be demonstrated by:
 - participating in the exercises and discussions during the course
 - constructive criticism of the Computer Systems
 - questioning about the intricacies of system structure, scope, content and operation
 - suggestions for ways to improve the existing systems
 - suggestions for future development
 - expression of commitment to use their influence to encourage and/or demand that information reported to the Computer Systems from their territories be timely and accurate

- requests for computer terminals
- requests for individual help or further training

The informational, operating and attitudinal objectives were interrelated. The participants would use the information presented to more efficiently search for information using the computer terminals. Demystifying the process of information gathering and storage, then simplifying operation by tailoring the content to the group's needs and interest would, it was hoped, improve both effective use of the Computer Systems and attitudes toward them.

2.2 Designing the Instructional Package

2.2.5 Developing Tests

When the objective had been developed, they were reviewed with the two managers of the Computer Systems group and agreed upon. The Senior Manager - Computer Systems was no longer taking an active part in this project and was not consulted. With the objectives established, the work of developing evaluation instruments could begin.

At this point in the process of instructional design, with the educational technologist having grown accustomed to assistance and support from the two managers, it was unexpected that they would both resist the development and administration of objective tests as a part of the

evaluation process. At first, they vehemently opposed the idea saying that, as peers of the prospective trainees, they did not want to alienate potential allies by being seen as evaluators, even though this would simply be part of their new role as instructors. The educational technologist explained that the primary objective of this testing was to evaluate the effectiveness of the instruction in meeting its objectives, not, as they assumed, to evaluate the participants. After some discussion, the technologist's proposal for a system of pre-and post-course testing and attitudinal questionnaires was accepted, on the condition that the educational technologist take complete responsibility for its administration and carefully explain its purpose. This was agreed and the instruments were developed.

As the objectives indicate, this training programme was intended to enable participants to use the Computer Systems to obtain valuable information and thereby improve the quality and scope of their management abilities. A "holistic" approach to training was needed, making "...the object of attention the complete activity rather than an isolated piece" (Staruch, 1984). Consequently, the evaluation instrument which was developed to measure achievement of the operating objectives should not require straight recall of bits of information. Rather it should simulate performance of on-the-job tasks as much as possible. The educational technologist decided that an

"open-reference" test in which trainees were asked to use any one of the Computer Systems to find answers to realistic problems within a flexible time limit, was the best way to approximate on-the-job performance. The "holistic" evaluation would be individually corrected and feedback given as approximate so that the testing would become a learning experience as well as pointing out areas where instruction could be improved (Ainsworth, 1984).

The pre-and-post course tests consisted of similar set of problem statements which required use of the Computer Systems and some theoretical questions on the location of specific data in the Systems. Questions were drawn representatively from all the Computer Systems covered in the course. It was important that the test questions be relevant and provide useful information so that the value of the Systems would be reinforced. Though still unable to reach members of the actual target population, the educational technologist conducted interviews with six members of the headquarters staff whose experience matched that of a 'typical' T & R engineer. Based on this scant research, the pre-and post test questions were developed.

These evaluation instruments were tested by the two managers and the Senior Manager - Computer Systems who felt their scope and degree of difficulty effectively measured achievement of the operating objectives. The performance tests were accepted, subject to formative evaluation.

Because the group was expected to be very heteroge-

neous as, to entry-level, attitude and motivation, it was difficult to establish criteria which would provide a fair, overall measure of the effectiveness of the instruction. Optimistically, it was hoped that 80% of the trainees would obtain a score of 80% or more, but, this being the first course of its kind to be given, we could not be certain if this was a realistic expectation given the diversity of the group.

Other, subjective methods of evaluation were developed to evaluate the reaction to instruction, measure attitude to some extent and to solicit recommendations for improvement. These were two course evaluation or critique forms, one developed by the educational technologist and one used as a standard by the department's technical training group. Observation and informal interviews would also be used to evaluate whether or not the attitudinal and informational objectives had been achieved. All these instruments were reviewed and accepted by the development team, subject to formative evaluation.

Kirkpatrick, suggests that a good evaluation procedure should consider four outcomes of training, namely, reaction, learning, behavior and results (Kirkpatrick, 1975). Others suggest that attitude change should also be considered (Blumenfield, 1966; Schwind, 1976). In this project, only reaction, learning, and attitude were measured, and only immediately after the course. No provisions were made for measuring behavior change,

on-the-job or organizational results. It was simply assumed that training would be applied on the job and that it was "good" for the organization.

Because he was not directly responsible for their job performance, the Senior Manager - Computer Systems did not feel it was appropriate to evaluate the T & R engineers on-the-job. And the organizational benefits of using the Computer Systems were assumed at the outset.

The experimental design for evaluation was also less than adequate. A pre- and post-course and measure was to be taken, but there was no control group involved. Subjects were to serve as their own controls and the difference between the before and after measurement would be taken as the effect of training. However, with this design the effects of "contemporary events, maturation and the initial learning", could not be separated from those of training. This design should be used, then, only if there is good reason to believe that the "before" measurement will not affect the trainee's response to the training or the after-measurement and that there are not likely to be any other influence, besides training, that might affect the trainee's response at the time of the after measure" (Bass & Vaughan 1966).

Rather than taking these assumptions as truths, one or two control groups should have been included in the design. One control group could be given the tests but not the training. This design would—safeguard against attributing

effects to training that may be due to other influences" (Bass & Vaughan, 1966). This design, however, is only adequate when there is no interaction between the "before" measure or external events and training. If an interaction effect is likely, two control groups should be used. The "second control group receives training and 'after' measure but not 'before' measure" (Bass & Vaughan, 1966). With this type of rigorous experimental design, analysis of covariance could have been applied to determine the effectiveness of training itself (See Table 1).

The pre- and post-test design with no control group was chosen mainly for convenience sake. There was no truly representative control group available and there was no real reason to think that the pre-test would influence response to training, so this design was an acceptable compromise. Now the instructional strategy could be developed.

2.2 Designing the Instructional Package

2.2.6 Developing An Instructional Strategy and Selecting Media

Developing an instrumental strategy involves the exploration and assessment of alternative teaching methods, display methods and logistical configurations, then selecting the optimal, given the resources available (Wileman & Gambill, 1983). In this case, the constraints

Table 1
Some alternative designs for the evaluation of training programmes

	A AFTER-ONLY WITH ONE CONTROL GROUP		B BEFORE - AFTER WITH SINGLE GROUP		C BEFORE - AFTER WITH ONE CONTROL GROUP		D BEFORE - AFTER WITH TWO CONTROL GROUPS	
	Experimental Group	Control Group	Experimental Group	Control Group	Experimental Group	Control Group	Experimental Group	Control Group II
'Before' Measurement	No	No	Yes (X ₁)	Yes (Y ₁)	Yes (X ₁)	Yes (Y ₁)	Yes (Y ₁)	No $Z = \frac{X_1 + Y_1}{2}$
Training	Yes	No	Yes	No	Yes	No	Yes	Yes
'After' Measurement	Yes (X ₂)	Yes (Y ₂)	Yes (X ₂)	Yes (Y ₂)	Yes (X ₂)	Yes (Y ₂)	Yes (Y ₂)	Yes (Z ₂)
Change	$d = X_2 - Y_2$		$d = X_2 - X_1$		$d = X_2 - X_1$ $d = Y_2 - Y_1$		$d = X_2 - X_1$ $d = Y_2 - Y_1$ $d = Z_2 - Z_1$	$I = d - (d' + d'')$

Note: From Training in Industry by B.M. Bass and J.A. Vaughan, Table 8-1, Sample Training Designs. (Adapted from Research Methods in Social Relations, by Claire Sellitiz, Marie Jahoda, M. Deutsch, and S. W. Cook, copyright 1959, Holt, Reinehart and Winston Inc. Reprinted.)

inherent in the situation were great influence in the selection and development of the "optimal" instructional strategy.

The first constraint involved the absence of a subject matter expert with sufficient knowledge of both the Computer Systems and plant maintenance standards to relate these topics in a realistic problem-solving approach. The time and commitment necessary to develop such expertise was not available and, as a result, the interesting idea of incorporating a realistic case study into the course was dropped. However, an attempt would be made to relate use of the Computer Systems directly to the daily tasks of the target group in order to ensure relevance and interest (Kearsley, 1982), but the problems presented would have to be somewhat one dimensional instead of complex and inter-related. In addition, though the needs assessment had not been sufficiently thorough, it had shown that the average levels of knowledge and ability with respect to the Computer Systems amongst members of target group were low enough to preclude any advanced level use of the Systems. It appeared that they needed a course on the basics of computer operation and an overview of System content. But, the paucity of advance research also made it necessary that we build in enough flexibility to accommodate a wide range of ability.

Another variable which severely limited the choice of instructional strategy was time. The course had to be ready

to be given in the late fall, after the hectic summer work period and before budgets and forecasts for the next year were due to be compiled. Late fall was one of the few periods in which the target group of T & R engineers would be available to participate in the training. With only a few months to develop a complete course, and given the scarcity of qualified personnel, the choice of instructional strategy was further limited.

The availability of departmental and production facilities was another limiting factor in the selection and development of the instructional strategy. The only person assigned to the project full time was the educational technologist. As previously explained, subject matter experts on the Computer Systems were available only as time permitted and the production of instructional media was to be done through the department's technical training group who had few commitments at the time, but limited resources.

The training group's production staff consisted of one typist, an illustrator, and one graphics art specialist. Their forte was the production of slides and overhead projection materials and they contacted the company's visual communications department for the actual photographic work. Though the company's visual communications group is also equipped to produce audio and video materials, the training group had no experience with producing these materials and no contacts in these areas, so did not take advantage of these facilities.

A related constraint involved money. Neither the Computer Systems group nor the department itself had budgetted for the development of training on the Computer Systems. In fact, as previously mentioned, the 1983 budget for training had been cut drastically, forcing the cancellation of regular track training for the year. In keeping with this policy of general cut backs on money for training, costs for development of this package were to be kept to a minimum and, if possible, slipped into other accounts. The resources available within the company and the department were to be used to the maximum and as little work as possible was to be contracted outside.

Other factors influencing the selection of an instructional strategy were availability of personnel and instructor preference. The two managers of the Computer Systems group had been "volunteered" as instructors for this course. Though they had no formal training in instructional techniques, they were experienced in giving presentations and had the subject matter expertise necessary to adequately represent the Computer Systems group. Both these men were accustomed to giving presentation using slides and/or overhead projections and, understandably, preferred to use a familiar technique when playing the unfamiliar role of instructor.

A further constraint, that of space, also influenced the selection of an instructional strategy. The Computer Systems group had no control over the selection of the

training facility. Because their training centers were being underused in 1983, the responsibility for supplying the space and accommodations for this course was given to the department's Training group. They chose the place and time for the training, and the Computer Systems group worked around these guide lines.

The facility was chosen because it was available in the late fall as required. It was located in a major switching yard outside a relatively central city headquarters location. It had one small classroom in which, at most, nine or ten desks with computer terminals would fit. A small group format was not only desirable, it was now mandatory.

Finally, and most importantly, the goals, content, audience and objectives established in the first steps of the instructional design process contributed to the selection of the instructional strategy. Through the process, it had been discovered that this group needed instruction in three basic areas:

- 1) what kind of information is available from the Computer Systems;
- 2) of that information, which is relevant to them; and
- 3) how to access that relevant information and use it to more effectively manage their plant and resources.

Given the audience and objectives, the constraints of

time, money, space, qualified subject matter experts and production facilities, as well as instructors' preference, the 'optimal' instructional strategy was chosen.

It was decided that the 'optimal' strategy would be to present the information first. This would include an initial slide presentation showing what information is available from each Computer Systems and how it is recorded and stored. This expository presentation would be followed by 'hands-on' practice in accessing relevant information using a computer terminal. Questions posed would be answered using the terminal. This would lead into independent use of the Computer Systems to answer questions about the distribution of resources, plant condition, etc. A small group format would be used in lieu of individualized instruction, computer-assisted instruction or simulations due to restrictions of time and resources. Some research on the topic of computer training for management suggests that small group instruction with peers is more effective than individual sessions, as the interaction stimulates discussion, especially if problems are related to typical work situations (Kearsely, 1982). Individual help would be provided as needed throughout the course and individualized job aids would be distributed for reference and later on-the-job use. Large group instruction was not only impossible given classroom size, but also inappropriate since individualized assistance would be required to operate the computer terminals and access the requested infor-

ation.

The strategy of having first an informational presentation followed by interactive exercise on each Computer System, was based on the results of the needs assessment and on learning theory. The informational presentation would describe the information available from a Computer System. By describing sequentially what and how information was reported, processed and stored by the computer, the initial presentation would provide essential information on how the System works, and as well would serve as an advance organizer. Slides were chosen as the medium of presentation on the basis of time and production facility constraints and respecting instructors' preference.

The production of taped audio cassettes to accompany the slides was considered but, as this point, it was felt that having instructors do live commentary would personalize these presentations and allow for both greater flexibility and control.

As the cursory assessment of audience characteristics has indicated, there would be some learners for whom the hardware, software, concepts, terms and technology associated with computers may cause 'information overload'. These trainees would feel insecure and vulnerable. Their learning curve would progress at a slower than normal rate (MacBeth, 1983). To combat the security problems associated with initial computer training, a non-judgemental climate of openness was essential. To resolve fears, lectures or

authoritarian presentations alone would not work. Interaction between instructors and trainees would be encouraged. By directly addressing the needs of trainees and showing enthusiasm throughout the sessions, the trust and confidence necessary would be built up.

Also, with novice users, ongoing guidance and 'hands-on' practice would be required if the training was to be effective. Beginners could run into problems which had not been anticipated and might become so unmeshed in detail that objectives could not be met. A proper ratio of instructors to trainees would ensure that the varying needs of the participants were met. A ratio of one to five was to be maintained during the 'hands-on' sessions of this course. Ongoing reinforcement would be used to counteract any insecurity and confusion. As interactive CAI was not a possibility, instructors were to provide feedback selectively as needed. The 'hands-on' practice sessions were developed to personalize the instruction and provide experience.

