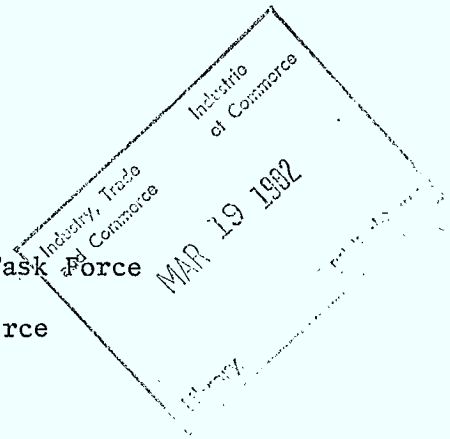

A Report to the

PEMD Information System Implementation Task Force

Department of Industry, Trade and Commerce

FEASIBILITY STUDY OF THE REDESIGN OF THE PEMD INFORMATION SYSTEM

July 31, 1980

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1.0 EXECUTIVE SUMMARY

The present PEMD information system suffers from extremely poor timeliness and excessively voluminous outputs that are cumbersome to use. Information is two to twelve or more weeks out of date, where an information lag of at most two to three days should be tolerated. Clerical searching through massive output listings is required in order to extract usable information for management - a task more suitable for computers. Certain data elements are missing or of poor quality, particularly on the financial side. As a result, the system cannot be used for project control or the timely production of budgeting and commitment control reports; these tasks are now done on the basis of extensive manual record keeping.

The alternative is to develop a revised on-line database system with a flexible query system, which will allow easy extraction of information in a form directly usable by management. In particular, outputs would be tailored to the tasks of project control, budgeting and commitment control, performance measurement, and statistical analysis and reporting. Outputs would be sharply condensed, and the database would be updated daily. A variety of data entry regimes would be possible, involving information delays of at most two to five days and ranging down to less than one hour, depending on the specific regime. Implementation could occur either on IBM or Digital Equipment hardware, with the choice depending only on internal organizational considerations.

It is recommended that such a system be developed initially with data entry activity centralized in Ottawa. Information would thereby normally be recorded in the database within 72 hours of its availability. Subsequent upgrading to allow on-line data entry at major regional offices should be considered following successful implementation and assessment of the system performance, allowing data normally to be recorded within 24 hours of availability.

The development and implementation cost of the recommended system (prior to any subsequent upgrading) is estimated at $50,000 and would require participation of the PEMD Secretariat (facilitating subsequent system use). Annual operating costs are estimated at $115,000. A clerical staff of 14, representing 4 staff years, would be required across the various program locations in order to control the flow of data into the system. A revised system can be operational by mid-February of 1981 if work begins by September 1, 1980.

The upgraded system would have estimated annual operating costs of $136,000 and would require 5 staff years spread across 14 positions to execute and control the data entry.

2.0 INTRODUCTION

2.1 Purpose of Report

The purposes of this report are as follows:

- to describe the data processing objectives and requirements of the PEMD program
- to evaluate the present PEMD data processing system in relation to these objectives and requirements
- to describe and examine alternatives to the present system
- to present conclusions and recommendations regarding the development of a revised PEMD information system.

2.2 Project Milestones

The following project milestones have occurred to date:

(a) March, 1980 - completion by Development Planning Associates, Ltd. of an evaluation of the PEMD program. PEMD was found to be a viable program, but a number of program changes were recommended. Among the recommendations were the development of a revised information system.

(b) April, 1980-formation of five task forces charged with examination of the recommendations of the program evaluation and development of implementation plans. The subject matter areas of the task forces were:

- Program Efficiency
- Information System
- Program Effectiveness (Sections A, B, C, D)
- Revision of PEMD Section E
- Accountability

(c) May, 1980 - preparation of a Request for Proposal for a feasibility study of a revised PEMD information system. Invitations to reply sent to seven firms.

(d) June 16, 1980 - selection of S & S Software, Ltd. to conduct the feasibility study. Commencement of the study.

(e) July 4, 1980 - presentation of draft statement of information-system objectives and requirements to the Information Task Force. Discussion and broad acceptance by the Task Force.

(f) July 23, 1980 - presentation of summary of project results to a meeting of the various PEMD Task Force Chairmen. Discussion of findings and agreement to submit a revised outline of the presentation notes to the PEMD Steering Committee in the form of an interim report on July 28. Final report of this feasibility study to be submitted to the Chairman of the Information Task Force on July 31 as per study proposal.

2.3 Project Actors

The main organizational actors within this project were:

PEMD Information System Task Force
PEMD Secretariat
PEMD Implementation Task Force Co-ordination
Programs Branch
Corporate Systems Branch
PEMD Accountability Task Force

In addition, discussions were held with representatives of the following organizational components of the Department as part of study:

Other PEMD Implementation Task Forces
Toronto Regional Office*
Financial Services Branch
Industry Sector Branches
Office of Overseas Projects

Also, brief discussions were held with the Special Programs Branch of the Canadian International Development Agency, and with officials of the Export Development Corporation.

2.4 Study Approach

The information on which this report is based was collected by means of interviews and discussions with officers and staff of the various organizational actors involved in the project. The purpose of these interviews and discussions was to determine:

- the structure and functioning of the PEMD program
- problems with the present information system
- the perspectives of the various actors as to the objectives and requirements of a revised PEMD information system
- working characteristics of the system's operating environment - data volumes, work flow, timings and so forth.

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* A one-day visit was made to the Toronto regional office.

Based on analysis of this information, study findings were synthesized in the areas of objectives and requirements, design alternatives that could meet these objectives and requirements, the implications of each design alternative, and conclusions and recommendations. These findings were discussed with the main organizational actors through the vehicle of in-depth presentations incorporating full discussion, and a number of elaborations and improvements to the findings were made as a result of the discussions.

3.0. OBJECTIVES AND REQUIREMENTS

3.1 Project Objectives

The objectives of the feasibility study, as outlined in the study proposal, were:

- to identify objectives and requirements for a revised information system
- to secure broad agreement within the client department as to these needs and objectives
- to examine and evaluate alternative re-design approaches in light of these objectives and requirements
- to prepare a final report describing the study and its results, and presenting conclusions and recommendations.

3.2 System Objectives

The following objectives of the PEMD information system have been identified:

1. To allow timely and cost-effective storage and retrieval of information in an efficient manner.

2. To satisfy project control information needs.

3. To provide budgeting and commitment control information to all levels of management.

4. To report to management on performance of program operations.

5. To provide statistical data on companies and projects on both planned and ad-hoc bases.

These objectives have been presented to the main organizational actors involved in the project, and broad agreement with them has been indicated.

3.3 System Requirements

In order to meet the system objectives, the following requirement must be met:

1. The system must support project management and control activites. These include:

   (a) Project verification - activities leading up to the decision to approve or reject duplication checks against other PEMD projects and CIDA special projects; checks to avoid violating funding limitations; incrementality assessment; examination of company's previous performance on other projects; retrieval of relevant market intelligence.

(b) Project status reporting - responding to inquiries from companies, MP's, the minister, or Departmental management as to the current status of a project (awaiting approval, rejected, funds committed, etc.).

(c) Exception reporting - identification of projects facing action deadlines (approval, payment of claims, receipt of reports, etc.) or projects behind schedule in relation to such deadlines.

(d) Provision of feedback to companies - letters requesting information or advising of action taken, summary reports of information on file and company standing within the program on the basis of performance (including repayment).

2. The system must provide budgeting and commitment summary reports to all levels of management, including project officers, Directors of regional offices and industry sector branches, PEMD Secretariat, Director General/Programs Branch, Assistant Deputy Minister/Finance. For the various PEMD projects within each such manager's jurisdiction, the summary should show total dollar volumes in each of the following categories:

(a) budget
(b) application received, awaiting officer recommendation
(c) forwarded to committee for decision
(d) approved, funds committed but not yet claimed
(e) claims received and awaiting approval
(f) claims approved
(g) budget less claims approved (balance remaining)
(h) total of categories (b) through (f), representing the total current financial loading on the program.

These dollar amounts should be reported by fiscal year, and should cover at least the current fiscal year and the next two fiscal years (representing the maximum lifetime of PEMD projects, under Section A, exclusive of renewals). The corresponding dollar amounts in each category as of the current date in each of the last two fiscal years should also be given, for comparison purposes. Optionally, similar totals for all other future fiscal years can also be given, covering renewals.

This information should be reported on both undiscounted and historically discounted bases; that is, "as is", and again on a projected basis taking into account historical experience as to rejection and decommitment rates.

A regular schedule should exist for the production of these reports, but in addition, they should be available upon request.

3. The system should periodically provide the following reports to management regarding program performance as to volume, timeliness, and success:

   (a) Application and claim inventories - the starting number of projects awaiting approval and claims payment at the outset of the period, the number of new projects received in each category during the period and the total number of projects completed (approved, and claims paid), and the number of projects in each category at the end of the period.

   (b) Analysis of the timeliness with which the applications and claims are being processed - percentage on time, percentage late by less than a week, percentage one to two weeks late, and so forth.

   (c) Analysis of the success performance of completed projects - percentage of projects that are successful, dollars of sales per dollar claimed, percentage of successful projects for which no claims are received.*

   These reports should be available by Section, by Region and for the total program, corresponding to the administrative levels at which action might be taken to correct poor performance. The success analysis reports should also be available by product group and by country for intelligence and planning purposes.

4. The system should be able to supply various types of routine and ad hoc statistical information about the program as follows:

   (a) A periodic percentage breakdown of applications by outcome - percentage rejected, by reason; percentage approved, percentage of approvals that are successful, etc.

   (b) Descriptive statistics showing number of projects and amounts of expenditure broken down using such control variables as industry sector, country, political riding, etc. (as well as combinations thereof), available both periodically and as required. The capability of using new control variables for such breakdowns should exist, and information should be available on both planned and ad-hoc bases.

   (c) Analysis of trends among discount rates (rejections, decommitments, etc.), project size, project distributions by country and industry sector, etc.).

   The reports described under (a) and (c) should also be available by Section, by Region, in total, and (where appropriate) by product group and country.

