OWNER'S COST CONTROL SYSTEM SELECTION METHODOLOGY

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OWNER'S COST CONTROL SYSTEM SELECTION METHODOLOGY

by

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ABSTRACT

Owner's cost control of large scale construction projects within a Project Management environment requires the processing of large amounts of information relating to quantities and unit rates for work expended and work yet to be performed. Cost control is based upon monitoring reports summarizing and presenting the available data and the adoption of appropriate management responses. Due to the amount of information to be considered, computer processing is almost universally adopted, necessitating management decisions upon the most appropriate of a number of competing computerized cost control programs to be adopted by a particular owner's organization. Such decisions require a basis for comparison. Unbiased comparisons are the ideal to be attained, and to this end, this thesis develops a methodology utilizing a classification system devised to remove some of the elements of bias currently surrounding decisions regarding suitability of any particular proprietary computer program for any owner.

The methodology consists of an owner initially determining his information reporting requirements in terms of the classification of data to be presented in each report. For any particular program, the information presented by every report is classified in a similar manner. By comparison of the owner's requirements and the particular program under review, determination may be made concerning the suitability of that particular program for the owner. A number of such available programs may be evaluated against the owner's

requirements utilizing the methodology and, by simple discrimination, achievement of unbiased selection of the most suitable is rendered possible.

The methodology has been computerized and an example of its use is included. Finally, suggestions for further work in this area are made.

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ABBREVIATIONS

ABR	Activity Bar Chart Report	Model Schedule
ALR	Activity Listing Report	Model Schedule
AMAR	Activity Manhours Allocation Report	Model Resource
APA	Accounts Payable & Accruals	Model Financial Accounts
AR	Actual Report	PERT/COST
BR	Budget Report	PERT/COST
CAR 1	Contingency Analysis Report	Model Cost
CAR 2	Cost Allocation Report	Model Cost
CAR 3	Cash Advance Request	Model Cashflow
CAL	Cost Account Ledger	Model Cost
CASR	Capital Appropriation Status Report	Model Cost
CCER	Cumulative Cashflow Envelope Report	Model Cashflow
CCR	Cost Comparison Report	Model Cost
CCR	Cost Category Report	PMS/COST
CDCR	Capital Disbursements Control Report	Model Cashflow
CFR	Cost by Facility Report	Model Cost
CMCS	Construction Management Control System	Proprietary System
CMR	Cumulative Manhours Report	Model Resources
CMR	Cost Milestone Report	PMS/COST
CNTR	Charge Number Time Report	PMS/COST
COSR	Change Order Summary Report	Model Cost
COR	Change Order Report	Model Cost

CPR1	Cost Planning Report	Model Budget
CPR2	Cost Period Report	Model Budget
CR	Cashflow Report	Model Cashflow
ER	Expediting Report	Model Schedule
ER	Estimate Report	PERT/COST
FPSR	Financial Plan & Status Report	PERT/COST
FPSR	Financial Plan & Status Report	PMS/COST
IR	Invoice Register	Model Cost
M	Modified: i.e., obtainable by modification of standard reports	PMS/COST
MCR	Manhour Cost Report	Model Resource
MLH	Manpower Levelled Histogram	Model Resource
MLR	Manpower Loading Report	PERT/COST
MLR	Manpower Loading Report	PMS/COST
MSR	Management Summary Report	PERT/COST
MSR	Management Summary Report	PMS/COST
O	Obtainable but not from Standard Reports	PMS/COST
OMR	Owner Furnished Materials Report	Model Cost
OSR	Organization Status Report	PERT/COST
OSR	Organization Status Report	PMS/COST
POG	Program Outlook Graph	PMS/COST
POR	Purchase Order Register	Model Cost
PPCR	Progress Payments Certification Report	Model Cost
PPSR	Program/Project Status Report	PERT/COST
PPSR	Program/Project Status Report	PMS/COST
PR	Procurement Report	Model Schedule

RR	Retentions Report	Model Cost
TPR	Tender Packages Report	Model Schedule
UPAR	Unit Price Analysis Report	Model Cost
URH	Unlevelled Resource Histogram	Model Resource
UWR	Unawarded Work Report	Model Budget
WBS	Work Breakdown Structure	General Usage

CHAPTER I

THE PROBLEM

1. The Construction Environment and Cost Control

1.1 General

Before an individual user chooses the most appropriate cost control computer software, the requirements needed from it must be considered. This is best achieved by first considering the system's operational environment. This thesis considers the user to be an owner and, among the general projects environment, only the narrower environment encompassed by the form of management known as Project Management will be considered. Cost control requirements within this environment are established in a general form following definition of the environmental conditions. Then, by way of an example, a possible user's requirements are predicated. Available cost control systems are compared against each other and against the user's requirements. Evaluation of the most suitable of the two available alternatives considered is shown to be a difficult process, leading to the problem statement.

1.2 Project Establishment

1.2.1 Project Need

Before a project can be established, there must be an owner with a need and with access to the resources by which the need may be

satisfied. The owner may be a public or private company or an arm of Government.

1.2.2 Project Life Cycle

The life cycle consists of need, design, construction, use and obsolescence. Use and obsolescence must be considered in the design stage, and their effects upon life cycle costs may be significant. For this thesis, their effects upon construction cost control may be ignored once the design stage is passed, and, from this point, references to a project will mean only the work necessary until completion of construction and including commissioning.

1.2.3 Project Design and Construction using Project Management

Project Management has come to mean the management of projects by organizations acting as agents for the owner. Their function is to meet the objectives of design and construction of a facility within time and cost limitations, utilizing required resources most efficiently. The project manager recommends award of contracts for design, supply and construction, together with miscellaneous associated contracts. Project Management methods are most suited to large complex projects, involving many engineering disciplines, or when completion is wanted sooner than could be achieved by the traditional process of awaiting design completion before commencing construction. In the latter case, the project phasing is known as fast-tracking. In fast-tracking, scheduling methods are used to enable work upon different design phases to be performed concurrently with construction of phases designed earlier. This enables contracts to be let for individual

phases, e.g. foundation construction, immediately upon completion of design and before completion of design on later phases, e.g. the structural frame.

1.2.4 The Project as an Activity Network

The project is envisaged as a series of tasks, the completion of which gives project achievement. Tasks are sub-divided in a form known as the Work Breakdown Structure (WBS) until a level is reached where the individual task, known as a work package, is ideally suited to be let as a contract. Each work package comprises a series of activities, logically related, each of which must be achieved in order to complete the work package. Performance is constrained by technological sequences, e.g. that formwork needs to be placed before concrete can be poured. Activities comprising a work package may be considered as a sub-network (also called subnet) of activities, interfacing logically with other subnets. The total of all subnets is the project activity network. The project manager chooses activity sequencing within the subnets during the early stages of project planning, considering such factors as physical constraints, resource availability, and timing of individual work packages.

1.2.5 Funding and the Life Cycle

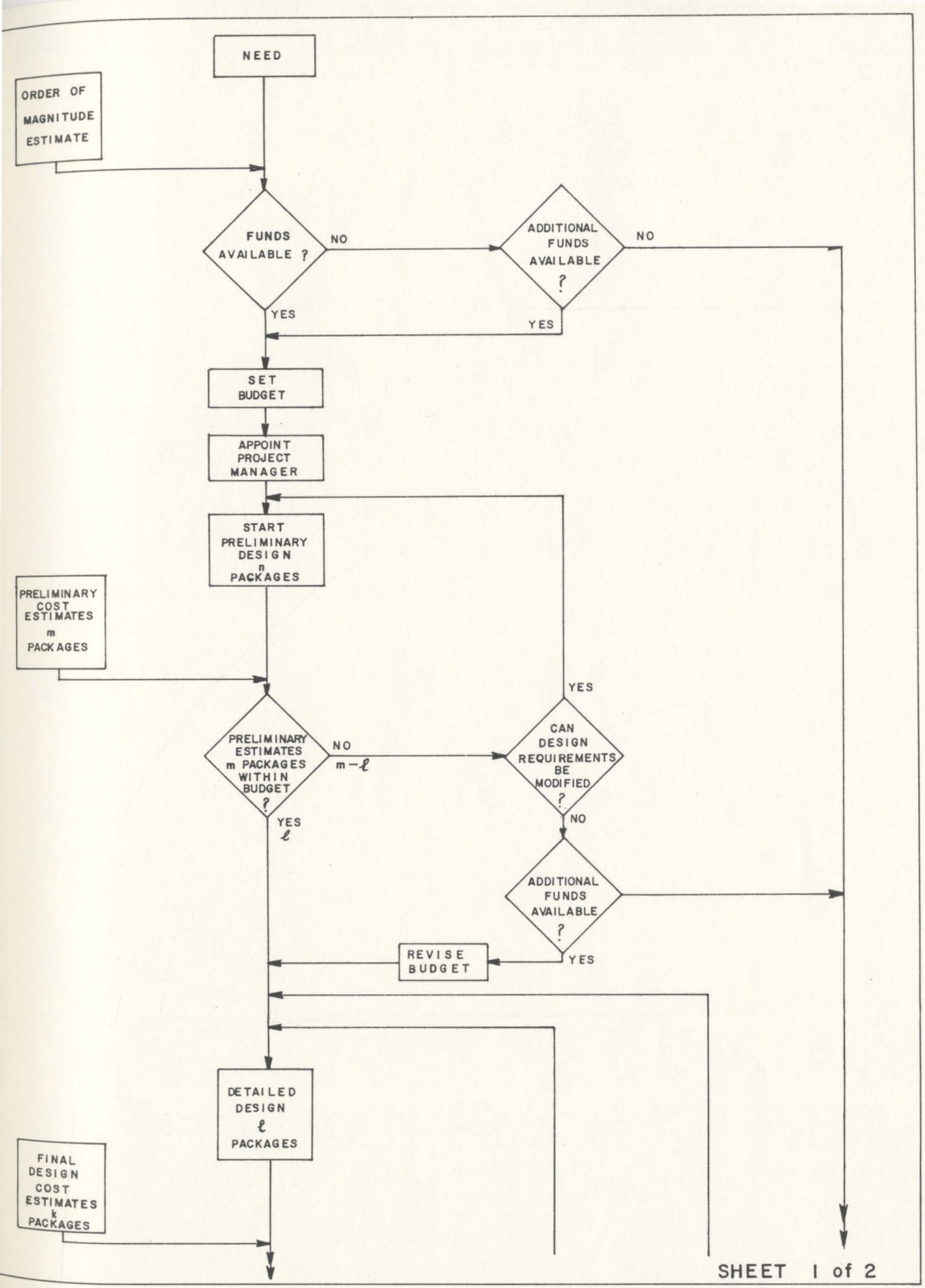
Planning is required for feasibility in terms of physical, economic and financial parameters. When using Project Management, cost objectives are less fully known than with other forms of construction management. Use of traditional design and construction of a project provides a last decision point after receipt of bids to reconsider proceeding with the project or otherwise if bids are much

higher than estimates. Using fast-tracking, much higher than estimate figures may be received as bids for later sections of work. With substantial funding already committed, the owner's choices are more limited than with traditional management. Negotiations to achieve savings, redesign with altered scope or quality, or commitment of more funds are essentially the only options available to the owner. The commitment of additional funding in order to achieve a revenue-producing facility is likely to be more attractive than postponement attracting high interest charges upon committed funds or cancellation resulting in disastrous consequences.

Figure 1 is a flow chart depicting the fast-tracking process in Project Management, predicated upon the use of WBS and division into work packages. At any one decision point some work packages may continue on each branch of the flow chart, due to overlapping of different stages in the various work packages. Re-assessment of cost estimates of work packages is needed at each review point for revision of funding requirements.

1.2.6 Estimating and the Cost Budget

The re-assessed cost estimate of a work package becomes its cost budget. For an accurate budget, it is necessary to have accurate estimates. Increase of information and detail about the project permits increased accuracy in estimates. The cost budget must provide for an element of uncertainty, dependent upon the degree of detail known during estimate preparation. The number of reviews and their position temporally will depend upon project size and viewpoint considered.



GURE 1. FLOW CHART: FAST-TRACKING IN PROJECT MANAGEMENT

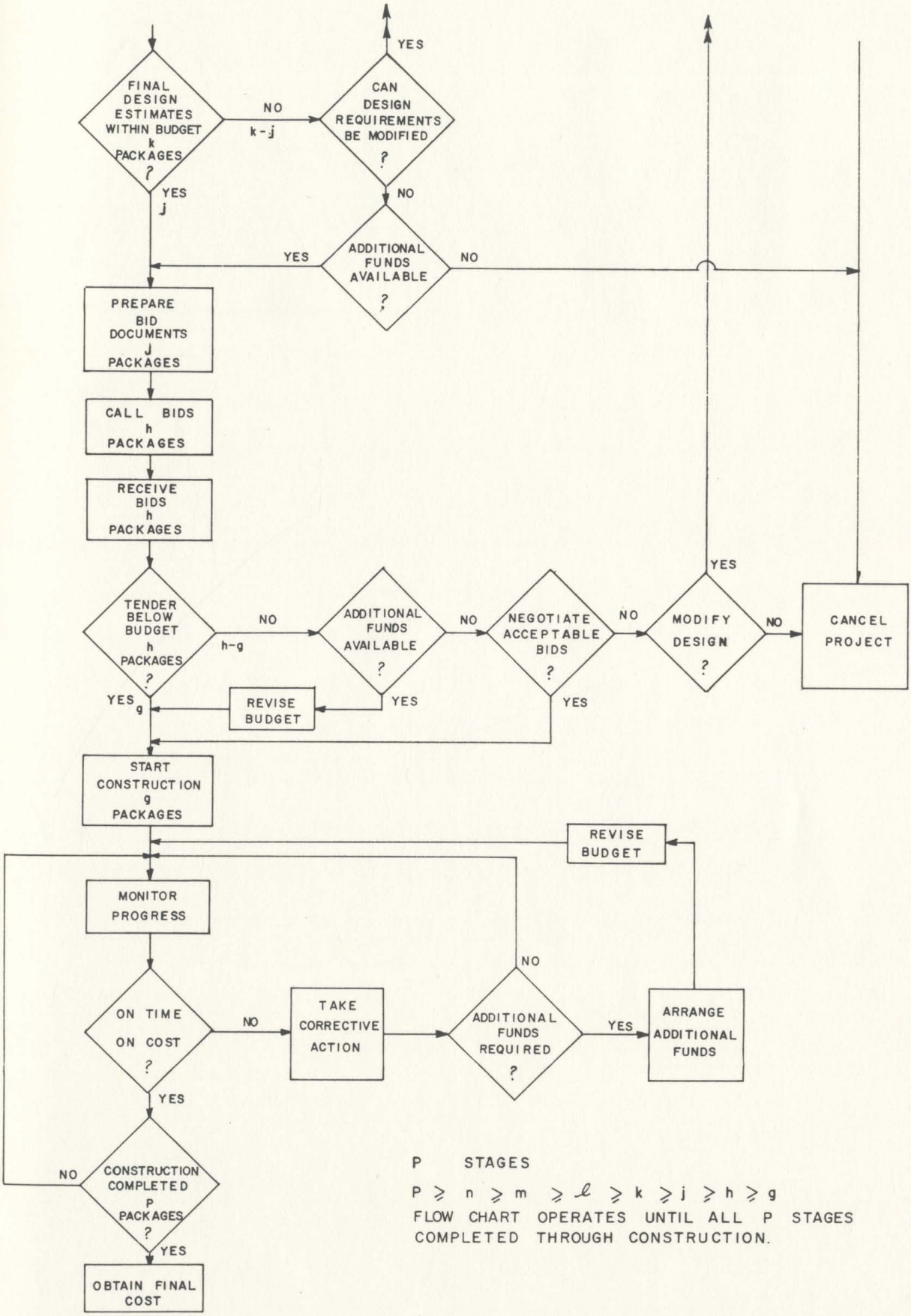


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FIGURE 1. FLOW CHART: FAST-TRACKING IN PROJECT MANAGEMENT

1.3 Environmental Factors

1.3.1 Parties Involved with the Project

The project manager is a specialist hired by the owner for a specific project. Remuneration is in the form of either a fixed or variable fee. A flat fee provides no incentive for performance, other than reduction in overheads within the project manager's own organization. A percentage fee based upon final cost of the project is no inducement for performance. The best fee arrangement should probably be a base fee plus target bonus, which should be realistically established to provide a genuine benefit to both parties. This way, the owner knows his maximum fee commitment and the project manager has a strong incentive to reduce costs. To fully earn this bonus, the project manager needs to ensure that overall cost falls within the original estimate and that he provides a functionally satisfactory facility with completion before owner-set dead-lines.

Other parties are also involved in the completion of a project, each setting a cost budget. In all stages of design and construction, the relevant parties are concerned with maintaining their costs within their budget figures, while completing on time and within specification. The parties involved comprise architects, consultant engineers, specialists, contractors, vendors and subcontractors. These parties are related to each other in the performance of the project as indicated by Figure 2.

1.3.2 Type of Contract

The type of contract affects the degree of control required from the cost control system. Where the scope of work is fully

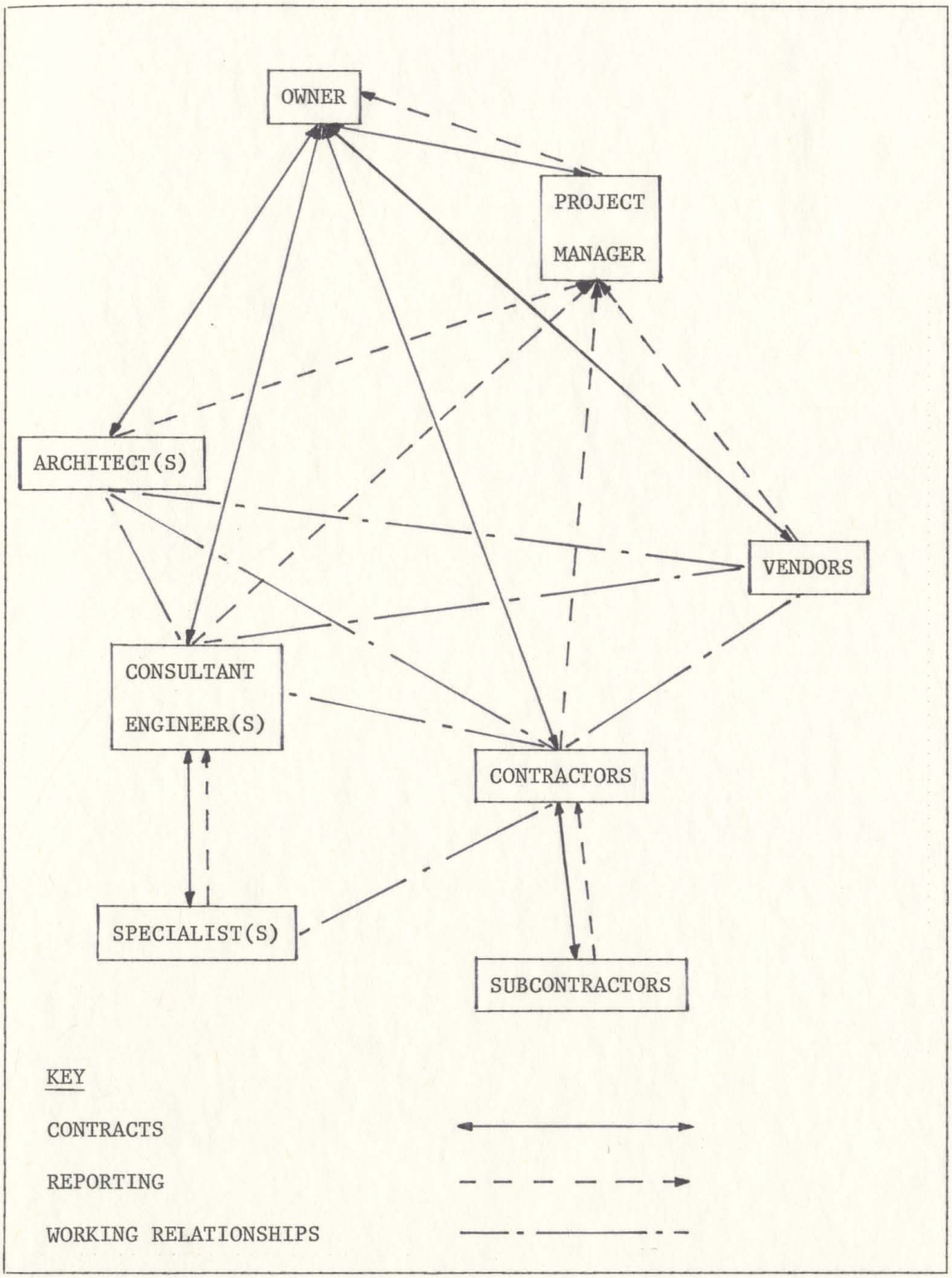

FIGURE 2. RELATIONSHIPS OF PARTIES (SIMPLIFIED)

defined, with design and working drawings complete before bid invitation, the cost estimate is more accurate and the amount of uncertainty is comparatively small. Figure 3 illustrates the variability of uncertainty with the contract type. This uncertainty is reflected in the variation of final cost from estimated cost. There is a trade-off against time required for project execution using the particular contract type. Dependent upon the timing, a single project may involve different types of contracts.

1.3.3 Type of Work

Cost control requirements for different paces of work vary because of the varying rates of expenditure, for instance the pace on pipeline construction is different than that for buildings. Hence, the progress and cost reporting required on a pipeline is more frequent than on buildings.

1.3.4 Project Size and Location

Generally, more elaborate means of information flow are required on larger projects, involving various individuals responsible for expenditure of project funds, but the cost of control tends to benefit from economies of scale. For very small projects, adequate control may be exercised through manual methods, while on larger projects, computerized systems are essential. Location of the computer, whether at head office or site, can affect speed of response of the system due to the time needed for information transmittal. On-line terminals must be provided to overcome this problem when the site is isolated and has reliability of power supply and transmission facilities.

		CONTRACT TYPE									
		LUMP SUM	UNIT PRICE	CONSTRUCTION MANAGEMENT	COST PLUS & GUARANTEED MAX	& INCENTIVE	COST PLUS & GUARANTEED MAX	CONVERTIBLE	TIME AND MATERIALS	COST PLUS	PROJECT MANAGEMENT
SCOPE DEF'N.	NONE									●	
	POOR				●		●	●	●		
	GENERAL										●
	ALL	●	●	●							
DESIGN	NONE							●	●		●
	SOME			●	●		●			●	
	ALL	●	●								
QUANTITY	UNKNOWN							●	●	●	
	VAGUE				●		●				●
	APPROX.		●	●							
	KNOWN	●									
UN-CERTAINTY	LOW	●									
			●								
				●							
					●						
							●				
								●			
									●		
										●	
	HIGH										●

FIGURE 3. CONTRACT TYPE AND UNCERTAINTY

Multi-disciplinary projects can require additional control on transportation systems, while congested inner-city locations may require more control over materials handling and expediting.

1.3.5 Multi-Project Situation

For an owner with a single construction project, the cost control system may be tailored to that situation. The multi-project situation requires a more adaptable system and more or less necessitates the use of computers sited away from the individual job site, with remote multi-accessing and printing features used to overcome delays with information transmission.

1.4 Requirements for Cost Control

1.4.1 Need for Cost Control

Costs are incurred from project inception until completion. With efficient planning, overall estimated costs can be minimized subject to owner constraints upon the availability of funding, resources, and the project time-span. Project costs can increase due to changes in borrowing costs, unforeseen occurrences, bad design, inadequate supervision, poor productivity, failure to follow the plan, and failure to react to these circumstances by timely corrective action. Proper control is essential therefore, throughout the project life on all aspects in order to minimize any increase in project cost.

1.4.2 Function of Cost Control System

The basic function of a cost control system is to ensure that project execution is performed as planned in relation to costs.

Divergences must not only be highlighted as soon as possible on occurrence to determine the reasons and to take remedial action, but must also be forecast through trend analysis. With different users, cost control inception occurs at different phases of project life. The owner's cost control should start simultaneously with the project release. Other parties should have their cost control procedures in place prior to project involvement.