For each System, the interactive 'hands-on' instruction would be given following the information presentation. Work-related examples were developed to be presented by the instructors. The trainees would follow on their individual computer terminals. For these exercises it would have been preferable to use the type of video-projector which enlarges and projects screen images directly from the terminal but this equipment was not available. As an

alternative, copies of screen images were projected using overhead transparencies.

Examples for the interactive practice sessions were developed to be relevant to this particular target group. Through consultations with representatives similar to the intended audience, the massive amount of information available from the Computer Systems was filtered, and examples were tailored to their interests and needs.

For each Computer System, the ratio of 'information presentation' portion of the lesson to 'hands-on' guided practice portion was approximately one to four. Depending on the size of the Computer System and its relevances to this group, lessons would range in total duration from ninety minutes to five hours.

Introductory and summary presentations were also developed. The introduction was intended to explain the role and function of Computer Systems group within the department, explain this training course to the target group and outline course organization, content and procedures. The introduction would also include a brief informal overview of computer terminal operation even though these skills had been designated as prerequisite for the course. The pre-course test would also be given as part of the introduction. The summary presentation for the end of the course would give a brief review of the Computer Systems covered, discuss the future plans at Computer Systems and encourage continued communication.

The overall strategy was designed with cognitive and affective objectives in mind, since the goal of the course was not only to teach T & R engineers how to effectively use the Computer Systems, but also to win their support. Given the previously mentioned constraints, this strategy of information presentation followed by guided participatory practice appeared to be optimum.

2.2 Designing the Instructional Package

2.2.7 Developing Instructional Materials

Having established the instructional plan, the next step in the process of instructional design was the development of the informational and instructional materials. The materials to be used to fulfill the instructional plan were to be researched, structured, sequenced, designed and produced to meet course objectives while keeping within the imposed limits of time and money.

Because of the lead-time needed for slide production by the department's training group, the design of the informational slide presentations became a priority. The first step taken was the development of a critical path which established the critical dates by which materials had to be produced if deadlines were to be met. To develop this schedule, estimates of presentation length were made by the two managers involved, with the help of the educa-

tional technologist. These estimates allowed the department's training production group to set their critical dates for slide production. As less lead-time was needed for the production of over head transparencies, and as their production involved different individuals, the critical dates for submitting those designs fell later on the critical path. These time constraints determined that the initial concentration for the development of instructional materials would focus on the informational slide presentations for the Computer Systems.

Design of the slide presentations began with the educational technologist consulting with subject matter experts. From the extensive background information thus gathered, a content outline for each slide presentation was extracted, in keeping with the established objectives. The next step was to sequence this information logically in order to explain what, how, when and why data are reported to that particular Computer System.

A standard format for structuring the content was established by the educational technologist in consultation with the two manager/instructors. The content compiled for each Computer System would be formatted into, first, an introduction giving the objectives, scope and benefits of the Computer System. Next an explanation of how the Computer System works was developed. It followed the flow of data through the System by describing a series of roles. Finally the presentation would explain briefly how the

System is used. This led into the 'hands-on' practice section of the lesson where examples would be done to show how to use the Computer System.

This standard format was developed in an attempt to provide standardization and a common link between what are really very dissimilar Computer Systems. This format design was intended to explain the unique scope, sources, processing and potential uses of the data in each System in a simple and concise manner, while at the same time, providing a unified picture of the Computer Systems by using common format and method of presentation.

After the information content had been selected and sequenced logically, the complete storyboard and script for the slide presentation were developed by the educational technologist. Each began with an introduction which served both as an advance organizer and a sales pitch. The body of the presentation was sequenced procedurally to illustrate who and what was involved as information flows through the Computer System. Finally, the function of the System was reviewed and uses suggested.

Trainee participation was encouraged throughout the presentation through the use of live commentary, embedded questions and occasional hand-out materials. Immediately following each presentation, a question period was scheduled, followed by a break. Then the guided practice sessions for that Computer System would begin.

For each System the storyboard, proposed visual design

and the script were reviewed by the two manager/instructors with the educational technologist and revised if necessary before being discussed with the graphics artist and illustrator in the department's training group. For the introductory portions, slides showing actual maintenance and/or computer related work were researched and selected for authenticity. The developmental stages showing the flow of information and the various roles were to be illustrated with caricatures. Colour was used as a cue throughout to highlight important points and designate roles (Griffin, 1983; Kemp, 1969).

Scripts were written in point form at the request of the instructors. They wanted the opportunity to personalize and adjust their commentary in response to the audience. The narration was intended to supplement the visual by directing attention and describing its content in more detail. The important points to stress for each slide were provided in point form for the instructors, leaving them room to expand as they desired. More detailed descriptions of System operation, drawn from previous interviews with subject matter experts, were made into hand-out materials to accompany each presentation. These could be used by the instructors and students for additional reference.

When the storyboard and script for a particular Computer System had been reviewed and approved by the subject matter experts and instructors, the proposed

designs for the slides were taken to the department's training group and discussed with the illustrator and graphics specialist. Then production work began.

When slide production was complete, review and editing was done by the educational technologist in conjunction with the graphics artist. Because of the thorough preparation and the high quantity of slides produced, minimal revision was needed. Except for a few minor flaws, the pictures and captions met specifications and contributed to course objectives. With the slides and scripts complete, the informational sections of the lessons were ready to be evaluated.

Preparation of the interactive practice sections of the lessons required a similar overall process, but less lead time was required for the production of the instructional materials, consequently these 'hands-on' exercises were developed after the slides had gone into production.

The first step in the development of the practice exercises was to select examples which would interest this audience. Out of the vast amounts and types of information available from the Computer Systems only some is relevant to T & R engineers. The major objective of the course was to enable these engineers to use the Computer Systems effectively. Effective use implies that the engineers be able to select information from the Systems which will help them solve their problems and manage their resources more efficiently. Effective use does not imply that these

engineers be able to access massive amounts of irrelevant data. That would constitute a waste of time and energy, both theirs and the computer's.

To help this target group to use the Computer Systems selectively and effectively, it was decided that brief exposure would be given to the total content of the Computer Systems but emphasis would be placed on extracting data which was of specific interest to T & R engineers. To find these examples the educational technologist consulted with former T & R engineers and aspiring T & R engineers, and with the regional and headquarters Computer Systems representatives who generally supply information when requested by users. In addition, two T & R engineers from the closest region were interviewed. From these discussion it was confirmed that most members of the target group had little idea of what kind of information was available from the Computer Systems and therefore had greatly difficulty in being selective.

The educational technologist was not permitted any further consultations with the target group, through this was requested. Based on scant user needs assessment but with continuing co-operation from the Computer Systems development and operations staff at headquarters, and relying on the information gathered for the development of the guide books, the examples and exercises began to be formulated. Examples were researched, proposed, tested and evaluated for relevance before being selected. For each

System and subsystem the plan was to guide the trainees through a few examples using overhead transparencies of the relevant screen images, the trainees following on their terminals. Then the students would do similar examples with less guidance, and finally they would attempt similar exercises on their own with minimal help. Many examples were developed for each System and subsystem with emphasis on those areas which were known to be a particular interest to this group. These exercises were personalized as much as possible by making direct reference to familiar territory titles, positions, maintenance activities etc. Examples were taken from all of the five regions so that in a mixed class every trainee would be able to recognize familiar locations, activities, programs, projects, etc.

The instructional materials required for these guided hands-on exercises included 1) overhead transparencies to describe the types of information available from a Computer System or subsystem and to describe any procedural rules for accessing that information; 2) overhead transparencies of the relevant input and output screens required for any guided example; 3) exercises for guided practice; 4) printed output samples as requested in exercises; 5) individual exercises.

The overhead transparencies were designed by the educational technologist and given to the department's training group for production. All other instructional materials were also designed by the educational technolo-

gist but typed and reproduced by the Computer Systems group. No permanent clerical staff was assigned to the project and consequently clerical work was distributed when and if resources were available. Much had to be done by the educational technologist.

As these instructional materials were being developed and produced, the original two enquiry guides developed by the educational technologist were also being tested and printed. Both guides were reviewed by two subject matter experts and two novice Computer System users before going to print. Because of the embedded indexing system used for these guides, the cutting, printing and binding procedures was quite complex. Estimates for printing from outside the company were much higher than those quoted in-house, and the cost of having these guides typeset was prohibitive, especially on a non-existent budget. As a result of these financial considerations, the job of printing the two guides was given to the company's Reproduction Center and the books were not typeset, they were simply typed. The Reproduction center was given sufficient lead time to have these two guides ready to be used as instructional materials for the T & R engineers' course.

The course would cover four Computer Systems, and though informational presentations and 'hands-on' exercises had been developed for all four major Computer Systems, only two new, up-to-date enquiry guides had been developed. They covered the two older Computer Systems. For the other

two major systems, the available guides covered both information extraction, in which we were interested, and data input, which would not be a part of this course. They were both sadly out of date.

One of these guides related to the system most frequently used and of most interest to T & R engineers. The other guide related to the newest and smallest of the Computer Systems which was still rapidly changing. Because of time limitations only one of these guides could be updated. It was decided that concentration would focus on updating and reproducing only the more relevant guide in time for the course.

The final step in the development of the instructional materials was the preparation of an instructor's guide or manual. With development time quickly running down, this step probably received inadequate attention. The manuals did include statements of objectives, the scripts and copies of the information presentation for each Computer System, the content needed to perform the guided and individualized exercises and follow up questions and problems. However, the manuals lacked information describing all materials and equipment needed for the lessons, omitted a complete description of the intended audience and failed to identify when and if handout materials were to be distributed.

Because there were many materials to be distributed, including outlines and detailed description of each presen-

tation, the 'how-to-do-it' job-aids, and printed output samples for the exercises, the instructor's manual should have included complete directions as to when to hand out and explain these. They did not. Fortunately, with the two instructors having participated on instructional development from the beginning and with the educational technologist scheduled to be present to assist during the course, these omissions failed to have any noticeable ill-effect during the actual instruction.

Because of constraints in time, money and other resources, the development of instructional materials followed a rather backward process. Instead of basing the selection of strategy on the objectives alone, the available facilities, resources and preferences had also to be considered. Compromises had to be made to meet short term goals.

2.2 Designing the Instructional Package

2.2.8 Formative Evaluation

All the instructional materials, including hand-outs, manuals, binders, etc., were designed, developed and produced on a tight schedule and budget and were ready in time for the planned formative evaluation, which took place two weeks before the actual course was to begin. The scheduling of this formative, small-group evaluation would

obviously leave little time for revisions to course materials before the formal sessions began, but due to prior commitments and responsibilities on the part of instructors and the target group, this was the only time available for testing the materials.

In fact, all the administrative work regarding course scheduling, accommodation, transportation, correspondence, pre-course reading, etc., had already been arranged by the department's training group while instructional materials were being developed for both the Computer System and maintenance sections of the programme. Contrary to accepted standards, it was assumed that the course would go ahead as planned regardless of the outcome of this formative evaluation session.

Instead of being a true developmental test of the materials, the formative evaluation was regarded as a trial run of the course, following which, only minor adjustments to the materials could be made. The trial run was intended to indicate where problems might arise, familiarize instructors with the instructional format and materials, help determine appropriate pacing, establish an appropriate number of examples and generally test the preparedness, completeness and effectiveness of the materials. Based on the participant's subjective and objective evaluations it was hoped that the materials could be fine-tuned in time to increase their effectiveness in achieving course objectives.

Because it was thought to be economically frivolous to transport trial run participants to the actual training site, and because the computer equipment had not yet been installed at that location, the formative evaluation session was planned to take place in a headquarters' boardroom where a sufficient number of computer terminals were available and could be temporarily installed. As some of the instructors had prior commitments and could therefore not be present at the same time, and because the conference room and computer terminals were only available temporarily, the trial run of the course had to be given in two separate sections; three days for training on the Computer Systems followed by two days of maintenance training.

The participants for this trial run were chosen by the department's training group from amongst the engineers working in the Track and Roadway department at headquarters. The six trainees were selected to be as similar to the target audience of T & R engineers as possible, and it was fortunate that most of those selected had either held this position in the recent past or had worked directly for a T & R engineer. With the materials prepared, the hardware installed and the participants selected, the formative evaluation session was conducted.

During this trial run participants were encouraged to comment on the format and content of the instructional materials, to give the instructors and designer feedback so

that some adjustments could be made if necessary.

The evaluation group was, on the whole a relatively young group of engineers, and throughout the course it seemed they were more open and willing to make comments and suggestions to the three-person Computer Systems instructional team, to whom they did not directly report, than to the maintenance instructors who were generally more closely linked in the chain of command. The subjective evaluations, observations, and informal interviews indicated that the Computer Systems sections of the programme were found to be interesting, well-prepared and informative. The objective evaluation provided by the pre- and post-course tests showed the course to be highly successful in achieving its objectives, with test scores going from a pre-course average of 35% to a post-course average of 85%.

The trial run was also to provide the summative evaluation of the recently developed enquiry guides. If this group found them useful, they would be distributed throughout the other courses. The innovative new format and structure were well-received and the content pronounced as valuable by the participants. Based on this positive assessment it was decided that the new enquiry guides would serve their intended purpose as reference tools and would therefore be distributed in the actual training session for T & R engineers.

Suggestions for improvement focused primarily on

logistical and environmental considerations. They included a request that a binder be provided in which course materials could be organized for later on-the-job reference and a plea for faster response time on the computer terminals. The former could be provided but, having no control of Computer System processing, nothing could be done about the sometimes slow computer response time. One participant felt that, though the information was valuable and well-presented, too much had been attempted in too little time. He wanted more time for practice. The five other participants felt that the pace was good and that this course provided an excellent general overview of the Computer Systems. They suggested that, in the future, more intensive training be given on specific topics of interest.

Overall, the Computer Systems course was well-accepted and well-liked and was thought to be a good introduction to the types of information available and how to access them. The participants in this trial run were encouraged to continue to communicate with the Computer Systems group if they had further needs, feedback or suggestions. Most of them maintained regular contact with group, which suggests that the course was also successful in achieving its objective of projecting an open and approachable image for the Computer Systems. At the end of the trial run, instructors and participants agreed that the course had achieved its overall objectives.