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*It is commonly believed that a sizeable percentage of PEMD projects are successful without claims being made, owing to a disinclination by companies to incur the costs of submitting and substantiating claims. No quantitative information is available, however, as to the extent to which this practice occurs. As it is potentially as important in judging the success of PEMD, particular effort should be made to collect and report information as to the extent of this practice.

5. The time lapse from data availability at source until data availability within the system should be short. This necessitates streamlined data validation procedures, daily or more frequent updating, and entry of individual data items as they become available.

6. Information should be retrievable easily and within minutes from the system, according to user-specified formats.

7. The system must be easy to use. In particular, it should avoid both the extensive use of clerical effort to search massive reports and manually extract relevant information from them.

8. The information recorded by the system should be useful in program terms, and should be comprehensive in relation to the information needs of the program.

9. The system should be tailored to the multi-location nature of the program - data are generated and information is required at both regional offices and headquarters in Ottawa. Proper security arrangements must be included so that information for each region is protected from unauthorized retrieval.

3.4 Other Objectives and Requirements

The following other considerations bear on the re-design of the PEMD information system:

1. There are important areas of overlap with other information systems within the Department. Industrial programs in general make extensive use of information on companies. Also, within the sister industrial incentive programs in particular (SBLA, DIPP, EDP), there is a desire for reporting compatibility. Finally, the FSB financial systems for recording budgets, commitments, and claim payments have significant potential overlap with the PEMD information system with respect to the PEMD program.

   These areas of overlap imply a significant long-run need for system integration within the department. System integration is accordingly an important long-range departmental goal, and the re-design of the PEMD system must at a minimum not jeopardize this goal.

2. Various sources of market intelligence exist within the Department, and formalized access to information from these sources would be of benefit to project officers in evaluating applications for PEMD assistance. The two most important such sources are general market reports from trade commissioners, and information on current company activities by country from the BOSS system.

3. There are cross-checks between PEMD and the Special Programs Branch of CIDA to avoid funding duplications between them. The PEMD information system should support these cross-checks.

4. Scoring systems to evaluate the incrementality and success probabilities of project applications are now under development as a result of the PEMD program evaluation. The information system should incorporate these systems and provide for their use as decision aids in application evaluation.*

5. Other conclusions reached by other PEMD implementation task forces may affect the detailed design of a revised PEMD information system. At the conclusion of this feasibility study, the work of the other task forces remains ongoing.**

3.5 Measurement of Objective Attainment

It is considered that the degree to which the objectives of the PEMD system are being achieved can be measured in terms of:

- the time required from data availability at source until data availability from the system
- the time required to recycle errors on data entry
- the volume of error recycling at data entry
- the amount of clerical effort involved in preparing and controlling information for data entry
- the length of time required to retrieve information from the system
- the amount of clerical effort involved in extracting useful output information for management from the system output
- out-of-pocket costs
- the degree of user satisfaction with the system
- the degree of utilization of available information by management

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* Sole reliance on scores as criteria for acceptance/rejection of application is regarded as inadvisable.

** During the feasibility, the other task force with which the consultants had closest contact was the Accountability Task Force. The results of the feasibility study do not appear to conflict with the likely findings of that Task Force.

- frequency with which information needed within the program is found to be unavailable from the system

- whether System Requirements 1 through 4 are met.

It will be recalled that System Requirements 1 through 4 correspond to Objectives 2 through 5 (see Sections 3.2 and 3.3). The remainder of the above measurement criteria pertain to the attainment of Objective 1.

3.6 Minimum Acceptable Achievement Levels

The following are considered minimum performance targets for a revised PEMD information system:

- 72-hour normal elapsed time from data availability at source to availability within the system

- 24- to 48-hour normal error recycling capability

- on-line information retrieval capability at major branches (Ottawa, Toronto, Montreal, Vancouver, Edmonton, Halifax)

- use of a database approach with a flexible query and report-writing system capable of handling at least 90 per cent of all information requests

- significant reduction of manual record keeping in the operation of the PEMD program

- significant reduction of the volume of routinely-generated hard-copy output from the system

- implementation of a revised system that addresses System Requirements 1 through 4 by mid-February, 1981.

4.0. EVALUATION OF PRESENT SYSTEM

4.1 Nature and State of Present System

The present system is a batch system designed in 1971 and revised substantially in 1977-78. The system is updated once per month. Information is recorded by company and by project. Data for Section A applications are received in Ottawa, checked and submitted for batch input at the time when the application is assigned to a project officer. Data for Sections B, C, and D projects are received by the regions, checked, and held until the project officer has completed all processing (i.e. when the approval/rejection decision is at hand). The data are then sent to Ottawa, reverified, and submitted for batch input. The input preparation and processing take two weeks. If any input errors are encountered, the corrected data are not entered into the system until the next batch is processed, one month later. As a result, project and company information is considerably outdated by the time it is available within the system.

A substantial fraction of the information captured from applications is in narrative/comment form, and therefore not susceptable to retrieval and analysis.

Financial data (commitments, payments, repayments) are not captured directly by the PEMD system. Instead, they are captured within the financial systems of Financial Services branch and written to tape;a tape match is then done against the PEMD file with financial data being recorded in the PEMD system on the basis of the match. The financial tape is frequently not available on schedule. In addition, no-match situations are frequently encountered. As a result, there is a serious lack of timely and accurate financial data.

The output of the system consists of monthly, quarterly, annual, and ad hoc reports. The scheduled reports collectively represent about 340,00 pages of printed output per year. If every ad hoc report were run every month, an additional output volume of approximately 180,000 printed pages would be generated.

A considerable amount of clerical and officer time within PEMD Secretariat is spent searching through and analyzing the output listings in order to extract and analyze information. In addition, a number of manual logs are maintained by clerical staff (in both PEMD Secretariat and Toronto Regional Office) in order to control the flow of projects.

Information from the present system is largely restricted to PEMD Secretariat. Additional manual records are kept at Toronto Regional Office in order to prepare reports for local management.

A particular type of output from the PEMD system bears further discussion. The system is presently set up to print letters to companies requesting information or advising them as to project status. The printing of these letters is presently controlled centrally by PEMD Secretariat, based on the project status information available from the system.

The printed letters are then sent to the various branches and regional offices for signature and individual mailing. Because the system's information is not up-to-date, the appropriateness of these letters and the timing of their availability is frequently not matched to the needs experienced by project officers.

4.2 Problems in Relation to Present Requirements

The problems that exist with the present system in relation to the present requirements are as follows:

1. The present system is inadequate for project control because of the long time delay from data availability at source to data availability within the system. As a result, a system of manual records and logs is maintained to control project flow. This record keeping is expensive in terms of clerical time, is cumbersome, and does not allow easy retrieval of information for project verification, status inquiries, exception reporting or provision of feedback to companies.

   In order to facilitate this requirement, data would have to be available from the system within a few days of its availability at source, and would have to be retrievable in a manner and format suitable to project control activities. Ideally, the time lag between source availability and system availability of data would be overnight.

2. The present system is not capable of producing up-to-date budgeting and commitment control information because of the lack of timeliness of the financial data and the absence of complete information owing to problems of tape matching.

   In order to meet this requirement, financial data would have to be recorded on the system within at most a few days of source availability, and in a manner which avoided problems of missing data owing to matching difficulties.

3. Because of the time delays in entering data, inventory reports of applications and claims would not be meaningful if produced by the present system.

   System modifications would be needed in order to provide timeliness reports on program performance. Not all of the actual dates of milestone activities within projects are recorded, and no facility exists to carry out the data manipulations and output operations involved in producing such reports.

   The information available within the present system as to project success is in narrative form, whose structure and form may differ from project to project. Such unstandardized information cannot be processed to produce performance reports regarding project success. To do so, a standardized method of coding this information would be required.

4. The system does not presently contain enough information to allow a thorough analysis of outcome frequencies. In particular, because Section B, C, and D projects are not entered into the system until they reach headquarters, no information on the rate of officer rejection is available.

   A number of reports giving descriptive statistics are presently produced. Because of the system's batch nature, however, no reporting flexibility exists - extensive reprogramming is necessary to produce new reports. Moreover, if up-to-date descriptive statistics are desired, the information on file must be augmented manually to include the data not yet recorded on the system.*

   At present, the system contains no facilities for conducting trend analyses. These are done manually using data extracted from the system.

5. Lengthy time lapses of two to twelve weeks or more occur between data availability at source and on the system for applications. Delays and gaps in financial data are also common. Updating occurs only once monthly instead of daily.

6. Information is retrievable only using the rigid format of batch reports, and only at monthly intervals.

7. The system produces massive hard-copy listings, from which information must be extracted manually. In addition, error reports from data input are hard to understand and interpret.

8. Although much of the information recorded is useful, this usefulness is limited by the lack of timeliness. In addition, the information is not comprehensive and cannot meet program needs, as discussed in points 1 through 4 above.

9. The system is centered around the PEMD Secretariat. Data for Sections B, C, and D, which become available in the regions, are less timely than data for Section A, which become available at the PEMD Secretariat. The system output receives little use in regional offices.

4.3 Problems in Relation to Future Requirements

The future system requirements are not expected to differ greatly from present requirements. The annual volume of PEMD projects, however, grew from 1978/79 to 1979/80 at a rate of about 30 percent. If this growth is continued into the future, the resulting increases in workload volume will compound present project control and clerical workload

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* Extensive manual effort was required to produce up-to-date statistics during the recent program evaluation study of PEMD.

problems if the present system is retained.

Presently, duplication checks of new CIDA projects against PEMD projects are carried out manually by PEMD Secretariat. This will represent a growing demand in future, in that the volume of CIDA projects is growing rapidly (from 200-300 to about 1000 within two years).

Because of the financial constraints that now face government for the foreseeable future, the absence of budgeting and commitment control reports is likely to prove more detrimental in future to the PEMD program than may previously have been the case.

Long-range plans for system integration are severely inhibited by the present PEMD system, in that it does not use standardized codes for product and company classification.

4.4 Other Problems

The present PEMD system contains no directly usable market intelligence information. The information on project success, which could be regarded as a form of market intelligence, is recorded in narrative form only and is not analyzable or retrievable.

