FINAL REPORT

TITLE: DEVELOPMENT OF A PLANNING MODEL FOR THE DEPARTMENT OF TELECOMMUNICATIONS FOR THE FEDERAL GOVERNMENT

BY: DR. A. BEN HASSINE

FOR: THE MINISTERY OF COMMUNICATIONS, OTTAWA

BY VIRTUE OF A CONTRACT N°: 0SU80-00172 - MINISTERY OF SUPPLY AND SERVICES

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SUMMARY

A planning model has been developed including the process of long range planning for the Department of Telecommunications in relation with all Departments of the Federal Government. This process consists of six majors phases:

1. Technological forecast
2. Data Collection
3. The establishment of specific objectives
4. Development of strategies
5. Departmental long range planning
6. Formulation of annual plans

The revision of the organization and control of operations are part of the process.

To make this model operational, most information for each phase is extracted from The Annual Review of Telecommunications in the Government of Canada 1979/80 and The Report on Telecommunications Management within the Department of Communications especially the part of the recommanded organization structure pages 22-30. The intention of integrating information from both the Annual Review and the report is to facilitate the understanding of the use of the model and its application by the Department of Communications as well as by all Departments involved in long range planning in Telecommunications. An appendix includes the use of the Crititial Path Method (C.P.M.) and Program Evaluation and Review Technique (PERT) as tools to be used as recommanded in section: Departmental Annual Plans and Budget page 14.

The Government Telecommunications Agency (CTA) is now maintaining an organization to pursue effective planning and coordination, and to provide consulting (including engineering support) services on request to assist those departments which may require assistance in their own planning; where workload permits,

Guidelines (Guide on Telecommunications Administration 1976, p. 13)

Departments should contact DOC early in the planning of projects requiring telecommunications support in order to:

a) identify services that have potential for consolidation with existing or planned shared networks and where better prices or conditions could be obtained through central procurement;
b) ensure compatibility with national telecommunications objectives; and
c) support DOC in the improvement of government, wide planning and co-ordination of shared and customized telecommunications services for departments.

In the initial assessment of new communications requirements, departments should assemble basic information for planning purposes, talking into account such factors as the volume and distribution of traffic, speed of services, security requirements, reliability of service, accuracy, survivability (continuity of service), inter-operability.

In the other hand DOC shall provide departments with information on existing and proposed shared and customized telecommunications services and other available services; this information shall also include standard delivery time after formal requests,

performance standards and the conditions under which all authorized users can receive telecommunications services through GTA at standard prices, as established by DOC in consultation with the Telecommunications Advisory Committee.

This of course require DOC to establish a technological forecasts based on up-to-date information from the private sector in telecommunications. The process consists of factor analysis of generic telecommunications development (trends and impacts), including electronic messaging, office communications/automation, teleconferencing, "Telidon", open system interconnection and space technology, policy, socio-economic and human factors. By doing so, the DOC will be in better position to determine majors technological trends in telecommunications and to make sound recommandations to all departments according to their needs and to economy of scale. It is necessary that DOC establish a process of planning by which it will achieve a true role of planning in telecommunications.

A real problem seems to exist in the planning process by departments. Some major departments indicated that they were aware of the extent to which new information technologies could reduce their costs and were actively investigating how to apply them. Most departments appear to think in terms of expanding existing facilities to meet future needs rather than exploring new options[1].

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(1) Annual Review of Telecommunications in the Government of Canada 1979/80.

Worth nothing also is the fact that the number of major changes foreseen (i.e. those which will cause costs and/or personnel requirements to rise or fall by more than 10%) is only slighly more than half the number recorded last year. Some of this discrepancy is accounted for by the fewer number of respondents who submitted the major change chart. The rest may be due to uncertainty engenderedby recent frequent changes in government and/or a more studied attempt at forecasting. The proportion of major changes recorded for each category (i.e., voice, record message, data, other data, image and video) is similar to that of last year, although data overtakes voice in the lead. Most of the changes reported are for basic administrative communications, and in fact this is the form of Communications system used by the majority of departments. Relocation plays less of a role as a source of change than last year, and plans to expand user access to data bases become an important factor.

The meaning of the above findings is clear: there is still little coherent planning outside the very large user departments, and little understanding of the opportunities represented by new Communications technologies. The reason is largely lack of expertise, not only in the emerging integrated technology and its applications, but also in basic telecommunications. This is particularly true in the regions. Thus, it is disappointing to note that only nine respondents report that funds are available to provide training for telecommunications personnel. Furthermore, virtually no increase in the numbers and rank of personnel is forecast, despite the fact that most departments have no

management-level capacity in telecommunications[2].

Major undertakings

The department has established a panel of experts, incorporating DOC expertise in various facets of telecommunications to undertake the long range planning and development of government telecommunications applications and infrastructures to meet its stated objectives. The general methodology entails a multi-phase process including:

Phase I - Assessment of telecommunications applications in the government

The process consists of a factor analysis of generic telecommunication applications (trends and impacts) and will involve a review of subject matters and user requirements for telecommunications applications to satisfy perceived government needs. The subject matters will include areas such as electronic messaging, office communications, automation, teleconferencing, Telidon, open system interconnection and space technology applications, etc. Environmental factors such as technology, policy, socio-economic and human factors will be considered.

Phase II - Evaluation of the level of demand of telecommunications applications and user requirements in the government

This will involve consultation with government departments and the telecommunication carriers and industries.

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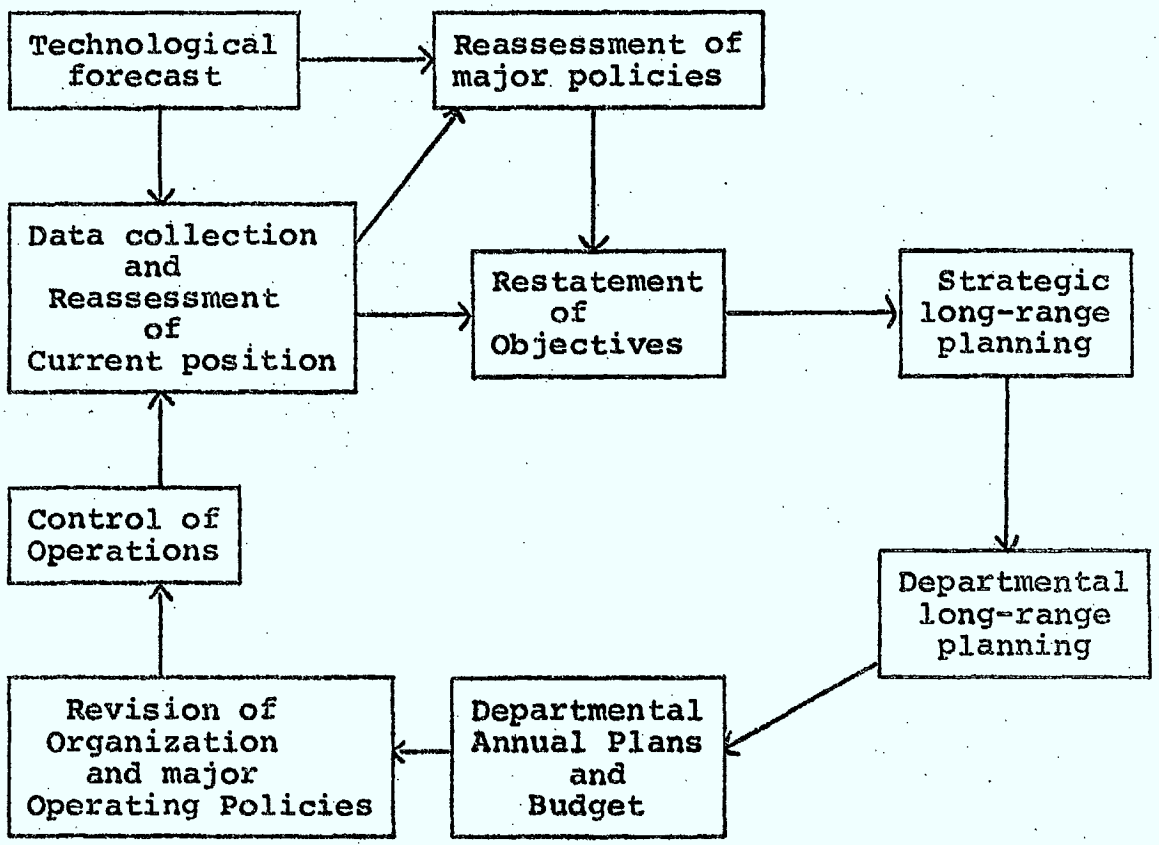
(2) Annual Review of Telecommunications in the Government of Canada 1979/80.

Phase III - Determination of the requirements for government telecommunication infrastructures

This activity entails the evaluation of existing and planned systems, networks and services to develop plans for the development of government telecommunications infrastructure required to meet the identified needs.

Proposed planning model



The process of planning

The process of planning can be thought of consisting of six major phases. The first is that of technological forecast in telecommunications, the second is of data collection for an assessment of the DOC resources and capabilities in relation with

all departments and an assessment of its environment. The third is the establishment of specific objectives within the framework of the major policies and reflecting the constraints and advantages found in the DOC and in the environment. Fourth comes the phase of developing strategies and preparing the strategic plan. The fifth consists of departmental long-range planning. Finally, the sixth phase is that of the formulation of annual plans. To the extent that planning is a process, it should be noted that operations, control and revising are a part of the process. The planning model shows how these phases fit together. The key components of each phase are discussed below.

1- Technological forecast in telecommunications

This process projects the trend as well as the impact of generic telecommunication applications including electronic messaging office Communication/construction teleconferencing, "Telidon", open system interconnection and space technology applications, etc.

It is stated that the following technologies will play an important role in future developments:
Satellites will handle an increasing proportion of communications traffic because they provide the high speed, high volume transmission needed to eliminate quening and storage space does not have to be protected or maintained. Furthermore, they render much of the complexity of communications systems transparent (invisible) to the user. Roof top - to - roof top transmission is now being tested and the introduction of the 32 bit microprocessor is likely to spar the use of Satellites by

demonstrating the inadequacies of wired systems. Fiber optics are expected to be used extensively to provide such high capacity local loops from ground stations, thereby rendering the satellite suitable for interactive communications.

Graphics and voice recognition technology development are also crucial because they are the key to managerial acceptance of office automation. These two technologies will receive a boost from more powerful micro-processors. Highly sophisticated graphics display is now possible, but interactive communication of graphics is still difficult. As for voice recognition, a survey of the latest Stanford Research Institute Publications on Computing shows a full half to be on this subject. Very limited voice recognition is already available. The Video disk, which stores 50,000 pages of information on each side and costs about the same as an ordinary record, is beginning to revolutionize information storage.

2- Data Collection and reassessment of current position

Data must be collected to permit a reassessment of the DOC's and all department's major policies and a restatement of its specific objectives. The data is also necessary for the strategic planning. This data should show the trends for the past three to five years, an assessment of the present situation, a projection for the next five years and some estimates beyond those five years.