Though this formative evaluation session had been given to a smaller group (six rather than nine trainees), at a different location (a central office building rather than a remote yard facility, with a different schedule (training from 08:00 - 17:00 hr. with the participants going home a night rather than twelve hour days and accommodations provided at the training center), and this group was, on average younger than the typical T & R engineer, the outcome had to be considered relatively representative of that which would result from the actual training sessions.

Based on the suggestions and comments of this group, minor adjustments were made to the materials. In one section more examples were developed, in another, some exercises were cut, the pace of instruction would be adjusted slightly to suit the audience, and organizing binders would be provided for the handout materials. With these adaptations completed over the two weeks provided for revision, the formal training was about to begin.

2.2 Designing the Instructional Package

2.2.9 Administrative, Logistical and Environment Considerations

The training facility selected for the course was in a major switching yard on the outskirts of a large regional

headquarters city. This Training Center consisted of one classroom, two recreation rooms, a kitchen/cafeteria and ten bedrooms. With the yard and workshops nearby, it was usually used to train labourers or supervisors in standard maintenance procedures. It had never before been used by management nor for computer-related training.

Ten computer terminals, a controller, modem and printer were temporarily installed in the classroom using a temporary circuit and cable, and were briefly tested two weeks prior to the beginning of the formal training sessions. The classroom was quite crowded with all this equipment, but could quite comfortably accommodate the anticipated nine-person class and the up to three-person instructional team.

Three groups of nine Track and Roadway engineers were to attend the four day course over three consecutive weeks. Trainees were to arrive on the Sunday for an opening dinner and would leave on the next Thursday afternoon. The idea of having an opening dinner to begin the course came from the Maintenance group who felt that it would provide an opportunity for the T & R engineers, many of whom had never met, to get to know one another and would also help establish the tone for the sessions.

The Senior Manager for Track and Roadway was aware, as were the Computer Systems representatives, that some resistance to computers and computerization existed on the part

of some of the old school Track and Roadway people. To help overcome any possible negativism, it was agreed that a guest speaker be invited to these opening ceremonies, to speak about the importance of both proper plant maintenance and computerization to the future of the company. The speaker was supposed to influence the attitude of the audience by stressing the point that both topics were vital to them. Chosen to make the opening statements were the head of the department, a Senior Manager from the eastern region and one from the west. With their introductory speeches they were to emphasize the innovative nature of this co-operative effort, stress the importance of both the Computer Systems and correct maintenance standards, create a positive and supportive atmosphere and motivate the participating Tract and Roadway engineers to make the most of this learning opportunity.

On the whole, they were quite successful in showing that this training and the Computere Systems in general had the support and blessing of top management across the country, although their actual effect on attitude was difficult to measure. With the tone thus established, real training began.

Chapter 3: The Instruction.

Chapter 3: The Instruction

3.1 Instructional Delivery

The Computer Systems section of the programme began on the first afternoon of the course with a brief introduction explaining how the group fits into the department, and what functions it performs. Next was explained the structure and sequencing of the Computer Systems course and an outline was presented.

The only pre-course instruction given to the participants had been to familiarize themselves with basic computer terminal operating procedures such as how to power it on and off and the functions of the various keys. Because the participants had varying levels of entry knowledge, some time was taken during the introduction to informally review the basics of computer terminal operations. Following this brief review, the pre-post-course testing system was introduced. It was explained that the purpose of the pre-course test was to measure the entry level of participants so as to later be able to compare it to a post-course test score in order to measure the gain and therefore the effectiveness of instruction. It was made clear that the materials, not the trainees themselves, were being tested, and that results would be kept confidential. After giving out the required job aides and explaining their usage, the test was distributed and taken.

Though there was some reluctance on the part of a few participants, peer pressure played an important motivating role at this point and eventually all of the trainees attempted to answer the questions. When the time allotted for the test had expired, the introductory session continued with an optional demonstration session in which interested group members were shown what the Computer System group was planning for the future with mini- and micro-computers. Though this section of the course was included purely for their information, everyone attended, some showing more enthusiasm and interest than others.

These introductory sessions made it apparent that there would be at least two major and recurring problems throughout the courses which could not be controlled. The first problem was a result of the failure to conduct a complete needs assessment and adequately determine the entry-level knowledge of the participants. The pre-course test showed that the audience had a very wide variance in entry level knowledge. Over the three sessions, pre-course scores ranged from 6 to 78 out of a possible 100 points. If the training were focused on those learners with weaker backgrounds, there was a risk of boring the more knowledgeable, but if the programme went too fast in an effort to have maximum impact on the advanced students the student at the more basic level might become lost. The pace would have to be adjusted. There was a need for flexibility and as much individualized help as possible to overcome this

wide variance. The composition of classes could not be controlled. Originally the maintenance people involved in course development, had attempted to group the three classes as to levels of knowledge with respect to maintenance practices but even this attempt had been unintentionally undermined as participants switched time slots to accommodate prior commitments. The result of this lack of selection control was three very heterogeneous classes with respect to entry-level skill and knowledge of the Computer Systems.

The other major uncontrolled variable which would continue to influence the effectiveness of the instruction was the location of the Training Center and its effect on the reliability of electronic signal transmission. Located in a major switching yard between two radio towers, using temporarily installed circuits and cables, an inordinate amount of computer down time and generally very slow responses were experienced. Though maximum co-operation was received from the control center at headquarters, the almost continual breakdowns in communications were more than a little frustrating for both trainees and instructors. These communications problems could and should have been anticipated and corrected, or another, more suitable location found, but were not, because site selection had been handled by the administrative, not the Computer Systems group. The technical problems had to be tolerated throughout the three sessions.

Training on the Computer Systems began in earnest on the second day of the course, the first day being taken up with maintenance topics and the Computer Systems introduction. The sessions began with one Computer System which was known to be of most interest to this audience. This system, being one of the most recently developed, is also one of the most 'user friendly'. It was felt that the training should begin with the most relevant and easy-to-use Computer System to acclimatize the more unfamiliar trainees and, it was hoped, whet their appetite for more.

This scheduling arrangement had the desired effect and, by the end of the second day, the participants were showing real interest. On the third day, training on the other Computer Systems continued from eight in the morning until nine at night. This was always a long, tiring day for all concerned, especially when the circuits were unreliable. The schedule had been arranged in this way to accommodate the instructors on the maintenance sections of the course who wanted to complete their topics in the first two days and leave to fulfill other commitments. The fourth day was somewhat less demanding. The only one small Computer System was covered and the others were reviewed with individualized exercises and assignments. The course ended on the afternoon of the fourth day with the post-course test and summary presentation reviewing what had been covered and explaining the future plans for the

Computer Systems.

To cover every Computer System, the same instructional format was used. First, using the informational slide presentations, the objectives were explained. Then the scope and benefits of the Computer System, how the system works and finally how the System could be used, were explained. Following the information presentations, using first guided, then individualized exercises, the trainees were shown the types of information available from the Computer System which could be useful to them. They also learned how to access similar types of information on their own. There was usually one instructor leading the class and two others providing individualized assistance to the learners at their terminals. To compensate for the wide variance in entry-levels and rates of learning, the slower learners were given as much one-to-one help as possible and the more advanced were kept interested through more indepth information and discussion with the leading instructor and other class members. Students were treated as individuals and given as little or much help as they requested or appeared to require.

The course of approximately 40 hours' duration combined the approximately 15 hours of general maintenance topics and about 25 hours on the Computer Systems.

3.2 Evaluation

Measuring the effectiveness of training is very important. In a true system of measurement, evaluation should take place during development, during the training itself, at the end of the instruction and at intervals following program completion.

The data collected are used to assess whether the objectives have been met and to identify strengths and weaknesses of the instruction, the personnel, facilities and equipment.

One widely used concept of evaluation is Kirkpatrick's (1975, 1959) four category model:

- 1) Reaction : participants impression of how well they liked the program
- 2) Learning : the extent to which the training content was assimilated
- 3) Behaviour: change in job behavior
- 4) Results : change in organizational variables:
e.g. costs, productivity, turnover,
etc.

This model was extended by Schwind (1975) who added attitude as a category. Schwind's five categories for evaluation are: 1) reaction, 2) knowledge, 3) attitudes, 4) behaviour, and 5) organizational results.

Ideally, evaluation should also include some analysis of cost and benefit. Objectives should be met with a reasonable return on investment.

For this training program a complete evaluation system

was not used. Reaction, knowledge and attitude were measured, but changes in job behaviour and organizational variables were not. Although effecting these changes was a major objective of the programme, management was reluctant to take the steps necessary to measure them. These changes are difficult to measure, new complex instruments would have to be developed and co-operation from many organizational members would be required. Management was not prepared to commit the time or money needed, especially when the training programme itself did not have a solid foundation.

The effectiveness of the Computer Systems sections of the course was evaluated by only two means. Subjective evaluation of reaction were performed using two types of course evaluation forms and through informal interviews. These subjective evaluations of the course content and format yielded positive results, with participants indicating that they both enjoyed the course and learned from it. Some valuable suggestions for improvements and follow-up were articulated.

The objective evaluations of knowledge gain showed a significant increase in the specific knowledge tested, with scores improving from a pre-course average of 46% to a post-course average of 80% (see Table 2).

Comments made by the trainees confirmed that the course had been found very valuable. Using statements such

Table 2
 Course 1, Pre-and Post-test Scores, % of Potential Increase Acheived, and
 Ages of Participants

	A Pre-test	B Post-test	C Point Gain	C % of Potential Increase Acheived	D Age
1	28	73	45	60	39
2	52	64	12	25	41
3	72	92	20	71	53
4	16	45	29	34	60
5	76	100	24	100	36
6	24	95	71	93	37
7	52	68	16	33	42
8	28	90	62	86	43
9	26	55	29	39	58
10	48	80	32	61	39
11	52	70	18	38	43
12	76	100	24	100	31
13	72	100	28	100	39
14	38	82	34	65	56
15	14	44	30	51	54
16	68	92	24	75	36
17	16	52	36	43	46
18	66	98	32	94	29
19	78	98	20	91	35
20	16	48	32	38	41
21	56	88	32	72	35
22	50	96	46	92	35
23	56	90	34	77	30
24	68	94	26	81	27
25	28	90	62	86	32
26	6	54	48	51	56
27	60	94	34	85	34
\bar{X}	46	80	33	68	41

Correlations: $r = \text{Pre-test/Age} = A/D = \boxed{-.85}$

$r = \text{Pre-test/ Post-test} = A/B = \boxed{.79}$

$r = \text{Post-test/Age} = B/D = \boxed{-.74}$

$r = \text{\% of Potential Increase Acheived/Age} = C/D = \boxed{-.62}$

$r = \text{Pre-test/ \% of Potential Increase Acheived} = A/C = \boxed{.55}$

as "very informative", "excellent", "long-overdue", "timely" and "more like this needed", the participants showed that there had been a great need and desire for this type of training. Though there was some constructive criticism pertaining primarily to the inordinate amount of computer down-time experienced and the deleterious effect this had on practice time, overall the course got rave reviews.

The evaluation pointed out some of the weaknesses of the course. Despite the overall success of the programme, over the three sessions it became apparent that certain variables over which there was little or no control had exerted a direct and detrimental influence on the effectiveness of the instruction.

The first and most troublesome of these uncontrolled variables was computer reliability. The location of the Training Center was not suited to reliable signal transmission. The switching, radio communications and temporary nature of the circuits and cables caused frequent interruptions which became annoying distractions and delays. At a few points the interruptions were of a duration sufficient to force the restructuring of the schedule and consequent loss of some of the sequential logic of the instruction. In some cases it may have also reinforced some of the mistrust and frustration sometimes felt by novice computer-users.

Though the ill-effect was not insurmountable, the

down-time did probably contribute to some loss of comprehension and may have caused less than optimal gain in knowledge and skills. On the positive side, however, experiencing the frequent transmission breakdowns, novice users became aware that the operator is not always the cause of the computer problems and, in the course of instruction, unexpectedly learned to distinguish user-related problems from transmission or equipment-related problems. The variable of computer reliability can probably never be completely controlled but its detrimental effects on learning could be reduced by finding or establishing training facilities where reliable electronic transmission and technical expertise are readily available.

Another variable which influenced the effectiveness of instruction but over which there was little control was the scheduling of the instruction. It was found that long days at a terminal were physically and mentally taxing and that extending the sessions into the evenings resulted in less than optimal comprehension. This schedule had been established before the course, had not been tested in a representative setting, and, though grueling, could not be changed as travel reservations, accommodations, etc., had been planned around it. The plant maintenance sections of the course could have been interspersed throughout to reduce the heavy concentration on computer use at the end of the course, but, the instructors for these sections

would or could not rearrange their schedules. In the future the schedule should be revised so as not to require extended days on the terminal.

The third and possibly least controllable of the variables affecting the instruction related to the characteristics of the learners themselves. Attitude, another criteria we did not fully measure, exerted a powerful influence on instructional effectiveness.

The trainees' attitudes towards computers and computerization in general, seemed to be causing variation in results. A measurement of attitude toward computers before and after instruction was suggested by the educational technologist, but the idea was not approved by management. However, thinking that this may be an important variable, a rough measurement was taken after the fact. The instructors were asked to rate what they perceived, as the attitude of each trainee, based on observation only. These were very rough measurements of attitude toward computerization, but, it was quite surprising to find no relationship between the attitude perceived and knowledge gained as measured by the objective tests.

Attitude is difficult to evaluate but perhaps there was no correlation because attitudes changed over the course of the training. In any case, there was no relationship found between initial attitude towards computers and knowledge gain, although there was a noticeable improvement in attitude towards computers in most students.

Having determined that there was no strong relationship between age and knowledge gained nor between attitude toward computers and knowledge gained, it seemed that the most reliable determinant of post-test score was pre-test score, or relative entry-level, but even this was not consistent. Those trainees who entered the course with a high score generally achieved 100% of potential gain. For these high entry-level trainees there appeared to be something of a ceiling effect. They could have learned more. Yet there were many participants who entered with relatively low scores and still achieved maximum gain. One trend was consistent and that involved the participants who entered with an average score of less than 20%. These trainees generally doubled or tripled their scores but certainly had not mastered the complete content by the end of the course.