1.4.3 Project Monitoring

A cost control system can function only if there is an adequate monitoring system functioning properly. This means that information obtained through monitoring must be relevant to the characteristics being monitored, and that it must be available in a timely manner, in order to permit action upon information presented. Monitoring cannot be a single happening. It must be performed at regular intervals, the frequency of which depend upon the characteristic being monitored.

A project comprises a number of work packages, some of which will become contracts during the project life, while others will remain as work packages for performance in-house. Control over the work package costs is needed to control project cost. This control may include any or all of monitoring by previous period, cumulation to date, forecast to complete and forecast final cost, with comparisons against budget or estimate, as appropriate. Trends compared with previous period and schedule may also be monitored. Identification of elements to be controlled within the parameters just outlined is required in order to control project costs.

Consider the project life. At an early date an estimate is made of capital cost. A budget is established. Definitive estimates are made, comprising estimates for each of design, construction and management with allowances for cost escalation and unforeseen changes. A contingency fund is set up to provide for variations between contract prices and the definitive construction estimate. When funds are required for design, construction, or management, appropriations are made. When orders are placed but payment is not immediately made, commitments are established. Cash disbursements are made. Records of transactions with vendors and contractors are needed. Value of work performed needs authentication. Holdbacks need determining. Costs incurred require certification. Also, materials furnished by the owner need controlling. Prices can vary, requiring analysis of unit prices. Besides control over total project cost, control over work package costs is required.

Also to be considered are the elements with which the project is executed, namely, resources. What resources are required? How many of each resource is required? When are they to be used? How much will they cost? Where will they be used? What substitutions may be made? What are the priorities on use of resources? Are resources readily available when required? Changes in any of these affect the project cost and they therefore require to be monitored and controlled.

In parallel with the project life, as considered above, in relation to monetary and other resources, the project also has a schedule life. Planning and feasibility studies are performed. Targets are established for activity durations. Some activities are

procurement of items. Delays in procurement could cause overruns. Expediting is used to assist in prevention of delays from suppliers. Some activities have float, the amount of which varies. Control of all aspects of schedule is required to avoid overruns.

Projects require financing throughout their life. The amount and timing is planned at the outset as project cashflow. If variations occur in amounts and/or timing, changes must be made to interest costs. Unless balanced by revenue changes, if applicable, liquidity problems could arise. It is essential therefore that cashflow be controlled.

Inventory costs are increased when items are held in inventory longer than needed with a pre-determined margin of safety. Payment must be made for items purchased and costs of purchases may be minimized if full advantage is taken of discounts for early payment and avoidance of charges for late payment. Items sold or charged-back must be paid for within allowable time periods. If delays occur in payments received, additional costs will be incurred. Control is required, therefore, over inventory, payables and receivables. This is accomplished through control over financial accounts.

The major areas over which control is required are indicated in Figure 4.

1.5 Reports Required from Cost Control System

1.5.1 General

Figure 4 shows monitoring areas required for effective control. This is exercised by management acting upon information presented in reports covering the various items which need monitoring. Figure 5,

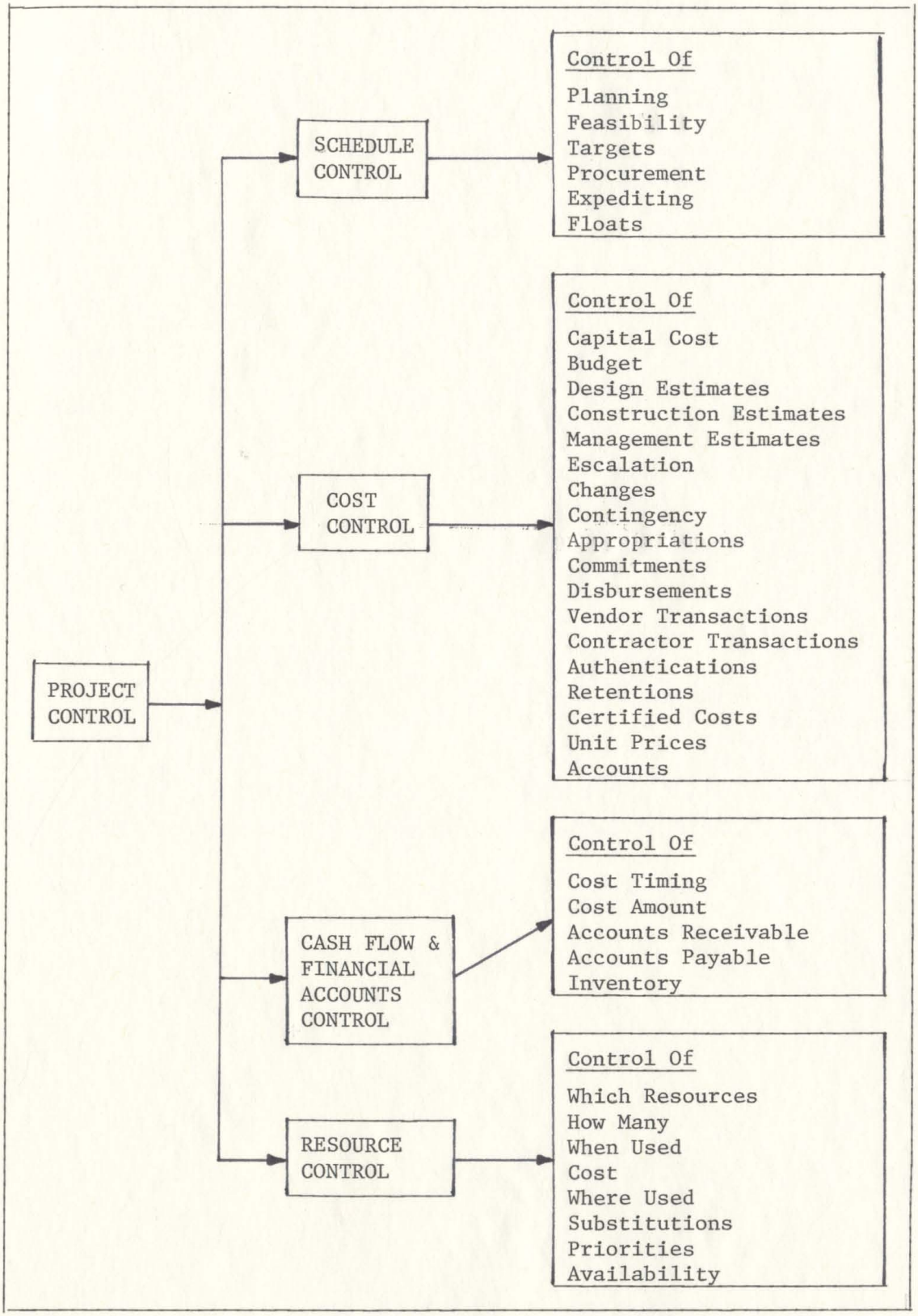

FIGURE 4. REQUIREMENTS FOR CONTROL

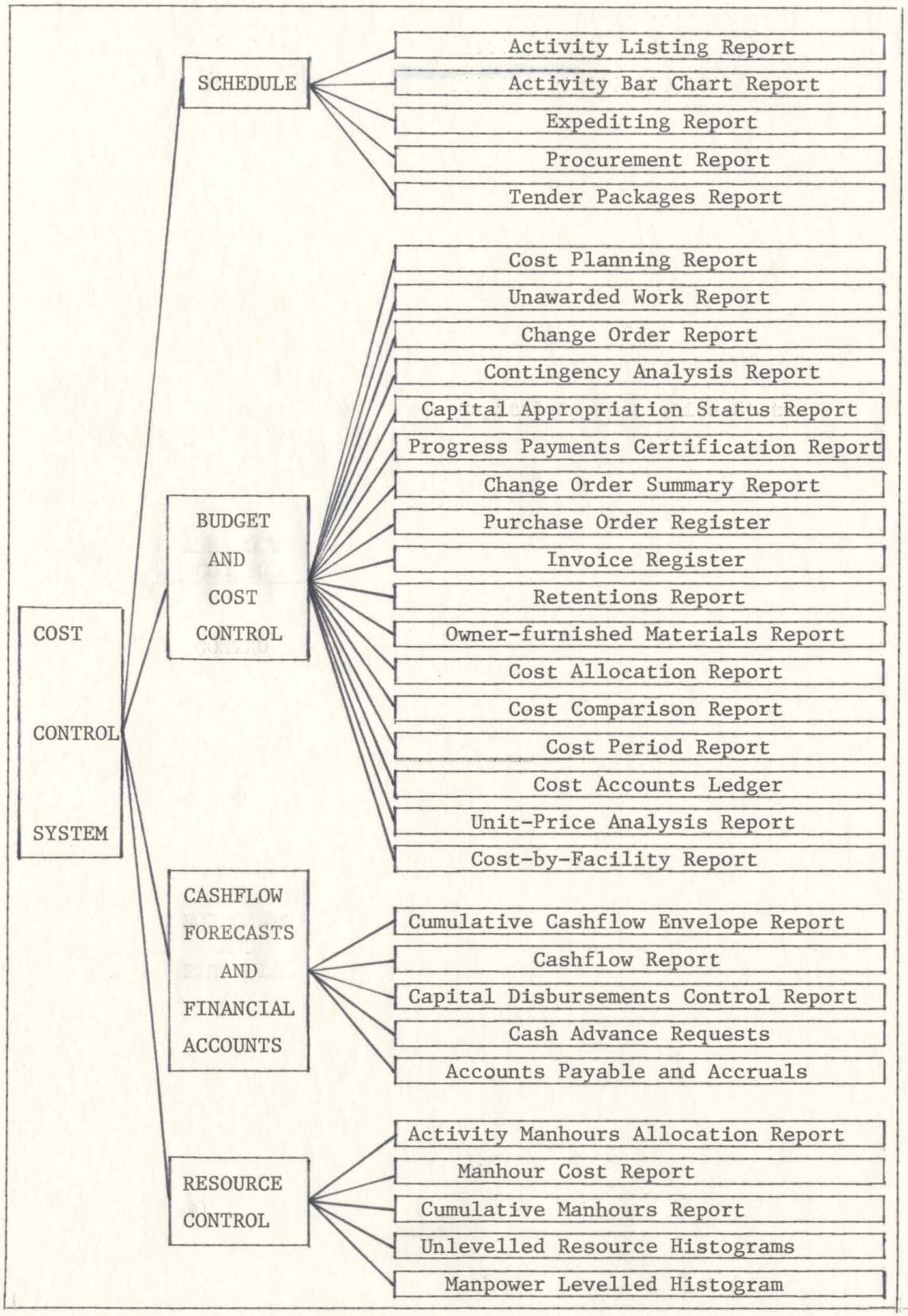

FIGURE 5. SUMMARY OF COST CONTROL REPORTS

by way of an example, indicates a possible user's requirement separated by monitoring areas. The reports for each monitoring area are separately detailed in the following sections. Abbreviations indicated following report titles in Section 1.5.3 are used later in Section 1.6.4.

1.5.2 Schedule Reports

Schedule reports are required to determine if the project is being performed in accordance with the times scheduled for activities, and to highlight deficiencies in performance. Where work involves a number of contractors, monitoring of schedule reports enables proper coordination of individual performing agencies. When purchasing and delivery functions are included in the network, a facility for adequate monitoring to enable expediting to be performed is required.

The schedule reports should be available in a variety of sorting options. Sorting options required, based on activity networks may comprise some or all of--network, subnet, preceding event, succeeding event, free float, secondary float, performing department, early start, late start, early finish, late finish, charge number and resource. The content of each report should include at least the identifiers for the activity, its description, and sorting parameters used. Separate reports, dependent upon their function, should include items as detailed in the following:

a) Activity Listing Report (ALR). Function is to indicate logical relationships of activities in time. This should list durations, dates, float, percentage complete, and performing agency. With responsible agency added, the report can be used to control

engineering as well as construction.

b) Activity Bar Chart Report (ABR). Function is to indicate relationships of activities in time. It provides similar information as the listing report, in a graphical format.

c) Expediting Report (ER). Function is to ensure material deliveries on schedule. It should list purchase order number, dates, durations and float for manufacture and shipping, together with destination and delivery terms.

d) Procurement Report (PR). Function is to ensure material ordering on schedule. It provides dates, durations and floats for requirements to purchasing department, tender issue and closing, bid evaluation, order placement, and items similar to expediting report.

e) Tender Packages Report (TPR). Function is to indicate major milestones in relation to time. It shows target dates for design, drawings, specifications, estimate revision and approval, tender documents, bid evaluation, appropriation request, and tender award.

1.5.3 Budgeting and Cost Control Reports

Estimates for individual work packages are made at varying stages. Each comprises a base estimate with allowance for contingency and escalation. The overall project estimate is the sum of the estimates of individual work packages. For proper control, it is necessary to allow for estimate revisions. The escalation fund provides for the increased cost for providing services over time. If cost with escalation exceeds the estimate, the contingency fund is depleted. Management can be alerted to excessive escalation by

monitoring these funds. Reports required by management in order to properly exercise budget and cost control follow:

a) Cost Planning Report (CPR). Reports estimate revisions at pre-tender stages. It gives information about account number, scheduled dates, budgeted and updated quantities rates and amounts, and changes.

b) Unawarded Work Report (UWR). Reports estimate revisions at any stage. Information contained is as given in the cost planning report.

c) Change Order Report (COR). Reports changes. Parameters are as in the planning report. Estimated cost for each change order is deducted from the relevant contingency fund.

d) Contingency Analysis Report (CAR 1). Highlights cost overruns and underruns. The report includes base, awarded, unawarded and total escalated construction cost estimates, transfers to/from contingency and total contingency. At summary level the report controls contingency, while escalation is controlled by detail level.

e) Capital Appropriation Status Report (CASR). Function is control over appropriations. This report comprises a listing of appropriations, subdivided into base construction cost estimate, escalation, contingency, design and management.

f) Progress Payments Certification Report (PPCR). Controls payments to subcontractors. Contents are cost code, description, contract amount, value of work completed, retentions, payable to date, paid to date and amount due.

g) Change Order Summary Report (COSR). Controls payment for changes. It includes change order listing using parameters as given in the progress payments certification report.

h) Purchase Order Register (POR). Reports purchases. It includes supplier's code and description, purchase order number, commitment, invoiced gross amount, retained holdbacks, payments and unpaid balance.

i) Invoice Register (IR). Reports disbursements. It contains invoice identity, accounting date, voucher number, gross amounts, holdbacks, discount period and interest-free period.

j) Retentions Report (RR). Reports retentions. Items reported are retentions and unsettled claims, listed by contractor, contract, current transactions and balance.

k) Owner-furnished Materials Report (OMR). Function is to avoid delays caused by owner-furnished materials. The report indicates base and escalated estimates, appropriations and cost.

l) Cost Allocation Report (CAR 2). Indicates cost allocations. Contents are cost centre, description, budget amount and date, appropriations, commitments, together with percentages of budget. Breakdowns are given for awarded and unawarded work, subdivided into contracts, owner-furnished materials, management and engineering and partially engineered work.

m) Cost Comparison Report (CCR). Compares incurred and estimated costs. It gives package number, description, base and escalated cost estimates, appropriations and actual costs.

n) Cost Period Report (CPR 2). Function is comparison of current and previous period report costs. The report contains package number

and description, base and escalated construction cost estimates, commitments and actual costs.

o) Cost Accounts Ledger (CAL). Reports cost accounts. It gives account number or items identified by cost package, and description. It includes budget amount and date, commitments, to complete costs and forecast total cost.

p) Unit-Price Analysis Report (UPAR). Assists future estimating. It reports description, contract quantity, unit price and cost, and progress certification for quantity and cost.

q) Cost-by-Facility Report (CFR). Accumulates cost by facility. Coding of items enables the same item, or group, in different packages, to be abstracted as a separate facility. They may be reported upon in terms of any of the foregoing reports which provide item identification.

1.5.4 Cashflow Forecasting and Financial Reports

Funds, when borrowed, involve interest costs, while when provided from the owner's own resources preclude the use of the funds elsewhere. Therefore, where provision of funding is needed, accurate forecasts of requirements during each financial period must be available. By cash-flow forecasting, projects are kept running without delays and with minimal idle funds. Financial accounts are necessary to minimize interest on overdue accounts and to maximize use of grace periods and discounts for early payment. Reports required for this element of project, financial, and cost control are outlined below:

a) Cumulative Cashflow Envelope Report (CCER). Shows cashflow needs. The report shows early and late, monthly and cumulative, cashflows generated.

b) Cashflow Report (CR). Controls cashflow. Contents are monthly cashflow and dates of payments, allowing for processing.

c) Capital Disbursements Control Report (CDCR). Acts as a cheque register. Contents are item reference, description, commitment, value complete, payments, cash requirements, and short term cashflow.

d) Cash Advance Request (CAR 3). Identifies funding requirements. It includes vendor and location, contract number and description, order date, and short term cash requirements.

e) Accounts Payable and Accruals (APA). Functions as a register of accounts payable and accruals. Included are identification of contractor/vendor and reference, payment record, and short term cash requirements.

1.5.5 Resource Control Reports

Provision of resources needed at the correct locations and times without unnecessary peaks and valleys in requirements levels is essential. The most critical resource on large projects is usually manpower, especially for control in design, and it is therefore discussed in the following:

a) Activity Manhours Allocation Report (AMAR). Controls manhours by activities. The report contains cost code, activity identification, durations, dates, floats and estimated manhours.

b) Manhour Cost Report (MCR). Controls cost. Included are cost code, work item description, target and actual hours, maximum scheduled, and percentage expenditures.

c) Cumulative Manhours Report (CMR). Controls usage of manhours. Items on the report are early and late curves for manhours quantities and percentages, and expenditures.

d) Unlevelled Resource Histograms (URH). Shows problems with physical feasibility. The histograms consist of plots of resource availability and requirements against time.

e) Manpower Levelled Histogram (MLH). Indicates manpower needs. The histogram consists of plots of manpower availability and requirements against time.

1.6 Existing Computerized Cost Control Systems

1.6.1 General

Reports are required in different areas as previously described. Individual computerized systems have capability for producing various reports. Reports available are used as yardsticks for evaluation of the suitability of a system. As an illustration, only two of many different systems available are considered, with their capabilities regarding control of cost given in terms of reports available. Abbreviations indicated following the report titles in Sections 1.6.2 and 1.6.3 are used later in Section 1.6.4.

1.6.2 Project Management System (PMS)

This system was designed by International Business Machines Corporation for use on IBM 360 or 370 computer configurations. The system comprises processors for each of network analysis, resource allocation, and cost control, together with a separate Report Generation Processor. The user may process data using the Report Processor alone or together with any combination of the others except the Resource Allocation Processor which can be combined with Network Processor but not with the Cost Processor. Activity-time status reports can be

obtained with a variety of sorting options. Information presented is the network and subnet titles, run date, sorting parameters, time summary level, preceding and succeeding events, type of event, a cycle code, activity description, time estimates, float, completion dates, scheduled date and department name. A bar chart report is also available. Hammocks may be used. Where Precedence is used, activity reports can only be obtained with sorts upon the network, subnet, work items and preceding work items. Reports indicate work item name, description, duration, float, early and late and scheduled dates, department, predecessor work item and lag relationships and durations.

Various resource allocation reports are available with different sorting parameters. Reports indicate for each activity, its description, cycle code and department, resource usage, primary float based on network relationships and based on resource allocation. Graphs of available resources against time are also available for availability and usage, as well as an activity schedule bar chart.

Reports utilizing the cost processor are: Manpower Loading Report (MLR), Management Summary Report (MSR) giving an analysis of total costs chargeable to specific WBS levels, Cost Category Report (CCR) detailing money and manpower costs, Financial Plan and Status Report (FPSR) giving a comparison between estimate and planned costs. Organization Status Reports (OSR) give direct costs for manpower and money costs. Cost Milestone Report (CMR) gives plot of actual, latest and expected completion dates for a charge number. Charge Number Time Report (CNTR) indicates cost time span start and finish and slack. Program Outlook Graph (POG) displays budget, actual and outlook cost data against time. Project/Project Status Report (PPSR) analyzes cost

and PERT data.

Users may modify reports or generate new reports using any of the given data. However, it is time consuming and can be costly to develop modifications to system standard reports.

1.6.3 PERT/COST

General Electric produced, this system is for use on the GE 600 computer. The system produces cost control reports based on data obtained using their PERT/TIME program. Only reports obtainable from PERT/COST are outlined in this section.

Management Summary Report (MSR) indicates for any selected organizational level, the cost to date, together with information obtained from PERT/TIME. Program/Project Status Report (PPSR) shows similar information detailed as a backup to the management summary report. Organization Status Reports (OSR) are available with four predefined sorting options and indicate the value of work to date and totals at completion, together with scheduled completion date. Financial Plan and Status Reports (FPSR) are obtainable in two formats. Both indicate a comparison of latest revised estimate against planned costs, the first showing cumulative costs while the second only prints totals for each month. Manpower Loading Reports (MLR) indicate resource usage detailed, summarized, or by individual organization.

In addition to the foregoing reports, information currently held on master files can be obtained, giving Budget Report (BR), Estimate Report (ER), and Actual Report (AR). Echo reports of input project parameters, rates, and WBS can also be obtained from master files.

1.6.4 Example Systems Compared with Possible User's Requirements

Consider the possible user's requirements given in Section 1.5 and the available reports obtainable using the PMS/COST Processor and PERT/COST. Both PMS/COST and PERT/COST reports include reports which are covered by schedule and resource requirements. Figure 6 illustrates the requirements and availability of reports relating to the budget and cost control (refer to Figure 5) area for the two cost systems under consideration. Similar comparisons can be made for the schedule, resource, cashflow and financial accounts areas. Difficulty has been experienced in matching these two available systems to requirements, due to differences in nomenclature and differences in stress upon functions of individual reports.

Consider control over different cost elements provided by the possible user's requirements considered in Section 1.5.3 and also by PMS/COST and PERT/COST described in Sections 1.6.2 and 1.6.3, respectively; as illustrated by Figure 6. As can be seen, for different elements, report titles under each system vary. Again, consider the element construction estimates in Figure 6. There are a variety of reports covering this element within the different systems as illustrated in more detail in Figure 7. First, in comparing the possible user's requirements against PMS/COST, the column headings for CPR at line 6 (Auth. Budget Amt.) matches FPSR line 7 (Planned Cumulative Cost), and CPR line 9 (Updated Est. Amt.) matches FPSR line 8 (Latest Rev. Est. Cumulative Cost), while UWR report similarly matches the same FPSR columns as shown at UWR lines 6 (Auth. Budget Amt.) and 9 (Updated Est. Amt.), respectively. CCR does not match FPSR, although CCR lines 3 (Certified This Period) and 5 (Certified to Date) are close

ELEMENT	CONTROL PROVIDED BY		
	POSSIBLE USER'S REQUIREMENTS	IBM/PMS	PERT/COST
	REPORT REF. TEXT 1.5.3	REPORT REF. TEXT 1.6.2	REPORT REF. TEXT 1.6.3
CAPITAL COST	CPR 2		
BUDGET	CAR 2,CAL	PPSR	
DESIGN ESTIMATES	CPR1,UWR		
CONSTRUCTION ESTIMATES	CPR1,UWR,CCR	FPSR	FRSR & OSR
MANAGEMENT ESTIMATES			
ESTIMATE REVISION	CPR1,UWR	Modified	
ESCALATION	CAR 1	Modified	
CHANGES	COR,COSR	Obtainable	
CONTINGENCY	CAR 1	Modified	
APPROPRIATIONS	CASR, CAR 2	Modified	
COMMITMENTS	CAR 2		
PURCHASES	OMR,POR		
DISBURSEMENTS	PPCR		
VENDOR TRANSACTIONS	IR		
CONTRACTOR TRANSACTIONS	PPCR	Modified	
AUTHENTICATION	CAR 2,CCR		
DIRECT COSTS		OSR	OSR
RETENTIONS	PR		
OWNER-FURNISHED MATERIAL	OMR	Modified	
CERTIFIED COSTS	CCR,CPR2	CCR	MSR & PPSR
ACCOUNTS	CAL		
UNIT PRICES	UPAR		
FACILITY	CFR		
CHARGE NUMBERS	PPCR	CNTR	FPSR
WBS		MSR	

FIGURE 6. COMPARISON OF MODEL AND EXAMPLE SYSTEMS (COST AREA ONLY)

ELEMENT: CONSTRUCTION ESTIMATES

Report Headings Providing Required Control

LINE NO.	POSSIBLE USER'S REQUIREMENT	PMS/COST	PERT/COST
	A) Cost Planning Report (CPR)	A) Financial Plan & Status Report (FPSR)	A) Financial Plan & Status Report (FRSR)
1	Sched.Start	Month	Actual Cost
2	Sched.Duration	Charge Number	Estimate Cost
3	Sched.Completion	Actual Incremental Cost	Planned Cost
4	Auth.Budget Qty.	Planned Incremental Cost	
5	Auth.Budget Rate	Latest Rev.Est. Incremental Cost	
6	Auth.Budget Amt.	Act.Cumulative Cost	
7	Updated Est.Qty.	Planned Cumulative Cost	
8	Updated Est.Rate	Latest Rev.Est. Cumulative Cost	
9	Updated Est.Amt.	Over/Under Plan (Cumul.)	
10	Change This Period		
	B) Unawarded Work Report (UWR)		B) Organization Status Report (OSR)
1	Sched.Start		Actual Cost
2	Sched.Duration		Planned Cost
3	Sched.Completion		Latest Revised Estimate
4	Auth.Budget Qty.		Project (Overrun)/ Underrun
5	Auth.Budget Rate		
6	Auth.Budget Amt.		
7	Updated Est.Qty.		
8	Updated Est.Rate		
9	Updated Est.Amt.		
10	Change This Period		
	C) Cost Comparison Report (CCR)		
1	Contract Price		
2	Previousy Certified		
3	Certified This Period		
4	Percentage		
5	Certified To Date		
6	Percentage Complete		
7	Max.Sched. Next Report		

FIGURE 7: COLUMN HEADINGS FOR REPORTS COVERING CONSTRUCTION ESTIMATES ILLUSTRATING DIFFERENT HEADINGS FOR CONSTRUCTION ESTIMATES WITHIN DIFFERENT SYSTEMS

to matching FPSR lines 3 (Actual Incremental Cost) and 6 (Actual Cumulative Cost), respectively.