The data on telecommunications should include not only the equipments that could meet the needs of the various departments but also the budgets for the projected periods.

Reassessment of major policies

Policy statements (3)

Telecommunications are resources used in the support of government program, to enable departments to meet their objectives efficiently and effectively; as such, they are not an end in themselves.

Departments have the primary responsibility for determining and funding their requirements, and for deciding the best means of satisfying their telecommunications needs:

Policy objectives

Among the policy objectives, it is important to emphasize the contribution of telecommunications to government programs through improved management and operations and the promotion of the sharing and support of sound government-wide and national communication systems, and prevent, wherever possible unecessary duplication in government telecommunications systems. Therefore, the Department of Communications assigned to its services sector the responsibility "to plan and coordinate telecommunications services for departments branches and agencies of the Government of Canada" (department Communications Act, RSC 1970, C-24, 5.5(d)). The Government Telecommunications Agency has the responsibility to plan, establish and manage telecommunications facilities and services that will satisfy the requested needs of federal departments and agencies in an economic basis (TB 714755, September 2, 1972) budgets for the projected periods.

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(3) Guide on telecommunication administration 1976, p. 6.

3- Setting specific objectives

The purpose of policies is to provide guidance for decision-making. Operating policies provide guidance for day-to-day operating decisions; major (DOC) policies provide guidance or direction in the setting of objectives (goals). While a major policy is general, the objectives must be specific to be useful.

The strategic objectives for long-range planning and development of government telecommunications are stated as:(4)

- Use of government telecommunications resources should efficiently and effectively meet the operational and program delivery requirements of government departments and agencies;
- Government telecommunications should provide capability for information access and sharing within the government and between the government and the public at large, and capability to ensure connectability of information sources;
- Planning and development of government telecommunications should permit orderly introduction and use of information technology in government operations, ensure that the government realizes fullest possible benefits, and that it supports Canadian industry.

These objectives should be restated in light of technological forecast and new data collected. This exemplifies how the setting of specific objectives can be adapted to the changing needs of DOC.

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(4) Annual Review of Telecommunications in the Government of Canada 1979/1980.

4- Strategic long-range planning

The achievement of the stated objectives require the establishment of long-range plans for the introduction and the use of the technology as well as a framework of policies and guidelines in support of planning, monitoring and co-ordination functions.(5)

Much has been written about business strategy, but each writer seems to define it differently. It is confused with goals, with major policies and with planning. What is strategy in the business world? Why is it so important to top management today?

Strategy is simply the process of devising alternative choices of achieving DOC objectives of relating these choices to departments resources and to the environment, and then selecting the best method of achieving those objectives. The theory or concept of strategy is closely related to probable changes in technology the use of the strategic approach, therefore, is basic to the process of planning, and strategic planning is a key part of the planning process.

The first step in strategic planning is to determine, to project what would happen over the next five years if all departments continued using the same telecommunication technology. It is possible that the results would be favorable, but this is highly unlikely. The most probable result of this projection is inefficiencies in government telecommunications. This brings us to the second step in strategic planning, namely, to determine whether, in the light of the data collection and analysis, the preliminary objectives

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(5) Annual Review of Telecommunications in the Government of Canada 1979/1980.

which have been set for the departments, to be reached in five years, still appear to be realistic. If so, the next step is one of identifying the finite, operational gaps between where these departments are in terms of telecommunications technology and where the objectives say they should be at some specific time in the future.

Once all the operational gaps between present operations in telecommunications and the objectives, have been identified, the fourth step consists of identifying the set of alternatives which are available to close each of the gaps. This is a critical part of the process, the persons engaged in it must be able to let their mind flow freely - all the possible alternatives must be listed in terms of new telecommunications equipments. It is obvious that each objective will present a long string of alternative actions, each with its advantages and disadvantages. The fifth step is the evaluation of risks, costs and benefits associated with each alternative, for each gap, and making the strategic choices necessary to reach each goal.

At this stage there is a set of choices, each of which seems to be best to reach each given objective, but one must be sure that they do not conflict with DOC policies and that they are internally consistant. One must also determine whether the total of the choices of future actions is within the capability of DOC and departments. What personnel and financial resources would be required and what would be the approximate combined financial results? The sixth step, therefore, besides reviewing personnel

requirements is to prepare budgets and cost benefit analysis for each year of the planning period. These need to be rough approximations to assess the realism of the goals and the set of strategic choices. It is not unusual to discover, at this stage, that some modifications to goals or to strategy may have to be made. It may prove advisable to be more aggressive in seeking new technology and setting goals, or, to choose a less risky path in reaching set goals.

The final step is that of preparing the written strategic plan. This will consist of:

(a) a summary of departments present position in terms of telecommunications usages;

(b) a statement of the objectives to be reached at some point (5 years) in the future;

(c) a description of each strategic course of action chosen to reach each stated goal, including an assessment of the risks and costs and accompagnied by a listing of the other alternatives which were considered for each goal;

(d) the set of preliminary financial resources and budgets showing probable results over the life of the plan.

5- <u>The operational plan</u>

After approval of the strategic plan, it must be broken down into operational categories and responsibility for each category assigned to a specific individual in each department. Depending upon the size of each department, a given manager may have responsibility for one or more of these operational planning categories. That individual must set the goals to be attained

each year for that operation; indicate the steps to be taken to achieve those goals, and detail the resource requirements in terms of manpower and cash over time. In a military sense, this operational plan can be thought of as consisting of tactics which show what each unit must carry out and when it should be done. According to the Guide on Telecommunications, "Departments must develop short and long term telecommunications plans and contact the DOC early in the planning of projects requiring telecommunications support in order to:

a) identify services that have potential for consolidation with existing or planned shared networks and where better prices or conditions could be obtained through central procurement;

b) ensure compability with national telecommunications objectives; and

c) support DOC in the improvement of government-wide planning and coordination of shared and customized telecommunications services for departments".

6- Departmental annual plans and budget

After completion and agreement upon the long term operation plan, it is necessary to make the short-term plan, which is associated with the annual budget. This short-term plan and annual budget should coincide in every way with the first year of the long term plan to achieve the goal set for the end of first year. This plan will be divided into twelve monthly periods and can, therefore be based on projected costs which are more detailed and accurate than those used for the long-range plan.

Planning for requested telecommunications services is provided by the Government Telecommunications Agency which develops one-year operational plans for the forthcoming fiscal plus one year as well as longer range plans for new services. The Government Telecommunications Agency maintains an organization to pursue effective planning and co-ordination and to provide consulting services (including engineering support) on request to assist those departments which may require assistance in their own planning. For departments with planning expertise G.T.A. can provide advice on how the economies of scale resulting from shared services or customized services can be applied to departmental services.

The following recommendations have been developed to strengthen the departmental telecommunications planning process for the fiscal year 1981-1982.(6)

The departmental Telecommunications Co-ordinator should conduct briefing sessions with senior executive management at headquarters, the Communications Research Center and the regions subsequent to the receipt of the call letter for the 1980-1981 Annual Telecommunications Report and the briefing that the Government Telecommunications Agency already provides the Telecommunications Co-ordinator. This stimulus will augment the written instructions that accompany the Annual Telecommunications Report. The Telecommunications Co-ordinator should also conduct instructional sessions with the actual personnel designated and tasked to complete the Annual Telecommunications Report. The aim of these

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(6) Annual Review of Telecommunications in the Government of Canada 1979/1980.

initiatives is to sensitize senior management to the increasing importance of operational telecommunications and to ensure that the inputs to the Annual Telecommunications Report are accurate and comprehensive and reflect both incremental and foreward planning. Senior executive management and senior management should be held accountable for the submissions of their respective sector and responsibility centres. The Telecommunications Co-ordinator should also request the return of the inputs early enough to allow for review, verification, amendments and consolidation of the inputs. The critical path method, and program Evaluation Techniques (CPM/PERT) are recommended for this process.

For those departments in which telecommunications are an integral part of the strategic and tactical requirements and responsibilities, the telecommunications planning process is detailed and sophisticated. Such departments include the Department of National defense, External Affairs, and Transport Canada. However, when telecommunications are used primarily as part of the administrative support for departmental programs. The planning process is less well developed.

Revision of organization and major operating policies

DOC as well as all departments must constantly modify and refine the mecanism by which they achieve their purposes-rearranging, their structure of roles and relationships and their decision making and control processes. The dynamic process of adjusting to environmental change and uncertainty of maintaining an effective

alignment with the environment while efficiently managing internal interdependencies - is enormously complex, encompassing myriad decisions and behaviors at several organization levels. The ability to enact a new or different environment is significantly constrained by what is known about allocating, structuring, and developing resources in the form of organizations. Since their appearance as a social invention, organizations have evolved through several distinct forms. Each of these new or modified forms has enabled manager to accomplish objectives previously considered unattainable.

Furthermore, each new form or organization has also required a new, or at least expanded, theory of management before it became practically useful. If managers believe that people cannot be properly guided, coordinated, and controlled within a new type of organization, then they are unlikely to behave in a way that will allow the system to become fully operational. Changes in managerial attitudes and behavior must usually precede changes in organization design. As it has been argued that although organizational adaptation is a complex and dynamic process, it can be broadly conceptualized as a cycle of adjustment potentially requiring the simultaneous solution of three major problems: entrepreneurial (domain definition) engineering (technology) and administrative (structure-process and innovation).

The Engineering Problem

The engineering problem involves the creation of a system which puts into actual operation management's solution to the

entrepreneurial problem. The creation of such a system requires management to select an appropriate technology (input - transformation - output) for distributing the chosen services and to form new information, communication and control linkages (or modify existing linkages) to ensure proper operation of the technology.

As solutions to these problems are reached, initial implementation of the organizational system takes place. However, there is no assurance that the configuration of the organization, as it begins to emerge during this phase, will remain the same when the engineering problem finally has been solved. The actual form of the organization's structure will be determined during the administrative phase as management solidifies relations with the environment and establishes processes for co-ordinating and controlling internal operations.

The Administrative Problem

The administrative problem, as described by most theories of management, is primarily that of reducing uncertainty within the organizational system, or, in terms of the present model, of rationalizing and stabilizing those activities which successfully solved problems faced by the organization during the entrepreneurial and engineering phases. Solving the administrative problem, however, involves more than simply rationalizing the system already developed (uncertainty reduction); it also involves formulating and implementing those processes which will enable the organization to continue to evolve.

Rationalization and articulation

In the ideal organization management would be equally adept at performing two somewhat conflicting functions: it would be able to create an administrative system (structure and processes) that could smoothly direct and monitor the organization's current activities without allowing the system to become so ingrained that future innovative activities would be jeopardized. Such a perspective requires the administrative system to be viewed as both a lagging and leading variable in the process of adaptation. As a lagging variable, the administrative system must rationalize, through the development of appropriate structures and processes. As a leading variable, on the other hand, the administrative system will facilitate or restrict the organization's future capacity to adapt depending on the extent to which management articulates and reinforces the paths along which such activity can proceed. When management embarks on a program of organizational change without considering the entrepreneurial enginneering, and administrative problems as interrelated aspects of the adaptive process, the results are frequently undesirable.