The BOSS system, which could serve as a partial source of intelligence information, is not widely understood. During the visit to the Toronto regional office on June 27, it was noted that the computer terminal there was last used on May 5, in an attempt to access BOSS. The user had given up after two or three unsuccessful tries.

Organizational differences exist which could impact the PEMD information system. Differences exist between Programs Branch and Corporate Systems Branch regarding hardware usage; these are discussed in more detail in Section 5. Some differences appear to exist between Programs Branch and Financial Services Branch. Programs Branch is not satisfied with the timeliness with which it receives financial data for entry into PEMD, while Financial Services feels that it must have control over all financial information in order to discharge its responsibilities under the Financial Administration Act. These differences suggest possible organizational barriers to the long-range goal of system integration.

The quality of the data recorded in the present PEMD system is not high. Certain fields have been used for different purposes throughout the lifetime of the system, with different formats. In other cases, there are missing data elements. A substantial data screening would thus be required to convert from the present system to a revised one.

5.0 ALTERNATIVES

The alternatives to the present system that would meet the system requirements (see Section 3.3) all possess a number of common features. They differ with respect to the manner in which data are entered into the system, and the type of hardware on which the system is installed. The features common to these alternatives will first be described. Then, the various alternatives will be described and evaluated against relevant criteria, and estimates of development times and costs and operating costs will be given.

5.1 Common Features

The following features should be possessed by any alternative to the present PEMD information system in order to meet the system requirements:

1. The system should have a database structure including three major types of data entity in hierarchical relation to one another:

   - company data - one record for each company that has applied for PEMD assistance, containing all program-relevant information describing the company ;

   - project data - one record for each project for which an application for PEMD assistance has been received, identifying the company submitting the application, containing all program-relevant information describing the nature of the project (type of product, country, etc.), and indicating the current status of the project (awaiting approval, approved and awaiting receipt of claim, etc.). Several different project records could pertain to the same company .

   - transaction data - one record for each transaction or major milestone in the life of each project:

     - application
     - project officer request for a receipt of further information
     - approval/rejection
     - commitment of funds (contract)
     - receipt of claim
     - payment of claim
     - Secretariat disencumbrance of funds
     - receipt of business or sales report
     - repayment of funds .

     Each transaction record would identify the project to which it pertained and include

     - type of transaction
     - transaction date
     - amounts of funds involved (if any) broken down by fiscal year .

In addition, the database should contain summary records of trade-commissioner market feedback by product and country.

This database structure corresponds to the natural logical breakdown of PEMD data and offers the most efficient means of storage and retrieval. The availability of individual transaction data by date is required in order to produce year-to-date information from previous fiscal years for the budgeting and commitment control report, and for project monitoring and performance reporting on timeliness.

Under this structure, the basic company and project data would be entered into the system upon receipt of an application, while transaction data would be entered at the time of each transaction's occurrence.

2. The database should be accessible by on-line terminal with display screen and printer at the major locations where PEMD applications are received - Ottawa, Toronto, Montreal, Vancouver, Edmonton, and Halifax.* The access method should be a flexible query facility capable of handling most of the information requests now answered by searching clerically through massive hard-copy listings. This query facility should include requests to run the various reports identified in System Requirements 1 through 4 (see Section 3.3). If any large hard-copy listings are still needed, for example in order to provide information to trade posts and other outlying locations, these should be recorded on computer-generated microfiche.

3. The time lapse from data availability at source to data availability from the database should be at most 72 hours, with 24- to 48-hour error recycling capability. The database should be updated at least daily.

4. The system should include comprehensive and understandable facilities for editing input data.

5. The database should be protected by appropriate security measures to prevent unauthorized access to information. In particular, regional offices should not have access to one another's information.

5.2 Data Entry Alternatives

There are four basic alternative means of entering data into a revised PEMD information system that meet the system requirements. They are:

1. On-line data entry with on-line update.

   Data would be keyed by PEMD program staff at the various

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* Collectively, the corresponding regions account for over 94 percent of total applications for PEMD assistance. Other access points can be added to the network on the basis of cost-effectiveness criteria.

Regional Offices and at Headquarters throughout each day, as the data became available. Upon key entry, the data would be edited immediately by the system. Error reports would be available to the entry operator as soon as entry was completed, and the database would be updated on the spot provided the keyed data were correct.

2. On-line data entry with batch update.

   Data would again be keyed by PEMD program staff on a geographically dispersed basis throughout each day. The data would be stored on an auxiliary device as it was keyed. Edit checks for internal consistency and validity would be done at the time of key entry and the results fed back to the operator.

   Data would be accumulated on the auxiliary device in this fashion throughout the day. The database would be updated once a day, at night, using the entire accumulation of information. Further edit checks, for consistency between the updating data and the data already contained in the database, would be carried out at the time of update, and an error report would be available to program staff each morning.

3. Decentralized data capture at key entry service bureaux, entry of captured data through local computer service-bureau remote job-entry stations, with batch update.

   At each location,input data would be submitted on appropriate input forms at the end of each day to a local key entry service bureau, which would key the data onto a computer-readable file. This file would then be submitted to a local job-entry station, maintained by the computer service bureau at which the database was stored, for entry into its computer. The database would be updated once daily using the files received from the various locations, and any error reports resulting from the editing checks would be transmitted to the appropraite job-entry station for distribution to program staff.

N.B. Under this (and the next) alternative, the input procedures would have to minimize the need for clerical data transcription. An application form would have to be designed from which company and project data could be keyed directly. Shorter, simpler forms would also be required for recording each type of transaction data from which keying could be done directly.

4. Centralized data capture and entry with batch update.

   Data would again be recorded at each location on appropriate input forms. At the end of each day, these would be physically sent to Ottawa by a fast method - courier, or air express.

At Ottawa, all data would be keyed through a single key-entry service bureau, sent to the service bureau where the database was maintained,and read. The database would be updated once daily from the resulting file, and error reports from the edit checks would be sent to the Ottawa office. Corrections would then be made by the Ottawa office, based on telephone checks with Regional Offices where appropriate.*

These four basic alternatives can also be combined in a variety of ways. For example, different alternatives could be followed at different locations, or one alternative could be pursued initially with plans to upgrade later to a different alternative. The choice between such hybrid alternatives, however, would have to be grounded upon an evaluation of the four basic alternatives.

Such an evaluation has been made against the following criteria:

- timeliness
- variable portion of operating costs
- special hardware requirements for data entry
- data-entry and data-control staff requirements
- staff training requirements for system use
- technical complexity of resulting software
- procedural complexity of system use
- degree of similarity to existing systems
- maintenance complexity
- other organizational considerations.**

These criteria are defined more fully in Table 1. The results of the evaluation are given in Table 2. These results can be summarized as follows:

- On-line data entry is faster than data capture through key-entry service bureaus, but more costly because of on-line connect charges and because of a lower rate of data entry using clerical staff as opposed to professional key-entry personnel.

- Internal staff requirements are higher for on-line entry because keying is done internally. The differences are in staff years rather than in number of positions required.

- In terms of training requirements, technical complexity, and maintenance complexity, on-line entry and update imposes

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* A variation of this alternative, whereby data would be keyed in Ottawa through existing microcomputer facilities, was examined and rejected on the grounds of insufficient capacity.

** Development costs and time have not been included in these criteria as they would be similar for the various alternatives. On-line entry and update, while more technically complex, would rely on existing standardized database software and thus avoid large additional programming costs. Whatever additional programming costs were incurred in comparison to the data-capture options would be approximately offset by the cost of developing more complex data-control procedures for the latter options.

the heaviest requirements, followed in order by on-line entry with batch update, decentralized capture, and then centralized capture (with the lowest requirements).

- On-line entry is simpler from a procedural view point, owing to less complicated data logistics. Centralized capture is, however, the most familiar procedural mode within the department.

- On-line entry offers greater internal control over data entry performance. The key to the suitability of the data-capture options is the ability of the service bureaux to provide top-quality service on a daily basis. This would be easier to ensure under centralized data capture than under decentralized data capture.

- Centralized data capture offers the easiest start-up for a revised system, enforces uniformity at start-up, and can later be upgraded to on-line data entry as required.

5.3 Hardware Alternatives

Two alternative computer-hardware options merit consideration for processing and database storage and retrieval. These are the use of a computer service bureau based on a large IBM installation, and the use of a time-shared computer service bureau using hardware manufactured by Digital Equipment Corporation (DEC).

The choice is restricted to these two alternatives for the following reasons:

- Treasury Board and Department of Supply and Services would be unlikely to sanction the acquisition of additional in-house computing facilities

- the Department's current in-house computing facilities are already overloaded

- the use of an outside service bureau is thus warranted

- most outside service-bureau processing by the Department is done under contract with IST, an IBM installation

- processing for the systems that service the other industrial-incentive programs within the Program Branch (SBLA, DIPP, EDP) is carried out at Dataline, a time-shared service bureau using DEC equipment

- other service-bureau alternatives are not desired by the Department at this time.

In terms of technical and economic criteria, either option would be suitable for the implementation of a revised PEMD information system. The system requirements can be met under either option, and costs are comparable between the two.

The choice between the two options rests on organizational considerations. The Corporate Systems Branch prefers the IBM option. Programs Branch prefers the DEC option.

The arguments in favour of the IBM option are:

- Current policy favours the use of IBM service bureaus under tender arrangements.

- Long-range plans for integrating information systems would be made technically easier to implement by operating all systems on the same hardware.

- Corporate Systems Branch has purchased IBM-oriented database management software (ADABAS) and wishes to benefit from its investment through the use of this package.

- Technical expertise on the use of IBM software is available within Corporate Systems Branch.

The arguments in favour of the DEC option are:

- Programs Branch is familiar with the DEC service bureau and has confidence in it.

- Programs Branch staff find DEC procedures and software particularly easy to use.

- The DEC option offers service-bureau compatibility with the information systems for other industrial-incentive programs (SBLA, DIPP, EDP).

A choice between these options is necessary before beginning the detailed design of a revised system, as detailed design depends on the type of hardware used.

5.4 Time and Cost Estimates

A summary of the estimated development time and costs of a revised system is given in Table 3. The estimated total development cost is $50,000 including computer charges but excluding departmental staff time. The estimated development time is 17 to 22 weeks. As noted earlier, these estimates are essentially independent of the type of data entry and the type of hardware used.