A similar comparison between the possible user's requirement against PERT/COST shows CPR line 6 (Auth. Budget Amt.) matching FPSR line 3 (Planned Cost), CPR line 9 (Updated Est. Amt.) matches FPSR line 2 (Estimate Cost), UWR lines 6 (Auth. Budget Amt.) and 9 matching FPSR lines 3 (Planned Cost) and 2 (Estimate Cost), respectively, CCR line 3 (Certified This Period) close to matching FPSR line 1 (Actual Cost), while CPR line 9 (Updated Est. Amt.) matches OSR line 3 (Latest Revised Estimate), CPR line 6 (Auth. Budget Amt.) matches OSR line 2 (Planned Cost), UWR lines 6 (Auth. Budget Amt.) and 9 (Updated Est. Amt.) match OSR lines 2 (Planned Cost) and 3 (Latest Revised Estimate), respectively, and CCR lines 1 (Contract Price) and 5 (Certified to Date) match OSR lines 3 (Latest Revised Estimate) and 1 (Actual Cost), respectively.

Similar comparisons may be made for each of the elements in Figure 6 to establish that different titles are used for the same data and also much of the data on some reports is not comparable to that on the report being considered. It is noted also that PMS/COST, even with modifications, does not monitor elements such as capital cost, design estimates, purchases, commitments and disbursements, and that both PMS/COST and PERT/COST are deficient in their control over budgets and costs.

1.7 Problem Statement

Different contract types have differing levels of uncertainty. With Project Management, the level of uncertainty is relatively high,

necessitating a high degree of cost control effort and thus a good monitoring system. Possible user's requirements for cost control have been expressed in terms of the monitoring required. Two example systems have been compared with the model. A decision for an individual user on which is the most suitable of the example systems for his needs cannot be readily made. The terminology used by different systems is part of the problem of evaluation, while another concern is the functions of different reports available from example systems, whereby one available report may satisfy two or three requirements or none.

A methodology is required both to remove differences in terminology and thereby to make unbiased comparisons between a user's needs and their satisfaction by a given system.

CHAPTER II

PROBLEM SOLUTION

2. A Methodology for Evaluation of Cost Control Systems

2.1 General

In order that the problem posed in the previous chapter may be solved, it is necessary that a user's requirements from a cost control system and also the reports generated by a system under consideration be presented using the same terminology. Then comparisons between requirements and available systems may be made.

2.2 Control Classification System

2.2.1 General

A system of classification has been devised whereby elements as previously discussed may be allotted a distinct position within the classification. The use of a classification then permits the components of a cost control system required by a user to be defined in terms of their allocations used within the classification table. Similarly, the elements of a cost control system to be evaluated may be defined in a like manner. Comparison of the apportionment of classification usage adopted by the user's requirement and the system under review then enable a determination to be made of the suitability of the evaluated system.

The classification is in terms of five zones, which are:

Zone I Field of Control

Zone II Area of Control

Zone III Level of Control

Zone IV Chronometry of Monitoring

Zone V Mechanism of Control

Following sections outline the elements of the classification in each of the zones, while the Glossary of Classifications at Appendix B ascribes the meanings used for each element of the classification.

2.2.2 Zone I Field of Control

This identifies the specific part of the control system being monitored. It may be considered that cost is a general term embracing values which may be expressed in components comprising money, resources (other than money) and time. Thus in terms of cost control, due to their interrelationships, cost is being considered in this general sense, as it has been in this thesis in considering cost control systems. For the purposes of classification, these components are considered separately and the narrower meaning of the term cost is applied to that specifically involving money. The flow of funds and the accounting for expenditures are integral parts of an adequate cost control system and are therefore also included in this primary classification. The fields of control are, therefore:

i) Schedule

ii) Resource

iii) Cost

iv) Cashflow

v) Financial Accounts

2.2.3 Zone II Area of Control

Within each field of control there are different items that together or individually govern the cost of a project. These items or areas may or may not be applicable to all fields of control. The areas of control used in this classification are listed below:

i) Planning
ii) Feasibility
iii) Target
iv) Listing
v) Bar Chart
vi) Float
vii) Responsible Agency
viii) Performing Agency
ix) Department
x) Tender
xi) Award
xii) Procurement
xiii) Expediting
xiv) Utilization
xv) Levelling
xvi) Manpower
xvii) Equipment
xviii) Materials
xix) Capital
xx) Budget
xxi) Estimate
xxii) Construction

xxiii) Management

xxiv) Appropriations

xxv) Escalation

xxvi) Contingency

xxvii) Changes

xxviii) Claim

xxix) Owner's Costs

xxx) Vendors

xxxi) Accounts

xxxii) Retentions

xxxiii) Commitments

xxxiv) Obligations

xxxv) Certification

xxxvi) Purchases

xxxvii) Disbursements

xxxviii) Reimbursables

xxxix) Invoices

xl) Receivables

xli) Prices

xlii) Inventory

xliii) Actuals

2.2.4 Zone III Level of Control

Controls may be exercised over the total program, a constituent project, or over individual components. These give the level of control exercised. Elements are:

i) Program

ii) Project

iii) Package

iv) Detail

v) Summary

vi) Facility

2.2.5 Zone IV Chronometry of Monitoring

At this zone in the classification, the intention is to determine whether the report under consideration is purely historical, that is no changes can be made since the items being reported are complete, and whether they are recent past (period) or more distant (previous), present (current), giving details of items in progress, or future (forecast), giving details of items upon which work is yet to be performed. Classification headings are:

i) Previous

ii) Period

iii) Current

iv) Forecast

2.2.6 Zone V Control Mechanism

The type of control to be exercised is indicated by this part of the classification. There are cases where reports themselves indicate the control mechanism adopted, as is the case with variance and trend reports. Other reports give no control by themselves, but need to be compared with reports generated at different points in time. Of these, the former are requirement reports, indicating the plan of how the particular item classified by the rest of the classification

system is envisaged to be performed, while the latter are status reports enabling actual performance to be compared manually with a requirement report. The information being compared may be presented on a single report. Control mechanisms are:

i) Variance

ii) Trend

iii) Requirement

iv) Status

v) Balance

2.2.7 Summary of Control Classification

The complete classification is summarized in Table 1. A report is classified using an identifier from each zone of the classification. It should be particularly noted that since the classification is based on the contents of the reports, a single report may fit more than a single classification. All categories applicable without repetition should be used.

2.3 Use of Classification

The classification system is used to reduce to a common basis the functions of various reports, such that the reports may be described free of individual bias in titling of the report and such that the classifications peculiar to a particular report appropriately describe the report.

TABLE 1

CLASSIFICATION SYSTEM

FIELD OF CONTROL ZONE I	AREA OF CONTROL ZONE II	LEVEL OF CONTROL ZONE III	CHRONOMETRY OF MONITORING ZONE IV	CONTROL MECHANISM ZONE V
Schedule	Planning	Program	Previous	Variance
Resources	Feasibility	Project	Period	Trend
Cost	Target	Package	Current	Require-
Cashflow	Listing	Detail	Forecast	ment
Financial	Bar Chart	Summary		Status
Accounts	Float	Facility		Balance
	Respons.Agency			
	Perform.Agency			
	Department			
	Tender			
	Award			
	Procurement			
	Expediting			
	Utilization			
	Levelling			
	Manpower			
	Equipment			
	Materials			
	Capital			
	Budget			
	Estimate			
	Construction			
	Management			
	Appropriations			
	Escalation			
	Contingency			
	Changes			
	Claim			
	Owner's Costs			
	Vendors			
	Accounts			
	Retentions			
	Commitments			
	Obligations			
	Certification			
	Purchases			
	Disbursements			
	Reimbursables			
	Invoices			
	Receivables			
	Prices			
	Inventory			
	Actuals			

2.4 Example of Classification

Once a report can be classified, the elements comprising the report are identified in a manner distinct from any individual title given by a particular system, thus eliminating confusion between different system terminologies. Consider a report with the heading as shown in Figure 8. The report can obviously be classified as a cost report at zone I. Since cost timings are given, it can also be classified as a cashflow report at zone I. Consider first columns A and B which serve merely to label the contract packages. Column D also labels the package with the Contract Price. However, column D in conjunction with column C can also be used to obtain the forecast final cost, a function which classifies as "cost commitment package forecast requirement" in order of zones I through V, respectively. Columns E and F total column H while columns G and J give percentages complete, and their collective, functional classification in order of zones I through V, respectively, is "cost certification package current status." Column K is a forecast of the cash requirement next period and accordingly classifies as "cashflow commitment package forecast requirement." If the information presented is defined by the user, the report would appear in the requirements area, whereas, if it is a report available from a system under study, it would be so categorized.

However, since cost commitments may be equated with cashflow, the user may decide only to use the latter two classifications. That is, the classification of this Certification Report is:

i) Cost Certification Package Current Status, and

ii) Cashflow Commitment Package Forecast Requirement.

CERTIFICATION REPORT (Package Level)

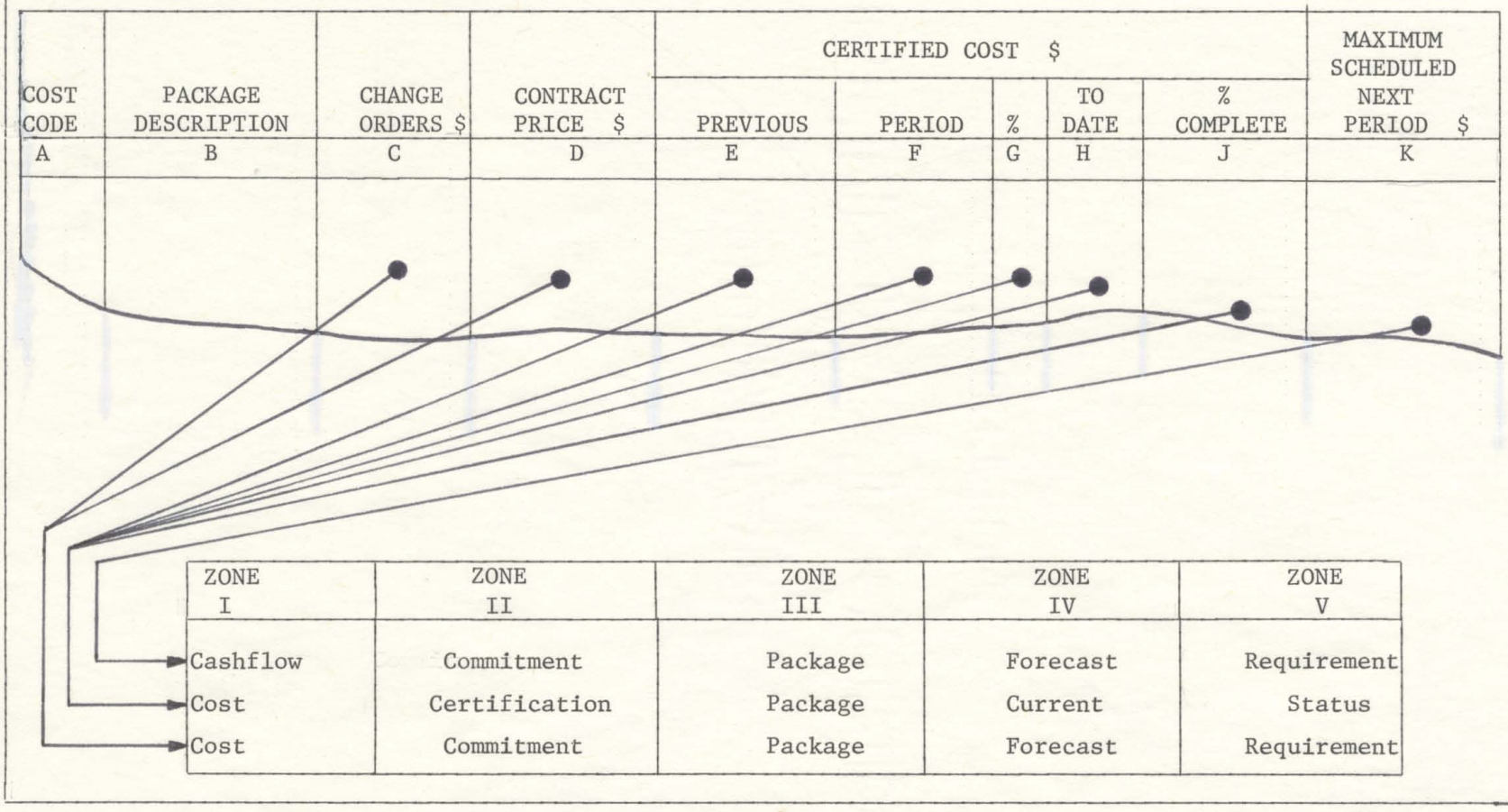

FIGURE 8. ILLUSTRATION OF CLASSIFICATION OF A REPORT

If the user's requirements had been only for a report certifying payments due, this report titled 'Certification Report' meets those requirements. In addition, it provides a report giving cashflow forecast requirement at the work package level.

2.5 System Evaluation Using the Classification

By means of the classification a user may identify the requirements that he seeks from a system. In a similar manner, when considering a particular available proprietary system, the availabilities from such a system may be identified purely in terms of the classification. It follows that by comparison between the user's requirements and the system's availabilities, an indication may be obtained of how close the particular system comes to meeting the user's requirements. Obviously if the availabilities completely satisfy the requirements as expressed through the classifications, the user has determined a system that meets all his requirements. Such would perhaps be the case in an ideal world, but in the real world this utopian situation does not exist unless the user has almost infinitesimally small requirements and the system under review has an exceptionally large range of attributes. In such a situation a simple manual comparison would probably suffice. However, excluding such a fortuitous circumstance, evaluation of a system would generally fall into the amorphous circumstances somewhat indicated in the comparison of user's requirements and example systems illustrated previously in Figure 6 in Section 1.6.4.

Particular reports may fall into a number of classifications. No match for the user's requirements for a specific report could be the result obtained if the available system report fulfilled less than

the number of classifications obtainable for the requirement report, even though there was only a single classification unmatched. When multiplied by, for example, the number of requirement reports suggested in Chapter I, Section 1.5, it is apparent that a particular proprietary system may come close to satisfying the user's requirements without any available report specifically matching a requirement report. For this reason, in comparing availabilities against requirements, it is necessary to consider, as well as perfect matches, the case of one classification less than the total requirement classifications being matched for each particular report. By these means, as well as determining perfect matches, systems close to meeting requirements are also identified.

Various available systems may be compared against the user's requirements and the viability in terms of the expressed needs may be determined by examination of a summary of perfect and near-perfect matches achieved by each competing system. For competing systems offering a similar number of perfect matches at a summary level, examination of the number of near-perfect matches may be the deciding factor in determining which of the systems is more appropriate to the user's needs. Examination of which reports are matched will be necessary in the case of closely competing systems, even down to which classifications within a near-perfect match are the ones satisfying the set criteria.

It is important to note that the criteria established are a comparison of an available system against requirements determined by the user. A comparison of user's requirements against an available system will give misleading results since the system to be adopted should be tailored to the user's requirements and not vice-versa.

CHAPTER III

COMPUTER PROGRAM

3. System Description for Employing Evaluation Methodology

3.1 General

The system used is considered in three parts, being respectively, input, processing, and output. Following system consideration, computer application of the system is dealt with.

3.2 System Input

Input to the system is performed in two stages. The initial stage consists of providing user's report requirements to the processor while the final stage provides report availabilities from the cost control system under study to the processor. A processing stage is required between the two input stages.

3.3 System Processing

The function of the processor is to match requirements for reports against availabilities of reports from a study cost control system. Data set is converted to a numeric format upon input and retained there in assigned locations dependent upon whether it relates to requirements or availability. Achievement of the processor's main function is attained by comparison of each available report data set in turn against each requirement report data set.

When the number of classifications of an available report equals or exceeds the number of classifications of an available report, there is a potential for a matching of the requirement report.

When, after consideration of all classifications of an available report up to the maximum of ten accepted by the system, a match with all the classifications of a requirement report is obtained, the information is stored in readiness for the output stage as a perfect match of requirements. The processing also determines when a match is obtained with all except one of the requirement report classifications. In such a case there is potential for achieving this when the number of available classifications is equal to or exceeding one less than the number of requirement classifications of a report. Upon determination of perfect matches and one classification less than perfect matches, data is reconverted into its original non-numeric format until all requirement report data have been considered.

3.4 System Output

Output is provided separately within each of the two criteria groups checked during processing. Requirements and available classifications satisfying the same criteria are output together under the relevant criteria headings. A summary of data input and matches obtained is given.

3.5 System Flow Chart

A flow chart of the process described in Sections 3.2 through 3.4 is included as Figure 9.

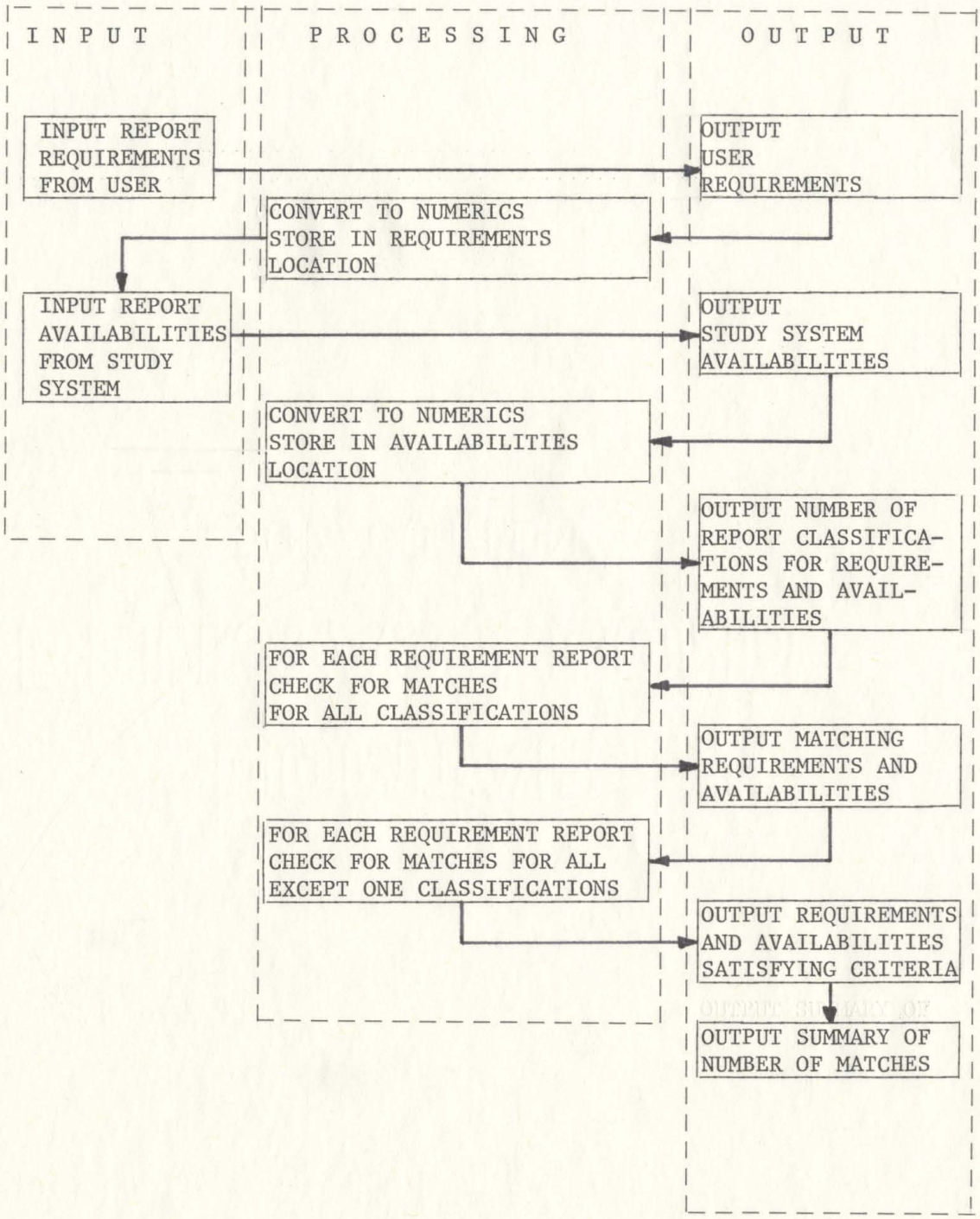

FIGURE 9. SYSTEM FLOW CHART

3.6 Computer Application

A computer program has been written to perform the matching process, and output from the program is dealt with in the example problem in Chapter IV following. The program and input requirements are included in Appendix D to this thesis.

CHAPTER IV

EXAMPLE PROBLEM

4. Application of the Methodology

4.1 Introduction

In order to develop the example problem, it is necessary to identify first the user's requirements in terms of the classification system. Then, for the system under review, to meet the user's needs, the reports available must all be classified. The ideal means for classification is for a knowledgeable group of the user organization to agree upon the classifications required for each report, and to perform a similar exercise upon each system to be considered. This is required in order to reduce individual biases held by different members of the organization and to obtain a consensus of the proper classifications into which each report fits.

For the example problem, the reports predicated by the author as a possible user's requirements for a control system in Chapter I, Section 1.5, are decided upon as the user's requirements. Next, the reports are classified.

The CMCS system has been chosen[1] for review and evaluation as the subject system for the example problem.

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[1]At the time of selection of a subject system to be compared with the user's requirements, the author had used and had a good understanding of the PMS system. Also, the choice of user requirements in Chapter I had been based partly on PMS and partly on critical

4.2 User Requirement Classifications

An example of one of the user's reports is illustrated in Figure 10, the report being used for control of work packages. The report identification 'A' denotes a requirement report while '16' is a user assigned identification.