Report on Telecommunication Management with the department of Communications recommends the designation of a Telecommunications Co-ordinator at the senior level position to ensure the provision of efficient and effective telecommunications services to the Departmental population which is approaching 2,000 person years; to control the current Administrative Services Branch budget of approximately $850,000; to co-ordinate telecommunications expenditures that will exceed $7,250,000 this fiscal year; and, to cope with complex

merging technologies, the following organizational recommendations should be implemented.

a. The Administrative Services Branch should recommend, through the appropriate channels, the designation of additional functions and specific terms of reference to the Departmental Telecommunications Co-ordinator position which should be at a senior level within the Branch. The framework for the terms of reference and job description for the Telecommunications Co-ordinator are well portrayed in the "Occupational Profile for Departmental Telecommunications Co-ordinator". The Telecommunications Co-ordinator Profile was developed by the Public Service Commission, in conjunction with the Government Telecommunications Agency. The following list of major functions and sub-functions of the Telecommunications Co-ordinator was extracted with some minor editorial changes from the Profile.

(i) Advise management on telecommunications matters.

- Provide updated information on telecommunications services.
- Inform the Department of existing policies, directives, guidelines and practices.
- Develop Departmental policy, directives and guidelines that are consistent with federal government objectives.
- Advise managers on budget forecasts for telecommunications services.
- Provide briefing sessions to Departmental personnel on telecommunications matters.

(ii) Act as the Departmental representative with other departments and central agencies.

- Represent the Department to discuss policies, directives as guidelines with central agencies.
- Represent the Department to discuss how to meet identified needs in telecommunications with Department of Communications/central agencies and commercial carriers and suppliers.
- Prepare administrative reports.

(iii) Develop short and long term plans for telecommunications.

- Provide for the collection and aggregation of Departmental data.
- Formulate the Departmental plan.
- Assess if the Departmental plan is compatible with national telecommunications objectives.
- Prepare reports in accordance with Treasury Board Secretariat requirements.

(iv) Address major changes in Departmental operational needs in Telecommunications.

- Assess on-going changes and needs concerning Departmental telecommunications.
- Recommend action.
- Ensure implementation of approved actions.

(v) Ensure effective use of telecommunications facilities.

- Establish standards for quality of systems/service.
- Maintain an inventory of equipment.
- Maintain an adequate reporting system on the use of facilities/equipment.
- Assess/analyse the use of telecommunications services in areas such as:
  cost effectiveness;
  efficiency, and;
  compliance with standards.
- Recommend actions to modify/improve the use of telecommunications.

(vi) Co-ordinate acquisitions of telecommunications facilities.

- Recommend/approve the acquisition of equipment/services.
- Negotiate needed services/equipment with appropriate organizations.
- Ensure that acquisitions are made in accordance with accepted practices.

(vii) Monitor Departmental telecommunications expenditures and compliance with central agency policies.

- Maintain information on Departmental telecommunications expenditures.
- Recommend correcting actions to deviations in expenditures.

- Authorize payment under section 27 of the Financial Administrative Act and ensure proper delegation as required.
- Ensure compliance with central agency regulations and policies.

(viii) Ensure the adequacy of security measures for telecommunications facilities in consultation with the Departmental officer responsible for telecommunications security.

- Advise management of the need of communications security.
- Develop telecommunications security procedures.

(xi) Exercise supervision.

- Supervise employees.
- Perform functional supervision of the telecommunications.
- Co-ordinate functions in the regions and district offices.

b. The Departmental Telecommunications Co-ordinator position should be a relatively discrete telecommunications position at a senior level with much less emphasis on accommodations. This senior level should be commensurate with the full complement of functions, sub-functions, tasks, duties and responsibilities of the position. Until the full complement of functions is delegated and undertaken by the position, an interim shadow position could be created to assume the lower

and middle level responsibilities in the hierarchy of the Telecommunications Co-ordinator functions.

(i) Considerations

The level of this position and the functions ascribed to it will support rapid introduction of the information technology advances that are impacting the working environment faster than personnel job classifications are responding. The level of skills, wage rate and classification of the Telecommunications Co-ordinator should be comparable to that of the Electronic Data Processing Co-ordinator. Federal government expenditures and growth trends on information related activities demonstrate conclusively that information personnel costs are escalating faster than information technology expenditures. This provides telecommunications expertise to offset the escalation of information personnel costs.

The implications of these trends are clear. With the development and implementation of information technology, the government can deliver more programs to the public than by increasing the number of person years in the area of information handling. This becomes very significant when consideration is given to a study conducted by the Department of Communications in 1979 which concluded that 53 percent of all government employees could be classed as information technology must be guided by the principles of planning, justification, control and evaluation of technology. This demands

the high level skills of the Telecommunications Co-ordinator, a job which will probably evolve into that of an Information Technology Manager who will harness and co-ordinate the merging technologies which are identified and ranked in order of expenditures as telecommunications, electronic data processing and office equipment. The government expenditures and growth trends on information related activities are illustrated graphically on the page 27.

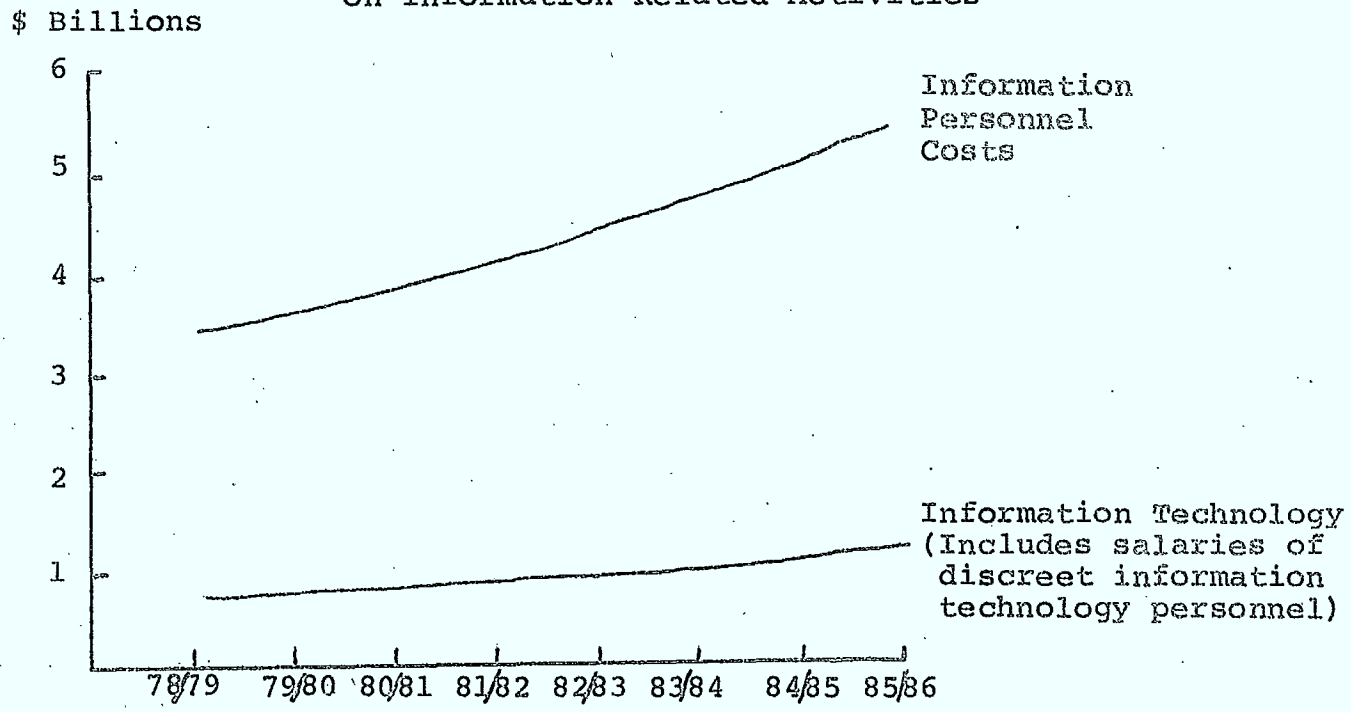
c. The Administrative Services Branch should establish two(2) discrete telecommunications positions in headquarters that would report on a line basis to the Telecommunications Co-ordinator. Three other telecommunications and accommodations positions in the National Capital Area would also report to the Co-ordinator on a line basis. In addition, the Co-ordinator would be responsible of telecommunications co-ordinating function of five(5) positions in the regions outside of the National Capital Area. The component positions of the proposed organization chart are shown on page 28.

d. The Administrative Services Branch should, in concert with the recommendations of the Ad Hoc Committee on Telecommunications Training and Needs Identification Study, and in consultation with the Government Telecommunications Agency and the Public Service Commission, develop training programs to satisfy areas where telecommunications knowledge or expertise is deficient and ensure that these programs foster the ideal of career progression. Quoting the introduction of

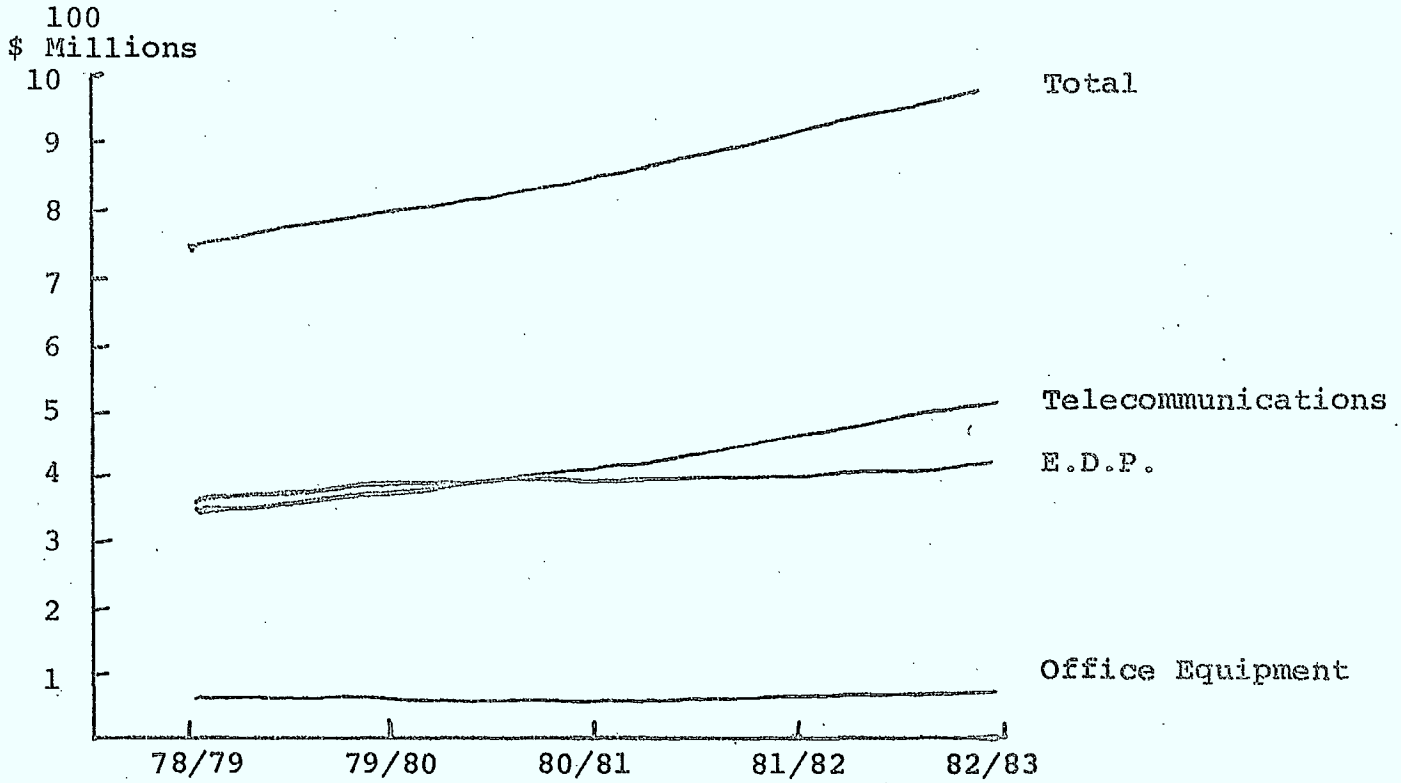
the Report of the Ad Hoc Committee on Telecommunications Training and Needs Identification Study:

> "It is generally recognized that telecommunications training has been neglected in the government. One of the explanations is that 'expertise' has been readily available, at little or no cost, from the private sector. In addition, a definition of the functions related to telecommunications has been lacking and there has not been a clear identification of either management or working level telecommunications functions. As information technology increases its sphere of influence and telecommunications technology becomes an increasingly important resource in support of departmental programs, the lack of resident telecommunications expertise is becoming alarmingly apparent. The government as a whole is approaching annual expenditures on telecommunications of a half billion dollars. We can no longer afford to use someone else's expertise where telecommunications is concerned."

Government Expenditures and Growth Trends
on Information Related Activities



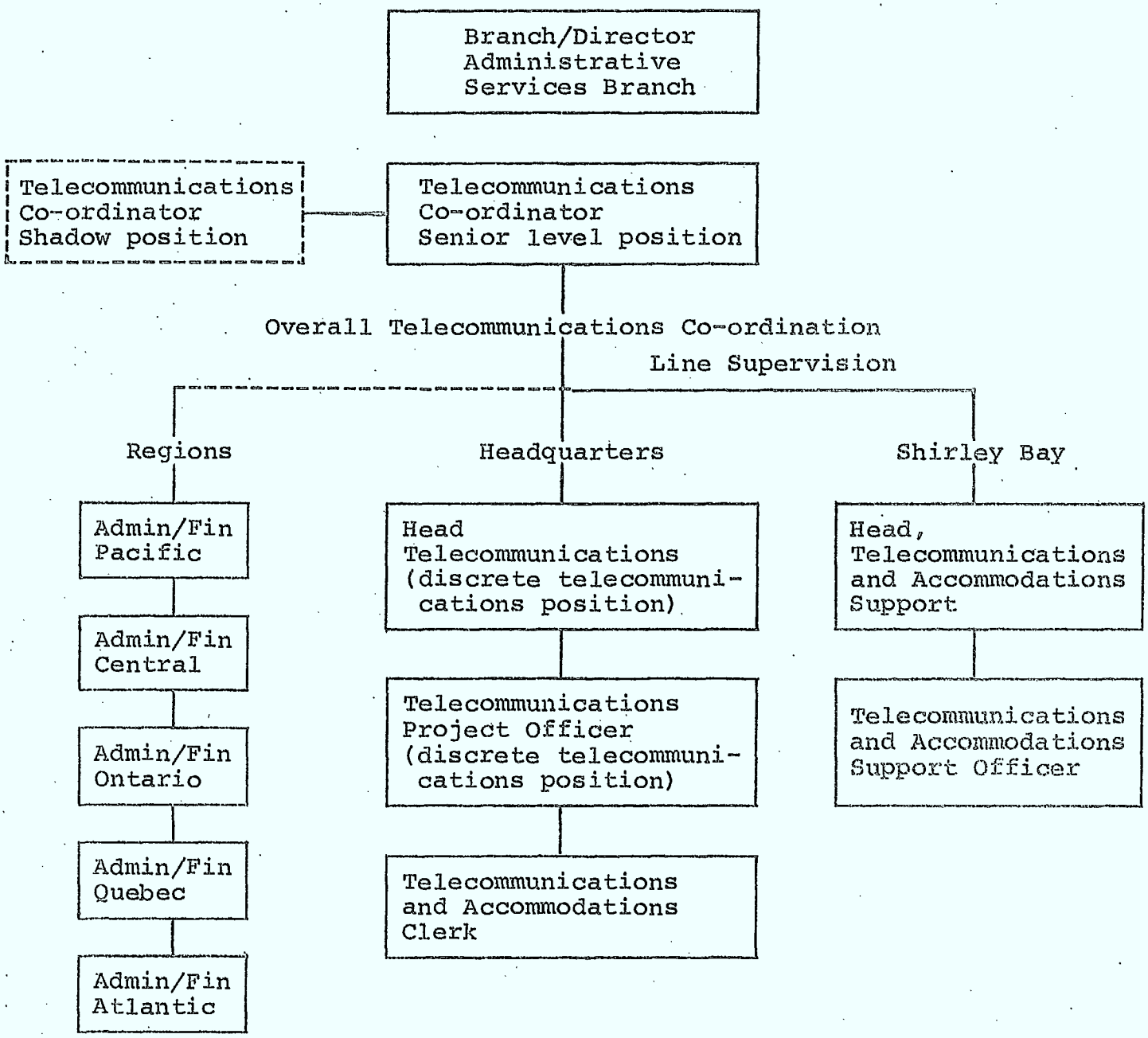
Government Expenditures on Information Technology



Information Technology Expenditures for Fiscal Year 1978/1979

Telecommunication	$ 343 million
Electronic Data Processing	$ 308 million
Office Equipment	$ 41 million
Discreet Information Technology Personnel	$ 50 million
	$ 742 million

ORGANIZATION CHART - ORGANIGRAMME



Departmental Telecommunications Perspective

Departmental Profile	Leader in Planning and Co-ordination
Budget (Administrative Services Branch)	$920,000
Expenditures (Operational Telecommunications)	$7,500,000
Person Years	1,939
Future	Expansive-Telecommunications is the Binding Agent in the Rapid Convergence of High Technology in the areas of Telecommunications, Electronic Data Processing and Office Equipment.

The Government Telecommunications Agency is willing to assist the Administrative Services Branch in the preparation of summary job descriptions for the positions in the organization chart outlined above.(7) However, the Administrative Services Branch must assume the responsibility for the assimilation of the telecommunications functions at the upper and lower echelons of the organization with other mandated operational functions, particularly accommodations and perhaps in the near future, communicating word processing.

The organizational recommendations were based to a large extent on empirical evidence rather than a structured examination of the key result areas (KRA's) because there are no existing reliable numeric and mesurable operational definitions of discrete telecommunications objectives within the Administrative Services Branch.(8) At present, the Head, Accommodations and Telecommunications is responsible for a multitude of common services including maintenance, building services, parking and taxi travel. An in-depth examination of the key result areas would have involved a more global and time consuming approach to encompass all organizational objectives. This approach was beyond the terms of reference and Working Agreement for this telecommunications project, however the Administrative Services Branch has contracted for a comprehensive organizational analysis which will focus on non-telecommunications objectives and the interrelationships with the telecommunications objectives.(9)

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(7) Discussion with Susan Baldwin, Planning and Co-ordination division (DPC), Government Telecommunications Agency, September 19, 1980.
(8) Conversations with D.H. Maryville, June 1980.
(9) Conversation with H. Pragnell, August 1980.

Implementation

An orderly and systematic plan for the implementation of the recommendations must be marshalled by the end of the calendar year to ensure implementation for the next fisal year.

Pending further negotiations, the Government Telecommunications Agency is willing to undertake the project management function of the implementation phase. However, it is apparent that a task force or project team concept should be utilized as the effective implementation of the recommendations will be dependent upon the assistance and co-operation of the Comptroller's Branch, the Computer Services Branch (DCB) and other components of the Personnel and Administration Branch. The Government Telecommunications Agency is also aware of the potential value of other departmental activity presently directed towards the improved management of telecommunications within the federal government. The objective oriented orchestration of Departmental personnel augmented by the Agency co-ordination of other departmental activity will result in the effective, efficient and expeditious implementation of improved telecommunications management within the Department of Communications.

Control of operations

If DOC has not previously engaged in long-range planning in telecommunications according to this model, the process starts with assessment of current position, and then continues around the circle indefinitely. The job of the Co-ordinator becomes much easier. Each month he must review the plan and check

whether the decisions were taken and implementation started, during the preceding month, in accordance with the plan.

A feed-back system must be established so that, again, at the end of each month, the Co-ordinator and other managers receive the necessary information on telecommunications performance and compare it with the projected data in the operational plan. Discrepancies call for corrective action in the form of operating decisions, policy changes or organizational changes. Or, corrective action may be needed because the environment has changed. A five-year plan is necessarily made on the basis of certain assumptions (forecasts) about the environment and it is necessary to state then in detail so that changes from the assumptions can be detected and changes made in goals, strategy or tactics.

In any case, it is advisable to make a reassessment of DOC and all department's current position and to review the external environment each year, and to extend the plan another year, while making the new annual plan and annual budget. In this way one always has a plan extending five years into the future.

APPENDIX

PROJECT CONTROL CHECK LIST:-

(A) PLANNING:-

- FUTURE CHECK POINTS SPECIFIED?
- TASK DESCRIPTION PREPARED?
- RESPONSIBILITY FOR EACH TASK DEFINED?
- REVIEW POINTS AND PROGRESS REPORTS PREPARED?
- REPORTING SYSTEM PREPARED?

(B) IMPLEMENTATION:-

- INDIVIDUALS ASSIGNED ?
- CONTINGENCY PLANS READY?

(C) COMPLETION:-

- FINAL TESTS PREPARED AND AGREED UPON?
- TRAINING PROGRAM PREPARED?
- MAINTENANCE SCHEDULES PREPARED?

III - NETWORK TECHNIQUES:-

A NETWORK IS A GRAPH DEPICTING THE SEQUENCE OF TASKS NECESSARY TO COMPLETE A PROJECT.

PURPOSE

- TO EVALUATE DIFFERENT MODES OF OPERATION (STRATEGIES) BEFORE THE WORK IS UNDERWAY.
- TO PROVIDE A TOOL FOR CONTROL.