The estimated operational costs of the centralized data-capture, batch-update option (exclusive of internal staff requirements) are shown in Table 4. These are about $105,000 annually plus likely annual printing charges of $5,000 to $10,000. As noted, the most uncertain element within this estimate is day-to-day processing, which depends on the level of system usage. The print costs would be more accurately estimable following detailed design.

As noted in Table 2, data entry costs differ under the four basic data entry regimes. Terminal, storage, day-by-day processing, and print costs are expected to be independent of the data-entry regime. The estimated total annual operating costs under each regime, assuming print costs of $10,000 per year, are summarized in Table 5. They range from $115,000 for centralized data capture with batch update to $148,000 for on-line entry and update.

TABLE 1

DEFINITION OF EVALUATION CRITERIA FOR DATA-ENTRY OPTIONS

1. Timeliness
   - elapsed time from data availability at source till availability within data base assuming no errors
   - additional elapsed time needed to recycle errors
2. Operating cost
   - incremental out of pocket cost for data transmission and external keying
3. Hardware requirements
   - special hardware needed especially for data entry
4. Personnel requirements
   - number of internal people and their staff years of effort needed to control data flow and do key entry
5. Training requirements
   - degree of training needed by internal staff for data control and data entry
6. Technical complexity
   - complexity of data entry and update software
7. Procedural complexity
   - degree of logistic and administrative difficulty involved in data entry
8. Similarity to existing systems
   - degree to which data entry regime resembles those for other incentive programs
9. Maintenance complexity
   - degree of difficulty in incorporating needed changes within data entry and update software and procedures
10. Other organizational considerations

TABLE 2

EVALUATION OF BASIC DATA-ENTRY OPTIONS

	On-line entry On-line update	On-line entry Batch update	Decentralized capture Batch Update	Centralized capture Batch update
Timeliness	Minutes	24 hours	24-48 hours (major locations)	48-72 hours (major locations)
	Minutes on error re-cyle	24-hour error re-cycle	24-48 hour-error re-cycle	24-48-hour error re-cycle
Operating cost	$5000/mth	$4000/mth	$2700/mth	$2200/mth
Hardware requirements (see Note 1)	None	None	None	None
Personnel requirements (see Note 2)	14 people	14 people	14 people	14 people
	5 staff yrs	5 staff yrs	3 staff yrs	4 staff yrs
Training requirements	High	High	Medium	Low
Technical complexity	Highest	High	Low	Lowest
Procedural complexity	Low	Low	High	Medium
Similarity to existing	None	None	None	SBLA EDP DIPP
Maintenance complexity	Highest	High	Low	Lowest
Other organizational considerations	[Availability of hardware for other applications]		[Performance of key entry service bureaux key to timeliness]	
	[Internal control over data entry performance]		Possible non-	Uniformity enforced
				Easiest start, can be upgraded as required

Notes

1. A terminal with screen and printer would be needed in each location for retrieval purposes under all options, at estimated cost of $250/month; would be available for on-line data entry.

2. All requirements given in absolute terms, rather than increase or decrease from present levels. Does not include personnel requirements of information retrieval and analysis. The latter would be expected to decrease substantially, however.

TABLE 3

ESTIMATED OUT-OF-POCKET SYSTEM DEVELOPMENT COST

Detailed design	$16,000
Programming	11,000
Implementation (System-Testing, Training, Coordination, Documentation) (see Note 1)	7,000
Data Conversion(see Note 2)	8,000
Computer charges	8,000 - 10,000
	$50,000

Elapsed time requirement

- 17 weeks minimum
- 22 weeks mean

Depends on size of team

Notes

1. Cost estimates cover training of conversion co-ordinator/data administrator only, not detailed training of all clerical staff.

2. Data conversion requires full time co-ordinator from PEMD Secretariat, cost not included in estimate. Co-ordinator should subsequently serve as data administrator and conversion would serve as training period.

   During conversion, data should be loaded in priority order, not all at once.

TABLE 4

ESTIMATED OUT-OF-POCKET OPERATIONAL COST

FOR CENTRALIZED DATA CAPTURE WITH BATCH UPDATE

Monthly Basis

Data entry	$2,200
Terminals (6 locations)	1,500
Storage	1,000
Day-to-day Processing (See Note)	4,000
	$8,700

Approximately $105,000 annually, exclusive of print costs. Estimated annual print costs of $5-10,000, based on present cost and anticipated reduction of output volumes.

Note

Processing costs are highly variable, depending on degree of system usage.

TABLE 5

ESTIMATED TOTAL-SYSTEM ANNUAL OUT-OF-POCKET OPERATING COSTS

UNDER EACH DATA-ENTRY OPTION

On-Line Entry, On-Line Update	$148,000
On-Line Entry, Batch Update	$136,000
Decentralized Data Capture Batch Update	$121,000
Centralized Data Capture Batch Update	$115,000

6.0 RECOMMENDATIONS

6.1 Most Feasible Alternative

It is felt that the most feasible alternative at present is the implementation of a revised PEMD database system using centralized data capture in Ottawa, batch database update, and on-line information retrieval. Once such a system is successfully operating, plans should be considered to upgrade to on-line data entry at major locations with batch update of the database.

The choice between implementation on IBM and DEC hardware involves only internal organizational considerations, and should therefore be made internally. This question must be resolved before starting detailed design of the revised system.

Decentralized data capture is rejected as being too complex logistically and offering insufficent control over the quality of data entry. Each regional office would have to deal with and control a separate key entry service bureau - a task with which these offices are totally unfamiliar. Centralized data capture is preferable despite the extra 24-hour delay that it entails, on the grounds of greater simplicity, uniformity, and control as well as some small cost advantage.

On-line updating of the database is regarded as unjustified at present. The 24-hour turnaround offered by on-line entry with batch updating is certainly sufficient at this time when compared to the tardiness of the present system. The additional up-to-the-minute timeliness offered by on-line updating is not needed to meet the system requirements. Moreover, on-line updating is more complex and more costly than batch updating.

The choice thus reduces to on-line entry versus centralized data capture, both with batch update. On-line entry is attractive because:

- Its 24-hour turnaround imposes little risk of timeliness problems in using the system for project control and reporting on commitments and expenditure. The 48-72-hour turnaround centralized capture is less atractive from this standpoint.

- Its procedural simplicity is desirable - data need not be continually sent to Ottawa.

- It offers more control over operations in that all key entry is internal to the Department.

The major disadvantage of on-line entry (aside from cost) is that it represents a very large departure from the present system, where all work is centered around the PEMD Secretariat and little use of the system is made in regional offices. The dislocations involved in the development, installation, and use of a database with on-line retrieval will be large, particularly in the regions,

and it would be risky to add to these dislocations by also requiring a transition to on-line entry at the same time. The regions are used to sending data to Ottawa, and they could continue to do so for some time under the centralized-capture option.

Accordingly, it is recommended that the Department first implement the database structure with on-line retrieval, and daily update through centralized data capture. Once implementation is complete and operation is successful, system performance should be reviewed with a view toward upgrading to on-line data entry.

Several strategies could be followed for this upgrading. They include:

- transition from centralized data-capture at Ottawa to centralized on-line entry at Ottawa, in order to gain experience

- transition to on-line entry at one regional office only (say Toronto, the largest) at first, also in order to gain experience and to allow gradual changeover

- on-line entry of high-priority information only (e.g. company name and number, project number, major transactions) while continuing the centralized capture of lower-priority information (e.g. company and project descriptions, other transactions).*

6.2 Other Recommendations

The following recommendations also pertain to the development of a revised PEMD system:

1. The revised system should be designed to be as simple and easy to use as possible.

2. In claims and other areas of overlap with other systems, the system should emphasize PEMD needs in order to avoid organizational conflicts and to expedite implementation. In the claims area specifically, only specific transaction data (dates, amounts of claims and requisitions for payment) are needed; these should be routinely supplied on a timely basis.

3. The groundwork for future integration with other systems should be laid now by introducing BRID numbers and SIC codes for company and product identification in the new system.

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* The possibility has been raised of using communicating word processors presently installed in the Department to transmit high-priority information to a computer. The viability of this option would have to be resolved at the detailed design level; key considerations would be interface suitability, storage capacity, and transmission speed. Since terminals will be needed anyway for retrieval under the new system, their use would initially appear to be preferable.

4. The BOSS system is useful as a source of market intelligence, but not sufficiently so that it must be accessible directly from within the PEMD system. Separate dial-up to BOSS is sufficient. Regional offices should have clear and adequate documentation of access procedures for BOSS.

5. The database query facility design must include the ability to check for duplication of new CIDA projects within the PEMD database.

   If the PEMD database also contained identifying information only (company, product, country) on CIDA projects, the system could also check for duplication of new PEMD projects within CIDA. This possiblity,including suitable cost-sharing arrangements, should be explored with CIDA.

6. The detailed design team should include a full-time member from PEMD Secretariat who can participate actively in data conversion. This person would be the logical candidate for data administrator of the new system. Consideration should be given to a prioretized data conversion starting with essential fields.

APPENDIX I

INFORMATION AND CALCULATIONS USED

IN COMPARISON OF ALTERNATIVES

Within the feasibility study, quantitative estimates of resource requirements have been made in five areas:

- Out-of-pocket data entry costs
- Data entry personnel requirements
- Computer storage costs
- Printing costs
- Development costs.

Development cost estimates are based on a project plan, presented in Appendix III of this report. The estimation of the remainder of these items is described in the present appendix.

A1.1 Out-of-Pocket Data Entry Costs

The report entitled "Monthly and Annual Number of Inputs into the PEMD System", by PEMD Information System Implementation Task Force, indicates the following level of annual activity within the present system:

PEMD 53 Input Form	(210 characters)	2,784 inputs
PEMD 51 Input Form	(309 characters)	21,552 inputs
PEMD 52 Input Form	(364 characters)	4,980 inputs.

If each input involved the full number of characters in the corresponding input form, approximately 7.5 million characters would be involved. On this basis, a volume of 8 million input characters per year was assumed. This is a very conservative (high) estimate, in that not all of the above inputs would involve the complete number of characters, since many represent updates. Nevertheless, in order to allow for additional information requirements and volume growth, as well as to provide a safety factor, estimates were based on this figure.