The classifications, being based upon the functions of the report, do not apply to the report's identification labelling which comprises columns A, B, and C. In considering the functions, consider first columns D, F, and H. Since "Completed Value to Date" is a combination of past and present obligations and, dependent upon the level of retentions held, "Payable to Date" is the past and current due obligations, and also, dependent upon the amounts paid, "Amount Due" is the current due obligation, these columns in total represent the present status of obligations and therefore may be classified reading from left to right in order zones I through V as "Cost Obligations Package Current Status".

"Retentions" obtained in column E may be readily seen to classify as "Cost Retentions Package Current Status" while "Paid to Date" in column G gives the present status of disbursements made under the contract packages, and therefore classifies as "Cost Disbursements Package Current Status".

If required for detailed level control of items within individual work packages, a report presenting this information and utilizing the same reporting format and headings as shown in Figure 10

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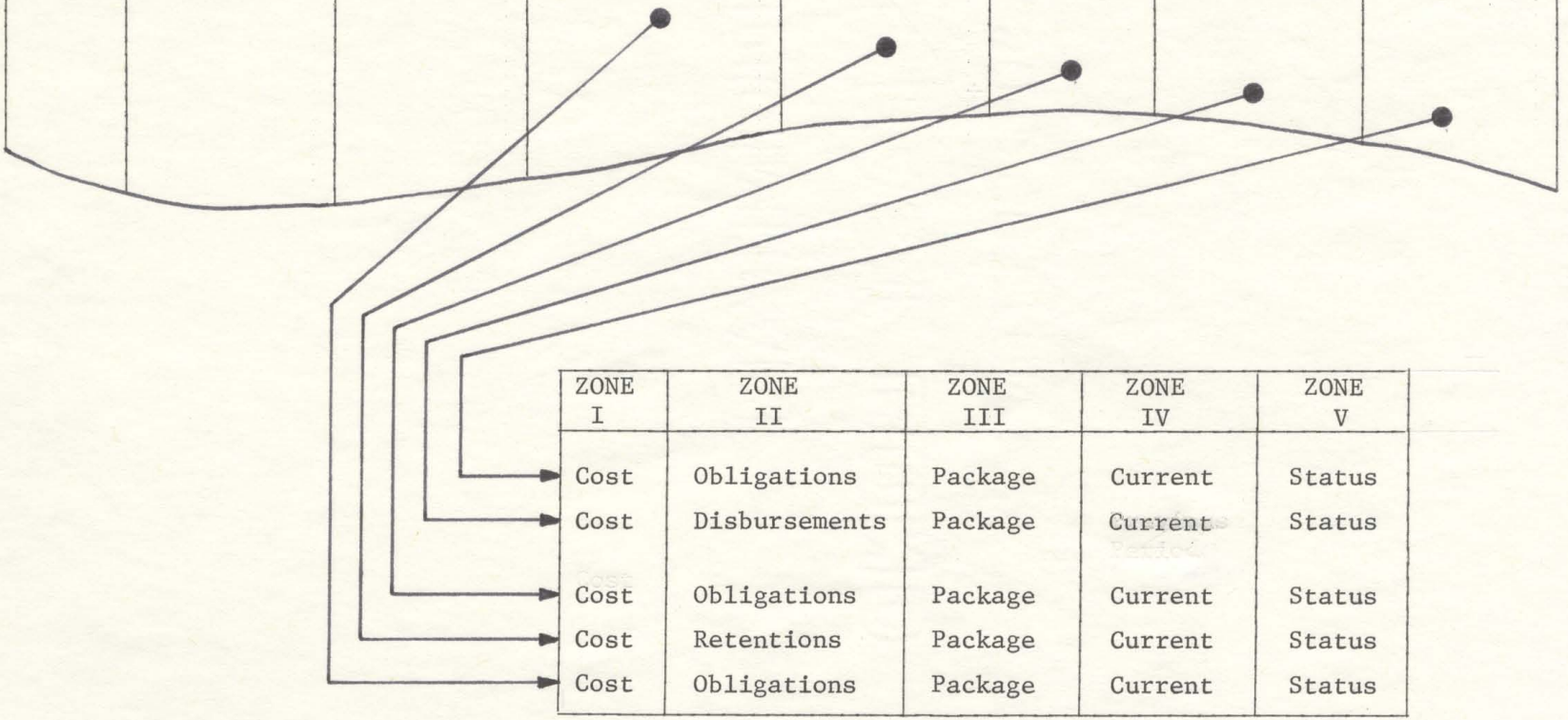
review of a report by Ahuja (ref. 2). For these reasons it was felt that the example problem should not use PMS in order to avoid potential biasing factors. The use of PERT/COST was considered but rejected since it was also used as an example in Chapter I.

REPORT A16 PROGRESS PAYMENTS CERTIFICATION REPORT

COST CODE	DESCRIPTION	CONTRACT AMOUNT	COMPLETED VALUE TO DATE	RETENTIONS	PAYABLE TO DATE	PAID TO DATE	AMOUNT DUE
A	B	C	D	E	F	G	H



ZONE I	ZONE II	ZONE III	ZONE IV	ZONE V
Cost	Obligations	Package	Current	Status
Cost	Disbursements	Package	Current	Status
Cost	Obligations	Package	Current	Status
Cost	Retentions	Package	Current	Status
Cost	Obligations	Package	Current	Status

FIGURE 10. ILLUSTRATION OF CLASSIFICATION OF REQUIREMENT REPORT A 16

would be classified as the detail level in zone III of the classification and would therefore be given a separate identity as a different report.

Figure 11 shows report 'A16' as part of the user's requirements and hence as part of the input to the computer.

4.3 Study System Availabilities Classifications

Reports from the available system are identified for use in application of the methodology by a report number assigned sequentially by the user, preceded by the letter "B" indicating an availability report. The capability of the program outlined in Chapter III permits a maximum of ten classifications within any report. Reports S1 and S3 of CMCS (ref. 12) exceed this capability and have therefore been split into separate reports based upon division at zone I classification comprising for report S1-4 schedule, 4 cost and 3 financial accounts categories, and for report S3-4 schedule, 4 cost and 4 financial accounts categories. Report T9 is not classified since it is identical to report T7, and report F7 is not classified as it is manually prepared and CMCS provides no format for the report.

Among the reports available in the study (CMCS) system is report "F4, Actual Contract Costs". This appears with user assigned availability identification of "B27" in this example and has headings as shown in Figure 12. Of the information presented by this report, the classifications are obtained in the same manner as the example in Section 4.2 preceding, and are also shown in Figure 12. User assigned availability identification "B29" covers CMCS report "F6, Contractor Payment Approval" for which the classification is shown in Figure 13.

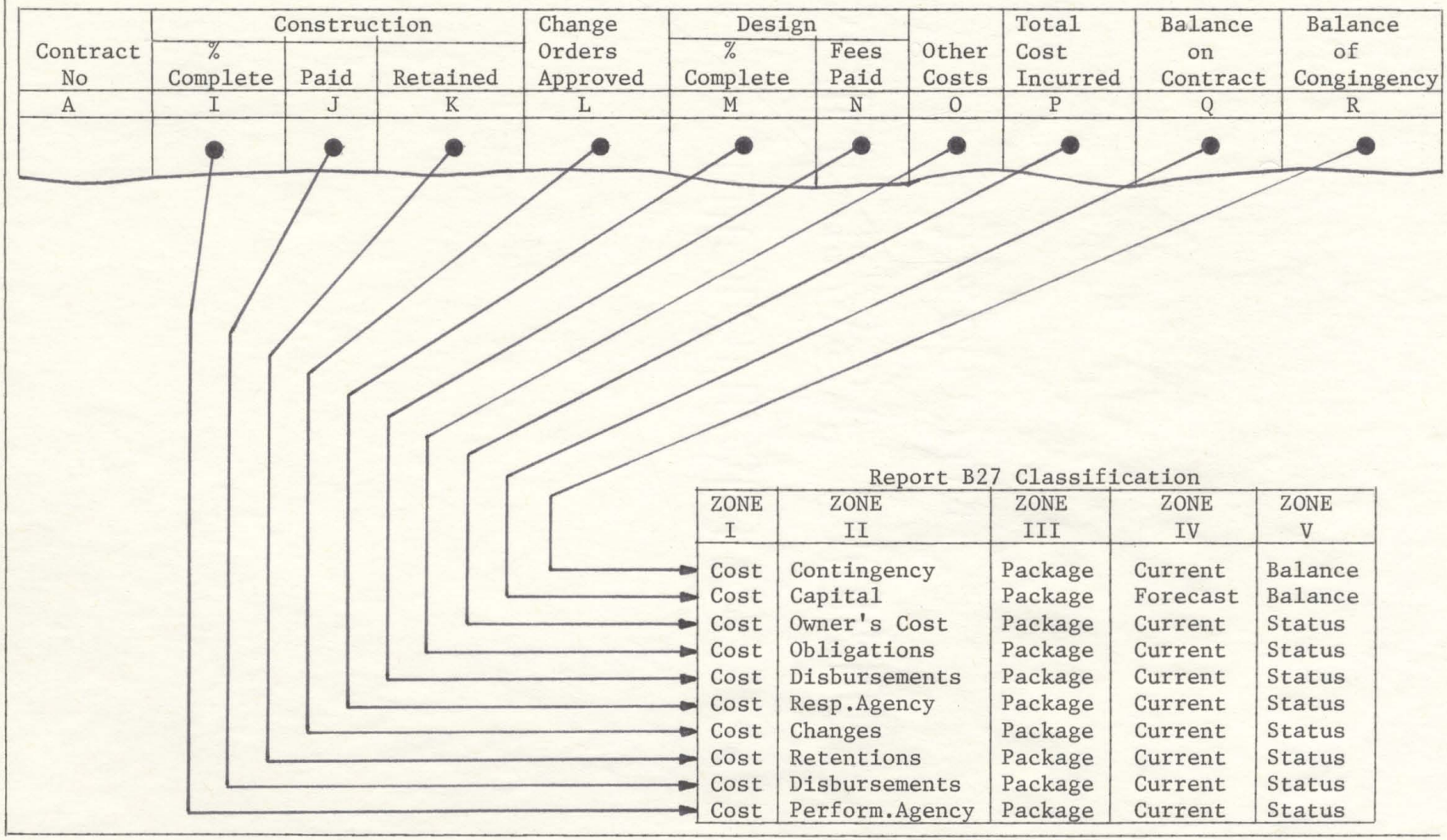
REQUIREMENTS INPUT TO COMPUTER ARE DETAILED BELOW

A14 1	ESCALATION CONTROL REPORT					
A14 3	COST	ESCALATION	SUMMARY	CURRENT	STATUS	
A15 1	CAPITAL APPROPRIATIONS REPORT					
A15 2	COST	APPROPRIATIONS	PACKAGE	CURRENT	STATUS	
A15 1	CAPITAL APPROPRIATIONS REPORT					
A15 3	COST	APPROPRIATIONS	PACKAGE	FORECAST	REQUIREMENT	
A16 1	PROGRESS PAYMENTS CERTIFICATION REPORT					
A16 2	COST	DISBURSEMENTS	PACKAGE	CURRENT	STATUS	
A16 1	PROGRESS PAYMENTS CERTIFICATION REPORT					
A16 3	COST	OBLIGATIONS	PACKAGE	CURRENT	STATUS	
A16 1	PROGRESS PAYMENTS CERTIFICATION REPORT					
A16 4	COST	RETENTIONS	PACKAGE	CURRENT	STATUS	
A17 1	CHANGE ORDER SUMMARY REPORT					
A17 2	COST	CHANGES	SUMMARY	CURRENT	REQUIREMENT	
A17 1	CHANGE ORDER SUMMARY REPORT					
A17 3	COST	CHANGES	SUMMARY	CURRENT	STATUS	
A17 1	CHANGE ORDER SUMMARY REPORT					
A17 4	COST	CHANGES	SUMMARY	FORECAST	REQUIREMENT	
A18 1	CHANGE ORDER PACKAGE REPORT					
A18 2	COST	CHANGES	PACKAGE	CURRENT	REQUIREMENT	
A18 1	CHANGE ORDER PACKAGE REPORT					
A18 3	COST	CHANGES	PACKAGE	CURRENT	STATUS	
A18 1	CHANGE ORDER PACKAGE REPORT					
A18 4	COST	CHANGES	PACKAGE	FORECAST	REQUIREMENT	
A19 1	PURCHASE ORDER REGISTER					
A19 2	FINANCIAL ACCOUNTS	COMMITMENTS	DETAIL	CURRENT	STATUS	
A19 1	PURCHASE ORDER REGISTER					
A19 3	FINANCIAL ACCOUNTS	OBLIGATIONS	DETAIL	CURRENT	STATUS	
A19 1	PURCHASE ORDER REGISTER					
A19 4	FINANCIAL ACCOUNTS	CLAIM	DETAIL	CURRENT	STATUS	
A20 1	INVOICE REGISTER					
A20 2	FINANCIAL ACCOUNTS	INVOICES	DETAIL	CURRENT	STATUS	

FIGURE 11

Report B27 "F4, ACTUAL CONTRACT COSTS"

Contract No	Construction			Change Orders Approved	Design		Other Costs	Total Cost Incurred	Balance on Contract	Balance of Congingency
	% Complete	Paid	Retained		% Complete	Fees Paid				
A	I	J	K	L	M	N	O	P	Q	R



Report B27 Classification

ZONE I	ZONE II	ZONE III	ZONE IV	ZONE V
Cost	Contingency	Package	Current	Balance
Cost	Capital	Package	Forecast	Balance
Cost	Owner's Cost	Package	Current	Status
Cost	Obligations	Package	Current	Status
Cost	Disbursements	Package	Current	Status
Cost	Resp.Agency	Package	Current	Status
Cost	Changes	Package	Current	Status
Cost	Retentions	Package	Current	Status
Cost	Disbursements	Package	Current	Status
Cost	Perform.Agency	Package	Current	Status

FIGURE 12. ILLUSTRATION OF CLASSIFICATION OF AVAILABILITY REPORT B27

Report B29 "F6 Contractor Payment Approval"

Original Contract Amount	A
Approved Change Order Cost	B
Total Contract Cost (To Date)	C
Value of Work in Place (Last Period)	D
Value of Work in Place (This Period)	E
Value of Work in Place To Date	F
Less Retainage	G
Total Amount Payable to Contractors to Date	H
Amount Paid to Contractors Last Period	I
Amount Payable to Contractors This Period	J
Balance Remaining in Contract	K

Report B29 Classification

ZONE I	ZONE II	ZONE III	ZONE IV	ZONE V
Cost	Capital	Package	Forecast	Balance
Cost	Obligations	Package	Current	Status
Cost	Disbursements	Package	Previous	Requirement
Cost	Obligations	Package	Current	Status
Cost	Retentions	Package	Current	Status
Cost	Actuals	Package	Current	Status
Cost	Actuals	Package	Period	Status
Cost	Actuals	Package	Previous	Status
Cost	Award	Package	Current	Requirement
Cost	Changes	Packages	Current	Status

FIGURE 13. ILLUSTRATION OF CLASSIFICATION OF AVAILABILITY REPORT B29

4.4 Comparison of Requirements and Availabilities

A manual comparison of requirement report A16 --"Progress Payments Certification Report" and availability report B27--"F4 Actual Contract Costs" is shown in Figure 14. Figure 15 illustrates part of the output reports obtained upon processing the requirements and availabilities using the computer program and also shows requirement report A16 completely matched by availability report B27 as just discussed. Report B27 also provides additional classifications in addition to those requested.

Requirement Report A16 does not have one classification, namely 'Cost Disbursements Package Current Status', matched by availability report B29, "Contractor Payment Approval", also discussed earlier, even though the latter provides other classifications beyond the owner's requirements. This may be seen in Figure 16, reports which match all except one requirement classification.

Figures 15 and 16 illustrate details of the classifications within each report satisfying the required criteria, with the matched requirements and availabilities presented adjacent to each other.

Figure 17 shows the non-summarized matching of requirements and availabilities, in this case for one classification less than perfect satisfaction of requirements. A similar format is also obtained for all classifications of requirements satisfied by availability reports. It should be noted that, as with reports A1 and A6, shown in Figure 17, a single requirement report may be satisfied within the given parameters by more than one availability report, although the converse will not occur.

MANUAL COMPARISON OF

REQUIREMENT REPORT A16 AND AVAILABILITY REPORT B27

CLASSIFICATIONS					Report A16 Columns Fig.10	Report B27 Columns Fig.12
ZONE I	ZONE II	ZONE III	ZONE IV	ZONE V		
Cost	Disbursements	Package	Current	Status	D.G.H	J.N
Cost	Retentions	Package	Current	Status	E	K
Cost	Obligations	Package	Current	Status	F	O
Cost	Perf. Agency	Package	Current	Status		I
Cost	Changes	Package	Current	Status		L
Cost	Resp.Agency	Package	Current	Status		M
Cost	Owner's Cost	Package	Current	Status		P
Cost	Capital	Package	Forecast	Balance		Q
Cost	Contingency	Package	Current	Balance		

FIGURE 14. MANUAL COMPARISON OF REPORTS

REQUIREMENT A16 AND AVAILABILITY B27

DETAIL OF REPORTS WHICH MATCH PERFECTLY

REQUIREMENT					AVAILABLE				
A 12 CHANGE ORDER REPORT PACKAGE					B 31 F8B CONTRACT LIST				
COST	CHANGES	PACKAGE	FORECAST	REQUIREMENT	COST	AWARD	PACKAGE	CURRENT	REQUIREMENT
COST	CHANGES	PACKAGE	FORECAST	REQUIREMENT	COST	ESTIMATE	PACKAGE	FORECAST	REQUIREMENT
					COST	APPROPRIATIONS	PACKAGE	CURRENT	STATUS
					COST	CHANGES	PACKAGE	CURRENT	STATUS
					COST	CHANGES	PACKAGE	FORECAST	REQUIREMENT
					FINANCIAL ACCOUNTS	OBLIGATIONS	PACKAGE	CURRENT	STATUS
					FINANCIAL ACCOUNTS	OBLIGATIONS	PACKAGE	PERIOD	STATUS
					FINANCIAL ACCOUNTS	CONTINGENCY	PACKAGE	CURRENT	REQUIREMENT
					FINANCIAL ACCOUNTS	RESPONS.AGENCY	PACKAGE	CURRENT	REQUIREMENT
					FINANCIAL ACCOUNTS	MANAGEMENT	PACKAGE	CURRENT	REQUIREMENT
A 16 PROGRESS PAYMENTS CERTIFICATION REPORT					B 27 FA ACTUAL CONTRACT COSTS				
COST	DISBURSEMENTS	PACKAGE	CURRENT	STATUS	COST	DISBURSEMENTS	PACKAGE	CURRENT	STATUS
COST	OBLIGATIONS	PACKAGE	CURRENT	STATUS	COST	OBLIGATIONS	PACKAGE	CURRENT	STATUS
COST	RETENTIONS	PACKAGE	CURRENT	STATUS	COST	CHANGES	PACKAGE	CURRENT	STATUS
					COST	RESPONS.AGENCY	PACKAGE	CURRENT	STATUS
					COST	OWNERS COSTS	PACKAGE	CURRENT	STATUS
					COST	RETENTIONS	PACKAGE	CURRENT	STATUS
					COST	CAPITAL	PACKAGE	FORECAST	BALANCE
					COST	CONTINGENCY	PACKAGE	CURRENT	BALANCE

FIGURE 15

DETAIL OF REPORTS WHICH MATCH ALL EXCEPT ONE REQUIREMENT CLASSIFICATION

REQUIREMENT					AVAILABLE				
A 16 PROGRESS PAYMENTS CERTIFICATION REPORT					B 29 F8B CONTRACT LIST				
COST	DISBURSEMENTS	PACKAGE	CURRENT	STATUS	COST	ACTUALS	PACKAGE	PREVIOUS	STATUS
COST	OBLIGATIONS	PACKAGE	CURRENT	STATUS	COST	ACTUALS	PACKAGE	CURRENT	STATUS
COST	RETENTIONS	PACKAGE	CURRENT	STATUS	COST	RETENTIONS	PACKAGE	CURRENT	STATUS
					COST	OBLIGATIONS	PACKAGE	CURRENT	STATUS
					COST	AWARD	PACKAGE	CURRENT	REQUIREMENT
					COST	DISBURSEMENTS	PACKAGE	PREVIOUS	REQUIREMENT
					COST	CHANGES	PACKAGE	CURRENT	STATUS
					COST	CAPITAL	PACKAGE	FORECAST	BALANCE
					COST	ACTUALS	PACKAGE	PERIOD	STATUS
A 18 CHANGE ORDER PACKAGE REPORT					B 31 F8B CONTRACT LIST				
COST	CHANGES	PACKAGE	CURRENT	REQUIREMENT	COST	AWARD	PACKAGE	CURRENT	REQUIREMENT
COST	CHANGES	PACKAGE	CURRENT	STATUS	COST	ESTIMATE	PACKAGE	FORECAST	REQUIREMENT
COST	CHANGES	PACKAGE	FORECAST	REQUIREMENT	COST	APPROPRIATIONS	PACKAGE	CURRENT	STATUS
					COST	CHANGES	PACKAGE	CURRENT	STATUS
					COST	CHANGES	PACKAGE	FORECAST	REQUIREMENT
					FINANCIAL ACCOUNTS	OBLIGATIONS	PACKAGE	CURRENT	STATUS
					FINANCIAL ACCOUNTS	OBLIGATIONS	PACKAGE	PERIOD	STATUS
					FINANCIAL ACCOUNTS	CONTINGENCY	PACKAGE	CURRENT	REQUIREMENT
					FINANCIAL ACCOUNTS	RESPONS.AGENCY	PACKAGE	CURRENT	REQUIREMENT
					FINANCIAL ACCOUNTS	MANAGEMENT	PACKAGE	CURRENT	REQUIREMENT
A 18 CHANGE ORDER PACKAGE REPORT					B 36 SA MASTER CHANGE ORDER FILE				
COST	CHANGES	PACKAGE	CURRENT	REQUIREMENT	COST	CHANGES	PACKAGE	CURRENT	STATUS
COST	CHANGES	PACKAGE	CURRENT	STATUS	COST	CHANGES	PACKAGE	CURRENT	REQUIREMENT
COST	CHANGES	PACKAGE	FORECAST	REQUIREMENT					

FIGURE 16

REQUIREMENT REPORT CLASSIFICATIONS SATISFIED BY ALL EXCEPT ONE CLASSIFICATION IN FOLLOWING REPORTS

		REFERENCE	REPORT TITLE
REPORT TITLES	REQUIREMENT AVAILABLE	A 1 1 E11 1	LISTING REPORT DETAIL LEVEL T5 SCHEDULE REPORT
REPORT TITLES	REQUIREMENT AVAILABLE	A 1 1 E12 1	LISTING REPORT DETAIL LEVEL T6 SIXTY DAY LOOK AHEAD
REPORT TITLES	REQUIREMENT AVAILABLE	A 2 1 E10 1	LISTING REPORT SUMMARY LEVEL T3 MASTER SCHEDULE
REPORT TITLES	REQUIREMENT AVAILABLE	A 6 1 E16 1	PROCUREMENT REPORT T11 PURCHASE ORDER CONTROL
REPORT TITLES	REQUIREMENT AVAILABLE	A 6 1 E17 1	PROCUREMENT REPORT T12 SHOP DRAWING AND SAMPLE CONTROL
REPORT TITLES	REQUIREMENT AVAILABLE	A 8 1 E23 1	COST PLANNING REPORT DETAIL LEVEL C6 DETAILED COST ESTIMATE (MANUAL PREP.)
REPORT TITLES	REQUIREMENT AVAILABLE	A 9 1 E18 1	COST PLANNING REPORT AT SUMMARY LEVEL C1 SUMMARY COST STATUS REPORT (MANUAL)

FIGURE 17

The summary report, Figure 18, gives a quick synopsis of the situation achieved by comparison of a particular study, or availability, system, against the requirements. In the top two-thirds of the summary, the number considered is equal to the number read, less those in error and omitted. In the case of errors in classifications, unless occurring in the same report, the numbers will be reduced by the same amount as for reports. Error indications enable correction of information input in error in order to achieve a correct display of the requirements matched.