TO CONSTRUCT A PROJECT NETWORK

- DETERMINE A LIST OF NECESSARY TASKS.
- ESTABLISH A RESTRICTION LIST SETTING THE ORDER OF ACTIVITY ACCOMPLISHMENT.
- CONNECT THE TWO LISTS WITH A SET OF DRAWING CONVENTIONS.

FUNDAMENTALS

ACTIVITY:-

A TIME CONSUMMING TASK WITH DISTINCT BEGINNING (START) AND END POINTS (FINISH).

EVENT:-

A MILESTONE FOR REACHING A CERTAIN STAGE (START OR END OF AN ACTIVITY).

TIME:-

THE TIME TO COMPLETE AN ACTIVITY LEADING TO AN EVENT.

RESOURCES:-

MEN, MATERIAL, MACHINES, MONEY AND TIME.

CONSTRAINTS:-

RESTRICTIONS OR LIMITATIONS.

CHARACTERISTICS OF NETWORK PROBLEMS:-

- PROJECT CONSISTS OF WELL DEFINED COLLECTIONS OF TASKS.

- TASKS MAY BE STARTED AND STOPPED INDEPENDENTLY WITHIN A GIVEN SEQUENCE .

- TASKS ARE PERFORMED IN A CERTAIN TECHNOLOGICAL ORDER.

IDENTIFICATION OF ACTIVITIES:-

- ACCORDING TO PLANNING OBJECTIVE:-

  - ACTIVITIES REQUIRING A CERTAIN LIMITED RESOURCE SHOULD BE SEPARATED FROM OTHERS.
  - IMPROVED CONTROL: BY DIVIDING ACTIVITIES BY RESPONSIBLE AGENCY.
  - PAYMENTS RECEIVED (IF PROPORTIONED TO A CERTAIN % COMPLETED).
  - PHYSICAL ELEMENTS OF THE FINAL PRODUCT (MOST COMMON).

  ACTIVITIES SHOULD BE WELL DEFINED WITH A START EVENT AND A FINISH EVENT.

RESTRICTION LIST:-

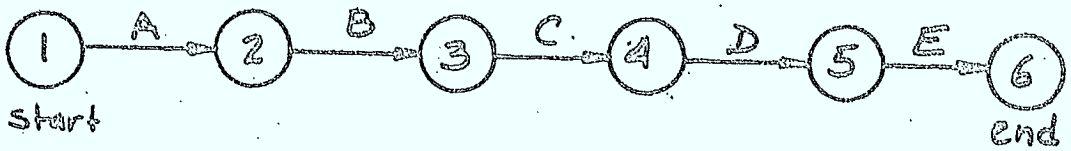
RELATIONSHIP BETWEEN ACTIVITIES:-

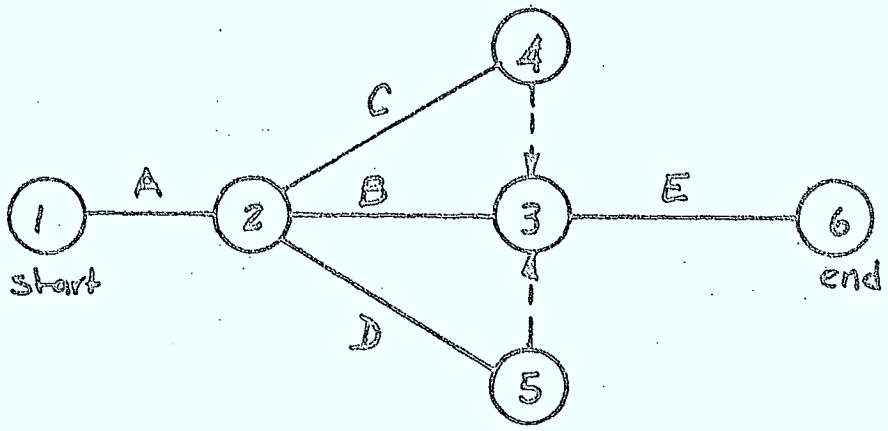
- WHAT MUST PRECEDE (PREREQUISITE)
- WHAT MUST FOLLOW (POSTREQUISITE)
- WHAT MUST BE CONCURRENT (CONCURRENCES)

EXAMPLE:-

ESTABLISHING A NETWORK -

Activity	Description
A.	INVESTIGATE PROJECT.
B.	INDENTIFY ACTIVITIES.
C.	LIST CONSTRAINTS.
D.	ESTIMATE DURATIONS.
E.	CALCULATIONS & PRESENTATION.





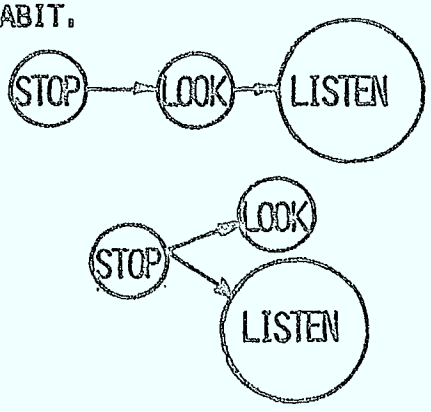
- A NETWORK PICTURES HOW A PROJECT CAN BE DONE.
- A SCHEDULE ESTABLISHES HOW IT IS PLANNED TO BE DONE.

ESSENTIALS:-

ACCURACY :-

- APPRAISE TIME PRIORITIES NOT PRIORITIES SET BY HABIT.

E.G.



COMPLETENESS:-

- IT IS EASY TO OVERLOOK A RELATIONSHIP BETWEEN AN ACTIVITY OCCURING EARLY IN A PROJECT AND ONE OCCURING NEAR THE END.

- PREREQUISITE/POSTREQUISITY RELATIONSHIPS ARE ONLY SHOWN IN THE RESTRICTION LIST.

- A MORE EXTENSIVE LISTING, E.G., ALL JOBS THAT FOLLOW EACH ACTIVITY, IS UNNECESSARY, TEDIOUS AND CONTRIBUTES TO ERRORS.

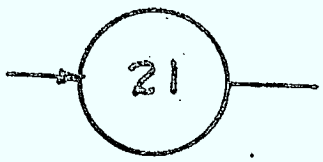
- AVOID TRIVIAL ACTIVITIES.

ACTIVITY REPRESENTATION:-

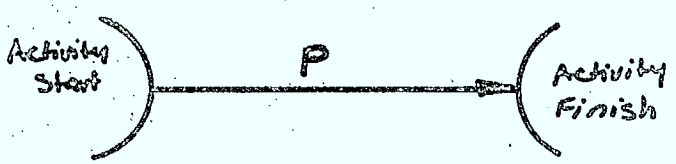
- MILESTONE CHARTS.
- WALL CHARTS.
- GANTT CHARTS.
- NETWORKS.

NETWORK REPRESENTATION

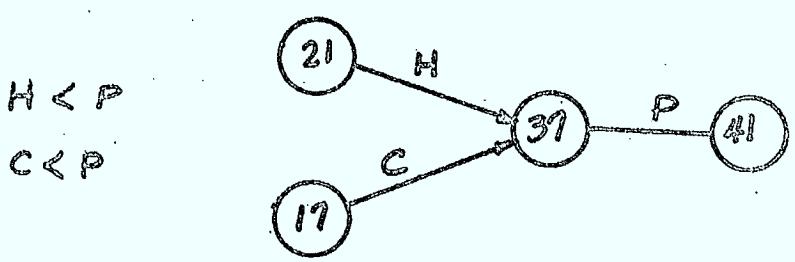
EVENT:- A CIRCLE.



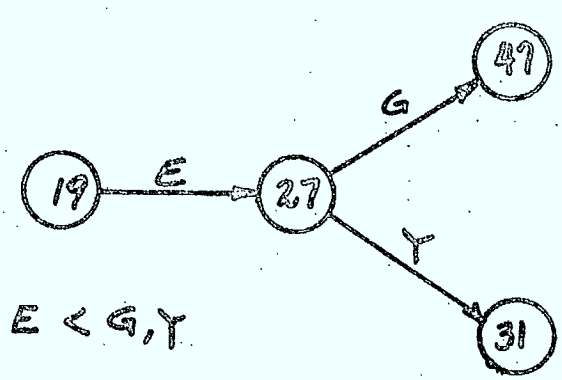
ACTIVITY:- ARROW CONNECTING TWO EVENTS, (NO SCALE ASSOCIATED).



MERGE:- TWO OR MORE ACTIVITIES ENDING WITH SAME EVENT. (SAME TIME).



BURST:- TWO OR MORE ACTIVITIES BEGINNING WITH SAME EVENT.



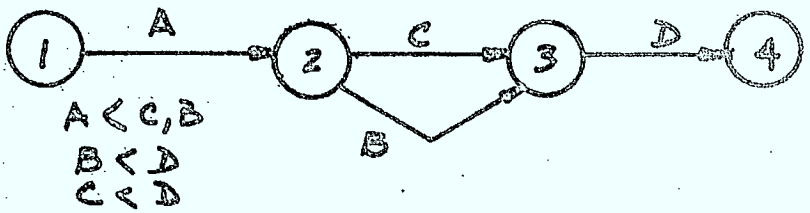
NETWORK VALIDATION:-

- CHECK NETWORK FOR VALIDITY (REPRESENTS PROJECT?)
- NEED MORE ACTIVITIES FOR GREATER SENSITIVITY?
- BETTER WAYS TO DO THE PROJECT?
- NETWORK CONSISTENT (UNIQUE ACTIVITY INDENTIFICATION, CORRECT NUMBERING, NO LOOSE ENDS, ETC.)

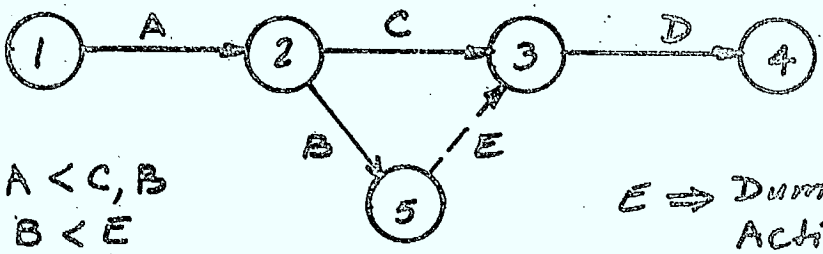
OFTEN NECESSARY TO REVISE ACTIVITY DESCRIPTIONS AS ACTIVITY DURATIONS ARE DEVELOPED:

- ONE ACTIVITY MAY BE INCLUDED IN A DIFFERENT ONE.
- A RESTRICTION LIST MAY SHOW THAT TWO OR MORE ACTIVITIES CAN THEORITICALLY BE DONE CONCURRENTLY BUT, IN PRACTICE, SOME PORTION OF ONE MUST BE COMPLETED BEFORE THE OTHER CAN START.

DUMMY ACTIVITY:- DASHED ARROW.