It was assumed that on-line entry would take place at the rate of 3333 character per hour*, using internal staff, while data capture would take place at the rate of 7000 characters per hour in service bureaux using professional operators.

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* Basic speed of 4000 characters per hour with allowance for errors.

The following out-of-pocket cost estimates thus emerge:

On-Line Entry: 2,400 hours per year

$36,000 per year for connect time at $15/hour **

($ 3,000 per month)

Data Capture: 1,143 hours per year

$14,400 per year for keying @ $10.50/hour *** (no verifying)

($ 1,200 per month)

Estimated CPU, and storage costs were then added to arrive at the following total estimates of monthly data-entry costs:

On-Line Entry, On-Line Update	
- Connect Time	3000
- CPU	2000
	5000
On-Line Entry, Batch Update	
- Connect Time	3000
- CPU and Storage	1000
	4000
Decentralized Data Capture, Batch Update	
- Keying	1200
- CPU and Storage	1500
	2700
Centralized Data Capture, Batch Update	
- Keying	1200
- CPU and Storage	1000
	2200

** Rate taken from IST rate schedule.

*** Standard hourly rate.

The CPU and Storage charges for on-line entry update reflect the fact that update processing occurs by day instead of at night. The CPU and storage charges for decentralized data capture reflect added data-handling charges for consolidation of local files. CPU charges are comparable for on-line entry with batch update and centralized data caputre; so are storage charges even though the storage utilization is less under centralized capture (storage charges are based on capacity, not utilization).

The costs of transporting data to Ottawa under centralized data capture were not included in the estimate, as these costs are already being incurred under the present system and the above are estimates of incremental costs.

A1.2 Data Entry Personnel Costs

The 1977-78 Annual Evaluation Report for PEMD indicated the following approximate regional distribution of PEMD applications during 1976-78:

Region	Percentage of Total
Ontario	45
Quebec	30
British Columbia	10
Alberta	7
All Others, Combined	8

It was therefore assumed that the estimated data total of 8 million characters per year would be distributed in the same fashion. At an assumed on-line entry rate of 3333 character per hour, 6 hours per day, the personnel requirements for on-line entry would be:

Ontario	180 staff days	(1 staff year)
Quebec	120 staff days	(1/2 staff year)
British Columbia	40 staff days	(1/2 staff year)
Alberta	28 staff days	(1/2 staff year)
All Others	32 staff days	(1/2 staff year)

It was assumed that a similar staff requirement would exist for data control in each regional office. The total staff requirement for on-line entry would then be:

Ontario	2 staff years
Quebec	1 staff year
All Others	1 staff year.

An additional staff year would be needed in Ottawa for the data administrator, and an additional position would be needed in both Ottawa and the Quebec region for backup purposes. Backup would already be available in the Ontario region with two staff persons, while the requirements in other regions would be too low to justify backup. Each region would, however need at least one position. Thus, the total personnel for needs for on-line entry would be as follows:

	Staff Years	Positions
Ottawa	1	2
Ontario	2	2
Quebec	1	2
All Others	1	8
	5	14

Under decentralized data capture, key entry would not occur internally but data control activities would still be necessary. The foregoing analyses suggests that these needs would total 1 staff year in Ottawa and Ontario Region, 1/2 staff year in Quebec region, and 1/2 staff year in all other regions combined. Allowing for backup positions in Ottawa, Ontario Region, and Quebec Region, the requirements would be as follows:

	Staff Years	Positions
Ottawa	1	2
Ontario	1	2
Quebec	1/2	2
All Others	1/2	8
	3	14

Under centralized data capture there would continue to be internal staff needs only for data control, and not for keying. The needs would be similar in the regions, but additional staff would be needed in Ottawa to assist the data administrator in co-ordinating the centralized data flow. It is assumed that one additional staff year would be sufficient, and that the corresponding person could act as the data administrator's backup.

Computer Storage Costs

Storage requirements, based on volumes within the present system as reported by PEMD Secretariat, were estimated as follows:

Company Records - 6000 records, 309 characters each, total of 1,854,000 bytes

Project Records - 3000 projects per year, retained for 5 years, 309 characters each, total of 4,635,000 bytes

Transaction Records - up to 20 transactions per project, 32 characters per record (date-6, type-2, 3 amounts covering 3 fiscal years - 24),total of 9,600,000 bytes

Total Storage Requirement - 16 megabytes not including market data

Since dedicated disk space of 50 megabytes is available at $1000 month from IST, and 16MB of non-dedicated space would be more costly, the cost figure of $1000 per month was used.

Print Costs

The monthly, quarterly, and annual reports produced by the present system collectively represent 340,000 pages of output per year. Additional ad hoc reports that are available would represent an additional 180,000 pages per year if run every month. (Source - PEMD Outputs Report, PEMD Information System Implementation Task Force.) At the IST rate of $0.06 per page, these outputs cost $20,400 to $31,200.

Preliminary analysis reveals that on-line displays can substitute for at least 82,000 of these output pages per year, and likely for most of the rest as well. A cost estimate of $5-10,000 per year for residual outputs plus new batch reports therefore seems reasonable.

APPENDIX II

PRELIMINARY DESIGN DOCUMENTATION

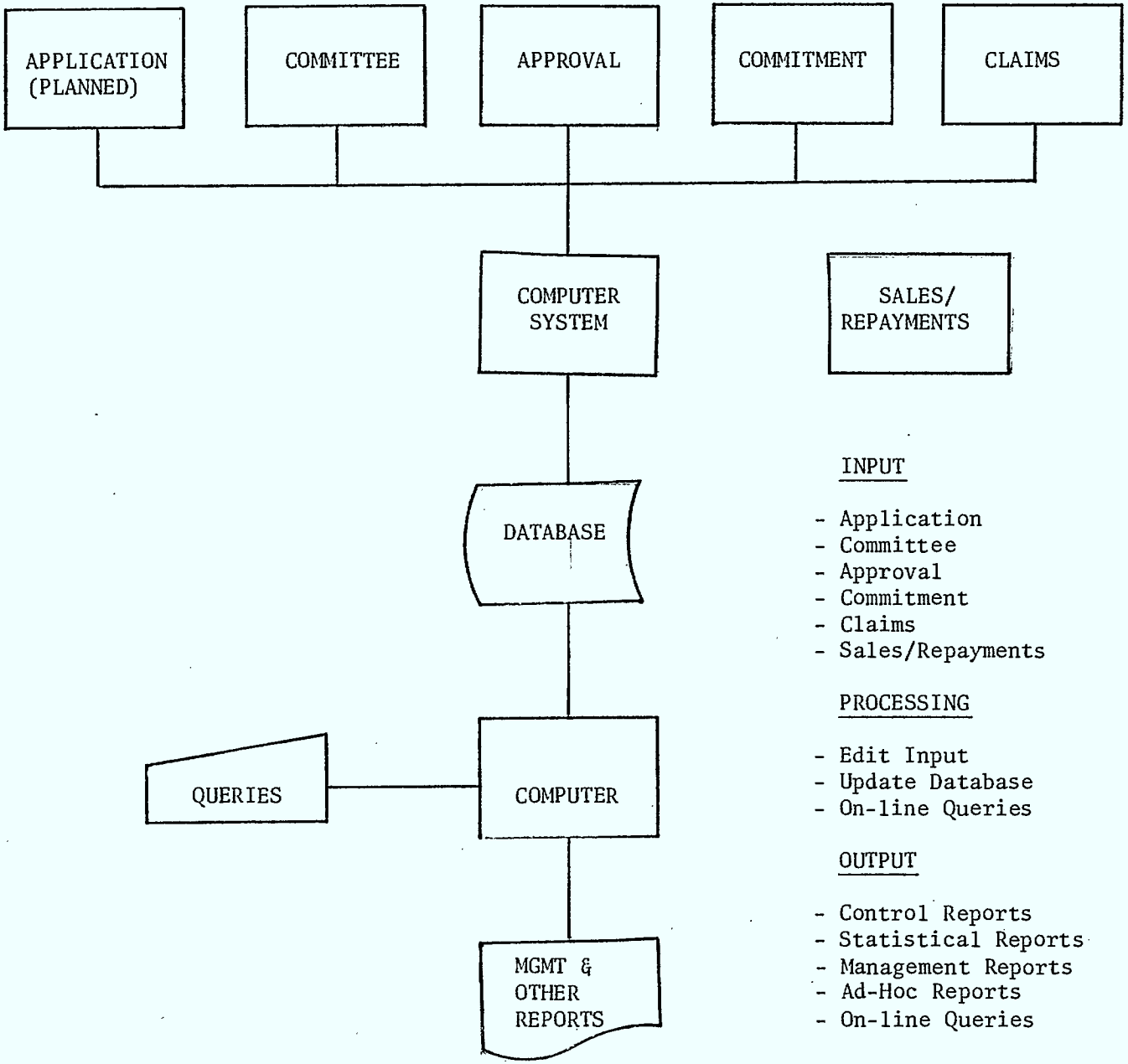
This Appendix contains

A2.1 System Flowchart for PEMD

A2.2 System Input Requirement

A2.3 System Output Requirement

A2.4 Database Sturcture



INPUT

- Application
- Committee
- Approval
- Commitment
- Claims
- Sales/Repayments

PROCESSING

- Edit Input
- Update Database
- On-line Queries

OUTPUT

- Control Reports
- Statistical Reports
- Management Reports
- Ad-Hoc Reports
- On-line Queries

A2.2 System Input Requirements

Input will be captured at various stages in order to reflect the most current state of each project. The hierarchy chart shows the various stages for data capture, which are as follows:

- Application:

  A new form should be introduced so that data is captured directly, thus avoiding manual transcribing of information from its incoming form to a key-entry input form. Data would include the basic compnay and project descriptions.