The bottom third of the summary is the most important for evaluation of satisfaction of needs as expressed by the classifications of reports. The number of perfect matches may exceed the number of requirement titles matched perfectly, a situation which has occurred in this example. Similarly, as may be seen, with one requirement classification unmatched, there are twenty-three matches obtained, although only fourteen requirement reports are matched. This enables the most suitable of competing available reports to be chosen.

The only other section of output from the computer program is shown in Figure 19. It comprises a listing of each acceptable report with title and the number of acceptable classifications. The left side indicates requirements while the right side indicates availabilities. This report is obtained prior to comparisons between availability and requirement classifications. Whichever category has the least reports has this indicated beyond its final report by asterisks in the report number and title areas and by 'UUU', for unassigned, in the column for number of classifications, as illustrated in the figure.

SUMMARY

		REPORTS	CLASSIFICATIONS
REQUIREMENTS	NUMBER READ	38	86
	NUMBER IN ERROR AND OMITTED	0	0
	NUMBER CONSIDERED	38	86
AVAILABILITIES	NUMBER READ	39	157
	NUMBER IN ERROR AND OMITTED	0	0
	NUMBER CONSIDERED	39	157

NUMBER OF REQUIREMENT TITLES INPUT TO PROGRAM	36
NUMBER OF REQUIREMENT TITLES CONSIDERED	36
NUMBER OF REQUIREMENT TITLES MATCHED PERFECTLY	8
TOTAL NUMBER OF PERFECT MATCHES	8
NUMBER OF REQUIREMENT TITLES MATCHED EXCEPT FOR ONE CLASSIFICATION	14
TOTAL NUMBER OF MATCHES WITH ONE REQUIREMENT CLASSIFICATION OMITTED	23

FIGURE 18

NUMBER OF REQUIRED REPORTS

NUMBER OF AVAILABLE REPORTS

REPORT NO	TITLE	NUMBER OF CLASSIFICATIONS	REPORT NO	TITLE	NUMBER OF CLASSIFICATIONS
37	UNLEVELLED RESOURCE HISTOGRAMS	2	37	9B PROPOSED CHANGE ORDER STATUS REPORT	1
38	MANPOWER LEVELLED HISTOGRAMS	2	38	9C APPROVED CHANGE ORDER MASTER LIST	1
***	**********	UUU	39	9D FACE VALUE OF CONTEMPLATED CHANGES	1

FIGURE 19

CHAPTER V

CONCLUSIONS AND RECOMMENDATIONS FOR FURTHER STUDY

5.1 General

Conclusions and advantages from the use of the classification and methodology are given, and recommendations for further study are made.

5.2 Conclusions

These are given in two parts, relating first to the classification system and second to the methodology for system selection.

5.2.1 Classification System

The classification system proposed has been shown to perform in a somewhat crude manner, depending as it must upon arbitrary distinctions between certain categories of the classification, an example of which is that between 'cost' and 'financial accounts' within the first zone. Other judgemental factors are that certain combinations of zone classifications may be equated to other classification combinations, an example of which showed cost commitment may be equated to cashflow as illustrated in Chapter II, Section 2.4. Possibly these problems could be overcome by narrowing the definition of terms particularly to overcome the latter problem but then obtaining a unique classification so refined that the probabilities of finding a sequence of classifications from available software to match a similar sequence of requirements for each report considered would be almost infinitesmal. Improvement of objectiveness in comparisons is

noted in being able to classify various system terminologies to a common base.

5.2.2 System Selection Methodology

The procedures adopted provide a basis for comparison of different proprietary system's suitability as measured against unique standard requirements established by an owner. The degree of sophistication varies with the number of requirement classifications established for each required report.

5.3 Advantages of Use of Classification and Methodology

Use of the classification system has the advantage that thought and care must be given to exactly what requirements are desired by an owner from a cost control system. This is illustrated in part by Figure 4 in Section 1.5.1 and also by the reports proposed, as an illustration of requirements, in Figure 5, Section 1.5.1 which may be used as a starting point for critical evaluation of a user's needs. Although intended for computer use, the classification may be used manually with benefit to an owner, since its structured nature forces logical thought processes concerning an owner's cost control needs.

Advantages of the methodology are the savings in time, in evaluation of competing cost control systems against the unique requirements of a user, made possible by use of a common classification system.

Choice of a cost control system is usually made by a group within the owner's organization. In addition to the classification system advantages already stated, because of computerization, use of the methodology diminishes the impact of human factors by reducing the effects of biases and particular system preferences held by individuals

in making the owner's selection.

A further advantage is security in being assured of having the most appropriate cost control system since, once adopted, a cost control system is usually used for a long period of time. The system selection methodology is relatively inexpensive compared with the costs of changing a system which would be necessitated if this rational basis was not used and an owner chose an inappropriate cost control system from the multitude available.

5.4 Recommendations for Further Study

5.4.1 Classification System

The definitions of each element of the classification system as given in the Glossary of Classifications at Appendix B are predicated upon report classifications by functions. Possible study areas would cover extension of the classification to provide classification for individual columns of reports, noting the caveat given in Section 5.2.1, or shortening of the classification, particularly in zone III, possibly through studies of frequency of use of different elements when applied to combinations of user's requirements and available proprietary systems.

5.4.2 System Selection Methodology

If requirement reports only needed a single element of information which could only have a single classification, the determination of the number of matches would be comparatively simple for any available system under study. If the elements in each report are ranked in order of importance, studies could be performed utilizing the methodology, to determine a ranking for a given system using increasing numbers of classifications matched against requirements.

APPENDIX A

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APPENDIX B

GLOSSARY OF CLASSIFICATIONS

(A) ZONE I. FIELD OF CONTROL

SCHEDULE:	The time-frame within which the project or a part is to be performed.
RESOURCE:	Physical item such as labour, equipment and materials required for construction work.
COST:	Monetary requirement for construction work.
CASHFLOW:	Relationship of monetary requirements in time.
FINANCIAL ACCOUNTS:	Accounts enabling full financial control over the project.

(B) ZONE II. AREA OF CONTROL

PLANNING:	Intended method of performance of the work.
FEASIBILITY:	Practicability of the method chosen for performance of the work.
TARGET:	Result aimed for in control of performance of the work.
LISTING:	Enumeration of attribute or portion thereof within the field of control.
BAR CHART:	Graphical format for presentation of information.
FLOAT:	Time available between sequential activities without jeopardy to Project Completion Date.

RESPONSIBLE AGENCY:	Agency responsible for control of a project (i.e., manager).
PERFORMING AGENCY:	Agency responsible for the physical execution of a project or a part (i.e., contractor).
DEPARTMENT:	Responsible area within the owner's organization.
TENDER:	Cost for which a contractor offers to perform a defined package of work.
AWARD:	Cost for which the owner accepts an offer to perform a defined package of work.
PROCUREMENT:	Location of, and order placement for, items essential to the performance of a contract.
EXPEDITING:	Hastening delivery of procured items.
UTILIZATION:	Effectiveness of use of available resources.
LEVELLING:	Spreading of work flow items to minimize both the maximum requirement for, and the sum of the changes in requirements for, a resource.
MANPOWER:	Number of men (of different skills) required to perform a work package (or packages).
EQUIPMENT:	Equipment requirements for performance of a work package (or packages).
MATERIALS:	Requirements for materials to be incorporated into the project.
CAPITAL:	Monetary requirements to execute the project.
BUDGET:	Allocation of money (or other resources) usually committed prior to commencement of construction of a project.

ESTIMATE:	Judgement of the quantity of a resource (or money) required to perform the work.
CONSTRUCTION:	Combination of resources required to achieve the project.
MANAGEMENT:	Conduct of the process of construction.
APPROPRIATIONS:	Monies authorized by the owner to the project manager to meet the requirements of the project.
ESCALATION:	Increase in the cost of performing an item of work over a period of time.
CONTINGENCY:	Provision for unexpected requirements for a resource.
CHANGES:	Alterations to the quantity (or quality) of work.
CLAIM:	Demand for payment due.
OWNER'S COSTS:	Costs incurred by the owner other than direct construction costs.
VENDORS:	Organizations from whom owner has purchased equipment or materials required to perform the work.
ACCOUNTS:	Records of income and expenditure transactions.
RETENTIONS:	Monies held back by owner.
COMMITMENTS:	Liabilities incurred upon order placement for which services have not yet been rendered.
OBLIGATIONS:	Payments due in fulfillment of services already received.
CERTIFICATION:	Authentication of value of services received.
PURCHASES:	Services required from outside suppliers to enable construction of the project.

DISBURSEMENTS: Payments made by the owner.

REIMBURSABLES: Payments made on behalf of the owner by the manager and subsequently reimbursed.

INVOICES: Statements rendered upon performance of a service requesting payment for the service.

RECEIVABLES: Monies owed to the owner.

PRICES: Monetary costs of services supplied.

INVENTORY: Level of a resource held but not presently incorporated within the project.

ACTUALS: Actual cost for a service performed.

(C) ZONE III. LEVEL OF CONTROL

PROGRAM: Ongoing series of projects.

PROJECT: Works being designed and constructed.

PACKAGE: Component of the project as identified by work content. (Same as work package).

DETAIL: Lowest level of identification of individual activities within the WBS.

SUMMARY: Highest level of identification of components within the WBS.

FACILITY: Component of the project as identified by a specific function or location.

(D) ZONE IV. CHRONOMETRY OF MONITORING

PREVIOUS: Position reported on the prior report as current.

PERIOD: Change in position between the prior report and the present report.

CURRENT: Position as presently reported.

FORECAST: Position as anticipated later than at the present time.

(E) ZONE V. CONTROL MECHANISM

VARIANCE: Difference between the current position and previously planned position at the current time.

TREND: Direction of movement (and magnitude) of a variance.

REQUIREMENT: Previously planned position at a specific time.

STATUS: Relationship of the present position to some predetermined point of measurement of position.

BALANCE: Level of an item (cost or resource) remaining.

APPENDIX C

COMPUTER PROGRAM CONTROL CARDS

The Job Control Cards are not indicated here as they will be specific to the data centre used. The Program is written in Fortran G.

Format of Data Cards is indicated below:

1. TITLE CARD

Card Cols.	Contents	Description
1	A or B	Identifier: A = requirement B = availability
2,3	01-99	Report Number. Must be sequential starting with 01.
4,5	01	Title Identifier
6,7	Blank	
8-47	Any Characters	Report Title - may be alphanumeric and may include any permissible character read by the computer.
48-80	Blank	

2. CLASSIFICATION CARD

Card Cols.	Contents	Description
1	A or B	Identifier: A = requirement B = availability (must match report to which classification belongs).
2-3	01-99	Report Number. Must match report to which classification belongs.

Card Cols.	Contents	Description
4-5	02-11	Classification number within report. Must be sequential starting with 02.
6-7	Blank	
8-27	See Description	Zone I classification, left-justified, exactly as shown in classification table (Table 1).
28-29	Blank	
30-45	See Description	Zone II classification, left-justified, exactly as shown in classification table (Table 1).
46-47	Blank	
48-55	See Description	Zone III classification, left-justified, exactly as shown in classification table (Table 1).
56-57	Blank	
58-65	See Description	Zone IV classification, left-justified, exactly as shown in classification table (Table 1).
66-77	Blank	
68-79	See Description	Zone V classification, left-justified, exactly as shown in classification table (Table 1).
80	Blank	

3. END CARDS

Card Cols.	Content	Description
1	Z	Signal to processor for end of stream of input data.
2-80	Blank	

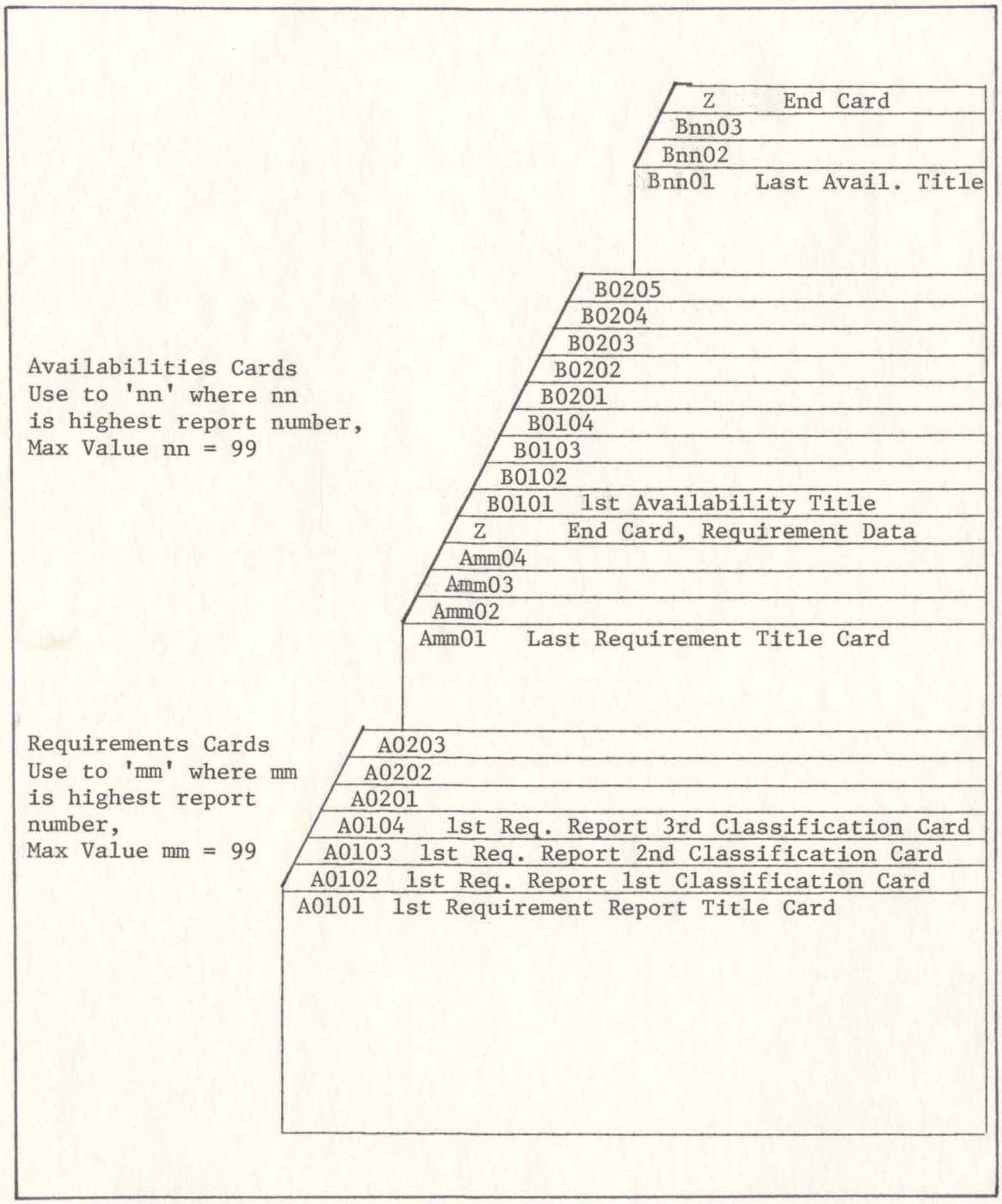

FIGURE 20. ORDER OF INPUT OF DATA CARDS

APPENDIX D

COMPUTER PROGRAM

The computer program developed and used in this thesis is included in the form of a listing in the pages following. The listing comprises the master program together with six subroutines whose names and functions are:

BLOCK	Handles block data
READ	Reads input data
ALTER	Converts to numeric format
CHANGE	Alters sequence
MATCH	Compares availabilities against requirements
REVERT	Converts to alphanumeric format for output

```
      DIMENSION RTITL(100,10),GH(3),RECONV(100,10),RCLASS(100),NATREQ(10PGM00005
     10),NNLASS(100),MMAR(10),MMA9(10),MCAS(10),MCAS(10)                PGM00010
      COMMON /KOMMON/                                                   PGM00015
     1LEV(100),TITL(100,10),KLA(25),KOUNT,MAC(10,5),TITLE(10),NW,KLASS(2PGM00020
     25),SABLE(5),TAB(5,63),REQMAT(10,5),REGTIT(10),CLASS(25),RECTIT(10)PGM00025
     3,BC,CD,AVAIL(100,10,5),KUSED,NUSED(100),MUSED(100),K2,K3,K9,R,S,  PGM00030
     4DF,EF,FG(4),JKL,NPAGE,LEVEL(100,10),CONV(100,10),NK,G2,NCLASS(100)PGM00035
     5,KKK,JMAT,MATREQ(100),MATAVA(100),RTITLE(100,10),MLA(10,25),       PGM00040
     6CLA(10,25),K,M,REQ(100,10),SYSTEM(100,10),IKK,IEF,KKX,KKY,KKZ,    PGM00045
     7MTREQ1(100),MAVALI(100),XTITL(100,10),YTITL(100,10),NKOUNT,NUMB(10PGM00050
     80),NNLEV(100),M2,M3,M6,M7,M12,M13,MUMB(100),KISS                  PGM00055
      INTEGER COUNT,ACCUNT,RCOUNT,SYSTEM,REG,REGTIT,M,REQMAT,X1         PGM00060
      INTEGER RECONV,RRKONV,RTITL,RECONT,TITLE,CLA                      PGM00065
      INTEGER AB,BC,CD,DF,EF,FG,R,S,T1,T2,T3,T4                         PGM00070
      DATA IBLNK /'    '/                                               PGM00075
      DATA JBLNK /'    '/                                               PGM00080
      DATA KBLNK /'  '/                                                 PGM00085
      DATA LZERO /'* * '/                                               PGM00090
      JKL=1                                                             PGM00095
C     JKL USED IN FORMATTING HEADINGS FOR OUTPUT FROM SUBROUTINE READ
C     JKL=1     REQUIREMENTS
C     JKL=2     AVAILABILITIES
      JZERO=0                                                           PGM00100
      JTWO=2                                                            PGM00105
      IONE=1                                                            PGM00110
      NTRACE=0                                                          PGM00115
      EF=0                                                              PGM00120
C     EF  USED TO ACCUMULATE INPUT DATA HAVING ERRORS AND IGNORED IN PROCESSING
      NPAGE=1                                                           PGM00125
C     NPAGE    USED FOR OUTPUT FORMATS AS PAGE NUMBER
      DO 300 K=1,100                                                    PGM00130
      MUSED(K)=0                                                        PGM00135
      NCLASS(K)=0                                                       PGM00140
      NUSED(K)=0                                                        PGM00145
  300 CONTINUE                                                          PGM00150
C     NUSED(XXX)    ACCUMULATES NUMBER OF CLASSIFICATIONS STORED WITHIN EACH
C                   REPORT TITLE
C                   INITIALISED TO 0
      CALL READ                                                         PGM00155
      DF=EF                                                             PGM00160
C     DF        SET TO NUMBER OF REQUIREMENT INPUT CARDS IN ERROR AND IGNORED
C     EF  NOW SETS NUMBER OF AVAILABILITIES INPUT CARDS IN ERROR AND IGNORED
      IDF=IEF                                                           PGM00165
C     IDF       SET TO NUMBER OF REQUIREMENT REPORTS IN ERROR AND IGNORED
C     IEF NOW SETS NUMBER OF AVAILABILITIES REPORTS IN ERROR AND IGNORED
      DO 301 K=1,100                                                    PGM00170
      MUMB(K)=NUMB(K)                                                   PGM00175
      K3=NUSED(K)                                                       PGM00180
      IF (K3) 396,3005,396                                              PGM00185
  396 DO 303 K2=1,K3                                                    PGM00190
      REQ(K,K2)=LEVEL(K,K2)                                             PGM00195
C     LEVEL(XXX,YY)       STORES INPUT DATA FROM SUBROUTINE READ IN NUMERIC FORM
C     REQ(XXX,YY)         STORES REQUIREMENTS IN NUMERIC FORM.
C                         FREES LEVEL(XXX,YY) FOR USE AGAIN FOR AVAILABILITIES
C     LEV(XXX)      ACCUMULATES NUMBER OF CLASSIFICATIONS WITHIN EACH REPORT NO.
  303 CONTINUE                                                          PGM00200
 3005 NCLASS(K)=LEV(K)                                                  PGM00205
C     NCLASS(XXX)      STORES NUMBER OF CLASSIFICATIONS WITHIN EACH REPORT NUMBER
C                      FOR REQUIREMENTS
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      MUSED(K)=NUSED(K)                                                  PGM00210
C     MUSED(XXX)     STORES NUMBER OF CLASSIFICATIIONS STORED WITHIN EACH REPORT
C                    TITLE FOR REQUIREMENTS
C     NUSED(XXX)     NOW LEFT AVAILABLE FOR STORAGE OF AVAILABILITIES
      DO 305 W=1,10                                                      PGM00215
      RTITLE(K,W)=TITL(K,W)                                              PGM00220
      YTITL(K,W)=XTITL(K,W)                                              PGM00225
  305 CONTINUE                                                           PGM00230
C     TITL(XXX,YY)         STORES TITLES AS INPUT
C     RTITLE(XXX,YY)       STORES REQUIREMENT TITLE AS INPUT.
C     TITL(XXX,YY)         NOW USED TO STORE TITLES OF AVAILABLE REPORTS
  301 CONTINUE                                                           PGM00235
      RCOUNT=KOUNT                                                       PGM00240
C     RCOUNT   USED TO STORE NUMBER OF REQUIREMENT REPORTS INPUT
      NREAD=KUSED+DE                                                     PGM00245
C     NREAD USED TO STORE TOTAL NUMBER OF INPUT REQUIRED CLASSIFICATIONS FED
C     TO THE SYSTEM, INCLUDING THOSE IN ERROR AND IGNORED IN PROCESSING
 1568 KK1=RCOUNT+1                                                       PGM00250
      IF (NKOUNT.EQ.JZERO) GO TO 1579                                    PGM00255
      DO 1575 K=KK1,1,NKOUNT                                             PGM00260
      DO 1575 W=1,10                                                     PGM00265
      YTITL(K,W)=XTITL(K,W)                                              PGM00270
 1575 CONTINUE                                                           PGM00275
 1579 CONTINUE                                                           PGM00280
 1574 EF=0                                                               PGM00285
      JKL=2                                                              PGM00290
      DO 399 K=1,100                                                     PGM00295
      NUSED(K)=0                                                         PGM00300
  399 CONTINUE                                                           PGM00305
      CALL READ                                                          PGM00310
      IF (NKOUNT-KOUNT) 1576,1577,1577                                   PGM00315
 1576 WRITE (6,1578) NKOUNT,KOUNT                                        PGM00320
 1577 NAVBLE=KUSED+EF                                                    PGM00325
C     NAVBLE USED TO STORE TOTAL NUMBER OF INPUT AVAILABLE CLASSIFICATIONS FED
C     TO THE SYSTEM, INCLUDING THOSE IN ERROR AND IGNORED IN PROCESSING
      DO 302 K=1,100                                                     PGM00330
      K3=NUSED(K)                                                        PGM00335
      IF (K3) 394,302,394                                                PGM00340
  394 DO 304 K2=1,K3                                                     PGM00345
      SYSTEM(K,K2)=LEVEL(K,K2)                                           PGM00350
  304 CONTINUE                                                           PGM00355
  302 CONTINUE                                                           PGM00360
C     SYSTEM(XXX,YY)       STORES AVAILABILITIES IN NUMERIC FORM.
C                          OBTAINED FROM LEVEL(XXX,YY)
      ACOUNT=KOUNT                                                       PGM00365
C     ACOUNT   USED TO STORE NUMBER OF AVAILABLE REPORTS INPUT
      KJ=0                                                               PGM00370
C     KJ USED TO OUTPUT CORRECT HEADING
      CD=1                                                               PGM00375
      KZ=0                                                               PGM00380
      KY=0                                                               PGM00385
      KKZ=0                                                              PGM00390
      KKY=0                                                              PGM00395
      DO 320 KF=1,100                                                    PGM00400
      KZ=KZ+1                                                            PGM00405
      KY=KY+1                                                            PGM00410
 3000 IF (KKZ.EQ.IONE) GO TO 3001                                        PGM00415
      IF (KKY.EQ.IONE) GO TO 325                                         PGM00420
 1100 IF (KJ-100) 321,322,321                                            PGM00425
  321 KI=0                                                               PGM00430
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3001 KKZ=0                                                              PGM00435
     IF (NUMB(KZ).EQ.JTWO.AND.NUSED(KF).EQ.JZERO) GO TO 324             PGM00440
 323 KG=KZ                                                              PGM00445
     IF  (NUMB(KZ).EG.JZERO) GO TO 1700                                 PGM00450
     NNLASS(KZ)=NCLASS(KF)                                              PGM00455
     GO TO 1701                                                         PGM00460
1700 NNLASS(KZ)=JBLNK                                                   PGM00465
     KZ=KZ+1                                                            PGM00470
     KKZ=1                                                              PGM00475
     GO TO 3000                                                         PGM00480
1701 CONTINUE                                                           PGM00485
     GO TO 325                                                          PGM00490
 324 KG=JBLNK                                                           PGM00495
     NCLASS(KF)=JZERO                                                   PGM00500
     DO 317 W=1,10                                                      PGM00505
     RTITLE(KF,W)=IBLNK                                                 PGM00510
     YTITL(KZ,W)=LZERO                                                  PGM00515
 317 CONTINUE                                                           PGM00520
     KI=KI+1                                                            PGM00525
 325 KKY=0                                                              PGM00530
     IF (NUMB(KY).EQ.JTWO.AND.NUSED(KF).EQ.JZERO) GO TO 327             PGM00535
 326 KH=KY                                                              PGM00540
     IF  (NUMB(KY).EG.JZERO) GO TO 1710                                 PGM00545
     NNLEV(KY)=LEV(KF)                                                  PGM00550
     GO TO 1711                                                         PGM00555
1710 NNLEV(KY)=JBLNK                                                    PGM00560
     KY=KY+1                                                            PGM00565
     KKY=1                                                              PGM00570
     GO TO 3000                                                         PGM00575
1711 CONTINUE                                                           PGM00580
     GO TO 328                                                          PGM00585
 327 KH=JBLNK                                                           PGM00590
     LEV(KF)=JZERO                                                      PGM00595
     DO 318 W=1,10                                                      PGM00600
     TITL(KF,W)=IBLNK                                                   PGM00605
     XTITL(KY,W)=LZERO                                                  PGM00610
 318 CONTINUE                                                           PGM00615
     KI=KI+1                                                            PGM00620
 328 IF (KI-2) 329,330,329                                              PGM00625
 330 KJ=100                                                             PGM00630
     GO TO 331                                                          PGM00635
 329 IF (CD.EQ.JZERO) GO TO 340                                         PGM00640
     WRITE (6,988)                                                      PGM00645
     WRITE (6,987) NPAGE                                                PGM00650
     NPAGE=NPAGE+1                                                      PGM00655
     WRITE (6,350)                                                      PGM00660
     WRITE (6,351)                                                      PGM00665
     WRITE (6,984)                                                      PGM00670
     WRITE (6,356)                                                      PGM00675
     WRITE (6,352)                                                      PGM00680
     WRITE (6,353)                                                      PGM00685
     WRITE (6,356)                                                      PGM00690
     X1=12                                                              PGM00695
     CD=0                                                               PGM00700
 340 WRITE (6,355)                                                      PGM00705
     WRITE (6,354) KG,(YTITL(KZ,W),W=1,10),NNLASS(KZ),KH,(XTITL(KY,W),WPGM00710
    1=1,10),NNLEV(KY)                                                   PGM00715
     KKZ=0                                                              PGM00720
     KKY=0                                                              PGM00725
     WRITE (6,355)                                                      PGM00730
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      WRITE (6,356)                                                    PGM00735
 1731 CONTINUE                                                         PGM00740
      X1=X1+4                                                          PGM00745
      IF (X1-56) 339,339,380                                           PGM00750
  380 CD=1                                                             PGM00755
  339 CONTINUE                                                         PGM00760
      IF (NUMB(KZ).EQ.JZERO) GO TO 1100                                PGM00765
      IF (NUMB(KY).EQ.JZERO) GO TO 1100                                PGM00770
  331 CONTINUE                                                         PGM00775
  320 CONTINUE                                                         PGM00780
  322 CONTINUE                                                         PGM00785
      KKK=0                                                            PGM00790
      DO 341 AB=1,3                                                    PGM00795
      IF (AB-2) 360,360,341                                            PGM00800
  360 BC=AB                                                            PGM00805
C     AB        PROVIDED TO ENABLE DIFFERENT MATCHING PARAMETERS TO BE APPLIED.
C               AT THE MOMENT ONLY ONE VALUE OF THE PARAMETER IS IN USE,
C               NAMELY A COMPLETE MATCH BETWEEN REQUIREMENTS AND AVAILABILITIES.
C               IT IS ENVISAGED THAT IN FUTURE CLOSE  BUT NOT EXACT MATCHES MAY
C               ALSO BE ADDED
      CD=0                                                             PGM00810
      KKZ=KKK                                                          PGM00815
      KKX=0                                                            PGM00820
      KKY=0                                                            PGM00825
      IKK=1                                                            PGM00830
      KISS=0                                                           PGM00835
      FG(AB)=0                                                         PGM00840
      FG(4)=0                                                          PGM00845
C     FG(AB) IS USED FOR IDENTIFICATION OF LOCATION FOR OUTPUT OF HEADINGS
C     FOR VALUES OF AB=1,2,3, AB ACCUMULATES.   VALUE OF AB=4 USED TO SET
C     OTHER VALUES GREATER THAN ONE.   VALUE OF ONE FOR FG(1),FG(2),FG(3) GIVES
C     HEADINGS.
      DO 307 K=1,ACCUNT                                                PGM00850
      K4=NCLASS(K)                                                     PGM00855
      IF (K4) 313,307,313                                              PGM00860
  313 K9=K                                                             PGM00865
      DO 314 K2=1,K4                                                   PGM00870
      LEVEL(K,K2)=REQ(K,K2)                                            PGM00875
      NK=K2                                                            PGM00880
      RECTIT(K2)=RTITLE(K,K2)                                          PGM00885
      KOUNT=1                                                          PGM00890
      NW=K                                                             PGM00895
      CALL ALTER                                                       PGM00900
      REQTIT(K2)=TITLE(K2)                                             PGM00905
C     REQTIT IS NUMBER OF REPORTS STORED
      DO 308 W=1,5                                                     PGM00910
      REQMAT(K2,W)=MAC(K2,W)                                           PGM00915
  308 CONTINUE                                                         PGM00920
  314 CONTINUE                                                         PGM00925
      K2=K4                                                            PGM00930
      COUNT=ACOUNT                                                     PGM00935
      M12=0                                                            PGM00940
      M7=0                                                             PGM00945
      DO 309 W=1,ACCUNT                                                PGM00950
      K5=LEV(W)                                                        PGM00955
      IF (K5) 393,309,393                                              PGM00960
  393 JMAT=0                                                           PGM00965
      DO 315 K3=1,K5                                                   PGM00970
      LEVEL(W,K3)=SYSTEM(W,K3)                                         PGM00975
      NW=W                                                             PGM00980
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      NK=K3                                                          PGM00985
      CALL ALTER                                                     PGM00990
C     MAC(JW,W) USED TO STORE REQUIREMENT IN NUMERIC FORMAT FOR USE IN
C     SUBROUTINE ALTER.
  315 CONTINUE                                                       PGM00995
      K3=K5                                                          PGM01000
      CALL MATCH                                                     PGM01005
      FG(AB)=FG(4)+FG(AB)                                            PGM01010
      FG(4)=0                                                        PGM01015
  309 CONTINUE                                                       PGM01020
  307 CONTINUE                                                       PGM01025
      JZERO=0                                                        PGM01030
  316 IQ=KBLNK                                                       PGM01035
      IF (AE-2) 1560,1561,1561                                       PGM01040
 1560 KKE=KKK                                                        PGM01045
      KKH=KKK                                                        PGM01050
      IF (KKH.LT.IONE) GO TO 341                                     PGM01055
      DO 1564 K7=1,KKH                                               PGM01060
      NATREQ(K7)=MATREQ(K7)                                          PGM01065
 1564 CONTINUE                                                       PGM01070
      I8=0                                                           PGM01075
      CD=1                                                           PGM01080
      X1=51                                                          PGM01085
      GO TO 1563                                                     PGM01090
 1561 KKE=KKY                                                        PGM01095
      KKH=KKY                                                        PGM01100
      IF (KKH.LT.JTWO) GO TO 341                                     PGM01105
      DO 1565 K7=1,KKH                                               PGM01110
      NATREQ(K7)=MTREQ1(K7)                                          PGM01115
 1565 CONTINUE                                                       PGM01120
      I8=0                                                           PGM01125
      CD=1                                                           PGM01130
      X1=51                                                          PGM01135
 1563 DO 312 K7=1,KKH                                                PGM01140
      I9=NATREQ(K7)                                                  PGM01145
      K3=MUSED(I9)                                                   PGM01150
      J2=0                                                           PGM01155
      J3=0                                                           PGM01160
      J6=0                                                           PGM01165
      J7=0                                                           PGM01170
      IF (I9.EQ.I8) GO TO 370                                        PGM01175
      GO TO 371                                                      PGM01180
  370 IF (AE-2) 1570,1571,1571                                       PGM01185
 1570 KKE=KKE-1                                                      PGM01190
      GO TO 371                                                      PGM01195
 1571 KKE=KKE-1                                                      PGM01200
  371 CONTINUE                                                       PGM01205
      I8=I9                                                          PGM01210
      DO 343 K2=1,K3                                                 PGM01215
      LEVEL(I9,K2)=REG(I9,K2)                                        PGM01220
      NW=I9                                                          PGM01225
      NK=K2                                                          PGM01230
      CALL ALTER                                                     PGM01235
  343 CONTINUE                                                       PGM01240
  335 CONTINUE                                                       PGM01245
      CALL REVERT                                                    PGM01250
  342 DO 334 JW=1,K3                                                 PGM01255
      DO 336 W=1,25                                                  PGM01260
      MLA(JW,W)=CLA(JW,W)                                            PGM01265
  336 CONTINUE                                                       PGM01270
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C      MLA(XX,YY) USED TO STORE ALPHANUMERIC CLASSIFICATION DURING COMPARISON
C      FOR REQUIREMENTS.  IT LEAVES CLA FREE FOR USE BY AVAILABLE CLASSIFICATIONS
C      K8 IS EQUATED TO NUMBER OF AVAILABLE REPORTS FOR TITLE NUMBER K7
C      K5 IS EQUATED TO THE NUMERIC VALUE OF THE PARTICULAR AVAILABLE
C      CLASSIFICATION UNDER COMPARISON
  334 CONTINUE                                                          PGM01275
C      KKK USED AS A COUNTER FOR THE NUMBER OF REPORTS WHOSE CLASSIFICATIONS
C          IN A REQUIREMENT REPORT ARE MET COMPLETELY BY AN AVAILABLE REPORT
       IF (AB-2) 1580,1581,1581                                         PGM01280
 1580 K8=MATAVA(K7)                                                     PGM01285
C      MATAVA(XXX) USED TO STORE REPORT NUMBER AVAILABLE WHICH MATCHES WITH,
C                  ALL CLASSIFICATIONS HELD IN REQUIREMENT REPORT STORED IN
C                  MATREQ(XXX)
       GO TO 1585                                                       PGM01290
 1581 K8=MAVALI(K7)                                                     PGM01295
 1585 CONTINUE                                                          PGM01300
       K5=LEV(K8)                                                       PGM01305
       DO 338 K6=1,K5                                                   PGM01310
       LEVEL(K8,K6)=SYSTEM(K8,K6)                                       PGM01315
       NW=K8                                                            PGM01320
       NK=K6                                                            PGM01325
       CALL ALTER                                                       PGM01330
       NK=K3                                                            PGM01335
  338 CONTINUE                                                          PGM01340
       K3=K5                                                            PGM01345
       LNK=NK                                                           PGM01350
       LK3=K3                                                           PGM01355
       IF (LNK.GT.LK3) GO TO 1780                                       PGM01360
       LLKP=K3+4                                                        PGM01365
       GO TO 1781                                                       PGM01370
 1780 LLKP=NK+4                                                         PGM01375
 1781 LLX1=LLKP+X1                                                      PGM01380
       LLX2=58                                                          PGM01385
       IF (LLX1.GT.LLX2) GO TO 1782                                     PGM01390
       GO TO 703                                                        PGM01395
 1782 CD=1                                                              PGM01400
  703 IF (CD.EQ.JZERO) GO TO 373                                        PGM01405
       WRITE (6,988)                                                    PGM01410
       WRITE (6,967) NPAGE                                              PGM01415
       NPAGE=NPAGE+1                                                    PGM01420
       CD=0                                                             PGM01425
       X1=15                                                            PGM01430
       WRITE (6,987)                                                    PGM01435
       IF (AB-2) 1590,1591,1591                                         PGM01440
 1590 WRITE (6,374)                                                     PGM01445
       WRITE (6,375)                                                    PGM01450
       WRITE (6,984)                                                    PGM01455
       WRITE (6,1550)                                                   PGM01460
       WRITE (6,1551)                                                   PGM01465
       GO TO 1595                                                       PGM01470
 1591 WRITE (6,1596)                                                    PGM01475
       WRITE (6,1597)                                                   PGM01480
       WRITE (6,984)                                                    PGM01485
       WRITE (6,1550)                                                   PGM01490
       WRITE (6,1551)                                                   PGM01495
 1595 WRITE (6,984)                                                     PGM01500
       WRITE (6,974)                                                    PGM01505
  373 WRITE (6,701)                                                     PGM01510
       X1=X1+1                                                          PGM01515
       J7=J7+1                                                          PGM01520
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      J4=0                                                                  PGM01525
      J5=0                                                                  PGM01530
      DO 3100 J8=1,K8                                                       PGM01535
      IF (NUMB(J8).EQ.ICNE) GO TO 3101                                      PGM01540
      J5=J5+1                                                               PGM01545
 3101 J5=J5+1                                                               PGM01550
 3100 CONTINUE                                                              PGM01555
      J21=K8+J6                                                             PGM01560
      J5=J5+J7                                                              PGM01565
      J7=K8                                                                 PGM01570
      J2=J2+1                                                               PGM01575
      DO 3102 J1=1,I9                                                       PGM01580
      IF (NUMB(J1).EQ.ICNE) GO TO 3103                                      PGM01585
      J3=J3+1                                                               PGM01590
 3103 J4=J4+1                                                               PGM01595
 3102 CONTINUE                                                              PGM01600
      J20=I9+K8                                                             PGM01605
      J4=J4+J2                                                              PGM01610
      J2=I9                                                                 PGM01615
      WRITE (6,710)R,J20,(TITLE(I9,W),W=1,10),S,J21,(TITL(K8,W),W=1,10)PGM01620
      X1=X1+1                                                               PGM01625
      CALL REVERT                                                           PGM01630
      IF (NK-K3) 750,751,752                                                PGM01635
  750 KP=K3                                                                 PGM01640
      KQ=NK+1                                                               PGM01645
      DO 755 KM=KQ,KP                                                       PGM01650
      DO 756 KN=1,25                                                        PGM01655
      MLA(KM,KN)=IBLNK                                                      PGM01660
  756 CONTINUE                                                              PGM01665
  755 CONTINUE                                                              PGM01670
      GO TO 760                                                             PGM01675
  751 KP=K3                                                                 PGM01680
      GO TO 760                                                             PGM01685
  752 KP=NK                                                                 PGM01690
      KQ=K3+1                                                               PGM01695
      DO 757 KM=KQ,KP                                                       PGM01700
      DO 758 KN=1,25                                                        PGM01705
      CLA(KM,KN)=IBLNK                                                      PGM01710
  758 CONTINUE                                                              PGM01715
  757 CONTINUE                                                              PGM01720
  760 DO 761 JW=1,KP                                                        PGM01725
      WRITE (10,3800) MLA(JW,5),MLA(JW,9),CLA(JW,5),CLA(JW,9)               PGM01730
      BACKSPACE 10                                                          PGM01735
      READ (10,3801) MMA5(JW),KBLNK,MMA9(JW),KBLNK,MCA5(JW),KBLNK,MCA9(JPGM01740
     1W),KBLNK                                                              PGM01745
      WRITE (6,346) (MLA(JW,W),W=1,4),MMA5(JW),(MLA(JW,W),W=6,8),MMA9(JWPGM01750