From these varied results and with a thumbnail sketch of each trainee's employment history, a hypothesis for predicting effectiveness of the course was tentatively developed. It appeared that the trainees who developed positive attitude and perceived the Computer Systems as tools to be used for their personal or professional advancement, gained much more from the course than did those who were satisfied with their present status and were not upwardly mobile. This hypothesis was tested and, to some extent, confirmed, in a subsequent series of courses. There it also appeared to be the personal motivation and

ambition of the trainee which most reliably predicted success in the course and thus greatly influenced the measured effectiveness of instruction (see Table 3).

At the root of the variation in knowledge gain was a trainee's proclivity to view the Computer Systems as tools for personal advancement. The results indicated that those participants who viewed themselves as potentially upwardly mobile within the department saw the usefulness of the Computer Systems and wanted to be able to use them for their own personal benefit, to increase their knowledge, marketability and their span of control. Those who appeared to be satisfied with their current position probably did not fully realize the personal benefits which could be attainable through effective use of the Computer Systems and therefore did not gain as much from the course. Though the peer pressure generated during the course ensured that all trainees made at least a perfunctory attempt to participate, it became clear that the perceptions and attitudes of the learners themselves were the greatest determinants of the amount of skill and ability gained.

As articulated in a recent article in Training, the changing work force is "more interested in career development and professional growth and what's in it for me? They are loyal to their professions, not to their companies... they are not going to respond well to the same old management and organizational policies". Inc. magazine agrees that people are more productive when they have a

personal stake in the outcome. "Experience with the productivity and inventories of people working in small, highly motivated operations seems to have had lasting effects..." concludes Inc. And the conclusion is echoed by Kennedy in Corporate Cultures, "Perhaps this is what the entrepreneurs have given large corporations - proof of what people can accomplish when treated as 'Individuals rather than imbeciles'" (The New Work Force, 1984). These ideas support the outcomes of this training course.

The three uncontrolled variables indentified, namely: computer reliability, scheduling and trainee's perception of personal benefits, powerfully affected the effectiveness of instruction, with the trainee's ambitions and perception of his or her personal future seeming to have the greatest impact on the amount of knowledge gained. These conclusions were confirmed, to some extent, during a subsequent series of similar courses (see Table 3).

It was agreed that the course would be more effective if computer reliability was improved and schedules revised.

The ambition and motivation factor would probably remain uncontrolled. Being aware of its great impact however, the influence of this factor on the effectiveness of this type of instruction could be tested and used, if possible, at future sessions.

As was mentioned, changes in on-the-job performances and increases in productivity, though major objectives, were not measured formally. However, the ongoing communi-

cations established with the group through the training, indicated that the same participants who perceived the potential personal benefits of effective use of the Computer Systems, did begin to use them more often and more effectively. Increased productivity as a result of effective use can only be assumed.

Chapter 4: Outcomes

Chapter 4: Outcomes

4.1 Immediate results

The overall effect of the course was overwhelmingly positive. As in the trial run, the instructors succeeded in changing the image of the Computer Systems group from that of a remote technically-oriented headquarters creation to that of an approachable, accessible and concerned team. Communications channels were opened up, the Computer Systems group was given a human face and 'sold' to the influential first level of senior management in the field. With these links established, the Computer Systems group gained valuable access to feedback and the support of a powerful group had been won. Even though each T & R engineer trained did not achieve total mastery of the Computer Systems, the support would be lasting, and the information disseminated through this group to middle management and clerical staff would also eventually influence the accuracy and reliability of the information being input to and stored by the Computer Systems.

The support gained through this initial instruction and accompanying public relations campaign would, it was hoped, spread and accumulate, eventually reaching the critical mass necessary to sway the whole department in support of the Computer Systems. By studying the results and trying to determine for whom this training produced the

greatest positive impact, future training could be tailored to selected participants, those who would help maximize the return on training investment. The training could be focused for the audience who would be most likely to activate and sustain a positive chain reaction in support of the Computer Systems.

In ~~the~~ period immediately following the completion of the course, evidence of its positive impact was tangible. Communication between these senior field managers and Computer Systems group accelerated. The training effort had effectively created a wider bandwidth and increased frequency of communication at this level. Through these trainees, communications concerning the Computer Systems were broadcast to both higher and lower levels at the regional and local offices. Other regional groups began asking, formally and informally for similar training. With this impetus, the Computer Systems began to be used more extensively and effectively.

At Computer Systems headquarters a report describing the course and making short and long term recommendations was drawn up. Based on the results and feedback from the course and on the prior needs assessments, it was recommended that a course of similar format on the Computer Systems be adapted for use with specific other groups within the department, beginning with the engineers and supervisors who work directly for the T & R engineers and perform similar activities. This group had been suggested

by the T & R engineers, and for them, a minimum amount of change to the existing materials would be required to keep the course content relevant. Further, it was recommended that this course be kept up to date and enhanced to provide ongoing, refresher and/or cyclically scheduled training for the T & R engineers as required. It was also recommended that a total system of training on the Computer Systems be developed and implemented for all interested groups respecting priorities yet to be established. This was to include the selection of appropriate methods and possible establishment of a training facility more conducive to the reliable operation of computer equipment. Also rescheduling was suggested so that continuous, hands-on, terminal practice time would be available, yet overly long sessions would not be a requirement.

Further, it was suggested that records of scores be kept confidentially so that future training could be appropriately tailored to various levels of ability, and that some attempt should be made to measure and group people into classes of similar ability, attitude and personal motivation so that instruction could be paced for optimal results. Finally it was recommended that a long range training strategy be drawn up for training on the existing Computer systems, new systems and other computer related training. The plan would include, not only development, but maintenance of existing materials, and provide for research, evaluation and selection of available

training packages.

4.2 Long Term Plans

A tentative long range training policy plan and strategy were drawn up by the educational technologist with the assistance of the two manager/instructors who had been involved with initial training session. It included suggestions about the types of training needed, about the distribution of responsibility for developing, producing, and administering the various types of training needs about which groups were to be trained, the prioritization, tentative schedules, locations and resources required.

From this long range strategy a list of groups to receive training on the Computer Systems similar to that which had just been completed with the T & R engineers, was extracted. From this list it was recommended that the next step in the training plan was to provide training to the group of engineers and supervisors immediately subordinate to the T & R engineers.

This was recommended as the next step because firstly, it could be done quickly and cheaply, a minimum of changes being required to keep the content up-to-date and topical for this group whose interests and concerns are similar to those of T & R engineers. Secondly, it could be easily adapted, increasing the return on investment and, making the course cheaper per person. Doing this training as a

next step would also demonstrate to the T & R engineers that the Computer Systems group was serious about acting on feedback from them, thus solidifying the relationship established during the course. And finally, the momentum gained through the first successful sessions would be sustained, more solidly establishing training as an integral part of the role of the Computer Systems group.

This report on the success and cost of the completed training, the suggestions for a long range policy for computer-related training and the short term recommendations was written and presented to the Senior Manager of the Computer Systems group, for his approval. It was hoped that in the near future, the report would be presented to the department's Cabinet, and approved so that plans could be carried out.

The overall success of the first training sessions and the high hopes for its continuation were however, marred by two unexpected reactions. The first, somewhat negative reaction to these events came from the five Regional Representatives of the Computer Systems who, justifiably resented the fact that a course had been given to senior regional people without their being consulted first. Though they did agree that this training was a positive step forward, it having been sadly neglected by both the regions and headquarters, they were disappointed that copies of the materials had not been distributed to them before the course so that they, and the returning trainees,

would have a common source of information. This was a legitimate complaint and, at their central meeting, the materials were distributed and the instructional sequence, techniques, etc. were explained.

From this experience a valuable lesson was learned. These Regional Representatives are the Computer Systems group's only direct link to the regions, and their support is needed to follow up and reinforce any training that the group may provide. It was decided that, in the future, they would not be cut off from the communications network. This had been an unfortunate and unintentional oversight on the part of the Computer Systems group, however, prompt corrective action ensured that their support was maintained and the future of training on the Computer Systems was not seriously threatened by their initial adverse reaction.

On the other hand, the second unexpected reaction had potentially more debilitating consequences. Despite the success of this initial course, the Senior Manager of the Computer Systems group, with whom the decision as to the future of training rested, was still unwilling to present the comprehensive training strategy to the department's directors for approval. Though support for the establishment of a departmental policy for ongoing training on computers was apparent, the Senior Manager of the Computer Systems group, did not want to commit himself.

At the same time, one of the two managers who had served as an instructor in the course was unexpectedly

transferred out of the group. The computer group had traditionally been thought of as the 'orphan' of the department and, this manager was supposedly being rewarded with a transfer out of the group and into the department's mainstream. However, the computer training effort lost a strong advocate with his departure. At this point, despite the success and positive image built by the initial computer effort, its future looked bleak.

Fortunately, there was a path around these obstacles. To counter balance the resistance of the Senior Manager and the loss of a strong supporter, there was a groundswell of support from other user groups who saw the value of this training. To capitalize on this positive force, it was decided that the Senior Manager would be bypassed in order to have training continue.

As the Senior Manager of the Computer Systems group was unwilling or unable to make a commitment, the alternative was to get support from someone else with as much influence. From inception it had been the Senior Manager of the T & R group who advocated this training effort. Though leadership there had changed since development had begun, the educational technologist and manager decided to approach the new Senior T & R Manager for support and approval for the proposed next step in the training plan, ostensibly because it involved other members of his subfunction. Asking this indirectly related Senior Manager for approval of the entire plan would have been too great a

break protocol and the established reporting structure, but when asked, that manager did give the necessary approval for the next step. Then, the Senior Manager of the Computer Systems group, happy to have the decision taken out of his hands, did not object. Though the total training plan had received neither hearing or approval, at least a mandate to take the next step had been obtained. This was the opportunity needed to increase the return on investment for this course and solidify the position as the group responsible for computer-related training for the department's management.

By the time the necessary approval was obtained, the year was coming to a close. Over the year just past, many of the department's Training Centers had been available because budget cuts had slowed down the regular technical training which usually occupied them. This would not be the case in the coming year. To make up for last year's cut backs, the training facilities would be in full use within two months.

No other facilities were available. Fortunately, the computer hardware had not yet been removed from the Centre at which the last course had been held. It was scheduled to be pulled out in short order, because the first technical training session would soon begin in the Center. If the next Computer Systems course was to be given, it would have to be done almost immediately. The necessary revisions and arrangements would have to be made within a month.

4.3. The Follow-up Course

During the month, the materials were revised as required and reproduced. With co-operation from the technical Training group who were in charge of the training facilities, arrangements were made for the training Center to be open and functioning for the available, four week period. Transportation and accommodations for some 40 people in four groups were arranged with regional approval and the assistance of the Training group.

At the same time, two new instructors for the Computer Systems sections of the courses were trained. As one of the previous instructors had been lost through a transfer, and because the remaining manager felt that this new group of new middle management trainees ought to be instructed by people of similar level, two of his subordinates from the middle management level were recruited as the new instructors. The two conscripted instructors were not entirely pleased to be selected as trainers, having families and previous commitments, but they reluctantly agreed to participate at the request of their immediate superior, the manager, who was now the major force supporting continuation of the training. The educational technologist would resume the responsibility for preparing and organizing all materials and being present to assist throughout the instruction.

With these rather tenuous arrangements settled, the

new instructors were to familiarize themselves with the instructional materials and be ready to give a trial run of the course to a sample of people from the Computer Systems group a week before the actual course was to begin. This trial run was more for the benefit of the new instructors than to test the materials which were basically the same as those used previously.

As before, the instructional materials were flexible, allowing the instructors to personalize them, adding or subtracting detail as required. This flexibility was an asset in the first session because the depth of detail could be adjusted to the needs of any particular class, though, as mentioned earlier, a more detailed instructor's manual should have been provided.

This flexibility effected each of the two new instructors differently. One, who had a thorough knowledge of his particular subject area and who had researched the other topics using the detailed references provided, found the flexibility advantageous. For the other, who did minimal preparation, it was obvious during the trial run that more guidance was needed to present his topics effectively. Consequently, his role in instructing was reduced and selected details were added to the lesson plans for which he was responsible.

It was also evident during the trial run that this course, with these instructors, would be quite different from the previous one, though the instructional materials

were basically the same. The commitment and motivations of the instructors would make a definite difference in tone. For the first course, the instructors had participated in instructional development, making choices concerning content and approving methods. They had evidently acquired a sense of ownership with respect to the course. They also seemed to believe in the value of the training and the Computer Systems, and wanted, not only to instruct, but to "sell" the Computer Systems to the trainees. The first two instructors demonstrated an enthusiasm and team spirit with respect to the training and the Computer Systems which was somewhat lacking in the second two recruited instructors. The first two seemed to see the course as an opportunity for personal and professional advancement and made an effort to be open and honest with the participants about the strengths and weaknesses of the Computer Systems. Though the manager who recruited the two new instructors, tried to instill this same openness and enthusiasm in the two new recruits, he was only partially successful. The two new instructors seemed to see the task as an inconvenient job they did not really want. Given the materials, they could and did instruct, but they never did muster the enthusiasm to truly 'market' the Computer Systems as had been done previously. This was not their real purpose, they were to teach not sell, but the educational technologist perceived an obvious difference in style and was apprehensive about its possible impact.

None the less, the new instructors were deemed adequate by the manager, there being very little choice. However, the manager decided to be present throughout the first session of the course in case any additional coaching was needed and for public relations purposes. With the assistance of the educational technologist, the new recruits would give four sessions of the training course to approximately 40 engineers and supervisors.

Mainly because of the time and space restrictions mentioned, the course was given in the same location, with the same equipment and on the same schedule as was the T & R Engineers' course. Also, because it had been requested that both engineers and supervisors attend, and, because the regional administrators responsible for choosing the candidates took some liberties with this request, the four groups assembled were at least as heterogeneous as the T & R Engineer groups, perhaps more so. The educational technologist expected that the same variable of computer reliability, scheduling, entry level knowledge, and trainees perception of personal benefit would influence the effectiveness of instruction. In addition, the less enthusiastic attitude of the instructors might have an impact.

Except for the expected down-time, coupled with frequent periods of slow response time on the terminals, and the justifiable complaints about the long hours, the training sessions followed the established format and

proceeded remarkably smoothly under the circumstances.