- Committee, Approval, Commitment, Claims, Sales, Repayment and Decommitment:

  This information will be captured and fed to the computer system on an on-going basis as the various milestones occur. The basic format would be as follows:

Company No:	Proj. No:	Date of Action	Date Effective	Amt.	Status Code
15	25	25/07/80	31/09/80	$120.00	Committee
17	32	23/08/80	01/03/81	$500.00	Commitment
15	25	26/07/80	01/05/81	$150.00	Approved
15	25	26/09/80	01/06/81	$150.00	Claim
21	38	12/12/81	01/12/81	5000.00	Decommitted
22	45	12/10/82	01/05/83	1000.00	Repayment

A2.3 System Output Requirments

Two major reporting facilities must be available through this system:

- On-line query facility: this capability is used to generate ad-hoc queries to do on-line retrieval of specific information. The retrieval information can be displayed on the visual display terminals, and the display can also be printed in hard-copy form.

  Information must be retrievable in any format or sequency provided the corresponding raw data exists within the database. Typical uses would be in project verification, project status inquiries, determination of project inventories and certain kinds of statistical inquiries.

- Batch and other reports: these reports can be divided into the following categories:

  - Input control hogs and Data Error/Exception Reports
  - Project, Control Exception Reports, (Projects Due for Action or Behind Schedule)
  - Correspondence with Companies
  - Budget and Commitment Control Reports
  - Timeliness and success analyses
  - Various statistical reports

As examples, the following pages describe conceptually the budgeting and commitment control report, a project status query, and a project inventory query.

Report Name: Budgeting and Commitment Control

Purpose: To control commitments and expenditures in relation to budgets and provide information for budget planning

Information Used:

- Company number
- Company name
- Status
- Amount of
  - Application
  - Commitment
  - Claim
  - Paid

Frequency: Weekly or ad-hoc

Other control reports can be generated, these reports will show:

- Applications awaiting approval
- Commitments waiting for claims

PROJECT STATUS

MAJOR MILESTONES

Section	Region	Company	Project		PLANNED	COMMITTEE	COMMITMENT	CLAIMS	SALES
A	1	1	2	1	→	→	→	→	→
A	1	1	3	0	→				
A	1	2	4	4	→	→			
A	1	3	5	0	→	→	→	→	
A	1	3	6	0	→	→	→		
A	1	5	5	5	→	→	→	→	→
A	2	6	1	5	→	→	→	→	
A	2	7	1	8	→	→			
B	1	7	9	0	→	→	→		
B	1	8	1	7	→	→	→	→	→
B	1	4	2	0	→	→			
B	2	9	1	0	→	→	→	→	→
B	3	8	1	1	→				
C	1	6	1	3	→	→	→		

PROJECT STATUS INQUIRIES

Information is entered into the system at various stages. This approach is recommended to keep the status as current as possible. A query can be made using any, all or a combination of data elements. The query reports can be printed in any sequence.

QUERY: REPORT PROJECT AT PLANNED STAGE

RESULT: 2 RECORDS

COMMAND: PRINT THESE RECORDS BY SECTION

RESULT:

SEC.	REG.	COMPANY	PROJ.	PROJ. DES.	DATE REC'D
A	1	1 ABC CO	21	POWR STN	14/07/80
B	3	8 XY CORP	11	STEEL MILL	15/07/80

QUERY: REPORT SECTION A PROJECT INVENTORY FOR ALL REGIONS

RESULT:

PLANNED	COMMITTEE	COMMITTED	CLAIMS	COMPLETED
1	2	1	2	2

If a further breakdown is required, this query can be further brokendown.

A4.2 DATABASE STRUCTURE

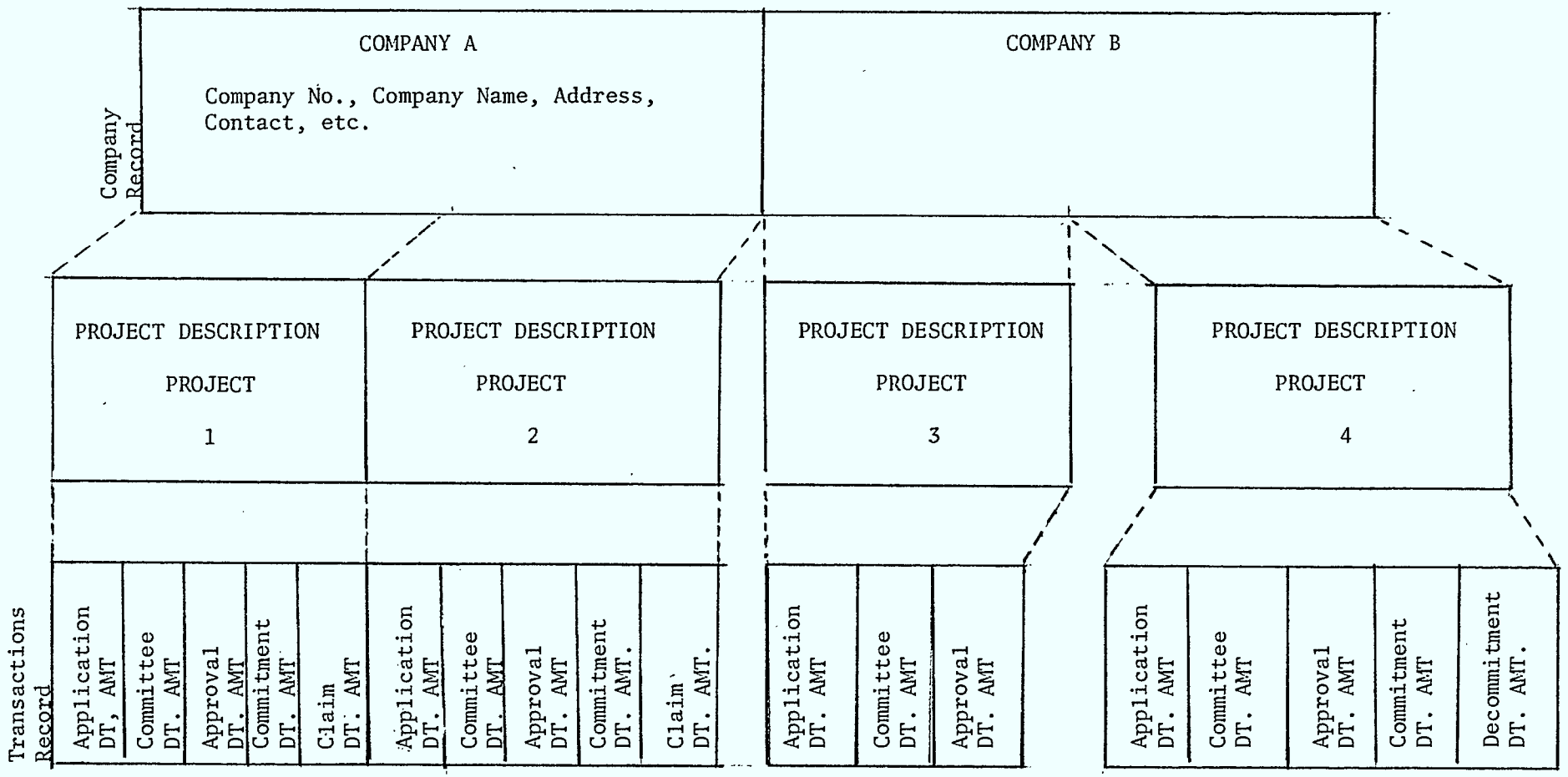
1. One record per company

2. One unique record per project, likely several projects per company

3. Storage of each transaction for each project

4. Need dedicated disk space at cost of $1000/month

PEMD SYSTEM DATABASE STRUCTURE



APPENDIX III

PROJECT PLAN AND COST

This Appendix contains:

A3.1 - Project Personnel

A3.2 - Project Plan

A3.2.1 - Design Phase Activites - Narrative
A3.2.2 - System Design Phase Schedule

A3.2.3 - Development Phase Activities - Narrative
A3.2.4 - System Development Phase Schedule

A3.3 - Estimated Actual Time Requirements

A3.4 - Time and Costs Summary

A3.1 Project Personnel

Senior Systems Analyst:

A person with systems design experience who is knowledgeable regarding the selected hardware and associated software (data-base management system, query language) environment. Must have experience in designing and implementing on-line database systems. Familiarity with the PEMD program would be an asset. This person would be in charge of the overall design, development and implementation of the new system.

Database Analyst/Designer:

This person must have the expertise required to design and install an optimum database structure.

Programmers:

One senior and one intermediate programmer to code document and install the required programs.

System Co-ordinator:

A person from PEMD office, must be very familiar with the working of the program. System co-ordinator should also know the present state of the PEMD data files; this is necessary to help with data conversion. This person will be required to train Regional Office personnel regarding data preparation, control and the use of the system.

The following abbreviations will be used in describing the project schedule.

Senior System Analyst	S/A
Database Analyst Designer	DBA
Senior Programmer	Prog. 1
Intermediate Programmer	Prog. 2
System Co-ordinator	SC

A3.2 Project Plan

Two major activities are:

- Design Phase activities
- Development Phase activities

A brief description of each sub-activity under these major activities is described in the following sections.

A3.2.1 Design Phase Activities:

1. Familiarization and Planning:

   Familiarization with the Feasibility report. Systems design and computer programming requirements are identified at a more detailed level.

2. Manual Task Definition:

   Definition of requirements resulting from human interfaces with the computer system. Preparation of source documents, other input and output related activities including logistical procedures and controls.

3. Reference Manual Identification:

   Determination of formats for specifications, other reference documents, and design phase report (see activity number 11).

4. Equipment Functions Definition:

   Definition of functions to be performed by hardware (terminals, etc.) at a level unique to this particular application (e.g. nature of console displays).

5. Equipment Specifications:

   Determination of hardware requirements, e.g. number and type of terminals.

6. Stand-alone Computer Program Function Definition:

   Definition of specific functions of stand-alone computer programs. Establishment of external requirement for program design, these are:

   - input forms, layouts
   - output, printout formats
   - report size, quantity, number of copies
   - report frequency
   - input acceptance, processing controls

7. Database Design:

   Determination of relationship between data elements, functions to be performed, and techniques of file organization to be used.

8. Query Program Design:

   Definition of requirements for on-line queries to the Database and the manner in which these queries can be made easily by the user.

9. Computer Program Test Requirements:

   Determination of test requirements for testing each program and program component.

10. System test requirements definition:

    Definition of criteria to verify the performance of the entire computer-based system as an integrated collection of programs and procedures.