     1),(MLA(JW,W),W=11,12),(MLA(JW,W),W=16,17),(MLA(JW,W),W=21,23),(CLAPGM01755
     2(JW,W),W=1,4),MCA5(JW),(CLA(JW,W),W=6,8),MCA9(JW),(CLA(JW,W),W=11,PGM01760
     312),(CLA(JW,W),W=16,17),(CLA(JW,W),W=21,23)                           PGM01765
      X1=X1+1                                                               PGM01770
  761 CONTINUE                                                              PGM01775
      WRITE (6,701)                                                         PGM01780
      WRITE (6,974)                                                         PGM01785
      X1=X1+2                                                               PGM01790
      IF (X1-55) 702,1790,1790                                              PGM01795
 1790 X1=0                                                                  PGM01800
  704 CD=1                                                                  PGM01805
  702 CONTINUE                                                              PGM01810
  312 CONTINUE                                                              PGM01815
      CD=1                                                                  PGM01820
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341 CONTINUE                                                          PGM01825
    WRITE (6,988)                                                     PGM01830
    WRITE (6,987)                                                     PGM01835
    WRITE (6,967) NPAGE                                               PGM01840
    NPAGE=NPAGE+1                                                     PGM01845
    WRITE (6,987)                                                     PGM01850
    WRITE (6,986)                                                     PGM01855
    WRITE (6,985)                                                     PGM01860
    WRITE (6,984)                                                     PGM01865
    WRITE (6,378)                                                     PGM01870
    WRITE (6,379)                                                     PGM01875
    WRITE (6,376)                                                     PGM01880
    WRITE (6,377)                                                     PGM01885
    WRITE (6,379)                                                     PGM01890
    WRITE (6,972)                                                     PGM01895
    WRITE (6,973)                                                     PGM01900
    IDE1=RCOUNT+IDE                                                   PGM01905
    WRITE (6,983) IDE1,NREAD                                          PGM01910
    WRITE (6,973)                                                     PGM01915
    WRITE (6,982) IDE,DE                                              PGM01920
    NREAD=NREAD-DE                                                    PGM01925
    WRITE (6,973)                                                     PGM01930
    WRITE (6,981) RCOUNT,NREAD                                        PGM01935
    WRITE (6,973)                                                     PGM01940
    WRITE (6,972)                                                     PGM01945
    WRITE (6,984)                                                     PGM01950
    WRITE (6,972)                                                     PGM01955
    WRITE (6,973)                                                     PGM01960
    IEF1=ACOUNT+IEF                                                   PGM01965
    WRITE (6,983) NKOUNT,NAVBLE                                       PGM01970
    WRITE (6,973)                                                     PGM01975
    WRITE (6,980) IEF,EF                                              PGM01980
    NAVBLE=NAVBLE-EF                                                  PGM01985
    WRITE (6,973)                                                     PGM01990
    ACOUNT=NKOUNT-IEF                                                 PGM01995
    WRITE (6,981) ACOUNT,NAVBLE                                       PGM02000
    ACOUNT=IEF1-IEF                                                   PGM02005
    WRITE (6,973)                                                     PGM02010
    WRITE (6,972)                                                     PGM02015
    WRITE (6,984)                                                     PGM02020
    WRITE (6,984)                                                     PGM02025
    WRITE (6,359)                                                     PGM02030
    WRITE (6,361)                                                     PGM02035
    WRITE (6,362) IDE1                                                PGM02040
    WRITE (6,361)                                                     PGM02045
    WRITE (6,363) RCOUNT                                              PGM02050
    WRITE (6,361)                                                     PGM02055
    WRITE (6,364) KKE                                                 PGM02060
    WRITE (6,361)                                                     PGM02065
    WRITE (6,365) KKK                                                 PGM02070
    WRITE (6,361)                                                     PGM02075
    WRITE (6,1598) KKE                                                PGM02080
    WRITE (6,361)                                                     PGM02085
    WRITE (6,1599) KKY                                                PGM02090
    WRITE (6,361)                                                     PGM02095
    WRITE (6,359)                                                     PGM02100
346 FORMAT (1X,':',4A4,A2,1X,3A4,A2,1X,2A4,1X,2A4,1X,3A4,             PGM02105
   1           ':',4A4,A2,1X,3A4,A2,1X,2A4,1X,2A4,1X,3A4,':')         PGM02110
350 FORMAT (1X,'                    NUMBER OF REQUIRED REPORTS        PGM02115
   1                                 NUMBER OF AVAILABLE REPORTS')    PGM02120
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351 FORMAT (1X,'                          ---------------------------          PGM02125
   1                                      ---------------------------')        PGM02130
352 FORMAT (1X,':REPORT:                      TITLE                    :   NUPGM02135
   1MBER OF    ::REPORT:                     TITLE                    :   NUMPGM02140
   2BER OF    :')                                                            PGM02145
353 FORMAT (1X,':  NO  :                                                :CLASSPGM02150
   1IFICATIONS::  NO  :                                                 :CLASSIPGM02155
   2FICATIONS:')                                                            PGM02160
354 FORMAT(1X,': ',I3,'  :',10A4,':',6X,I3,6X,'::  ',I3,' :' ,10A4, ':PGM02165
   1       ',I3,6X,':')                                                     PGM02170
355 FORMAT(1X,':       :                                              :      PGM02175
   1          ::       :                                             :       PGM02180
   2          :')                                                           PGM02185
356 FORMAT(1X,':------:-----------------------------------------:------PGM02190
   1---------::------:-----------------------------------------:-------PGM02195
   2--------:')                                                             PGM02200
359 FORMAT (26X,'-----------------------------------------------------------PGM02205
   1-----------------------------------------')                             PGM02210
361 FORMAT (26X,':',70X,':',21X,':')                                        PGM02215
362 FORMAT (26X,':  NUMBER OF REQUIREMENT TITLES INPUT TO PROGRAM           PGM02220
   1                  :   ',I8,'          :')                               PGM02225
363 FORMAT (26X,':  NUMBER OF REQUIREMENT TITLES CONSIDERED                 PGM02230
   1                  :   ',I8,'          :')                               PGM02235
364 FORMAT (26X,':  NUMBER OF REQUIREMENT TITLES MATCHED PERFECTLY          PGM02240
   1                  :   ',I8,'          :')                               PGM02245
365 FORMAT (26X,':  TOTAL NUMBER OF PERFECT MATCHES                         PGM02250
   1                  :   ',I8,'          :')                               PGM02255
374 FORMAT (48X,'DETAIL OF REPORTS WHICH MATCH PERFECTLY')                  PGM02260
375 FORMAT (48X,'-----------------------------------------')                 PGM02265
376 FORMAT (88X,':  REPORTS    : CLASSIFICATIONS :')                        PGM02270
377 FORMAT (88X,':  -------    : --------------- :')                        PGM02275
378 FORMAT (88X,'-------------------------------')                           PGM02280
379 FORMAT (88X,':              :                 ;')                        PGM02285
701 FORMAT (1X,':',64X,':',64X,':')                                         PGM02290
710 FORMAT (1X,':',5X,A1,2X,I2,2X,10A4,12X,':',5X,A1,2X,I2,2X,10A4,12XPGM02295
   1,':')                                                                   PGM02300
967 FORMAT (120X,'PAGE',I4)                                                 PGM02305
972 FORMAT (26X,'-----------------------------------------------------------PGM02310
   1-----------------------------------------')                             PGM02315
973 FORMAT (26X,':',23X,':',37X,':',12X,':',17X,':')                        PGM02320
974 FORMAT (1X,':-----------------------------------------------------------PGM02325
   1-----------:-----------------------------------------------------------PGM02330
   2----------:')                                                           PGM02335
975 WRITE (6,988)                                                           PGM02340
980 FORMAT (26X,':',4X,'AVAILABILITIES',5X,':',4X,'NUMBER IN ERROR ANDPGM02345
   1 OMITTED', 6X,':',I8,4X,':',2X,I8,7X,':')                               PGM02350
981 FORMAT (26X,':',23X,':',4X,'NUMBER CONSIDERED',16X,':',I8,4X,':  'PGM02355
   1,I8,7X,':')                                                             PGM02360
982 FORMAT (26X,':',4X,' REQUIREMENTS ',5X,':',4X,'NUMBER IN ERROR ANDPGM02365
   1 OMITTED', 6X,':',I8,4X,':',2X,I8,7X,':')                               PGM02370
983 FORMAT (26X,':',23X,':',4X,'NUMBER READ       ',16X,':',I8,4X,':  'PGM02375
   1,I8,7X,':')                                                             PGM02380
984 FORMAT ('-')                                                            PGM02385
985 FORMAT (62X,'-------')                                                  PGM02390
986 FORMAT (62X,'SUMMARY')                                                  PGM02395
987 FORMAT ('0')                                                            PGM02400
988 FORMAT ('1')                                                            PGM02405
1550 FORMAT (26X,'REQUIREMENT',56X,'AVAILABLE')                             PGM02410
1551 FORMAT (26X,'-----------',56X,'---------')                             PGM02415
1578 FORMAT (1X,'ERROR NKOUNT=',I8,'      KOUNT=',I8)                       PGM02420
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 1596 FORMAT (30X,'DETAIL OF REPORTS WHICH MATCH ALL EXCEPT ONE REQUIREMPGM02425
     1ENT CLASSIFICATION')                                              PGM02430
 1597 FORMAT (30X,'----------------------------------------------------PGM02435
     1----------')                                                      PGM02440
 1598 FORMAT (26X,': NUMBER OF REQUIREMENT TITLES MATCHED EXCEPT FOR ONPGM02445
     1E CLASSIFICATION  :   ',I8,'          :')                       PGM02450
 1599 FORMAT (26X,':  TOTAL NUMBER OF MATCHES WITH ONE REQUIREMENT CLASSPGM02455
     1IFICATION OMITTED :   ',I8,'          :')                       PGM02460
 3800 FORMAT (4A4)                                                     PGM02465
 3801 FORMAT (8A2)                                                     PGM02470
      STOP                                                             PGM02475
      END                                                              PGM02480


      BLOCK DATA                                                       BLK00005
      DIMENSION TAA(5,20),TAC(5,20),TAD(5,20),TAE(5,3)                 BLK00010
      DIMENSION TABLE(5)                                               BLK00015
      COMMON /KOMMON/                                                  BLK00020
     1LEV(100),TITL(100,10),KLA(25),KOUNT,MAC(10,5),TITLE(10),NW,KLASS(2BLK00025
     25),SABLE(5),TAB(5,63),REQMAT(10,5),REQTIT(10),CLASS(25),RECTIT(10)BLK00030
     3,BC,CD,AVAIL(100,10,5),KUSED,NUSED(100),MUSED(100),K2,K3,K9,D,S,  BLK00035
     4DE,EF,FG(4),JKL,NPAGE,LEVEL(100,10),CONV(100,10),NK,G2,NCLASS(100)BLK00040
     5,KKK,JMAT,MATREQ(100),MATAVA(100),RTITLE(100,10),MLA(10,25),      BLK00045
     6CLA(10,25),K,M,REQ(100,10),SYSTEM(100,10),IKK,IEF,KKX,KKY,KKZ,    BLK00050
     7MTREQ1(100),MAVALI(100),XTITL(100,10),YTITL(100,10),NKOUNT,NUMB(10BLK00055
     80),NNLEV(100),M2,M3,M6,M7,M12,M13,MUMB(100),KISS                  BLK00060
      INTEGER REQ,SYSTEM                                               BLK00065
C     SUBROUTINE BLOCK IS SOLELY USED FOR THE STORING OF BLOCK DATA
C     THIS COMPRISES:   1.   THE CLASSIFICATION TABLE IDENTIFIED AS TAA,TAC,TAD
C                            AND TAE.     THE TABLE IS IDENTIFIED IN THESE FOUR
C                            LOCATIONS DUE TO A LIMITATION OF NO MORE THAN 20
C                            CONTINUATION CARDS
      EQUIVALENCE (TAB(1, 1),TAA(1,1))                                 BLK00070
      EQUIVALENCE (TAB(1,21),TAC(1,1))                                 BLK00075
      EQUIVALENCE (TAB(1,41),TAD(1,1))                                 BLK00080
      EQUIVALENCE (TAB(1,61),TAE(1,1))                                 BLK00085
      EQUIVALENCE (SABLE(1),TABLE(1))                                  BLK00090
      INTEGER TAA,TAB,TAC,TAD,TABLE,SABLE,TAE                          BLK00095
      INTEGER DE,EF,FG,G2,G3,CONV,W                                    BLK00100
      DATA TABLE/05,46,54,58,63/                                       BLK00105
      DATA R/'A'/                                                      BLK00110
      DATA S/'B'/                                                      BLK00115
      DATA TAA/'SCHE','DULE','    ','    ','    ',                    BLK00120
     9         'RESC','URCE','S   ','    ','    ',                    BLK00125
     9         'COST','    ','    ','    ','    ',                    BLK00130
     9         'CASH','FLOW','    ','    ','    ',                    BLK00135
     9         'FINA','NCIA','L AC','COUN','TS  ',                    BLK00140
     9         'PLAN','NING','    ','    ','    ',                    BLK00145
     9         'FEAS','IBIL=','ITY ','    ','    ',                    BLK00150
     9         'TARG','ET  ','    ','    ','    ',                    BLK00155
     9         'LIST','ING ','    ','    ','    ',                    BLK00160
     9         'BARC','HART','    ','    ','    ',                    BLK00165
     9         'FLOA','T   ','    ','    ','    ',                    BLK00170
     9         'RESP','ONS.','AGEN','CY  ','    ',                    BLK00175
     9         'PERF','ORM.','AGEN','CY  ','    ',                    BLK00180
     9         'DEPA','RTME','NT  ','    ','    ',                    BLK00185
     9         'TEND','ER  ','    ','    ','    ',                    BLK00190
     9         'AWAR','D   ','    ','    ','    ',                    BLK00195
     9         'PROC','UREM','ENT ','    ','    ',                    BLK00200
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9          'EXPE','DITI','NG  ','    ','    ',                    BLK00205
9          'UTIL','ISAT','ION ','    ','    ',                    BLK00210
9          'LEVE','LLIN','G   ','    ','    '/                    BLK00215
 DATA TAC/'MANP','OWER','    ','    ','    ',                    BLK00220
9          'EQUI','PMEN','T   ','    ','    ',                    BLK00225
9          'MATE','RIAL','S   ','    ','    ',                    BLK00230
9          'CAPI','TAL ','    ','    ','    ',                    BLK00235
9          'BUDG','ET  ','    ','    ','    ',                    BLK00240
9          'ESTI','MATE','    ','    ','    ',                    BLK00245
9          'CONS','TRUC','TION','    ','    ',                    BLK00250
9          'MANA','GEME','NT  ','    ','    ',                    BLK00255
9          'APPR','OPRI','ATIO','NS  ','    ',                    BLK00260
9          'ESCA','LATI','ON  ','    ','    ',                    BLK00265
9          'CONT','INGE','NCY ','    ','    ',                    BLK00270
9          'CHAN','GES ','    ','    ','    ',                    BLK00275
9          'CLAI','M   ','    ','    ','    ',                    BLK00280
9          'OWNE','RS C','OSTS','    ','    ',                    BLK00285
9          'VEND','ORS ','    ','    ','    ',                    BLK00290
9          'ACCO','UNTS','    ','    ','    ',                    BLK00295
9          'RETE','NTIO','NS  ','    ','    ',                    BLK00300
9          'COMM','ITME','NTS ','    ','    ',                    BLK00305
9          'OBLI','GATI','ONS ','    ','    ',                    BLK00310
9          'CERT','IFIC','ATIO','N   ','    '/                    BLK00315
 DATA TAD/'PURC','HASE','S   ','    ','    ',                    BLK00320
9          'DISB','URSE','MENT','S   ','    ',                    BLK00325
9          'REIM','BURS','ABLE','S   ','    ',                    BLK00330
9          'INVO','ICES','    ','    ','    ',                    BLK00335
9          'RECE','IVAB','LES ','    ','    ',                    BLK00340
9          'PRIC','ES  ','    ','    ','    ',                    BLK00345
9          'INVE','NTOR','Y   ','    ','    ',                    BLK00350
9          'ACTU','ALS ','    ','    ','    ',                    BLK00355
9          'PROG','RAM ','    ','    ','    ',                    BLK00360
9          'PROJ','ECT ','    ','    ','    ',                    BLK00365
9          'PACK','AGE ','    ','    ','    ',                    BLK00370
9          'DETA','IL  ','    ','    ','    ',                    BLK00375
9          'SUMM','ARY ','    ','    ','    ',                    BLK00380
9          'FACI','LITY','    ','    ','    ',                    BLK00385
9          'PREV','IOUS','    ','    ','    ',                    BLK00390
9          'PERI','OD  ','    ','    ','    ',                    BLK00395
9          'CURR','ENT ','    ','    ','    ',                    BLK00400
9          'FORE','CAST','    ','    ','    ',                    BLK00405
9          'VARI','ANCE','    ','    ','    ',                    BLK00410
9          'TREN','D   ','    ','    ','    '/                    BLK00415
 DATA TAE/'REQU','IREM','ENT ','    ','    ',                    BLK00420
9          'STAT','US  ','    ','    ','    ',                    BLK00425
9          'BALA','NCE ','    ','    ','    '/                    BLK00430
 END                                                               BLK00435


 SUBROUTINE READ                                                   RED00005
 DIMENSION L(25)                                                   RED00010
 DIMENSION TABLE(5),IX(8), TYTL(10),JIX(8)                         RED00015
 COMMON /KOMMON/                                                   RED00020
1LEV(100),TITL(100,10),KLA(25),KCUNT,MAC(10,5),TITLE(10),NW,KLASS(2RED00025
25),SABLE(5),TAB(5,63),REQMAT(10,5),REQTIT(10),CLASS(25),RECTIT(10)RED00030
3,BC,CC,AVAIL(100,10,5),KUSED,NUSED(100),MUSED(100),K2,K3,K9,P,S,  RED00035
4DE,EF,FG(4),JKL,NPAGE,LEVEL(100,10),CONV(100,10),NK,G2,NCLASS(100)RED00040
5,KKK,JMAT,MATREC(100),MATAVA(100),RTITLE(100,10),MLA(10,25),      RED00045
6CLA(10,25),K,W,REC(100,10),SYSTEM(100,10),IKK,IEF,KKX,KKY,KKZ,    RED00050
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C
      7MTREQ1(100),MAVALI(100),XTITL(100,10),YTITL(100,10),NKOUNT,NUMB(10RED00055
      80),NNLEV(100),M2,M3,M6,M7,M12,M13,MUME(100),KISS                    RED00060
       EQUIVALENCE (SABLE(1),TABLE(1))                                     RED00065
       INTEGER REQ,SYSTEM                                                  RED00070
C      SUBROUTINE READ IS USED SOLELY TO READ INPUT DATA
C                      AS EACH CARD IS READ IT IS CHECKED TO DETERMINE IF IT IS
C                      A TITLE CARD.    IF A TITLE CARD THE CONTENTS ARE STORED.
C                      IF NOT THE DATA ON THE CARD IS READ TO TEMPORARY STORE
C                      FROM WHICH IT IS READ BACK USING THE DIFFERENT FORMATS
       INTEGER A,B,P,Q,R,S,Z                                               RED00075
       INTEGER TAA,TAB,TAC,TAD,TABLE,SABLE,TAE                             RED00080
       INTEGER DE,EF,FG,G2,G3,CONV,W                                       RED00085
       DATA IBLNK /'    '/                                                 RED00090
       DATA Z /'Z'/                                                        RED00095
       IEF=0                                                               RED00100
       JZERO=0                                                             RED00105
       IONE=1                                                              RED00110
       ITWO=2                                                              RED00115
       DO 935 J=1,100                                                      RED00120
       LEV(J)=0                                                            RED00125
C      LEV(XXX) IS USED TO STORE THE NUMBER OF CLASSIFICATIONS READ FOR EACH
C               TITLE.    IT IS INITIALISED TO ZERO IN ALL LOCATIONS
       NUMB(J)=2                                                           RED00130
       NNLEV(J)=0                                                          RED00135
       DO 935 K=1,10                                                       RED00140
       LEVEL(J,K)=9999999                                                  RED00145
       TITL(J,K)=IBLNK                                                     RED00150
       XTITL(J,K)=IBLNK                                                    RED00155
  935 CONTINUE                                                             RED00160
C      LEVEL(XXX,YY) IS USED TO STORE THE CLASSIFICATIONS FOR EACH REPORT IN
C                    NUMERIC FORMAT. WHERE XXX IDENTIFIES THE REPORT NUMBER AND
C                    YY IDENTIFIES THE CLASSIFICATION NUMBER WITHIN THE REPORT.
C                    IT IS INITIALISED TO A VALUE OF 9999999 IN ALL LOCATIONS
       I=1                                                                 RED00165
C      I            A COUNTER USED FOR SUBSRIPTS AS NOTED BELOW
       KOWWNT=0                                                            RED00170
       KOUNT=1                                                             RED00175
C      KOWWNT IS USED TO COUNT THE NUMBER OF CLASSIFICATIONS ACCEPTED FOR EACH
C             REPORT.    IF NONE ARE ACCEPTED IT DECREMENTS THE MAIN COUNTER
C             IDENTIFIED AS KOUNT FOLLOWING KOUNT'S OTHERWISE AUTOMATIC
C             INCREMENT.     THE REASON IS TO USE SEQUENTIAL VALUES OF SUBSCRIPTS
C             FOR ACCEPTABLE DATA IN LEV AND LEVEL AND THEREBY USING THE
C             INITIALISED VALUES IN THOSE LOCATIONS FOR TERMINATING LATER
C             SUBROUTINES
C                      ASSOCIATED WITH THE CLASSIFICATION CARDS
C          KOUNT       COUNTS NUMBER OF REPORTS CONSIDERED
       NKOUNT=1                                                            RED00180
       IT=0                                                                RED00185
       KUSED=0                                                             RED00190
       LKOUNT=60                                                           RED00195
C      LCOUNT USED TO COUNT LINES FOR OUTPUT LAYOUTS
       LOEND=Z                                                             RED00200
C      LOEND VALUE OF Z USED AS END OF INPUT STREAMS FOR DATA
       IE=1                                                                RED00205
C      IE VALUE OF 1 USED FOR INITIAL HEADINGS OF ECHO OF INPUT DATA
  140 DO 141 J=1,25                                                        RED00210
       KLA(J)=IBLNK                                                        RED00215
       L(J)=0                                                              RED00220
  141 CONTINUE                                                             RED00225
  101 READ  ( 5,4) JA,JID,JICONT,JIDUMM,( TYTL(J),J=1,10),(JIX(J),J=1,8)RED00230
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  934 IF (JA.EQ.LGEND) GO TO 500                                        RED00235
      IF (LKOUNT-53) 150,150,151                                        RED00240
  150 GO TO 152                                                         RED00245
  151 WRITE (6,957)                                                     RED00250
      LKOUNT=5                                                          RED00255
      WRITE (6,956)                                                     RED00260
      WRITE (6,948) NPAGE                                               RED00265
      NPAGE=NPAGE+1                                                     RED00270
      IF (JKL-1) 153,154,155                                            RED00275
  153 WRITE (6,949)                                                     RED00280
      GO TO 500                                                         RED00285
  154 WRITE (6,944)                                                     RED00290
      WRITE (6,947)                                                     RED00295
      GO TO 156                                                         RED00300
  155 WRITE (6,945)                                                     RED00305
      WRITE (6,946)                                                     RED00310
  156 WRITE (6,956)                                                     RED00315
  152 CONTINUE                                                          RED00320
      IF (JICONT-1) 930,931,932                                         RED00325
  930 WRITE (6,933)                                                     RED00330
      GO TO 500                                                         RED00335
  931 IT=IT+1                                                           RED00340
      NUMB(IT)=1                                                        RED00345
      DO 1301 MM=1,10                                                   RED00350
      XTITL(IT,MM)=TYTL(MM)                                             RED00355
 1301 CONTINUE                                                          RED00360
      IF (JID-1) 938,937,938                                            RED00365
  938 KOUNT=KOUNT+1                                                     RED00370
      NKOUNT=NKOUNT+1                                                   RED00375
      I=I+1                                                             RED00380
      IF (KOWWNT) 939,939,937                                           RED00385
  939 I=I-1                                                             RED00390
      IEF=IEF+1                                                         RED00395
C     IEF STORES NUMBER OF REPORTS IN ERROR                             
      DO 940 NICE=1,10                                                  RED00400
      TITL(I,NICE)=ISLNK                                                RED00405
  940 CONTINUE                                                          RED00410
      IT=IT-1                                                           RED00415
      NUMB(IT)=0                                                        RED00420
      IT=IT+1                                                           RED00425
      NUMB(IT)=1                                                        RED00430
  937 KOWWNT=0                                                          RED00435
      A=JA                                                              RED00440
      ID=JID                                                            RED00445
      ICONT=JICONT                                                      RED00450
      IDUMMY=JIDUMM                                                     RED00455
      DO 928 J=1,10                                                     RED00460
      TITL(I,J)=TYTL(J)                                                 RED00465
  928 CONTINUE                                                          RED00470
      DO 927 J=1,8                                                      RED00475
      IX(J)=JIX(J)                                                      RED00480
  927 CONTINUE                                                          RED00485
      LCONT=ICONT                                                       RED00490
      LEV(I)=0                                                          RED00495
      GO TO 101                                                         RED00500
  932 WRITE (10,4) JA,JID,JICONT,JIDUMM,( TYTL(J),J=1,10),(JIX(J),J=1,8)RED00505
      BACKSPACE 10                                                      RED00510
      READ (10,5) B,IE,ICONL,IDUMMY,(KLA(J),J=1,5),IY,(KLA(J),J=6,9),IY,RED00515
     1(KLA(J),J=11,12),IY,(KLA(J),J=16,17),IY,(KLA(J),J=21,23)          RED00520
C CONTENTS OF A AND B ARE 'A' FOR REQUIREMENTS WANTED FROM SYSTEM UNDER STUDY
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C CONTENTS OF A AND B ARE 'B' FOR AVAILABILITY FROM THE SYTEM UNDER STUDY
C     ID          IS SEQUENCE NUMBER OF REPORT.   VALUE FROM 00 TO 99
C     IE          IS SEQUENCE NUMBER OF REPORT.   VALUE FROM 00 TO 99
C                 VALUES OF ID AND IE MUST BE IDENTICAL FOR THE SAME REPORT
C     ICONT       IS SEQUENCE NUMBER OF CARDS
C     ICONU       IS SEQUENCE NUMBER OF CARDS. MUST BE 1>PREVIOUS CARD'S VALUE
C                                                      MAX VALUE = 11
C     IDUMMY      USED FOR SPACING ON DATA CARDS
C     TITL(I,J)   IS STORAGE OF REPORT TITLE
C     KLA(J)      IS USED FOR STORAGE OF CLASSIFICATION OF REPORT
C          J=1 THROUGH 5 USED TO STORE 1ST LEVEL OF CLASSIFICATION
C          J= 6 THROUGH 10 USED TO STORE 2ND LEVEL OF CLASSIFICATION
C          J=11 THROUGH 15 USED TO STORE 3RD LEVEL OF CLASSIFICATION
C          J=16 THROUGH 20 USED TO STORE 4TH LEVEL OF CLASSIFICATION
C          J=21 THROUGH 25 USED TO STORE 5TH LEVEL OF CLASSIFICATION
C          IY      USED FOR SPACING ON DATA CARDS
      IF (ID-IE) 950,102,950                                              RED00525
  950 WRITE (6,1) A,ID,ICONT,IDUMMY,(TITL(I,J),J=1,10)                    RED00530
      WRITE (6,91) A,ID,ICONT,B,IE,ICONU                                  RED00535
      GO TO 980                                                           RED00540
  102 CONTINUE                                                            RED00545
      IF (B.EQ.A) GO TO 104                                               RED00550
      IF (B.EQ.LOEND) GO TO 500                                           RED00555
      WRITE (6,1) A,ID,ICONT,IDUMMY,(TITL(I,J),J=1,10)                    RED00560
      WRITE (6,80) A,ID,ICONT,B,IE,ICONU                                  RED00565
      LKCUNT=LKCUNT+2                                                     RED00570
      GO TO 500                                                           RED00575
  104 CONTINUE                                                            RED00580
      LCONT=(LCONT+1)                                                     RED00585
      IF (LCONT-ICONU) 90,103,951                                         RED00590
  951 WRITE (6,1) A,ID,ICONT,IDUMMY,(TITL(I,J),J=1,10)                    RED00595
      WRITE (6,83) A,ID,ICONU,B,IE,ICONU                                  RED00600
      GO TO 981                                                           RED00605
   90 WRITE (6,1) A,ID,ICONT,IDUMMY,(TITL(I,J),J=1,10)                    RED00610
      LKCUNT=LKCUNT-1                                                     RED00615
  981 WRITE (6,82) A,ID,ICONT,B,IE,ICONU                                  RED00620