As expected, there was a wide variation in entry level knowledge with pre-course scores ranging from 0 to 68%. There was also an age range comparable to that found amongst the T & R Engineers, from 27 to 60 years. But, as with the previous course, there was no relationship between these variables and knowledge gain from the course. Rather, these results confirmed the previously identified variable of ambition or ability to perceive the Computer Systems as tools for personal and professional advancement as a major factor in determining knowledge gain (see Table 3).

In this department it is engineers who have the best chance of professional advancement and upward mobility. Non-engineers can reach senior status but these are definitely the exceptions, not the rule.

Acting on the request of the T & R Engineers, both engineers and supervisors (non-engineers), attended this four-session course. In each session, representatives of each of these two unofficial sub-classes were present.

The group always included some young engineers who generally have a good chance for advancement within the department and some supervisors, a subclass of non-engineers who had worked their way up to this position but would probably go no further. Most of the supervisors had been at least five years in their current job, usually more, while the engineers always had less than two years in

Table 3

Course 2, Pre- and Post-test Scores and % Potential Increase Achieved by Upwardly-mobile and Non-mobile participants

	A Pre-test	B Post-test	C Point Gain	D % Potential Increase
Upwardly-mobile Participants				
1	20	84	64	80
2	14	84	70	81
3	30	100	70	100
4	36	80	44	68
5	26	44	18	24
6	38	96	58	93
7	40	86	46	76
8	36	98	62	96
9	54	90	36	78
10	24	64	40	52
11	64	100	36	100
12	26	100	74	100
13	36	100	64	100
14	48	100	52	100
15	48	84	36	69
16	34	88	54	81
17	44	94	50	89
18	38	100	62	100
19	68	100	32	100
20	20	36	16	20
21	34	70	36	54
22	26	98	72	97
X	34	86	52	79
Non-mobile Participants				
1	10	40	30	33
2	8	60	52	56
3	14	40	26	30
4	12	50	38	43
5	22	44	22	28
6	24	48	24	31
7	18	48	26	31
8	28	54	26	34
9	0	44	44	44
10	22	42	20	25
11	0	0	0	0
12	16	34	18	21
13	0	10	10	10
14	0	6	6	6
X	11.5	33.5	22	28

their current job as they advanced rapidly through the ranks. Perhaps the correlation which should have been studied was, number of years in present job versus knowledge gained in the course, but unfortunately, the possibility of this relationship existing had not surfaced until the courses were completed and this information was not accessible.

The alternative means of testing the hypothesis about perceived personal benefit and knowledge gain was to compare the gains made by engineers to those made by non-engineers who were less likely to aspire to higher levels and less mobile. In looking at this correlation the intention was not to reinforce the department stereotype which depicts engineers as somehow 'naturally superior', but rather to ascertain whether the trainee's perception of the Computer Systems as a tool for upward mobility had direct influence on the effectiveness of the instruction regardless of the instructors' enthusiasm, the computer reliability, scheduling, or entry-level knowledge. If this relationship held, it would be wise in the future to, as much as possible, group classes according to this variable, and, to concentrate instruction on those who perceive the Computer Systems as useful and would therefore be likely to bring optimal return on this investment in training.

The comparison of the results from the engineers versus these non-engineers seemed to prove the hypothesis about the influence of personal motivation, correct.

Pre-course scores for engineers ranged from 14% to 68% with an average of 34% while pre-course scores for the non-engineers ranged from 0 to 28% with an average of 11.5%, (see Table 3). This outcome points out the possibility that engineers had greater motivation and/or opportunity to use the Computer Systems before the course and therefore may have had a greater understanding of their potential, as well as a more extensive background in basic terminal operation.

Post-test scores for the engineers ranged from 44% to 100% with an average of 86%. For the non-engineers the range on the post-test went from 6% to 60% with an average of 33.5% (see Table 3). These results indicate that the engineers gained much more from this course than did the others. This was in part due to their greater entry level knowledge and in part due to the pace and content of the course, but these variables do not seem to completely explain the definite stratification of scores across the two unofficial subclasses within the total group.

Admittedly the two subclass groups were small. There were 22 engineers and 14 non-engineers attending this set of training sessions. But the contrast in results seems to indicate that the trainee's perception of the usefulness of the Computer Systems, personally, did directly influence their knowledge gains. The engineers, whose futures include transfers and varied duties, could see that the Computer Systems could provide standard records of

work-related information which were accessible at any location, for any inventory. The Computer Systems could provide the mobile engineers with a built-in historical record of a new territory and increase their span of control in any position. The non-engineers and others who reached a permanent plateau on their career path whether by choice or through lack of qualifications, seemingly did not perceive the total benefits available for the Computer Systems. Those who had been in their current position for years, as most of these had, already knew more about their territory than the Computer Systems contained, did not expect to move on, and therefore could not see how the Computer Systems would bring them benefit.

In retrospect, the results of the T & R course also confirmed this hypothesis. It was the engineers who had, by choice, or otherwise, become stationary, remaining in their current position for years and having no prospect or inclination for advancement, who gained the least from this course on the Computer Systems. For that group, perhaps a different approach to training should be attempted. Prerequisites, content and motivational factors would have to be re-evaluated and geared to their specific needs and interests, so they would be able to perceive how the Computer Systems could benefit them personally. This is a more difficult goal to achieve because some of the most saleable characteristics of the Computer Systems, such as the broad scope and standardization of information avail-

able, could not be used as selling points with this stationary group. The Computer Systems would have to be promoted simply as a reliable record-keeping system, the benefits being that information would be accurate and available on request. Since most of this group keeps this type of essential information 'in their heads', or in a paper file of their own, the benefits of the Computer Systems would certainly be more difficult to sell. In addition, since members of this group are generally not very mobile, nor very influential at upper levels, the affect of this training would not travel far either. Perhaps the staff members in the immediate work environment would benefit from the chain-reaction which would result from effective training, but the positive reaction would spread no further. Overall, to accomplish the general goal of "effective use of the Computer Systems" it is more efficient for the Computer Systems training group to concentrate on the more highly motivated and mobile engineer-dominated groups than to labour to convince the immobile or resistant of the benefits of the Computer Systems.

4.4 The Plan of Action

Based on the results and feedback obtained from this and the previous T & R engineers course, a revised listing of groups to be trained was developed. Although there was

still no formal long range plan nor an accepted training policy, the decision-makers did not object to continuing the computer-related training effort.

This lack of definite commitment and direction had some negative and some positive effects. On one hand, the lack of direction gave the Computer Systems training group some control as well as flexibility. With the technology developing and changing so reapidly it was advantageous for the group to be lean and proactive. With no definite policy established, the group was still able to direct its efforts to the subjects and content which would bring the greatest return on investment. With no formal mandate, the group could practically create its own, within bounds. On the more negative side however, with no actual policy there was some confusion as to the division of responsibility for training; as to which groups are to be trained, by whom, which types of training are to be addressed, and in what order. The lack of commitment also kept resources at a minimum (which may have been the primary reason for it).

After these two initial successes, a plan of action for computer-related training was developed by the Computer Systems training team. In developing the plan, the education technologist had to work against the tendency of management to take this first successful solution and apply it to all problems, equating quality with quantity. Other groups would not receive optimal benefits from a course developed for one specific function. Instead of measuring

success by the number of people trained, the plan would be structured for maximum impact. The groups to be trained would be those which would manifest the most benefit both for themselves and for the Computer Systems group. Those chosen to receive instruction would bring the best return on investment. Though it is difficult to assess the impact of training before the fact, the results of initial sessions gave some direction.

The groups to receive training first should be upwardly-mobile engineers and those in positions of influence who would realize the advantage of having extensive, standardized information at their finger tips to increase their knowledge, span of control, their efficiency and transferability. The content and objectives of these training courses would be adjusted to suit the needs and interest of the particular group.

In other words, both the learners themselves and their work environment were to be assessed before and during instructional development. If a group of up and coming engineers were trained, their supervisors and subordinated should also receive some training so that a supportive environment is created. The plan of action had to be tempered by political considerations, but was intended to bring optimal benefit to the organization and the individual by providing training where and when it would have the most impact.

Also, the success of the training programme coupled

with the trend toward use of personal computers, (Training, 1984), led to the development of a plan for a complete information centre. The centre was to be set up as a management tool to put the appropriate micro and mainframe hardware and training into the hands of the end-users. It was intended to be multi-purpose: to channel demands on the data-processing group, to evaluate, supply, develop and/or conduct basic training and to explore the possibilities of integrating the company's main frame data bases with personal computers. Clientele was to be able to get the information and assistance they needed from the Computer Systems and get it efficiently (Moody, 1983; Sneider, 1983).

The foregoing training had shown that the backgrounds and rates of progress of individual trainees were difficult to control. The trainees were concerned with applications. Training would have to be flexible and needs-oriented, and advice, assistance and communication would have to be ongoing. Thorough periodic needs assessments were recommended because of the many different and changing knowledge and skill requirements in the department. Ideally a combination of small group or individualized training backed up with video presentations, interactive videodisc and/or computer-based training was recommended. It was recommended that initial training on computer capabilities, be followed up with continued support and consultation, including the establishment of informal user groups,

newsletters, etc. (Woolley, 1983). The information centre was proposed as a means to train and support end-users and to provide managers with the information they needed to meet their individual needs, the needs of their people and the needs of the company as well (Gabel, 1984).

As these outcomes indicate, what started out as an isolated training programme was evolving into a ongoing training function. Inter-departmental politics prevented the group from being officially recognized as responsible for computer-related training but that role had been assumed informally without opposition. Though there had been many problems and obstacles along the way, the initial training programme had filled a long neglected need, with such positive impact that continuation of the function seemed inevitable. The influence and responsibilities of the training function began to develop in ascending and expanding spiral. As needs were revealed, the mandate expanded and responsibilities increased. Some of the needs had been identified in the initial needs assessment but had not been slated to be addressed until after the ability to meet them had been demonstrated. Fortunately, the results of the initial efforts were positive and progress was made. However, lack of direction and commitment by senior management and the unclear definition of goals and roles continued to be a problem.

4.5 An Expanded Model for the Systematic Design of

Instruction

During the course of this project and through the analysis afterward, it became apparent that the model used, that described by Dick & Carey in The Systematic Design of Instruction, is a good tool but should be extended to better fit the requirements of an industrial setting. Some steps should be added to the design process to accommodate more of the many variables influencing the design of effective instruction in complex organizations. Through ongoing communication, negotiations regarding individual, subsystem and system goals should continue as required throughout the process.

Following a thorough needs assessment, solution selection and negotiation of goals and roles, the analysis stage should be expanded to include analysis of learner characteristics and entry-level, analysis of work environments, task analysis, instructional analysis and cost/benefit analysis. Thorough analyses at this point will help assure that the instructional strategies chosen, including methods, media and follow-up activities, will effectively facilitate the achievement of long and short term objectives for all members of the target group, with reasonable return on investment.

Later in the process, a total system of evaluation should be designed to ensure that adequate formative evaluation is performed and that summative evaluation

encompasses measurements of trainee reaction, knowledge gain, attitude, behaviour change on-the-job, and organizational results (Kirkpatrick, 1975; Schwind, 1975). By including all these forms of evaluation in the model, the achievement of all significant objectives can be measured.

It is also important that evaluation be well-designed, thorough, valid and reliable. "Evaluation should be planned at the same time as the training program and should constitute an integral part of the total program from beginning to end... Evaluation should follow the most rigorous design possible... Evaluation should be carried out at several levels and at several times" (Bass & Vaughan, 1966).

With these steps included, an expanded model for the systematic design of instruction would appear as in Figure 6.

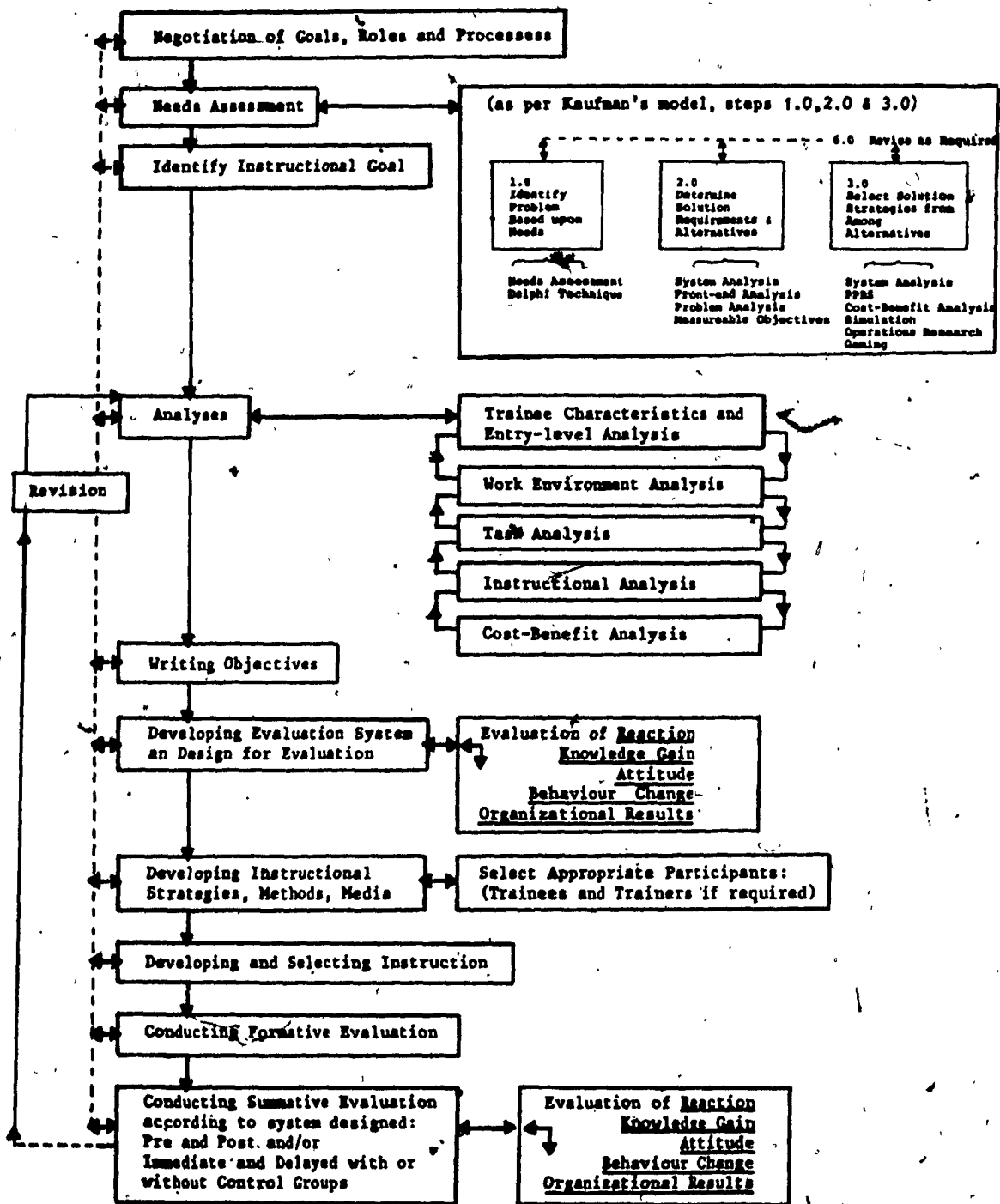


Figure 6: An expanded model for the systematic design of instruction

Chapter 5: In Hindsight

Chapter 5: In Hindsight

5.1 An analysis of Problems Encountered

Attempting to follow a standard model of the instructional design process, (Dick & Carey, 1978), a training programme was developed, implemented and evaluated. The instruction met its objectives and proved very successful overall. However, in applying the principles of instructional technology to a complex socio-technical organization there will be problems. To resolve these problems both systems must be flexible and able to adapt their processes and goals. Both systems will be changed by the interaction. Being aware of potential problem areas, the educational technologists will become better prepared to circumvent them, to be adaptive, to negotiate goals ongoingly and to make adjustments within bounds in order to achieve the global objective. A discussion of the general problem areas confronted during this project will give other educational technologists an idea of the range of problems they may expect to encounter as they attempt to achieve enduring performance improvements in complex socio-technical organizations.