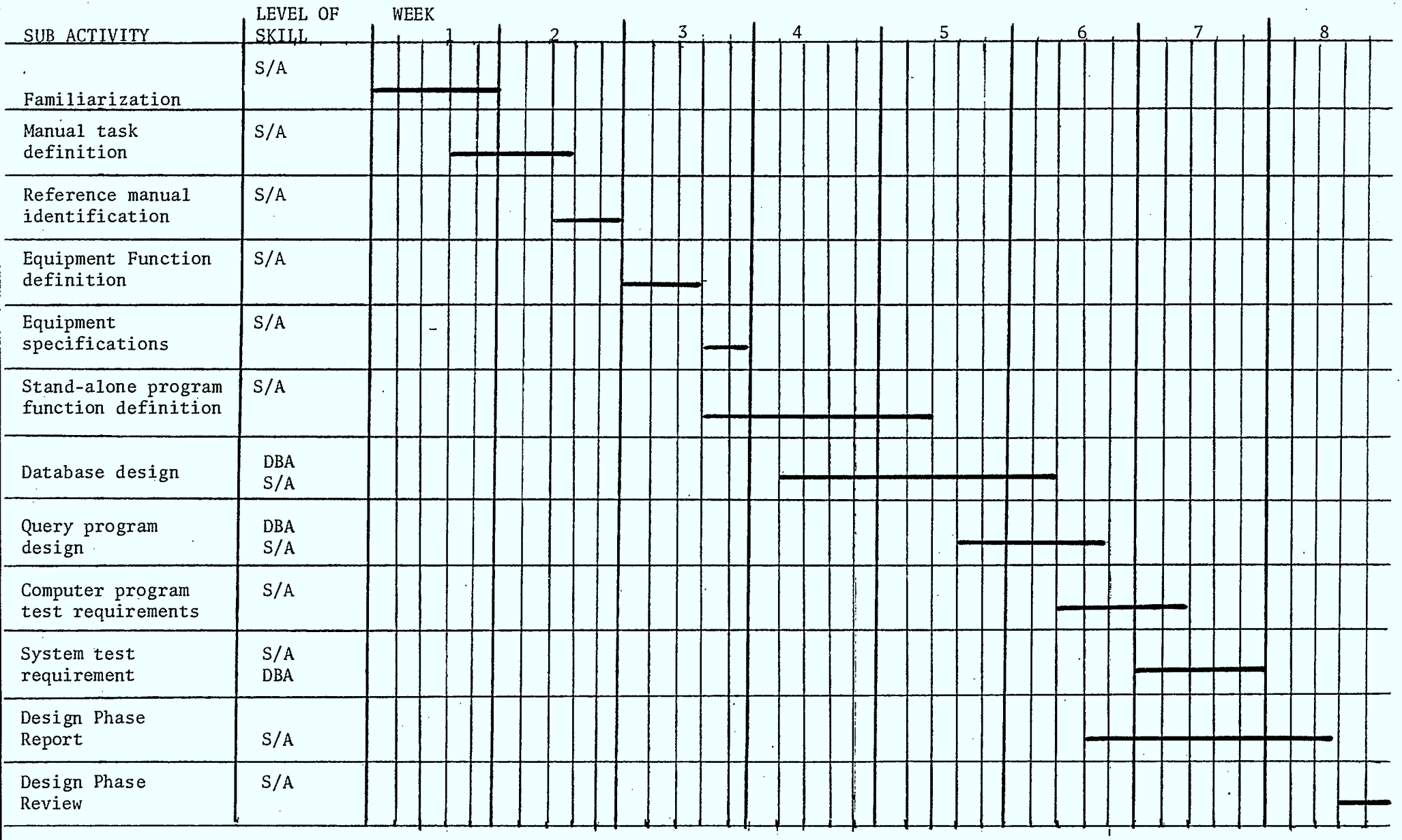
11. Design Phase Report:

    Preparation of the report containing the Design Specification, Performance Specification, etc., in the format agreed upon in Step 3.

12. Design Phase Review:

    Presentation to the management of IT&C. After conclusion of a successful project review, proceed with the next major activity i.e. Development Phase.

A3.2.2 SYSTEM DESIGN SCHEDULE



A3.2.3 Development Phase Activities

1. Implementation Planning:

   Formulate the following:

   - A plan to test all computer programs as units and overall testing of the system
   - A plan to train personnel
   - A conversion plan. This plan should provide for the conversion of procedures, data files.

2. Computer Program Design:

   Prepare logic flowcharts. This activity is parallel with the implementation planning.

3. User Review:

   Obtain user approval and agreement for the implementation plan.

4. Equipment Acquisition and Installation:

   Ensure the availability of any special hardware (terminals). This hardware is identified in the Design Phase activity (item number 5).

5. Coding and Debugging:

   Each computer program component is tested in a planned sequence.

6. System Testing:

   Perform systems tests to verify that the computer based system meets the design objectives.

7. Reference Manuals:

   Prepare reference manuals for various persons involved in the system.

9. Changeover Plan Preparation:

   Update the preliminary program phase, the final changeover takes place at the beginning of the Operation Phase.

10. Development Phase Report Preparation:

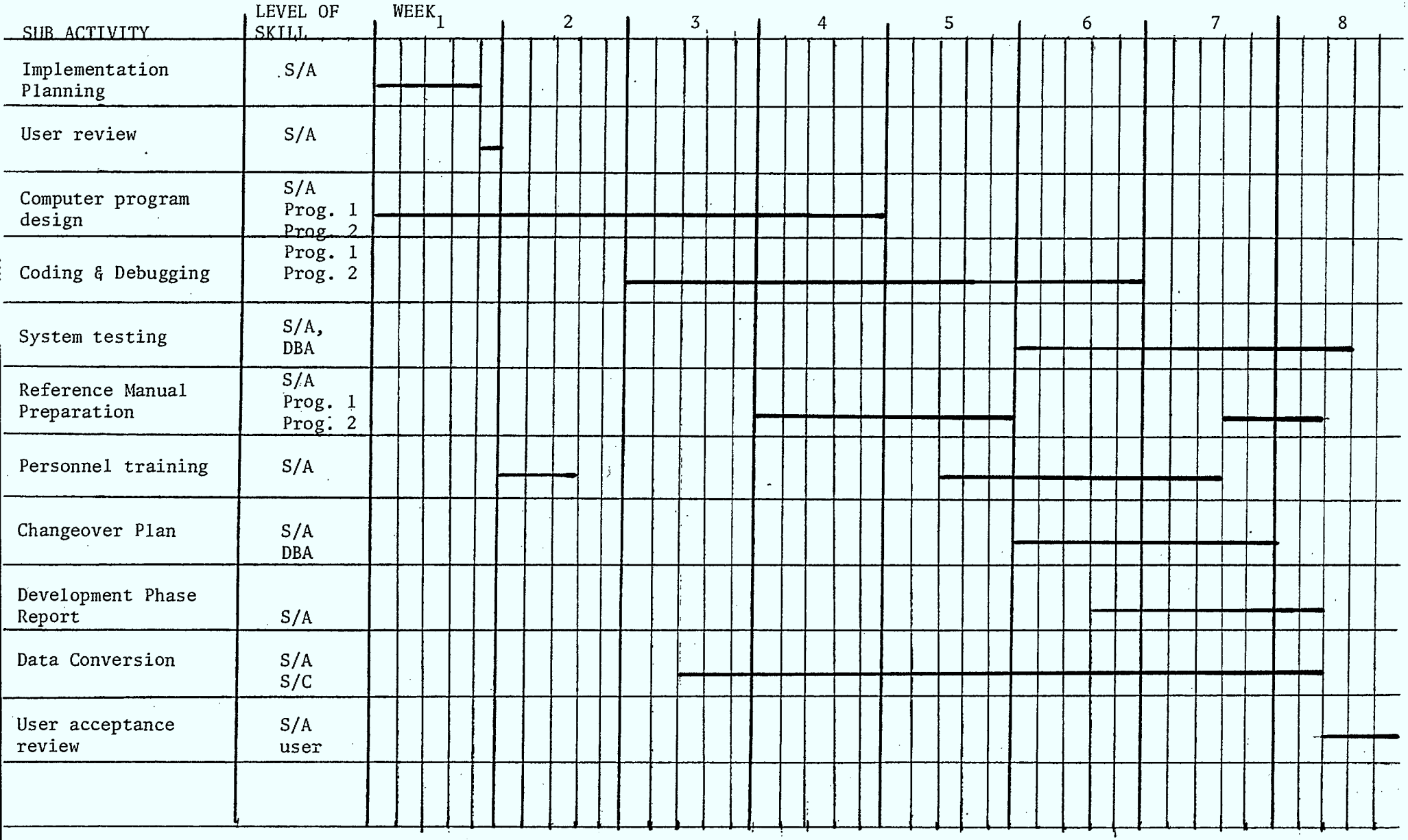
    At the conclusion of the Development phase prepare a report documenting:

    - a summary of activities undertaken during design and development
    - up-to-date system specifications

12. User Acceptance Review:

    Obtain user agreement and acceptance of the system.

A3.2.3 SYSTEM DEVELOPMENT PHASE SCHEDULE



A3.3 Estimated Actual Time Requirements

System Design Phase

Sub-Activity Senior Systems Analyst	No. of days
1 - Familiarization	4
2 - Manual Task Definition	2
3 - Reference Manual Identification	2
4 - Equipment Function Definition	3
5 - Equipment Specification	2
6 - Stand-alone Computer Program Function Definition	7
7 - Database Design	4
8 - Query Program Design	4
9 - Computer Program Test Requirements	2
10 - System Test Requirements	3
11 - Design Phase Report	5
12 - Design Phase Review	2
	40

Database Analyst/Designer	
1 - Database Design	7
2 - Query Program Design	3
3 - System Test Requirements	2
	12

System Development Phase

Sub-Activity Senior Systems Analyst	No. of days
1 - Implementation Planning	4
2 - User Review	1
3 - Program design	3
4 - System testing	8
5 - Reference Manual Preparation	5
6 - Personnel Training	5
7 - Changeover plan	2
8 - Development Phase Report	3
9 - Data Conversion	6
10 - User Acceptance Review	3
	40

Senior Programmer

1 - Program Design	10
2 - Coding and Debugging	10
3 - Reference Manual Preparation	5
	25

Intermediate Programmer

1 - Program Design	10
2 - Coding and Debugging	10
3 - Reference Manual Preparation	5
	25

A3.4 Time and Cost Summary

Level of Skill	Activity	Time (weeks)	Cost
Senior System Analyst	Design	8	$12,000
Database Analyst	Design	2.5	4,000
Senior System Analyst	Develop	8	12,000
Database Analyst	Develop (test)	1	1,500
Senior Programmer	Program	5	7,500
Intermediate Programmer	Program	5	5,000
			$42,000

APPENDIX IV

SYSTEM REQUIREMENTS DOCUMENT

A4.1. Introduction

The purpose of this document is to present the objectives and requirements of a revised PEMD information system, to describe the information to be reported by the system, and to record the constraints, assumptions, and limitations which must be observed.