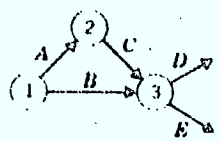
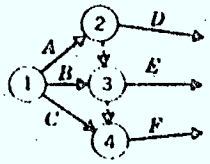
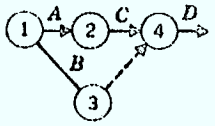
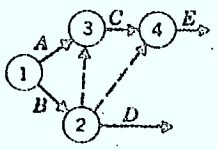
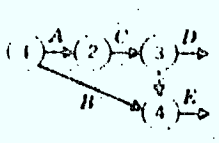
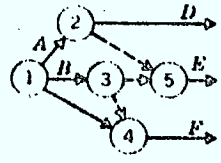
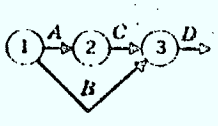
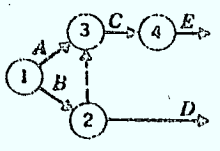


A < C, B
B < D
C < D



A < C, B
B < E
E < D
C < D

E ⇒ Dummy Activity
uses zero resources
zero time

Case	Spillover	Cascade	Unnecessary	Redundant
Restriction	$A < C$ $B < E$ $C < D, E$	$A < D, E$ $B < E, F$ $C < F$	$A < C$ $B < D$ $C < D$	$A < C$ $B < C, D, E$ $C < E$
Incorrect network segment				
	B is not a prerequisite of *D*	*A* is not a prerequisite of *F*	Artificial dummy 3, 4 is unnecessary	*B* is a redundant restriction on *E*
Correct network segment				

Correct and incorrect use of network dummies

GOOD PRACTICE:-

- NETWORKS ARE EASIER TO CHECK IF ALL ARROWS FLOW FROM LEFT TO RIGHT.

- ELIMINATE ARROW CROSS-OVERS AS MUCH AS POSSIBLE.

- LABEL EACH ACITIVITY WITH A CONCISE DESCRIPTION RATHER THAN A LETTER SYMBOL TO AVOID CONTINUED REFERENCE TO ACTIVITY LIST.

- ASSIGN NODAL NUMBERS AFTER THE ENTIRE NETWORK IS DRAWN AND CHECKED.

  (SOME COMPUTATIONAL PROGRAMS REQUIRE A NUMBERING SYSTEM WHERE THE NODE AT THE BEGINNING OF AN ACTIVITY, NODE i , IS ALWAYS SMALLER THAN THAN AT ITS END, NODE j).

IV NETWORK CALCULATIONS:-

PERT - PROGRAM EVALUATION AND REVIEW TECHNIQUE, 1950's.

TO PLAN AND ACCELERATE THE DEVELOPMENT OF THE POLARIS BALLISTIC MISSILE SUBJECT TO UNCERTAINTIES.

PERT IS A TOOL TO PLAN AND SCHEDULE LARGE PROJECTS WITH

- NUMEROUS ACTIVITIES.
- UNCERTAIN COMPLETION TIME.
- CERTAIN SEQUENCE TO FOLLOW.

USE :-

MORE WITH RESEARCH AND DEVELOPMENT PROJECTS.

CPM - CRITICAL PATH METHOD, 1950, DUPONT.

TO OBTAIN A TRADE-OFF BETWEEN THE COST AND THE COMPLETION DATE FOR LARGE PROJECTS.

GIVEN:

- TIME NEEDED TO COMPLETE EACH EVENT - DETERMINISTIC.
- RELATIONSHIP BETWEEN THE AMOUNT OF RESOURCES EMPLOYED AND THE TIME NEEDED TO COMPLETE THE PROJECT.

USE :-

IN PROJECTS SUCH AS CONSTRUCTION, WHERE THERE HAS BEEN SOME EXPERIENCES IN HANDLING SIMILAR PROJECTS.

DATA:-

- o DETERMINISTIC - APPROPRIATE FOR MOST INDUSTRIAL PROJECTS.
- o STOCHASTIC - A RANGE OF POSSIBLE ACTIVITY TIMES .

ESTIMATES DO NOT REFLECT UNCONTROLLABLE CONTINGENCIES, E.G., FLASH FLOODS, LEGAL DELAYS, ETC.

B U T

THEY SHOULD ACCOUNT FOR WEATHER CONDITIONS AND OTHER FACTORS THAT AT LEAST CAN BE ANTICIPATED.

SOURCES OF DATA:-

OBJECTIVE DATA -

- . RECORDS OF PAST PERFORMANCES ON SIMILAR PROJECTS.
- . HISTORICAL DATA : WEATHER RECORDS, SUPPLIER'S LITERATURE, APPLICABLE LAWS AND REGULATIONS, etc.

SUBJECTIVE DATA -

- . FROM PERSONS RESPONSIBLE FOR DOING THE WORK : FOREMEN, SUB-CONTRACTOR, CONSULTING FIRMS, OTHER PROJECT MANAGERS, etc.

RELIABILITY AND APPLICABILITY OF DATA IS BOUND TO VARY ACCORDING TO THE SOURCE.

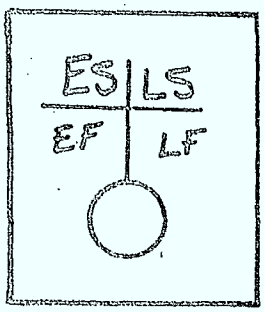
JUDGMENT IS VITAL TO CONVERT GUESSTIMATES TO ESTIMATES.

C P M CALCULATIONS :-

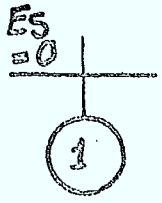
- ACTIVITY DURATION (D)
- EARLIEST START (ES), EARLIEST TIME AN ACTIVITY CAN BEGIN WHEN ALL PRECEDING ACTIVITIES ARE COMPLETED AS RAPIDLY AS POSSIBLE.
- LATEST START (LS), LATEST TIME AN ACTIVITY CAN BE INITIATED WITHOUT DELAYING THE MINIMUM PROJECT COMPLETION TIME.
- EARLIEST FINISH (EF):- ES + D
- LATEST FINISH (LF) :- LS + D
- TOTAL FLOAT (TF), THE AMOUNT OF SURPLUS TIME OR LEEWAY ALLOWED IN SCHEDULING ACTIVITIES TO AVOID INTERFERENCE WITH ANY ACTIVITY ON THE NETWORK CRITICAL PATH; THE SLACK BETWEEN THE EARLIEST AND LATEST START TIMES.

$$TF = LS - ES$$

$$(TF = LF - EF)$$

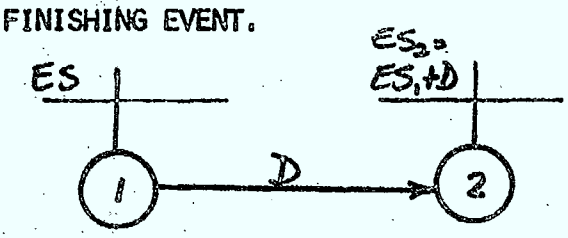


PROCEDURE :-

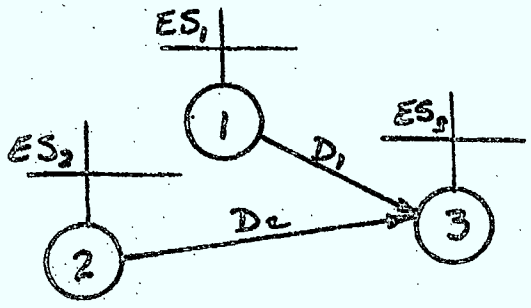


1. SET ES FOR START EVENT = 0

2. FOLLOWING A FORWARD PATH, ADD THE ACTIVITY'S DURATION TO STARTING EVENT'S ES, GIVING ES OF FINISHING EVENT.



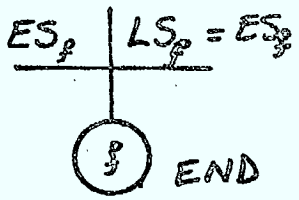
3. FOR MERGES, CALCULATE LIMITING ES, WHICH IS THE LARGEST ES + D FOR ALL MERGING ACTIVITIES.



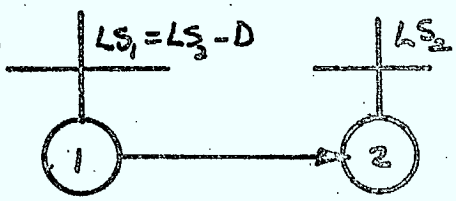
$$ES_3 = \max \begin{cases} ES_1 + D_1 \\ ES_2 + D_2 \end{cases}$$

4. WHEN ARRIVING TO LAST EVENT, THE LAST ES IS THE MINIMUM DURATION OF THE PROJECT.

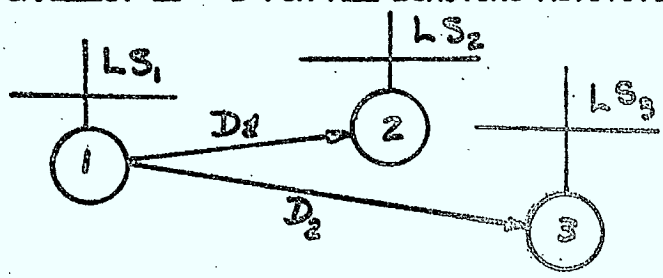
5. To calculate LS, set LS of last event equal to its ES.



6. Following a backward path, subtract the activities duration from LS of its end event giving LS of starting event.



7. <u>For bursts</u>, calculate limiting LS of event, which is the smallest LS - D for all bursting activities.



$$LS_1 = Min \begin{cases} LS_2 - D_2 \\ LS_1 - D_1 \end{cases}$$

8. Continue until reaching starting event.

9. Calculate earliest finish and latest finish at each event.

$$EF = ES + D$$

$$LF = LS + D$$

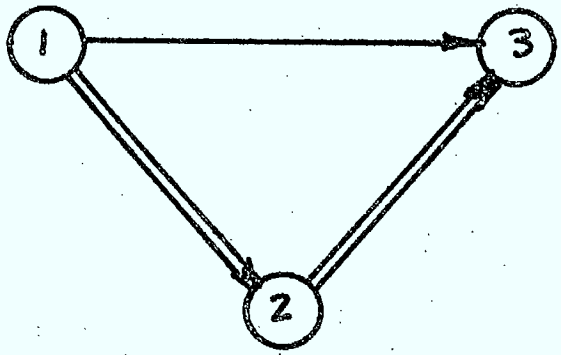
CRITICAL ACTIVITY:- AN ACTIVITY WITH NO LEEWAY.
(ZERO TOTAL FLOAT)

FOR A CRITICAL ACTIVITY -

$$LS = ES$$

$$TF = 0$$

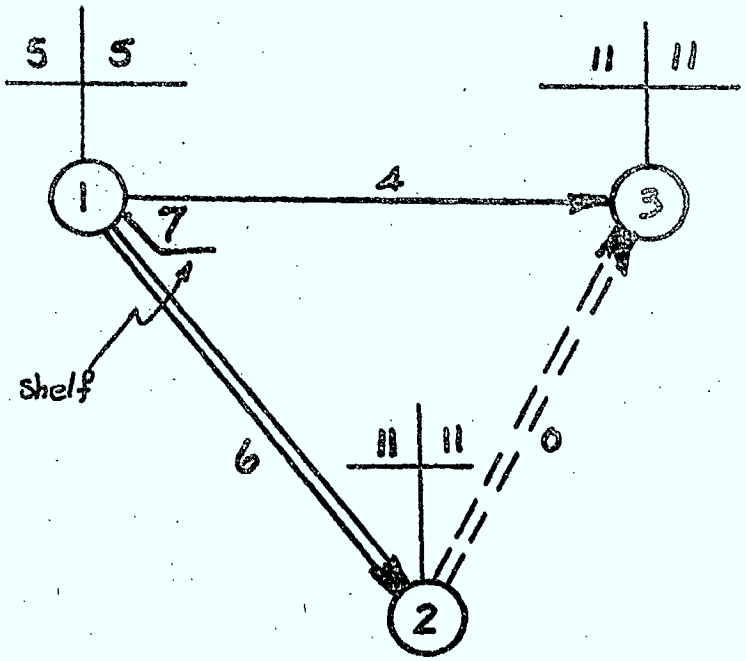
CRITICAL PATH :- THE SEQUENCE OF CRITICAL ACTIVITIES.