Following this analysis problems encountered, a checklist of possible impediments to effective training is presented. The checklist can be used by any training specialist who is preparing to begin a new project. It

presents some of the questions that should be asked of oneself and discussed with other members of the organization during subsequent negotiations of goals, roles and processes. It is intended to be used as a tool by the educational technologist to help structure interviews with other key players in the organization and clarify expectations at the outset.

Problem 1: Negotiation of Goals

The first and foremost problem in this training project was the fact that the goal(s) of this organization were never formally established. Individual goals were apparent, but system members did not come together to negotiate goals for the system as an entity (Boyd, 1982).

Accepting these constraints drastically limited the scope of solutions to be contemplated. With no negotiations there was no choice but to follow the dictates of management and hope that success would lead to confidence and a more open, participative approach in the future.

If at all possible, before beginning a training project, the members of the organization should meet for discussion and negotiation of goals, roles and processes. All can participate in a co-operative effort to

determine goals for the organization which both respect individual objectives and benefit the whole system. The consequences of not negotiating goals will appear repeatedly throughout this analysis.

Problem 2: Management Commitment

As no formal training organization had existed in the Computer Systems group, it was essential that the programme have the support of senior management. Short term support was demonstrated by their active participation in the first course, but following that, it waned rapidly. Management was willing to make a short-term commitment but did not seem prepared to support the establishment of a formal group for enduring performance improvement.

Though senior management approved the continuation of the training, no one was prepared to give formal support, no one would take the risk and provide the resources officially. Lack of commitment at upper levels can lead to complete failure of the training function even if "structure is good, its objectives are sound, and its staff is highly qualified and capable... If management

expects results from the training department, it must give responsibility accompanied by authority. This authority must include planning, controlling, co-ordinating and administering of all education and training activities" (Denova, 1971).

In this project, commitment was never strong. The Senior Manager of the group was more interested in publicity than in qualitative or quantifiable results. Without adequate direction or control, forces became somewhat scattered, some resources were misallocated, motivation deteriorated, methods and procedures were adapted for short term rather than planned for the long term, and equipment and facility problems could not be controlled.

Later, when the project proved successful and development continued still with no real commitment, the role of the educational technologist became even less clearly defined. The indecision, lack of commitment and absence of clear goals caused some frustration and waste.

Problem 3: Supervisor Involvement

Lack of supervisor involvement is somewhat related to lack of management commitment. Supervisors are an integral part of the work environment and their support for follow-up and transfer of training is critical. Talking with the subordinates about the course, clarifying expectations for their return, and providing assistance to returning trainees to facilitate use of new skills on the job are essential (Denova, 1971).

Performance improvement can rise or fall depending on the commitment and involvement of supervisors. Their support may improve with that of upper management, or it may result from their direct investment in the training. In the project described, supervisor involvement was not solicited, although one of the objectives of the first course was to gain the support of the trainees who were supervisors themselves. Their participation in the first course led to demand for training for their subordinates.

Those subordinates who returned after the second course to a supportive supervisor and work environment were more likely to use their new skills. This supervisor support is essential if performance improvement is to

endure.

Problem 4: Definition of the Role of Training

Again, this problem is somewhat related to inadequate goal negotiation and the guarded support given to training function by management. If goals are not negotiated, no group is absolutely sure where responsibilities begin or end. Management misconceptions about what training can and should do for them can contribute to perceived failure.

The role of trainers, instructional developers and educational technologists must be clearly defined so that management have realistic expectations and know when, where and how their co-operation will be required if performance is to be permanently improved. Supervisor involvement is also necessary. Ideally, supervisors and managers should be responsible for seeing that their staff is trained and that the training is used on the job. However, most managers seem to refuse to accept this responsibility and delegate it to training group.

Training group is a service, a support function, not a line function. The role of the

educational technologist in industry is to act as a performance improvement consultant and/or training development specialist. Training's function is to analyse needs, design, develop, possibly deliver, administer and evaluate training programmes which correspond with the goals of the organization. Supervisors are then responsible for seeing that the newly learned skills are used on the job to improve performance.

The training group should not simply react to requests as was often done in the project. Training should be proactive. Looking at the whole organization it must work with management to identify priorities and systematically develop optimal solution.

In this project, playing the role of consultant, the educational technologist took a holistic view of the system in question and performed a preliminary needs assessment and prioritization. However, this role had no precedent in the organization. Recommendations made by the educational technologist to senior management were largely ignored until independently seconded by one of their own. The instructional development began as a reaction to a request even though a similar

training programme had been indentified as a solution alterntive following the proactive assessment of needs.

The tools and processes used by educational technologists, as well as the training function in general, is still not well understood in many organizations. Educational technology, being a purposely generalist and adaptive discipline, will probably have to clarify and defend the utility of the techniques within each new environment. This should be done as part of a formal negotiation of goals and roles by the main members of the organization before a project begins. Once goals and roles have been defined and the training function is producing effective programmes etc., credibility will improve.

Problems 1 to 4 are related. They all stem from the fact that the goals of this system were never negotiated. Decisions were made unilaterally by top management rather than in consultation with the affected groups. This is standard practice in any traditional organizations, but when this powerful autocratic force is withdrawn, the process it stimulated will rapidly wind down unless some solid structures and "grass roots" support have developed along the way. For long term results, goals, roles and processes must be negotiated.

Another series of problems relates to certain misconceptions about training which seem to prevail at the management level. Some of these misconceptions can be blamed on the failure to negotiate goals for the organization. These harmful misconceptions will have to be dispelled if a training system is to survive and evolve.

Problem 5: Relationship between Training and Organizational Goals

Few managers view training as instrumental in achieving organizational goals, especially in the short-term. If they did, their commitment to training and follow-up would be practically assured. Many managers see their involvement in training and development as detracting from more important duties which are seen as more directly related to bottom line results.

Although educators and trainers may believe in the relationship between training and improved organizational results, there is usually little done to indicate a direct link between the two, at least in the short term (Kirpatrick, 1975). To change this conception, training must be quantifiably related to key

organizational results and this role must be clarified in an initial negotiation of roles and goals. This clarification of training's contributions was not attempted in the project described here. Had it been, perhaps greater commitment could have been mustered.

Problem 6: Low Expectations for Training

Related to imprecise role definition and to the problem of training not always being seen as instrumental in the achievement of organizational goals, is the fact that many managers do not have much confidence that training can immediately improve performance on the job. They are generally skeptical and their low expectations may be reinforced if training professionals fail to evaluate and demonstrate effectiveness. A vicious circle develops, low expectations lead to failure, lead to insufficient accountability, to reinforced low expectations, etc. This circle can be broken by clearly defining the role of the training function at the outset, clarifying expectations and performing thorough evaluations of instructional programmes, then making the revisions needed to improve

effectiveness.

In this pilot project, no one was quite sure what to expect from the training. The evaluation conducted, though incomplete, did enhance the credibility of the group and raised expectations for future projects. A complete system of evaluation including evaluation of on-the-job behaviour and organizational results, would have added to the credibility (Kirkpatrick, 1975; Schwind, 1975).

Problem 7: Training viewed as Education

In the organization in question, as in others, training is sometimes viewed as a form of education. This may not sound like a problem but, it reinforces the idea that training groups cannot be held accountable. By viewing training as primarily educational, managers sometimes fail to see that training can also be aimed at ongoing skill development that will contribute immediately to improved work performance. The initial project described here, was aimed at just that, but was regarded by some as non-essential education anyway, because all goals were not clarified

through negotiations.

Education tends to have less well-defined goals and is often perceived as simply "nice to know". Identifying it with education, some managers view training as an "inherent good", accepting its contribution to the organization on faith rather than demanding evidence of its effectiveness. This can lead to the neglect of thorough evaluation.

Although education and long-term development may have a role in a comprehensive training and development plan, aiming an initial programme in that direction reinforces the misconceptions. If the results are difficult to quantify, the training group may be seen as unaccountable. Immediate and quantifiable changes should result from effective training (Spitzer, 1984). Once credibility and accountability have been established, less immediately quantifiable goals can be addressed.

Though immediate benefits are sometimes difficult to measure, as in this project, an attempt should be made to clarify the goals of the instruction and evaluate the progress made toward those goals. If we do not try to measure the benefits, we reinforce the idea that

training, in the short run at least, is essentially inconsequential.

Problem 8: Assuming that Training will be Applied

An idealistic but naive assumption may dominate some management groups. It goes like this: "given useful, practical, interesting or otherwise useful information employees have the capability and motivation to find applications for it and use it to improve their work performance" (Spitzer, 1984). This assumption influenced the project described to such an extent that no attempt to measure actual change in behaviour on-the-job was even contemplated.

It would be nice if this assumption were true, but it should not be assumed that trainees will be able to apply new skills on the job without support and assistance. If a thorough needs assessment and analysis of learner characteristics are performed as the project begins, the training should be relevant, and transfer to the job situation is likely to occur. However, without thorough front-end analysis, transfer of skills should not be assumed. This assumption can lead to inadequate follow-up.

In this case, the front-end analysis had not been sufficiently thorough. Fortunately, however, the content was found to be job-relevant. To follow-up, informal communications and a plan to set up an information centre were used to assist trainees in using what they had learned. This essential assistance and motivation should have been established formally through our Regional Representatives and through supervisory support. Follow-up evaluations should have been incorporated to measure how well skills were transferred so that necessary revisions to the instructional system could be made.

The erroneous assumption that skills learned will be transferred, can undermine attempts to provide training which has lasting effects on job performance. By conducting thorough analyses at the outset, the training is likely to be relevant and transferrable. Then, clarifying goals and roles in the beginning, it is assured that adequate support and feedback are built into the training plan so that transfer can occur and performance can improve.

Again a misconception, training is often seen as a fringe benefit or reward. This was not the case in the initial project because all members of a group were to attend and no one knew what the course would involve. This misconception spread rapidly, however and by the time the second session was run, people were calling in favours to have certain individuals attend the course. This view causes trainees to lose sight of the ultimate performance improvement purpose. Training should be a beneficial, enjoyable experience but unless performance improvement is the goal, the function cannot be held accountable for real results and will not develop credibility.

Problem 10: Course Mentality

Most people are used to courses. Training groups usually run courses. Training is often mistakenly evaluated by the number of the courses that are held. Overcoming this tendency to equate good instruction with number of training programmes run is difficult (Spitzer, 1984). This tendency was beginning to manifest itself on this project, as more and

more user groups requested instruction and demand began to be seen as an indication of success.

Essentially, management wanted the same course to be run again and again, with minor content changes, to serve all needs. This would not be appropriate in all cases, but as long as the traditional attitudes dominated, it was impossible to re-evaluate, innovate and use alternative performance improvement technologies. The "course mentality" and the tendency to apply the same solution to all types of problems must be challenged and refuted through ongoing negotiation of goals, assessment of needs, priority setting and cost-benefit analysis, if truly appropriate instruction is to be made available. The information centre concept was one attempt to deal with this misconception.

Problem 11: Classroom Mentality

Related to "course mentality" is a prevailing belief that training should occur in a classroom, away from the job. Although there is definitely some on-the-job and individualized training in most organizations,

much training is done in a classroom and conforms to the general framework of classroom instruction. Though interaction and participation were encouraged, the training developed for this project was quite traditional in format, in keeping with instructor preference. Classroom instruction was supplemented with job aids and individualized assistance but it took place in an isolated, protected environment far different from that at the work place. In this course however, the benefits of getting this group together, away from the office for concentrated, hands-on training, far outweighed the problems of an artificial environment. In planning instruction however, it is important to be aware of this tendency and to evaluate whether classroom training is the optimal mode or simply the expected method.

Problem 12: Concept of Quality in Training

Another misconception which can influence the development of training programmes concerns quality. Quality means different things to different people. To some its guaranteed by the process used. To others, product is all

that matters. Some equate it with quantity. Others look for a combination of all these factors. Unfortunately, quality training often seems to mean number of programmes, length of programmes, intensity, workload, number of participants, level of participants, reputation of instructors or the "flashiness" of the event. These are not legitimate criteria for judging the quality of training.

The quality of training can only be measured by its results, by the benefits it brings to the individual and the organization. Appearance, facilities, logistics, equipment, instructors, presenters and accommodations are important, but only in so far as they contribute to the results.