The project was initiated in late May of 1980, when the PEMD Information System Implementation Task Force issued a Request for Proposal for the feasibility study. S & S Software was selected on June 16, 1980 to conduct the study, at which point work began.

The project involves

- PEMD Secretariat
- Regional Offices
- Industry Sector Branches
- Programs Branch
- Corporate Systems Branch
- Financial Services Branch
- PEMD Implementation Task Forces

The information contained in the report is based on verbal interviews and disucssions, the 1977/78 Annual Report of the PEMD Program, and a review of the present PEMD system. Analysis and synthesis of the information were followed by presentations providing useful feedback that was incorporated into the findings.

A4.2 Project Scope

The project involves the storage and retrieval of company, project and market information relevant to the operation and management of the PEMD program, including the entry of data and the on-line retrieval of information in display and/or report formats.

The project will not examine the integration of the PEMD system with other systems, such as the financial system or other systems which store and retrieve company or market information. The use of BRID numbers for company classification and SIC codes for product classification will be undertaken, however, as a prelude to system integration at some future date.

The administrative areas to be examined include procedures and organization for input data preparation and control, information retrieval procedures, methods for the dissemination of generalized market intelligence from trade commissioners to PEMD, procedures for cross-checking for duplication with CIDA programs, and procedures for the timely provision of relevant financial information to the PEMD program. The activities of input data preparation and control and information retrieval will involve both PEMD Secretariat and Regional Offices, while the remainder of these administrative areas involve relationships between PEMD Secretariat on the one hand and Office of Overseas Projects, CIDA, and Financial Services Branch on the other hand.

The project does not involve the structure or organization of the PEMD program, nor does it involve any detailed examination of workflows within areas of the Department aside from PEMD Secretariat and PEMD operations within Regional Offices.

A4.3 Objectives

The objectives of the projects are:

- To improve the timeliness and appropriateness of information available to management regarding the PEMD program, and to substitute on-line computer retrieval of information for retrieval through clerical searches of batch listings.

The objectives of the system are:

- to allow timely and cost-effective storage and retrieval of PEMD-related information in an efficient manner
- to satisfy PEMD project control information needs
- to provide PEMD budgeting and commitment control information to all levels of management
- to report to management on the performance of PEMD program operations
- to provide statistical data on companies using PEMD and on PEMD projects, on both planned and ad-hoc bases.

These objectives are in principle on-going, but in practice they have not been well met in the past and can thus be regarded as new objectives for a revised system. The objectives are not expected to change in future.

The degree of attainment of these objectives are to be measured in terms of:

- the time required from data availability at source until data availability from the system
- the time required to re-cycle errors on data entry
- the volume of error re-cycling at data entry
- the amount of clerical effort involved in preparing and controlling information for data entry
- the length of time required to retrieve information from the system
- the amount of clerical effort involved in extracting useful information for management from the system output
- out-of-pocket costs

- the degree of user satisfaction with the system
- the degree of utilization of available information by management
- frequency with which information needed within the program is found to be unavailable from the system
- the availability of the outputs described in the Systems Report Section of this document.

The minimum acceptable levels of achievement are:

- 72-hour normal elapsed time from data availability at source to availability within the system
- 24- to 48-hour normal error recycling capability
- on-line information retrieval capability at major locations (Ottawa, Montreal, Toronto, Vancouver, Edmonton, Halifax)
- use of a database approach with a flexible query and report-writing system capable of handling at least 90 per cent of of information requests
- significant reduction of manual record keeping in the operation of the PEMD program
- significant reduction of the volume of routinely-generated hard-copy output from the system
- implementation of a revised system by mid-February, 1981 that can provide the outputs described by the System Reports section of this document.

A4.4 Requirements

A data-entry regime is required, whereby information relevant to the PEMD program that is received at regional offices or headquarters can be

- verified
- sent to PEMD Secretariat
- keyed at a suitable service bureau
- read and used to update a database

within a 48- to 72-hour time span. The use of a revised form for PEMD assistance applications, from which data can be keyed directly, will be required. Suitable data control procedures will be necessary. Input errors should be recyclable within 24 to 48 hours.

Procedures will also be required for the delivery of data on claim receipts and payments from Financial Services to PEMD Secretariat, and for PEMD Secretariat to control the entry into the database of these data plus data on commitments already in its possession, in the same manner and within the same time frame.

The database system must allow daily batch updates. The database must store data on companies, projects, and markets. The project information will consist of a fixed descriptive portion and a variable number of transaction records. The approximate data volumes are as follows:

Data Type	Number of Characters per Record	Initial Number of Records	Number of Additional Records per year
Company Description	3-400	6,000	1,500
Project Description	3-400	30,000	3,500
Market Data	To be determined in detailed design		

Up to 20 transactions per project, 20 to 25 characters per transaction.

The database system must allow on-line retrieval of information for project control and statistical purposes using a flexible and easy-to-use query system in at least the following locations:

- PEMD Secretariat, Ottawa
- Toronto Regional Office
- Montreal Regional Office
- Vancouver Regional Office
- Edmonton Regional Office
- Halifax Regional Office

The system must provide weekly project control exception reports and commitment control reports, as well as periodic reports analyzing the timeliness of PEMD program operations and the success of PEMD assistance.

The use of BRID numbers for company identification, and of SIC codes for produce identification, should be incorporated into the new system.

These requirements will necessitate the use of a standardized PEMD application form, changes in data handling activities and organization in the 12 Regional Offices and PEMD Secretariat, and the design, development, and programming of a new database system. A conversion of the data stored by the present PEMD system will also be required.

A future requirement is to examine the advisability of upgrading the new system to allow on-line entry of data in order to achieve data availability on the database within 24 hours of its availability at source. This examination should be based on an assessment of the performance of the new database system following its implementation.

A4.5 System Reports

The system must provide two types of reporting facilities - an on-line query facility, and a batch reporting facility.

All of the information stored in the database must be retrievable according to user-specified formats and in user-specified sequences using the query facility. The retrieved information must be available both in console display form and in hard-copy form.

The batch reports must include the following:

- input control logs and data error/exception reports, providing identification for control purposes of new entries into the database as well as clear explanations of any error or exception conditions

- weekly project control exception reports, listing projects requiring action during the coming week and projects behind schedule

- weekly budgeting and commitment control reports, showing the total dollar volumes in the following categories:

  - application received, awaiting officer recommendation
  - forwarded to committee for decision
  - approved, funds committed but not yet claimed
  - claims received and awaiting approval
  - claims approved/paid
  - total of the above
  - budget
  - budget less claims approved/paid (balance remaining)

  This information should be broken down by fiscal year, covering the current year, the next two years, future years combined, and the previous two fiscal years on a year-to-date basis. Information should be reported on both undiscounted ("as is") and historically discounted (projected after allowing for historical experience as to rejections, decommitments) bases. Information should be available by project officer, region, industry sector, and for the total program.

  - periodic timeliness analyses, showing by region and in total the frequencies with which program operations are completed on schedule and within certain deviations from schedule

  - periodic success analyses, showing by region, industry, sector, country, and in total, success ratios (sales per dollar of assistance) and percentages (frequency of success) for PEMD programs

To the maximum extent possible, use of the statistical reports now produced by the present system should be replaced by the use of on-line queries. If large listings are needed for reference purposes, these should be produced on computer-generated micro-fiche. Despite these strictures, a need for some additional batch reports of a statistical variety may be identified during detailed design.

A4.6 Constraints, Limitations and Assumptions

The present overall structure and organization of the PEMD program are assumed as given. A further decentralization of the program, whereby Section A applications are processed by Regional Offices, would not qualitatively affect the system requirements.

Implementation of the revised database system should occur by mid-February of 1981, based on a project start date of September 1, 1980. Budgeting and commitment control information should be available by December 31, 1980. Data conversion should occur on a prioretized basis beginning with essential fields.

The design, development and implementation budget should be $50,000 including computer charges. The project team should include a person from PEMD Secretariat who is familiar with existing data, who can assist with data conversion, and who would serve as the Data Administrator for the new system. (The cost of this person's time would be in addition to the project budget.) Target operating budget for the system should be $115,000 annually.

The following system assumptions have been made:

- data volumes will be comparable to workloads within the present system, assuming updates affect every field in a record. An incremental safety margin of 0.5 million characters per year has been included in assumed data volumes

- personnel requirements for data control will be equal to data entry requirements using internal staff, based on the present distribution of work among regional offices

- the use of revised application form for PEMD assistance will be acceptable

- copies of input documents can be made locally before sending them to Ottawa

- adequate courier or air express services are available for sending documents to Ottawa

- a key entry service bureau can be found which will offer quality service on an overnight basis every day

- error correction can be done centrally be PEMD Secretariat based on telephone communciations as necessary with regional offices

- the co-operation of Regional Offices, Industry Sector Branches, and Financial Services Branch will be forthcoming regarding the operation of the new system

- program operations can be adapted to accommodate the periodic entry of information about a given project into the database as it becomes available.

The following project assumptions have been made:

- Basic program structure and organization will remain unchanged, except for a possible decentralization of responsibility for Section A Applications

- the focus of the project should be on meeting the information needs of the PEMD project only, while not jeopardizing future intentions to integrate information systems.