INDICATE CRITICAL ACTIVITIES BY DOUBLE LINES.

REMARKS:-

1. EACH ACTIVITY FROM A COMMON EVENT CAN HAVE A DIFFERENT LS.
2. ALL ACTIVITIES STARTING FROM A COMMON EVENT HAVE THE SAME ES.
3. TO ACCOMODATE THIS SITUATION, ATTACH A SHELF TO EACH ACTIVITY IN A BURST THAT HAS LARGER LF VALUE THAN THE LIMITING ONE.

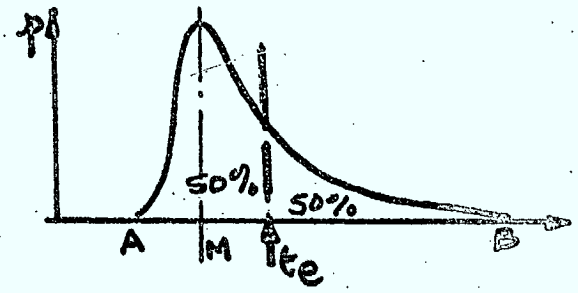


P E R T CALCULATIONS

THREE ESTIMATES ARE GIVEN FOR EACH ACTIVITY:

- OPTIMISTIC (A) EVERYTHING GOES RIGHT.
- MOST LIKELY (M)
- PESSIMISTIC (B) EVERYTHING GOES WRONT.

BETA DISTRIBUTION IS ASSUMED.



EXPECTED TIME OF ACTIVITY $t_e = \frac{A + 4M + B}{6}$

(50% PROBABILITY)

t_e IS USED AS A SINGLE ESTIMATE IN DETERMINING THE CRITICAL PATH AND BOUNDARY AS IN CPS.

VARIANCE OF ACTIVITY

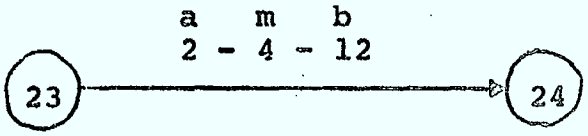
$$\sigma^2 = \left(\frac{B - A}{6}\right)^2$$

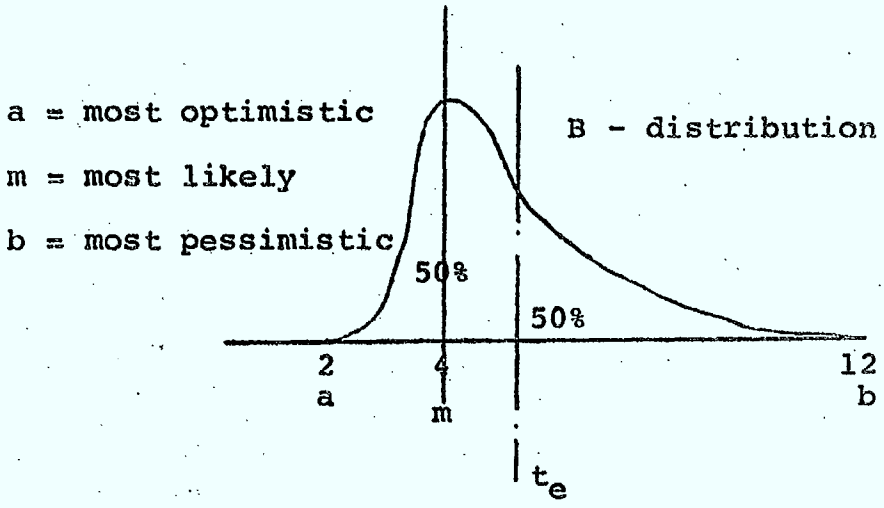
For ES, LS, EF, LF

$$\sigma^2_{\Sigma t_e} = \Sigma \sigma^2_{t_e}$$

The variance of the earliest start of an event is the sum of the variances included in the calculation of that ES. Same for other boundary times.

EXAMPLE:





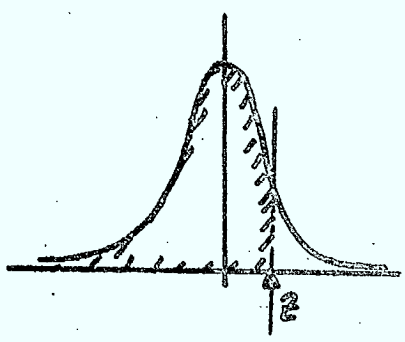
$$t_e = \frac{a + 4m + b}{6} \; ; \sigma t_e = \frac{b - a}{6}$$

$$t_e = \frac{2 + 4 \times 4 + 12}{6} = 5 \; ; \sigma t_e = \frac{12 - 2}{6} = 1.67$$

MEETING A DEADLINE DATA:-

IF GIVEN A SCHEDULED TIME SS OF ONE OF THE ACTIVITIES AS A MILESTONE, ONE CAN CALCULATE THE PROBABILITY OF ITS OCCURANCE FROM THE KNOWLEDGE OF ES, AND ITS VARIANCE (ASSUMING THAT ACTUAL COMPLETION TIMES FOR MILESTONE IS NORMALLY DISTRIBUTED).

$$Z = \frac{SS - ES}{\sigma_{ES}}$$



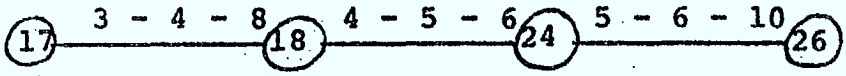
Z IS COMPARED WITH UNIT NORMAL CURVE TO DETERMINE THE PROBABILITY OR LIKELIHOOD OF ITS OCCURANCE.

TO FIND SS FOR A GIVEN PROBABILITY :

GIVEN p FIND Z ($p = 97.7\%$ Say) (2σ)

$$SS = ES + Z \cdot \sigma_{ES}$$

START FINISH



$t_e = 4.5$ $t_e = 5$ $t_e = 6.5$

$\sigma_{t_e} = 0.83$ $\sigma_{t_e} = 0.33$ $\sigma_{t_e} = 0.83$

Total: $t_e = 4.5 + 5 + 6.5 = 16$

$$\sigma_{t_e} = \sqrt{(0.83)^2 + (0.33)^2 + (0.83)^2} = 1.22$$

Assuming normal distribution for t_e

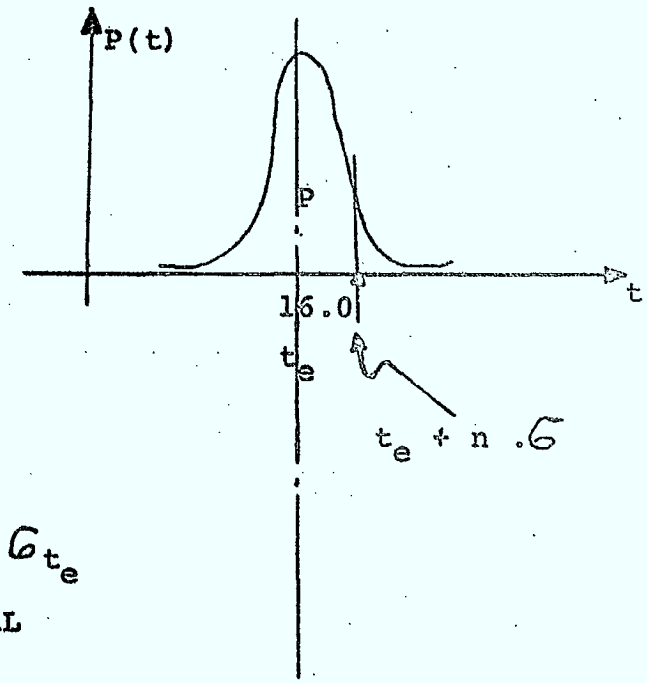
$t_e + 0 \cdot \sigma_{t_e} \Longrightarrow p = 50\%$

$t_e + 1 \cdot \sigma_{t_e} \Longrightarrow p = 84.1\%$

$t_e + 1.67\sigma_{t_e} \Longrightarrow p = 95\%$

$t_e + 2 \cdot \sigma_{t_e} \Longrightarrow p = 97.7\%$

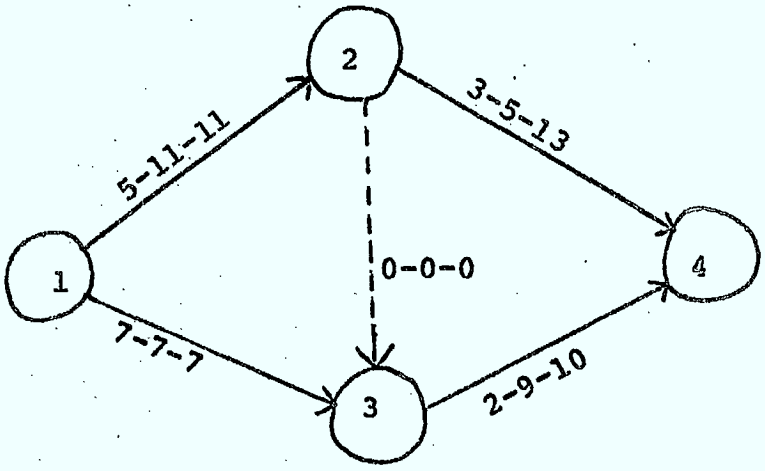
$t_e + 3 \cdot \sigma_{t_e} \Longrightarrow p = 99.9\%$



or : for $p = 80\% \Rightarrow t = t_e + z \cdot \sigma_{t_e}$

z from table of UNIT NORMAL

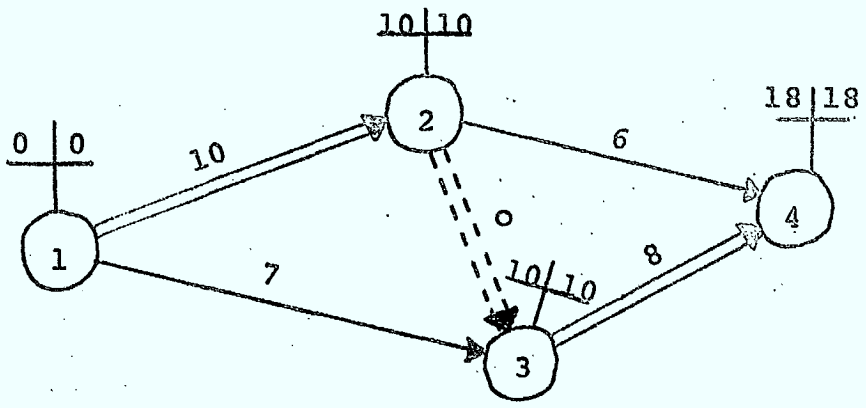
EXAMPLE:



Activity	Expected Time	Variance σ^2_{ij}
1,2	$\frac{5 + 4 \times 11 + 11}{6} = 10$	$\left(\frac{11 - 5}{6}\right)^2 = 1.0$
1,3	$\frac{7 + 4 \times 7 + 7}{6} = 7$	$\left(\frac{7 - 7}{6}\right)^2 = 0$
2,4	$\frac{3 + 4 \times 5 + 13}{6} = 6$	$\left(\frac{13 - 3}{6}\right)^2 = 2.78$
3,4	$\frac{2 + 4 \times 9 + 13}{6} = 8$	$\left(\frac{10 - 2}{6}\right)^2 = 1.78$

$\sigma^2_{ES4} = \sigma^2_2 + \sigma^2_4 = 1 + 1.78 = 2.78$

$\therefore \sigma_{ES4} = \sqrt{2.78} = 1.67$



1) For $SS_4 = 17$

$$\therefore Z_4 = \frac{SS-ES}{\sigma ES_4} = \frac{17 - 18}{1.67} = -0.6$$

$$\therefore p = 27.43\%$$

2) For $SS_4 = 19$

$$\therefore Z_4 = \frac{19 - 18}{1.67} = +0.6$$

$$\therefore p = 72.6\%$$

3) For $SS = ES + 2\sigma \Rightarrow Z = 2 \quad \therefore \quad p = 97.7\%$

$$\therefore SS = ES + Z \cdot \sigma$$

$$= 18 + 2 \times 1.67 = 21.3$$

TO MEET A DEADLINE:-

WHEN NO USABLE FLOAT REMAINS WITH EXCESSIVE RESOURCE DEMANDS, A DECISION IS NECESSARY FOR WHETHER OR NOT TO ACQUIRE MORE OF THE LIMITING RESOURCE.

TO REDUCE PROJECT TIME: -

- REDUCE EXPECTED TIME OF ACTIVITIES ON THE CRITICAL PATH BY:

  - OVERTIME
  - TRANSFER RESOURCES FROM SLACK PATHS TO CRITICAL ONES
  - ADD RESOURCES
  - SUBSTITUTE COMPONENTS
  - TRY PARALLEL ACTIVITIES FOR CRITICAL PATH
  - ELIMINATE PARTS OF ACTIVITIES
  - SHORTEN DURATION OF PREREQUISITE OR POSTREQUISITE TO ALLOW FLOAT FOR RESCHEDULING KEY ACTIVITIES
  - EXTEND TOTAL TIME OF PROJECT DURATION

FACTORS :- COST, CONVENIENCE, GOODWILL, ETC.

COMPUTER REPORTS:-

- LISTING OF

  . ACTIVITIES ON CRITICAL PATH.
  . ACTIVITIES IN ORDER OF INCREASING SLACK.
  . ACTIVITIES IN LATEST STARTING DATE SEQUENCE.
  . ACTIVITIES IN LATEST FINISHING DATE SEQUENCE.

- SORTING BY

  . DEPARTMENT
  . RESOURCE
  . RESPONSIBILITY
  . ETC.

ADVANTAGES AND LIMITATIONS OF NETWORK ANALYSIS

ADVANTAGES:

- FORCES ATTENTION TO DETAIL
- ENFORCES LOGICAL PLANNING
- REDUCES THE RISK OF OVERSIGHT
- PROVIDE A GOOD COMMUNICATION MEDIUM

HIGHLIGHTS:

- ACTIVITY INTER-RELATIONS
- PROJECT DURATION
- PROJECT COST
- PROJECT CASH FLOW
- CONTROL OF PROGRESS
- ALLOW MODIFICATIONS
- OPTIMAL UTILIZATION OF RESOURCES

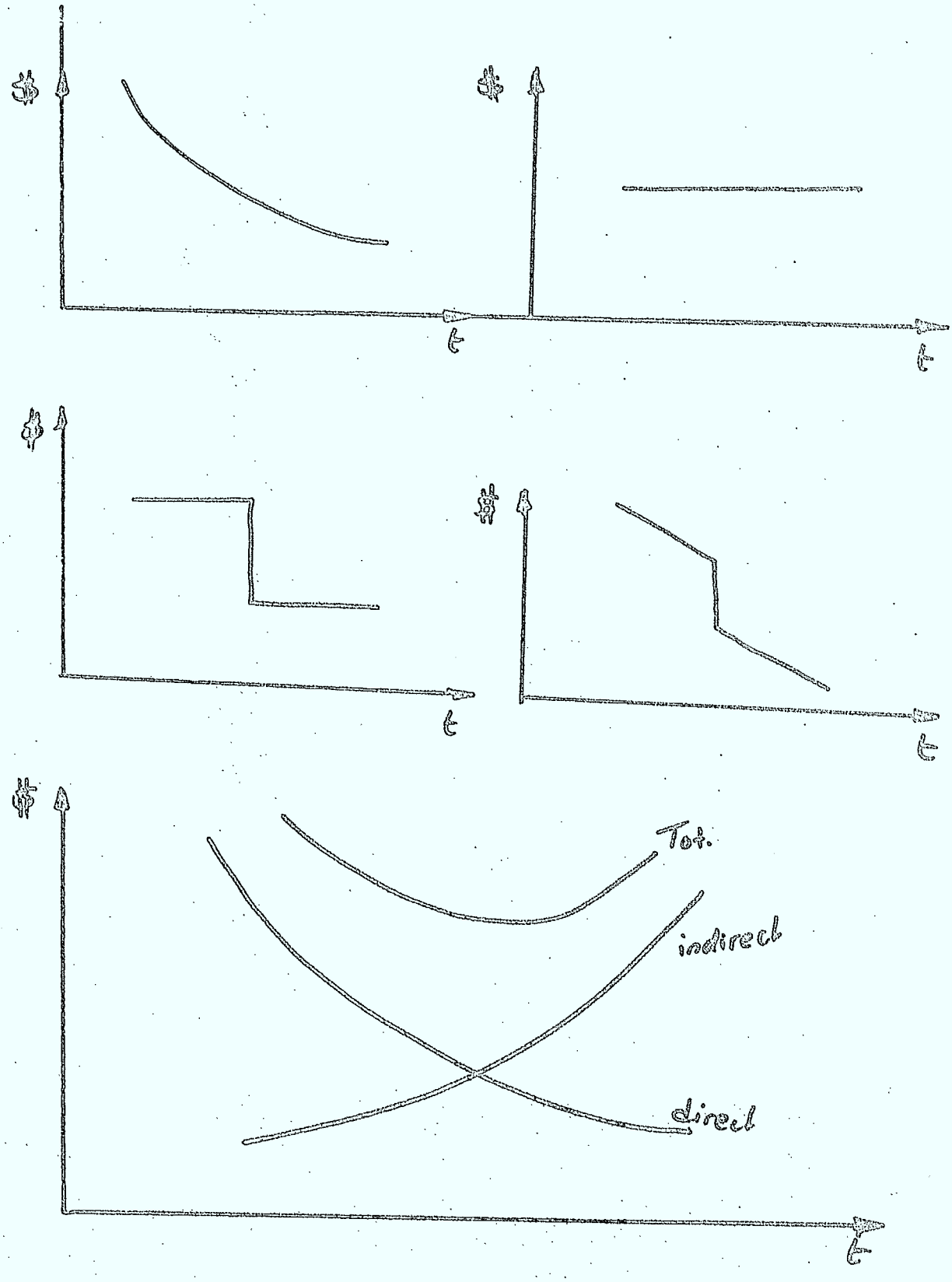
NETWORK DRAWINGS HELP AS:

- COMMUNICATION DEVICE
- RELATIONSHIP FOR EACH PART OF THE WHOLE PROJECT IS EASIER TO COMPREHEND
- MISTAKES OF COMMISSION AND OMMISSIONS ARE MORE APPARENT

LIMITATIONS:

- TIME CONSUMING
- SOMETIMES DIFFICULT TO AMMEND
- MAY CREATE PROBLEMS IN COMPARING ACTUAL TO EXPECTED COMPLETION.

PROJECT COSTS :- NORMAL vs. CRASH



V - PROJECT BUDGETING

- COSTS ARE TO BE MEASURED AND CONTROLLED PRIMARILY ON A PROJECT BASIS, RATHER THAN ACCORDING TO THE FUNCTIONAL ORGANIZATION.

- INDIVIDUAL ACTIVITIES OR GROUP ACTIVITIES FORM THE MICRO COST CENTERS FOR ACCOUNTING RATHER THAN ORGANIZATIONAL UNITS (DIVISIONS, DEPARTMENTS, SECTIONS, ETC.)

- RESPONSIBILITY FOR EXPENDITURE SHOULD COINCIDE WITH RESPONSIBILITY FOR MANAGING.

- MANAGERS SHOULD ALSO BE RESPONSIBLE FOR CONTROLLABLE COSTS ASSOCIATED WITH THE PROJECTS ACTIVITIES, IN ADDITION TO SEEING THAT ACTIVITIES ARE COMPLETED ON SCHEDULE.

- COST OVERRUN UNDER A PROJECT MANAGEMENT CAN MORE EARLY BE DETECTED FOR CORRECTIVE ACTION.

- PROJECT MANAGEMENT COST SYSTEMS ARE EASIER TO DESCRIBE THAN TO IMPLEMENT.

- COST ALLOCATIONS CREATE PROBLEMS.

- COST ACCOUNTING BY WORK PACKAGES IS TO BE USED WHEN A PROJECT HAS BEEN BROKEN DOWN INTO ACTIVITIES SMALL ENOUGH FOR PURPOSES OF DETAILES PLANNING AND SCHEDULING.

- BUDGETING COSTS BASED ON EARLY START OR A LATE START SCHEDULE.

HASSINI, A. BEN
--Development of a planning model for the department of Telecommunications for the federal government: final report