In the project described, we tried to focus attention on results by formalizing evaluation to some extent. The actual knowledge gain figures and subjective reactions were recorded and did add a significant dimension to management's perception of course quality. Follow-up evaluation, had it been done, would have further extended that concept and raised the expectations of management. The goal should be to have quality equated with effectiveness in improving on-the-job performance, not with number of programmes run.

Now, aware of the problems which can result if goals and roles are not formally established, and working around the misconceptions about training which may colour management's decisions, the educational technologist must still confront problems related to the actual design and development of instruction. The first step in most models of the instructional design process (Dick & Carey, 1978; Gammuto, 1980) is the assessment of needs. Many problems can develop at this point.

Problem 13: Needs Assessment

This project began with the recognition that a problem existed with respect to the level of "effective use of the Computer Systems". The initial needs assessment indicated that the problem stemmed not only from lack of training, but was also due to environmental, logistical, organizational and motivational factors. Before the causes could be thoroughly investigated and solutions properly prioritized, this phase of the project was terminated.

It often happens that performance and instruction specialists start with a solution (e.g. training, teaching, designing, etc.) and assume that there is a gap in results which

this intervention will successfully eliminate (Harless, 1975). In the project, training had been identified as one solution alternative. It had not been assigned the highest priority, but management felt it was the easiest step to take. Fortunately even though further analysis was not possible, real needs based on knowledge and skill gaps and performance problems did exist and had been identified. The training would be designed to meet those needs as much as possible. Training will not make significant impact on job performance unless it is designed to meet real needs (Gilbert, 1978; Kaufman, 1984).

Problem 14: Focusing on Quick Solutions

The initial needs assessment had revealed more than just a training-related cause for less than optimal use of the Computer Systems, yet, as is often the case, the only solution alternative considered was development of an instructional package. In this project this decision was based on the individual goals of the Senior Manager of the Computer Systems group who wanted visible results and publicity quickly, easily, and at the least cost.

Many managers look for the quickest and easiest solutions to performance problems. The need for further investigation and analysis before prescribing solutions is generally ignored and training may be selected as "the" solution. A training programme is often quicker and easier to implement, and more visible than trying to change organizational structure, job descriptions, managerial responsibility or other contributing factors.

This quick-fix mentality is an obstacle to effective performance improvement which educational technologists will have to overcome by ensuring that overall goals, roles, and processes are clearly defined and understood. Training should not be expected to solve non-training problems (Harless, 1975).

Problem 15: Failure to Focus on High Priority Needs

Related to the quick-fix mentality, lack of commitment and confused goals is the tendency to focus on "safe" or trivial problems rather than the critical ones. This was a problem at the start of this project, until force was applied from outside the group, requesting training in a critical area. Prior

to that, the focus had been on producing job-aids, the enquiry guides and manuals, a useful but non-crucial solution alternative.

Training should focus on key result areas, only then will it have impact and gain credibility. Educational technologists and managers need to work together openly so that resources can be applied to organizational high priorities. By participating in the negotiation of goals, seeing that needs are assessed and prioritized, then selecting the most critical for resolution, the likelihood of producing training with impact and obtaining ongoing active management commitment and support, will be increased.

Problem 16: Focus on Fragments Rather Than on the Whole System

This problem is also related to the lack of management commitment and to the vaguely defined role of the educational technologist or training specialist in the organization. Organizations are complex socio-technical systems. Activities are interrelated. Problems and solutions applied in one area affect others.

If, as a result of their unwillingness to make a major commitment, management chooses to focus on one area or one individual need, rather than looking at the whole system, the solution developed may not have the intended impact. Unless overall system performance is considered, in the design of any training system, its effectiveness could be in doubt. To avoid this problem, educational technologists must encourage a systemic view. They should be proactive, seeking out holistic performance improvement opportunities rather than reactive, responding passively to individual training requests which may not bring adequate return on investment.

Training as an activity is also a component in what should be an integrated system of human resource development. Ultimately, it should be related to selection criteria and career pathing and should contribute to the development of the organization as well as the individual.

In the project described in this paper, the focus was initially on a fragment of the system, even though a whole complex of inter-related problems had been indentified. No manager wanted to commit the time and money

needed to address the whole at the outset. However, the "whole" had been identified and a stepwise plan of action was drawn up by the educational technologist to attack those problems in priority order. Commitment was still forthcoming only step by step, but at least the training system was in focus, and initially, progress was made proactively as well as in reaction to individual requests. Still, this training system was in no way connected to the trainee's career path or eligibility for promotion. Perhaps in the future, the benefits of integrating the various elements of the human resource development system will be considered.

After needs have assessed, priorities identified, solution alternatives proposed and solutions selected (Kaufman, 1979), the instructional goals have to be defined. Then, according to the standard model, learner characteristics should be assessed and the task analysis conducted (Dick & Carey, 1978). Problems can arise at this stage too.

Problem 17: Assessment of Trainee Characteristics

Some emphasize it more than others but the creators of most models of instructional design, include in the recommended process, a step in which the learners are analysed and characterized. The educational technologist is to examine the demographic characteristics of the trainees and research the instructional implications of any bias, motivation, interest, learning styles and preference and/or psychological or physical handicaps or assets. This step could not be adequately covered during this project due to the individual goals of the senior manager and lack of resources (both time and money). Neglecting a thorough analysis at this point led to great heterogeneity in the classes and a wide range in eventual knowledge gains. If at all possible, the educational technologist should insist on doing a thorough audience analysis so that objectives and methods can be matched to the particular needs of the audience.

Problem 18: Assessment of Work Environment

This step is not explicit in many models of the instructional design process (Dick & Carey, 1978; Gammuto, 1980) but evaluation of

the work environment is essential if objectives include use of new skills on-the-job. This assessment should take place at the same time as the learner assessment and task analysis.

Performance environments can be full of constraints. There may be disincentives for using the new skills, unclear expectations, lack of support, lack of assistance or supervision or lack of opportunity to use the new skills on the job. Also, if people do not see the training as personally relevant it is not likely that performance will be improved (Training, 1984).

Before training is developed one must be sure that it is job-relevant and has support in the work environment. On this project, no opportunity for actual assessment of work environment was allowed. Suggestions for research along this line were turned down. Senior management assumed that "we can tell you what they need to know" and "they'll use it if we tell them to". Information on the work environment and performance requirements had to be gathered from secondary sources.

Had there been an opportunity to analyse the typical work environment and performance requirements thoroughly, the instruction would

have been more job relevant and constraints to using the new skills could have been eased. Candidates who would not be likely to use the new skills would not be selected to attend the course. In these ways the impact and overall results of the training could have been optimized. Because no such assessment was possible, training was given to some who could not use it. For those to whom the instruction was not personally relevant or not applicable, it was a waste of time.

The educational technologist may have control over the learning experience but has virtually no control over the work environment. To ensure that skills learned in class will transfer to the work environment and persist over time, an analysis of that environment should be conducted. The educational technologist should attempt to discover if there is anything about the trainees' supervisors or subordinates, or about the organization itself which will inhibit or possibly enhance the use of the new skills on the job.

In this project, though no formal work environment assessment could be performed, the instructional design team was aware of a general negative feeling toward the Computer

Systems, although pockets of enthusiasm did exist. To demonstrate that the Computer Systems had the backing of the organization, the idea of having high level guests speak in support of them was proposed and accepted. This quick-fix strategy appeared to have the desired effect. The course participants were made aware that their efforts to use the Computer Systems more effectively would be approved and supported by their superiors and as a result, the affects of the instruction appear to have endured amongst those who found it personally relevant.

The educational technologist should be aware of the significance of these two oft-neglected assessment steps and attempt to do the necessary research and incorporate those findings into course content and design if the instruction is to be relevant and enduring.

Problem 19: Task Analysis

A sound analysis of the task(s) to be taught depends on a thorough assessment of learner characteristics and work environment. It is difficult to break down a complex task into meaningful chunks unless the trainees'

abilities and interactions in the work place are known. In this project, representatives of the intended audience who were familiar with the environment were consulted on the task analysis. Their input helped, but some steps were still missed initially, and the variation in entry knowledge and knowledge gains could not be anticipated.

Again, partly because of lack of commitment on management's part and partly because of the role of the training function being poorly defined, there is often an over-emphasis on the development and delivery of instruction and not enough emphasis on analysis, clarifying expectations and follow-up. If possible, the educational technologist should see that a substantial portion of resources be allocated to these functions. Once design and development begins new problems can arise.

Problem 20: Lack of Resources

People, time and money are needed to produce effective instructional packages but one or another is usually in short supply. On this project all three resources were scarce. One educational technologist attempted to co-ordinate and direct the entire project often

taking on a variety of roles and duties, from subject matter expert to clerk/typist. Necessity is often the mother of invention. All materials had to be produced in-house and these support services were not under the control of the educational technologist. This was definitely not the ideal situation but there were few alternatives for a temporary consultant trying to establish a training function within the Computer System group with no budget for it. In a more secure position, the educational technologist should detail requirements, establish a budget and insist on having quality support.

Problem 21: Content Selection

If the foregoing analysis steps have been incomplete, as in this project, it follows that the content selected may not accurately match trainees' needs, abilities or environment. Because the group was so heterogeneous, some found that too much was covered and there was not enough practice time. For them, the training was superficial; there not being enough time to gain confidence and competence in the skills. Others found the scope and

depth of instruction appropriate and had enough practice to leave confident in their ability to transfer the skills. More thorough analysis up-front would have helped in tailoring the content and objectives to suit the various sub-classes within the group.

Problem 22: Choice of Instructional Method/Media

The combination of methods and media used in an instructional package should be chosen after thorough exploration of alternatives. Alternative methods, techniques, media and logistical configurations should be analysed until the most effective mix is found (Wiseman & Gambill, 1983).

On this project some of these decisions were made for the educational technologist. Lack of time and money resources disallowed computer-assisted instruction as an alternative. Instructor preference as well as the subject matter itself, dictated that slides would be used for the information presentations. Availability of the training facilities dictated class size and the physical arrangement of the classroom.

The only choice left to the educational

technologist was how to get the trainee actually using the Computer Systems. Some research indicated that computer training courses for business and industry should have the following characteristics:

- "the applications selected for demonstration should be directly applicable to the employee's job;
- A combination of demonstration and example is needed to provide a sense of comfort and control;
- hands-on exercise should be planned carefully in advance ...
- participants... should be as homogeneous as possible in terms of job responsibilities/ interest" (Kearsely, 1982).

One study indicated that computer use should be taught in the context of actual job tasks. The computer should be portrayed as a tool, not an end in itself, with computer applications being integrated into the mainstream of job-related training, not isolated in separate courses (Kearsely, 1982).

In this project these findings were used and an attempt was made to tailor the instruction to the needs and interests of the specific groups to be trained, designing

demonstrations, examples and exercises relevant to them. An attempt was also made to integrate the computer training into the group's regular job activities by combining it with the course sections on plant maintenance. In the future, the original idea of a case study approach — combining the two topics would help solidify this merge of Computer Systems into the mainstream.

Though much of the choice may be taken out of the selection of method and media, the educational technologist must make advantageous use of research to justify use of innovative instructional approaches which have been proven effective.

Problem 23: Representativeness of the Trial Run

Before any instructional package is implemented it must be tested with at least one representative sample of the population, and under circumstances similar to that expected in the actual instructional setting. A formative evaluation was included in this project to test the instructional materials and improve them, if possible, before actual use. It also served as a familiarization and practice phase for the new instructors. The problem was that it was

not a simple matter to obtain a truly representative sample of the target population for the trial run. An attempt was made to simulate the target population using people who had just held the same position and some who would likely advance into that position but, on average, the group was somewhat younger and found the instruction more personally and professionally relevant at this point in their careers than did the target group. These differences probably worked to raise their knowledge gains somewhat.

Another problem in the formative evaluation was in simulating the actual classroom environment. The trial run was performed with six students in a headquarters conference room, from 8:00 to 17:00 hrs. each day, for three days duration. Technical help was close at hand at all times. On the other hand, at the actual course sessions there were nine or ten people per class, in a noisy switching yard, working up to twelve hours a day and living in the Training Center during the course. There were frequent periods of computer downtime, slow response, and minimal technical assistance available.

The difference between the two settings

served to paint a somewhat more optimistic picture during the trial run, than could be reasonably expected in the real-life situation, but it was fortunate to have any opportunity or testing. Formative evaluation was definitely not standard practice in the department's technical Training group. The arrangements for the trial run were made by that group and some of the differences were not obvious until the actual courses were underway.

The instructional team should have insisted that the population and setting for the formative evaluation matched those expected in the formal situation. Also more time should have been scheduled between the first formative evaluation and the target date so that revisions and re-evaluation could be completed as required.

Problem 24: Inappropriate Trainees

This problem is related to the fact that a thorough analysis of learner characteristics was not performed. Because a specific population had been selected for training there was little choice, and it would have been difficult to exclude anyone. However, during the course

it was found that there were some amongst the group who: a) did not want the training b) did not need the training. c) did not have the necessary prerequisites or d) would not have the opportunity to use the new skills on the job. The instructional design and development team should have had a greater role in the selection and preparation of participants. Perhaps a "trainability diagnosis exercise" should have been developed to select candidates who would realize the most benefit from the instruction. (Robertson & Downs, 1979; Casey, 1984). Again, the vague role definition of the educational technologist was responsible for some mismatch between training and trainee.

Problem 25: Incomplete Integration of Job and Training

In this project, as in many, participants were given little in the way of preparation or follow-up to integrate job and training and vice versa. Many were dumped from their job into the course and then back to the job. Expectations are unclear. This can tend to depreciate the value of the training and the trainee (Spitzer, 1984). An attempt was made to circumvent the negative effects of this

"dumping" by discussing ways in which the skills and information could be used on the job and by using job-relevant examples during the course.

In addition, thorough assessment of needs and work environments, cooperation of managers and supervisors, and training of a sufficient number of people would have helped guarantee that there was support on-the-job for the new skills. This advance research and follow-up would help ensure that people can integrate their newly learned skills. Only if it is integrated on-the-job will training be effective and enduring, a contributor to organizational efficiency, not an obstacle.

Problem 26: Quality of Instructional Delivery

For in-class instruction, the selection of an instructor is a critical decision. The tone established during in-class sessions will affect the entire performance improvement process. For this project, the educational technologist had no part in the selection of instructors, but should have had. It was fortunate that the initial two instructors had the credibility, subject matter expertise and

natural teaching and selling skills to be effective. However, educational technologists should not rely on luck for the effective delivery of instruction, or in any other stage of the instructional design process. Delivery of content is just as crucial as any other step in determining the ultimate effectiveness of training, and, because it depends on the skills of individuals, those skills should be objectively evaluated before the individual is selected as an instructor.

In this project, the poorly defined role of the educational technologist along with lack of time and personnel, prevented objective evaluation, but educational technologists should insist that instructors be selected and evaluated using valid, fair and reliable instruments if they want the instructional materials used effectively (Caldwell & Marcel, 1985).

After the instruction has been developed and delivered you might assume that the problems are over. Do not. Problems in the evaluation system and in follow-up can still diminish the returns from an otherwise effective training programme.

Problem 27: Incomplete Evaluation System

Evaluation is a systematic means of determining to what extent an instructional programme has achieved its objectives. It should point out the strengths and weaknesses of the programme, so that revisions can be made as necessary. According to Schwind (1975), five categories ought to be evaluated, including: 1) reaction 2) knowledge 3) attitudes 4) behaviour and organizational results. Cost should also be considered (Spencer, 1984).

In this project, only reaction and knowledge gain were measured. There was a gaping hole in the evaluation system for a number of reasons. First, there was resistance to any form of evaluation by management. No one wanted to be held accountable and no one wanted to "test" their peers. The educational technologist insisted that some form of evaluation was mandatory to determine effectiveness. The development and administration of measures of reaction and knowledge gain were permitted when the educational technologist offered to accept all responsibility and be held accountable for the

results. This was not standard practice in the department and was considered quite a breakthrough. Suggestions for measuring attitude, behaviour change on the job and long-term organizational impact were not entertained for primarily political reasons. Management felt that type of evaluation was going too far, prying into the affairs of others.

Something of an adversarial relationship had existed between members of the target group and the Computer Systems group in past and management did not want to 'strain' the new relationship by acting as 'big brother' and 'checking up on' trainees once back on the job. This may have been an excuse for not attempting the difficult measures, but it served to stifle further efforts to measure on-the-job results. No further formal evaluation was allowed. Ongoing informal contact with the trainees, direct and indirect was supposed to provide sufficient follow-up.

This strange adversarial relationship which results when organizational goals are not negotiated properly, coupled with the reluctance to be held accountable, make it

difficult for any training function to gain credibility. These problems lead to a training function's productivity being evaluated by the number of programmes run, rather than by a programme's ability to improve performance or have impact on the organization. If educational technologists are interested in quality above quantity of programmes, they will have to work to convince management that a total system of evaluation is necessary. The evaluation of training should focus more on performance and impact, and less on 'customer satisfaction'.

Problem 28: Inadequate Experimental Design

Not only were factors neglected which should have been measured, the design the evaluation was also inadequate. No control groups were used so it is difficult to precisely specify how much of the knowledge gained was due to the training and how much was due to external events. One control group to take the tests but not the training, or two control groups one to take the test but not the training and the other to take the training and the post-test only, would have provided a

firmer basis for concluding that the training produced the desired results (Bass and Vaughan, 1966).

In this project, however, the rigorous design of evaluation was not possible partly because it was difficult to find representative control groups, partly because of management's apparent aversion to formal evaluation, and partly because goals had not been negotiated and thorough evaluation had not been given a high priority.

Problem 29: Inadequate Follow-up

What happens after the formal training is often more critical than what happens during training. Unfortunately, many trainers have a 'hit and run' approach. Programmes are run, then participants are left to find out how to use the information. No matter how well they are taught, if the new skills are not used on the job, the training has not served a useful purpose. One-shot training does not endure. There must be adequate follow-up to ensure that the entropy and inertia do not set in. It is critical that training professionals see their role as a continuing one. A course should be

seen as just the start of the performance improvement process (Denova, 1971).

In the beginning, this project was going to take the hit and run, one-shot approach. However as it developed, job aids and skill transfer materials were incorporated to help trainees transfer learning from classroom to job. Eventually, follow-up courses were planned for supervisors and subordinates to provide some support in the work environment. Regional contacts were brought in to provide assistance and informal communications between trainees and instructors were encouraged. As the management's focus gradually expanded to include more of the whole system, follow-up became an integral component, linking the subgroups and courses. The integrative role of the training function became more obvious. This need for adequate follow-up could have been anticipated and provided for at the outset had a thorough analysis been done, which focused on the whole system rather than on a fragment of it.

Problem 30: Inadequate Cost/Benefit Analysis

Surprisingly, throughout this project no

one was overly concerned with analysing costs or benefits. Perhaps because the training function within the Computer Systems group was not formally established and/or because it used support staff and facilities from another group, no estimates of costs were demanded and no budget was set up. Money spent on the training programme was absorbed into other accounts. No one was sure how much it cost until the educational technologist made a rough estimate after the fact. Even then, the figures were to be kept confidential.

The reluctance to account for costs may stem from the prevailing belief that training cannot be expected to achieve verifiable and measureable impact or improvement to on-the-job performance. If costs are recorded, they must be justified and it is difficult to measure the benefit to balance the cost.

In many training groups, only the costs are recorded. Benefits are widely considered too difficult to quantify. However, calculating only costs forces the quality of training to be evaluated by costs alone; the more programmes produced or administered at the cheapest price, the better the training group is rated. This is not an accurate measure of quality and

reinforces the erroneous assumption that quality can be equated with quantity.

Management may believe that quantifiable benefits from training may not be forthcoming or that they are too difficult to measure. But, with no measureable benefits to balance the costs, no return on investment can be calculated. This makes management nervous. All projects are supposed to be justified with an R.O.I. Rather than attempting to put a value on the benefits or impacts, which result from the expenditure, often neither costs or benefits are calculated. This 'avoidance behaviour' is what took place during this project. No explanations for costs were required, but no one knew if the programme was justified through its benefits or not.

If the training function is to gain credibility and be evaluated by the quality rather than the quantity of its programmes, measurements of cost effectiveness must be made. Cost/benefit analysis should become a mandatory step in the instructional design process, to be undertaken in the analysis phase, before development begins.

Costs are quite easily estimated, especially if records from past projects are

available. Benefits and impacts will be more difficult to assess, but attempts must be made if the training function is to justify its work. Recent literature suggests that calculating the benefits or training may not be as difficult as once thought (Spencer, 1984), but this field deserves greater attention.

When training groups can accurately demonstrate the cost effectiveness of their programmes, they will be treated as equal and accountable by management. Only then can the value of their products be fairly evaluated.

5.2 A Checklist of Possible Impediments to Effective Training

The purpose of analysing this project and its problems is not to frustrate other who try to put the theory of educational technology into practice, but to demonstrate that we who practice educational technology, must be adaptive to survive in complex socio-technical organizations. Knowing that these problems can and do exist in many organizations, the educational technologist had a head start toward solving them.

The checklist on the next pages lists some of the questions that an educational technologist should ask in preparation for, and throughout any training project.

Before a project begins these questions can be

reviewed privately to broaden the focus of the initial analysis and help ensure that all relevant factors will be considered.

During ongoing negotiations of goals, roles, and processes, the checklist can be used unobtrusively to structure interviews, clarify expectations, and encourage commitment to a complete process of performance improvement.

As the process of instructional design, development, delivery and evaluation progresses, the checklist can be used to supplement simpler models of the process to help ensure that all potentially influential factors are being considered.

When a project is completed, the checklist can be used to help analyse outcomes by pointing out where any problems may have occurred.

It is hoped that the checklist will prove to be a useful guide to educational technologists working in industry, and that it will be refined and developed through use.

A Checklist of Potential Impediments to Effective Training

This checklist is meant to help educational technologists pinpoint impediments to effective training so that problems can be anticipated and circumvented or resolved if possible.

It is to be used as a guide at any stage of the instructional design or performance improvement process; before, during or after a project.

If in going through it, a problem is found which can or does threaten the success of the project, try to determine why it exists and how it can best be resolved.

	<u>Possible Problem?</u>	<u>Impact</u>
Are the goals of the organization clearly defined?	_____	_____
Is training and/or instruction needed? Or will training/instruction contribute to the achievement of organizational goals?	_____	_____
Are the goals of the instruction clear?	_____	_____
Is there real commitment by management?	_____	_____
Will there be sufficient supervisor involvement?	_____	_____
Is the role of the educational technologist well defined?	_____	_____
Is training seen as instrumental to the goals of the organization?	_____	_____
Are valuable results expected from training? Will there be an attempt to measure the value of the results?	_____	_____
Is training seen as functional, as opposed to purely educational or a social responsibility?	_____	_____

	<u>Possible Problem?</u>	<u>Impact</u>
Will there be adequate provision for the transfer of training to on-the-job performance or is it merely <u>assumed</u> that training will be applied on-the-job?	_____	_____
Is training seen as essential, not just a fringe-benefit?	_____	_____
Is the organization open to varied methods of training to suit the need?	_____	_____
and Can a "course mentality" be overcome?	_____	_____
Can a "classroom mentality" be overcome?	_____	_____
Can a "duration fixation" be overcome?	_____	_____
Is there an accurate concept of quality in training? and Is quality not simply associated with quantity of programmes run or number of trainees attending?	_____	_____
Will a thorough assessment of needs be possible?	_____	_____
Will the focus on long-term results, not simply on "quick fixes"?	_____	_____
Will the focus be on high priority needs?	_____	_____
Will the focus be on the whole system, not just on fragments of it?	_____	_____
Will adequate analysis of trainee entry characteristics and behaviours be possible?	_____	_____
Will adequate analysis of the work environment be possible?	_____	_____
Will thorough task analysis be possible?	_____	_____
Will adequate cost-benefit analysis be possible?	_____	_____
Will thorough instructional analysis be possible?	_____	_____

	Possible Problem ?	Impact
Are there adequate resources (time, money, people, materials) to develop, produce and deliver the instruction?	_____	_____
Will objectives be matched to identified needs?	_____	_____
Will content be selected in accordance with needs and objectives?	_____	_____
Will methods and media be selected in accordance with need, objectives and content?	_____	_____
Will thorough formative evaluation be possible?	_____	_____
Will appropriate trainees be selected for this instruction?	_____	_____
Can integration of training to the job be built into the programme?	_____	_____
Will the quality of instructional material be acceptable?	_____	_____
Will a complete system of evaluation be built into the programme? and	_____	_____
Will it include measures of reaction?	_____	_____
learning?	_____	_____
attitude?	_____	_____
behaviour change?	_____	_____
organizational results?	_____	_____
Will adequate design for evaluation be incorporated?	_____	_____
Will there be adequate followup to training be provided for support and feedback?	_____	_____
Is it worth it?	_____	_____

5.3 Conclusion

The foregoing analysis has shown that problems were encountered at every stage in the instructional design process. Through analysis, design and development to delivery, evaluation and follow-up, there were inadequacies, interventions and misconceptions forcing compromises. Fortunately, the project was successful overall despite the many obstacles, but it is obvious that it could have had much more impact had some of the major problems been resolved.

Many of the problems experienced grew from the fact that there was no negotiation of goals for the organization as a whole (Boyd, 1982). The Senior Manager of the Computer Systems group was unwilling to make the necessary commitment to training because the long-term goals of the organization were unclear. Because his goals remained short term only, adequate analyses, evaluation and follow-up could not be justified and build into the instructional design. The result was less than optimal impact.

Much of the success of the project can be attributed to the fact that many other members of the organization, the instructional team included, were willing to open up channels of communication, to take a holistic view of this organization and accordingly adjust subsystem goals to reach a more global goal. These members of the organization were willing to have their individual goals challenged

and changed as a result of interaction. They were ready to adapt in an effort to benefit themselves and the organization through effective use of the Computer Systems.

Values in the work force are changing and the mismatch of goals encountered in the project may have been due to the fact that the Senior Manager was still operating under the old authoritarian system, while many of the other system members had adopted a new value system (The New Work Force, 1984). The Senior Manager wanted publicity, but within the status quo, while many of the other subgroups wanted to learn, change, develop, be challenged and transformed. This is a positive trend because it is adaptive organizations which have the best chance for survival and growth in these times of rapid technological change (DeGreene, 1982).

With the catalyst of the recent bestseller In Search of Excellence (Peters & Waterman, 1982) there have been reams written about "corporate culture". Although the authors define it simply as the shared values conveyed by the organization's myths, stories and legends, this catchy concept is now used so broadly that it may no longer be useful (Kanter, 1983).

Whatever the terminology, an organization's culture, processes, rules, relationships and/or structure is prescribed by its goals. In the organization which has been the topic of this report, cultures were in conflict because system goals had not been negotiated. The Senior Manager

of the Computer Systems group still clung to vestiges of the older culture in which autocratic decision-making was the norm and the company came first. Many other members of this organization were opening up to a new culture or at least a new matrix-type structure, where communication and negotiation can lead to the attainment of both individualized interest and the common good (The New Work Force, 1984). This new "culture" requires greater participation and commitment on the part of its members, but the rewards are that the system continually works toward mutually negotiated goals which allow for both personal and corporate advancement.

During this project it became apparent that the training and instructional development function could exert great influence on the culture of the organization. By encouraging and promoting communication and by seeking to demonstrate the commonalities between individual and corporate goals, the process of instructional design and delivery began to cause changes to the processes and relationships within this organization. In the process people began to perceive the benefits of establishing and working towards common, system goals rather than pursuing only their own objectives. Eventually, even the Senior Manager began to see how the two types of goals could compliment and reinforce each other, though he never did adjust to the point of providing real commitment to training.

Adaptive organizations have the best chance of survival and growth in these times of rapid technological change and the training/instructional design group can play an integral role in the process of adaptation. As another best selling author points out "high touch" must accompany "high tech" (Naisbitt, 1982). The training group can be the agent of change in an organization encouraging communication and working toward the ongoing negotiation of system goals. To promote flexibility, the training group itself must be adaptable, revising its tools and methods and seeking new goals as required.

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