      LCONT=LCONT-1                                                       RED00625
      LKCUNT=LKCUNT+1                                                     RED00630
      GO TO 980                                                           RED00635
  103 CONTINUE                                                            RED00640
      KB=0                                                                RED00645
      DO 110 K=1,5                                                        RED00650
      KK=0                                                                RED00655
      KA=KB+1                                                             RED00660
C          K       =LEVEL OF CLASSIFICATION TABLE
C          KA   =  REFERENCE NUMBER OF 1ST ITEM IN K TH LEVEL OF CLASSIFICATION
C          KB   =  REFERENCE NUMBER OF LAST ITEM IN K TH LEVEL OF CLASSIFICATION
C          KC   =  INDEX OF FIRST BIT OF STORAGE AT A PARTICULAR LEVEL OF CLASSN.
C          KD   =  INDEX OF  LAST BIT OF STORAGE AT A PARTICULAR LEVEL OF CLASSN.
C          SEE      KLA      IN REGARD TO KC AND KD
      KB=TABLE(K)                                                         RED00665
C          TABLE(K)= VALUE OF NUMBER OF ITEMS IN K TH LEVEL OF CLASSIFICATION.
      M=(1+5*(K-1))                                                       RED00670
  105 DO 106 KC=KA,KB                                                     RED00675
  107 IF (KLA(M).EQ.TAB(1,KC).AND.KLA(M+1).EQ.TAB(2,KC).AND.KLA(M+2).EQ.RED00680
     1TAB(3,KC).AND.KLA(M+3).EQ.TAB(4,KC).AND.KLA(M+4).EQ.TAB(5,KC)) GO RED00685
     2TO 109                                                              RED00690
  113 IF (KK-1) 111,106,111                                               RED00695
  111 IF (KB-KC) 112,961,112                                              RED00700
  112 GO TO 106                                                           RED00705
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  109 MA=(M+4)                                                          RED00710
      KK=1                                                              RED00715
      DO 108 LA=M,MA                                                    RED00720
      KD=((KC+1)-KA)                                                    RED00725
      L(LA)=KD                                                          RED00730
  108 CONTINUE                                                          RED00735
  106 CONTINUE                                                          RED00740
  110 CONTINUE                                                          RED00745
  120 CONTINUE                                                          RED00750
      IF (A-B) 952,122,123                                              RED00755
  122 P=1                                                               RED00760
      GO TO 125                                                         RED00765
  123 IF (A-S) 953,124,954                                              RED00770
  124 P=2                                                               RED00775
  125    LER=(L(21)+(L(16)*10)+(L(11)*100)+(L(6)*1000)+(L(1)*100000))   RED00780
      KOWWNT=KOWWNT+1                                                   RED00785
      LERT=I*1000000                                                    RED00790
C     KOWWNT  COUNTS THE NUMBER OF CLASSIFICATIONS INTO WHICH THE REPORT FITS
      LEVEL(I,KOWWNT)=(LER+LERT)                                        RED00795
C     DETERMINES NUMERIC EQUIVALENT FOR CLASSIFICATION'S FIVE LEVELS
C    FORMAT II122345
C           II          IDENTIFIER - REPORT NUMBER
C             1       POSITION OF FIRST LEVEL          1= SCHEDULE
C                                                      2= RESOURCES
C                                                      3= COST
C                                                      4= CASHFLOW
C                                                      5= FINANCIAL ACCOUNTS
      CONTINUE                                                          RED00800
C               22    POSITION OF SECOND LEVEL         1= PLANNING
C                                                      2= FEASIBILITY
C                                                      3= TARGET
C                                                      4= LISTING
C                                                      5= BARCHART
C                                                      6= FLOAT
C                                                      7= RESPONS.AGENCY
C                                                      8= PERFORM.AGENCY
C                                                      9= DEPARTMENT
C                                                     10= TENDER
C                                                     11= AWARD
C                                                     12= PROCUREMENT
C                                                     13= EXPEDITING
C                                                     14= UTILISATION
C                                                     15= LEVELLING
C                                                     16= MANPOWER
C                                                     17= EQUIPMENT
C                                                     18= MATERIALS
C                                                     19= CAPITAL
      CONTINUE                                                          RED00805
C                                                     20= BUDGET
C                                                     21= ESTIMATE
C                                                     22= CONSTRUCTION
C                                                     23= MANAGEMENT
C                                                     24= APPROPRIATIONS
C                                                     25= ESCALATION
C                                                     26= CONTINGENCY
C                                                     27= CHANGES
C                                                     28= CLAIM
C                                                     29= OWNERS COSTS
C                                                     30= VENDORS
C                                                     31= ACCOUNTS
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C                                                  32= CHARGE NUMBERS
C                                                  33= COMMITMENTS
C                                                  34= OBLIGATIONS
C                                                  35= CERTIFICATION
C                                                  36= PURCHASES
C                                                  37= DISBURSEMENTS
C                                                  38= REIMBURSABLES
C                                                  39= INVOICES
      CONTINUE                                                          RED00810
C                                                  40= RECEIVABLES
C                                                  41= PRICES
C                                                  42= INVENTORY
C                                                  43= ACTUALS
C                3   POSITION OF THIRD LEVEL        1= PROGRAM
C                                                   2= PROJECT
C                                                   3= PACKAGE
C                                                   4= DETAIL
C                                                   5= SUMMARY
C                                                   6= FACILITY
      CONTINUE                                                          RED00815
C                 4  POSITION OF FOURTH LEVEL       1= PREVIOUS
C                                                   2= PERIOD
C                                                   3= CURRENT
C                                                   4= FORECAST
C                  5 POSITION OF FIFTH LEVEL        1= VARIANCE
C                                                   2= TREND
C                                                   3= REQUIREMENT
C                                                   4= STATUS
C                                                   5= BALANCE
C                                                   6= VENDOR LIST
      LEV(I)=LEV(I)+1                                                   RED00820
  943 WRITE (6,1) A,ID,ICONT,IDUMMY,(TITL(I,J),J=1,10)                  RED00825
  942 WRITE (6,2) B,IE,ICONU,IDUMMY,(KLA(J),J=1,5),IY,(KLA(J),J=6,9),IY,RED00830
     1(KLA(J),J=11,12),IY,(KLA(J),J=16,17),IY,(KLA(J),J=21,23)          RED00835
      WRITE (6,955)                                                     RED00840
      LKOUNT=LKOUNT+3                                                   RED00845
      N=KOUNT                                                           RED00850
      KUSED=KUSED+1                                                     RED00855
      NUSED(I)=KOUNT                                                    RED00860
      GO TO 140                                                         RED00865
  500 IF (KOUNT) 499,499,498                                            RED00870
  499 IF (B.EQ.LOEND) GO TO 1540                                        RED00875
      KOUNT=KOUNT-1                                                     RED00880
      IEF=IEF+1                                                         RED00885
      NKOUNT=NKOUNT-1                                                   RED00890
      DO 497 NICE=1,10                                                  RED00895
      TITL(I,NICE)=IBLNK                                                RED00900
  497 CONTINUE                                                          RED00905
      I=I-1                                                             RED00910
      NUMB(IT)=0                                                        RED00915
  498 CONTINUE                                                          RED00920
 1540 CONTINUE                                                          RED00925
      RETURN                                                            RED00930
  952 WRITE (6,1) A,ID,ICONT,IDUMMY,(TITL(I,J),J=1,10)                  RED00935
      WRITE (6,64) A                                                    RED00940
      GO TO 62                                                          RED00945
  953 WRITE (6,1) A,ID,ICONT,IDUMMY,(TITL(I,J),J=1,10)                  RED00950
      WRITE (6,65)                                                      RED00955
      GO TO 62                                                          RED00960
  954 WRITE (6,1) A,ID,ICONT,IDUMMY,(TITL(I,J),J=1,10)                  RED00965
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      WRITE (6,66) A                                                    RED00970
      GO TO 62                                                          RED00975
961   WRITE (6,1) A,ID,ICONT,IDUMMY,(TITL(I,J),J=1,10)                  RED00980
      WRITE (6,61)                                                      RED00985
      GO TO 980                                                         RED00990
980   WRITE (6,60)                                                      RED00995
      LKCUNT=LKCUNT+1                                                   RED01000
 62   EE=EE+1                                                           RED01005
      WRITE (6,2) B,IE,ICONU,IDUMMY,(KLA(J),J=1,5),IY,(KLA(J),J=6,9),IY,RED01010
     1(KLA(J),J=11,12),IY,(KLA(J),J=16,17),IY,(KLA(J),J=21,23)          RED01015
      WRITE (6,955)                                                     RED01020
      LKCUNT=LKCUNT+4                                                   RED01025
920   GO TO 142                                                         RED01030
142   GO TO 140                                                         RED01035
  1   FORMAT(1X,A1,I2,I2,A2,10A4)                                       RED01040
  2   FORMAT(1X,A1,I2,I2,A2,5A4,A2,4A4,A2,2A4,A2,2A4,A2,3A4)            RED01045
  4   FORMAT (A1,I2,I2,A2,10A4,8A4)                                     RED01050
  5   FORMAT (A1,I2,I2,A2,5A4,A2,4A4,A2,2A4,A2,2A4,A2,3A4)              RED01055
 60   FORMAT (3X,'     FOLLOWING CARD WITH THESE IDENTIFIERS HAS BEEN IGRED01060
     1NORED IN PROCESSING')                                             RED01065
 61   FORMAT (3X,'ERROR IN CLASSIFICATION OF PART OF FOLLOWING CARD')   RED01070
 64   FORMAT (3X,'ERROR   FIRST IDENTIFIER  A  IS LESS THAN ONE      A= 'RED01075
     1,5X,I1,6X,'ON FOLLOWING INPUT CARD WHICH IS IGNORED')             RED01080
 65   FORMAT (3X,'ERROR CONTENTS OF A > :A:  BUT ALSO < :B:             RED01085
     1FOLLOWING INPUT CARD IGNORED')                                    RED01090
 66   FORMAT (3X,'ERROR  CONTENTS OF A >:B:                             RED01095
     1FOLLOWING INPUT CARD IGNORED')                                    RED01100
 80   FORMAT (3X,'CARD REF  ',I1,I2,I2,3X,'IS NOT MATCHED BY FIRST IDENTRED01105
     1IFIER ON CARD REF',3X,I1,I2,I2)                                   RED01110
 81   FORMAT (3X,'CARD REF  ',I1,I2,I2,3X,'IS NOT MATCHED BY SECOND IDENRED01115
     1TIFIER ON CARD REF',3X,I1,I2,I2)                                  RED01120
 82   FORMAT (3X,'CARD REF  ',I1,I2,I2,3X,'HAS THIRD IDENTIFIER NON-SEQURED01125
     1ENTIAL ON FOLLOWING CARD REF',3X,I1,I2,I2)                        RED01130
 83   FORMAT (3X,'CARD REF  ',I1,I2,I2,3X,'HAS THIRD IDENTIFIER DUPLICATRED01135
     1ED ON CARD REF',3X,I1,I2,I2)                                      RED01140
933   FORMAT (1X,'ERROR  SEQUENCE NUMBER < 01 ')                        RED01145
944   FORMAT (39X,'  REQUIREMENTS INPUT TO COMPUTER ARE DETAILED BELOW')RED01150
945   FORMAT (39X,'AVAILABILITIES INPUT TO COMPUTER ARE DETAILED BELOW')RED01155
946   FORMAT (39X,'-------------------------------------------------')RED01160
947   FORMAT (39X,'  -------------------------------------------------')RED01165
948   FORMAT (120X,'PAGE',I4)                                           RED01170
949   FORMAT (1X,'ERROR',80X,'JKL < 1 ',3CX,'ERROR')                    RED01175
955   FORMAT (' ')                                                      RED01180
956   FORMAT ('-')                                                      RED01185
957   FORMAT ('1')                                                      RED01190
      END                                                               RED01195


      SUBROUTINE ALTER                                                  ALR00005
      DIMENSION AVATIT(100)                                             ALR00010
      COMMON /KOMMON/                                                   ALR00015
     1LEV(100),TITL(100,10),KLA(25),KCUNT,MAC(10,5),TITLE(10),NW,KLASS(2ALR00020
     25),SABLE(5),TAB(5,63),REQMAT(10,5),REQTIT(10),CLASS(25),REQTIT(10)ALR00025
     3,BC,CD,AVAIL(100,10,5),KUSED,NUSED(100),MUSED(100),K2,K3,K9,R,S,  ALR00030
     4DE,EE,EG(4),JKL,NPAGE,LEVEL(100,10),CONV(100,10),NK,G2,NCLASS(100)ALR00035
     5,KKK,JMAT,MATREQ(100),MATAVA(100),RTITLE(100,10),MLA(10,25),      ALR00040
     6CLA(10,25),K,M,REQ(100,10),SYSTEM(100,10),IKK,IEE,KKX,KKY,KKZ,    ALR00045
     7MTREQ1(100),MAVALI(100),XTITL(100,10),YTITL(100,10),NKCUNT,NUMB(10ALR00050
     80),NNLEV(100),M2,M3,M6,MT,M12,M13,MUMB(100),KISS                  ALR00055
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      INTEGER REQ,SYSTEM                                                ALR00060
      INTEGER AVAIL,AVATIT                                              ALR00065
      INTEGER DE,EF,FG,G2,G3,CONV,W                                     ALR00070
      CALL CHANGE                                                       ALR00075
      DO 601 NN=1,5                                                     ALR00080
      AVAIL(NW,NK,NN)=MAC(NK,NN)                                        ALR00085
  601 CONTINUE                                                          ALR00090
      AVATIT(NW)=TITLE(NK)                                              ALR00095
  600 CONTINUE                                                          ALR00100
      RETURN                                                            ALR00105
      END                                                               ALR00110


      SUBROUTINE CHANGE                                                 CHE00005
      DIMENSION PAC(6),PBC(6)                                           CHE00010
      COMMON /KOMMON/                                                   CHE00015
     1LEV(100),TITL(100,10),KLA(25),KOUNT,MAC(10,5),TITLE(10),NW,KLASS(2CHE00020
     25),SABLE(5),TAB(5,53),REQMAT(10,5),RECTIT(10),CLASS(25),RECTIT(10)CHE00025
     3,BC,CC,AVAIL(100,10,5),KUSED,NUSED(100),MUSED(100),K2,K3,K9,R,S,  CHE00030
     4DE,EF,FG(4),JKL,NPAGE,LEVEL(100,10),CONV(100,10),NK,G2,NCLASS(100)CHE00035
     5,KKK,JMAT,MATREQ(100),MATAVA(100),RTITLE(100,10),MLA(10,25),      CHE00040
     6CLA(10,25),K,W,REQ(100,10),SYSTEM(100,10),IKK,IEF,KKX,KKY,KKZ,    CHE00045
     7MTREQ1(100),MAVALI(100),XTITL(100,10),YTITL(100,10),NKOUNT,NUMB(10CHE00050
     80),NNLEV(100),M2,M3,M6,M7,M12,M13,MUME(100),KISS                  CHE00055
      INTEGER REQ,SYSTEM                                                CHE00060
      INTEGER PAC,PBC,TITLE                                             CHE00065
      INTEGER DE,EF,FG,G2,G3,CONV,W                                     CHE00070
      DO 501 MD=1,4                                                     CHE00075
      PAC(MD)= LEVEL(NW,NK)/(10**(MD-1))                                CHE00080
  501 CONTINUE                                                          CHE00085
      DO 502 MD=5,6                                                     CHE00090
      PAC(MD)= LEVEL(NW,NK)/(10**(MD))                                  CHE00095
C     PAC(1)=II12345
C     PAC(2)=II12234
C     PAC(3)=II1223
C     PAC(4)=II122
C     PAC(5)=II1
C     PAC(6)=II
  502 CONTINUE                                                          CHE00100
      DO 503 MD=1,3                                                     CHE00105
      PBC(MD)=(PAC(MD)-(10*PAC(MD+1)))                                  CHE00110
  503 CONTINUE                                                          CHE00115
      PBC(4)=(PAC(4)-(100*PAC(5)))                                      CHE00120
      PBC(5)=(PAC(5)-(10*PAC(6)))                                       CHE00125
      PBC(6)=PAC(6)                                                     CHE00130
C     OF CLASSIFICATION FORMAT II122345
C     PBC(1)                    =        5
C     PBC(2)                    =       4
C     PBC(3)                    =      3
C     PBC(4)                    =   22
      TITLE(NK)=PBC(6)                                                  CHE00135
C     PBC(5)                    =  1
C     PBC(6)                    =II
      DO 504 MD=1,5                                                     CHE00140
      MAC(NK,MD)=PBC(6-MD)                                              CHE00145
  504 CONTINUE                                                          CHE00150
C     TITLE  = TITLE REFERENCE        II
C  MAC(NK,1) = CLASSIFICATION CODING    1        1ST LEVEL
C  MAC(NK,2) = CLASSIFICATION CODING    22       2ND LEVEL
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C   MAC(NK,3) = CLASSIFICATION CODING       3     3RD LEVEL
C   MAC(NK,4) = CLASSIFICATION CODING        4    4TH LEVEL
C   MAC(NK,5) = CLASSIFICATION CODING         5   5TH LEVEL
      CONTINUE                                                          CHE00155
      RETURN                                                            CHE00160
      END                                                               CHE00165


      SUBROUTINE MATCH                                                  MAH00005
      COMMON /KOMMON/                                                   MAH00010
     1LEV(100),TITL(100,10),KLA(25),KOUNT,MAC(10,5),TITLE(10),NW,KLASS(2MAH00015
     25),SABLE(5),TAB(5,63),REQMAT(10,5),RECTIT(10),CLASS(25),RECTIT(10)MAH00020
     3,BC,CD,AVAIL(100,10,5),KUSED,NUSED(100),MUSED(100),K2,K3,K9,P,S,  MAH00025
     4DE,EF,FG(4),JKL,NPAGE,LEVEL(100,10),CONV(100,10),NK,G2,NCLASS(100)MAH00030
     5,KKK,JMAT,MATREQ(100),MATAVA(100),RTITLE(100,10),MLA(10,25),      MAH00035
     6CLA(10,25),K,W,REQ(100,10),SYSTEM(100,10),IKK,IEF,KKX,KKY,KKZ,    MAH00040
     7MTREQ1(100),MAVALI(100),XTITL(100,10),YTITL(100,10),NKOUNT,NUMB(10MAH00045
     80),NNLEV(100),M2,M3,M6,M7,M12,M13,MLME(100),KISS                  MAH00050
      INTEGER REQ,SYSTEM                                                MAH00055
      DIMENSION YA(5)                                                   MAH00060
      INTEGER ADD,ADDIT,SEC,RECTIT,VAITIT,CLASS,YYY,X,W                 MAH00065
      INTEGER RETIT,YA,YB,YZ,BC,CD                                      MAH00070
      INTEGER DE,EF,FG,G2,G3,CONV,REQMAT,AVAIL,P,S                      MAH00075
      IZERO=0                                                           MAH00080
      ICNE=1                                                            MAH00085
      AB=BC                                                             MAH00090
      ITWO=2                                                            MAH00095
      IF (AB.LT.ITWO) GO TO 1501                                        MAH00100
      IF (AB.EQ.ITWO) GO TO 1502                                        MAH00105
 1503 CONTINUE                                                          MAH00110
 1501 KAB=K2                                                            MAH00115
      KBB=0                                                             MAH00120
      GO TO 1505                                                        MAH00125
 1502 KAB=K2-1                                                          MAH00130
      IF (KAB.LE.0)   GOTO  550                                         MAH00135
      KBB=1                                                             MAH00140
 1504 CONTINUE                                                          MAH00145
 1505 IF (KAB.GT.K3) GO TO 1260                                         MAH00150
      IF (KAB.EQ.K3) GO TO 1261                                         MAH00155
      IPOSS=2                                                           MAH00160
      GO TO 1262                                                        MAH00165
 1261 IPOSS=1                                                           MAH00170
      GO TO 1262                                                        MAH00175
 1260 IPOSS=0                                                           MAH00180
      GO TO 1250                                                        MAH00185
 1262 DO 1230 M2=1,K2                                                   MAH00190
      IMAT =0                                                           MAH00195
      N2=JMAT+1                                                         MAH00200
      N3=1                                                              MAH00205
 1253 DO 1229 M3=1,K3                                                   MAH00210
      IF (IMAT) 1228,1229,1228                                          MAH00215
 1229 ISUM=C                                                            MAH00220
      IIREQ=REQ(K9,M2)/10**6                                            MAH00225
C     IIREQ=K
      IIREQ=REQ(K9,M2)-(IIREQ*10**6)                                    MAH00230
C     IIREQ=REQUIREMENT CLASSIFICATION IN FORMAT 12345
      IISYS=SYSTEM(NW,M3)/10**6                                         MAH00235
C     IISYS=NW
      IISYS=SYSTEM(NW,M3)-(IISYS*10**6)                                 MAH00240
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C     IISYS=AVAILIBILITY CLASSIFICATION IN FORMAT 122345
      IF (IIREQ.EQ.IISYS) GO TO 1223                                    MAH00245
 1222 CONTINUE                                                          MAH00250
      GO TO 1228                                                        MAH00255
 1223 IMAT=IMAT+1                                                       MAH00260
      GO TO 1224                                                        MAH00265
 1224 JMAT=JMAT+1                                                       MAH00270
 1228 CONTINUE                                                          MAH00275
 1230 CONTINUE                                                          MAH00280
      IF (JMAT.EQ.KAB)   GOTO  1510                                     MAH00285
      GOTO  550                                                         MAH00290
 1510 IF (KBB.LT.ICNE) GO TO 1241                                       MAH00295
      KKY=KKY+1                                                         MAH00300
      IF (KKZ.EQ.IZERO) GO TO 1520                                      MAH00305
      KKX=KKX+1                                                         MAH00310
      IF (KQ.EQ.MATREQ(KKX)) GO TO 1522                                 MAH00315
      KKX=KKX-1                                                         MAH00320
 1520 MTREQ1(KKY)=KQ                                                    MAH00325
      MAVALI(KKY)=NM                                                    MAH00330
      KISS=2                                                            MAH00335
      GO TO 530                                                         MAH00340
 1522 IF (KKX.EQ.KKZ) GO TO 1524                                        MAH00345
      GO TO 1525                                                        MAH00350
 1524 KKZ=0                                                             MAH00355
 1525 KKY=KKY-1                                                         MAH00360
      KISS=1                                                            MAH00365
      GO TO 530                                                         MAH00370
 1241 KKK=KKK+1                                                         MAH00375
      MATREQ(KKK)=KQ                                                    MAH00380
      MATAVA(KKK)=NM                                                    MAH00385
      GO TO 530                                                         MAH00390
 1250 GO TO 550                                                         MAH00395
  530 CONTINUE                                                          MAH00400
      IF (KBB.LT.ICNE) GO TO 1526                                       MAH00405
      IF (KKY.GT.IZERO) GO TO 551                                       MAH00410
      GO TO 550                                                         MAH00415
 1526 IF (KKK.EQ.IZERO) GO TO 550                                       MAH00420
  551 IF (KISS.EQ.ICNE) GO TO 550                                       MAH00425
      IF (BC-2) 670,671,671                                             MAH00430
C     INITIALLY PROGRAM SET FOR ALL REQUIREMENTS MET.
C     FOR FUTURE DEVELOPMENT CHANGE LOCATIONS TO 670,671,672 RESPECTIVELY
  670 FG(4)=1                                                           MAH00435
      KKA=MATREQ(KKK)                                                   MAH00440
      KKB=MATAVA(KKK)                                                   MAH00445
      GO TO 1527                                                        MAH00450
  671 FG(4)=1                                                           MAH00455
      KKA=MTREQ1(KKY)                                                   MAH00460
      KKB=MAVALI(KKY)                                                   MAH00465
 1527 IF (CD) 580,550,580                                               MAH00470
  560 WRITE (5,572)                                                     MAH00475
      CD=1                                                              MAH00480
      WRITE (6,573) NPAGE                                               MAH00485
      NPAGE=NPAGE+1                                                     MAH00490
      IF (BC.EQ.ICNE) GO TO 1530                                        MAH00495
      WRITE (6,1528)                                                    MAH00500
      WRITE (6,1529)                                                    MAH00505
      GO TO 1531                                                        MAH00510
 1530 WRITE (6,570)                                                     MAH00515
      WRITE (6,598)                                                     MAH00520
 1531 WRITE (6,594)                                                     MAH00525
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      WRITE (6,652)                                                     MAH00530
      WRITE (6,653)                                                     MAH00535
      WRITE (6,564)                                                     MAH00540
      WRITE (6,565)                                                     MAH00545
      WRITE (6,653)                                                     MAH00550
      WRITE (6,566)                                                     MAH00555
      YYY=14                                                            MAH00560
  580 IF (BC.EQ.ICNE) GO TO 581                                         MAH00565
      IF (KISS.EQ.ITWO) GO TO 531                                       MAH00570
  581 IF (KKK.EQ.IKK) GO TO 535                                         MAH00575
      GO TO 550                                                         MAH00580
  535 IF (BC.EQ.ICNE) GO TO 531                                         MAH00585
      GO TO 550                                                         MAH00590
  531 WRITE (6,567)                                                     MAH00595
      M7=M7+1                                                           MAH00600
      M13=0                                                             MAH00605
      M6=0                                                              MAH00610
      M4=0                                                              MAH00615
      M5=0                                                              MAH00620
      DO 3200 M8=1,KKA                                                  MAH00625
      IF (MUMB(M8).EQ.ICNE) GO TO 3201                                  MAH00630
      M6=M6+1                                                           MAH00635
 3201 M5=M5+1                                                           MAH00640
 3200 CONTINUE                                                          MAH00645
      KNA=KKA+M6                                                        MAH00650
      M7=KKA                                                            MAH00655
      M12=M12+1                                                         MAH00660
      DO 3202 M1=1,KKB                                                  MAH00665
      IF (NUMB(M1).EQ.ICNE) GO TO 3203                                  MAH00670
      M13=M13+1                                                         MAH00675
 3203 M4=M4+1                                                           MAH00680
 3202 CONTINUE                                                          MAH00685
      KNB=KKB+M13                                                       MAH00690
      M12=KKB                                                           MAH00695
      KKC=1                                                             MAH00700
      WRITE (6,568) R,KNA,KKC,(RTITLE(KKA,NM),NM=1,10)                  MAH00705
      WRITE (6,569)                                                     MAH00710
      WRITE (6,574) S,KNB,KKC,(TITL(KKB,NM),NM=1,10)                    MAH00715
      WRITE (6,567)                                                     MAH00720
      WRITE (6,566)                                                     MAH00725
      YYY=YYY+6                                                         MAH00730
      CD=1                                                              MAH00735
      IKK=IKK+1                                                         MAH00740
      IF (YYY-54) 550,550,515                                           MAH00745
  515 CD=0                                                              MAH00750
  550 CONTINUE                                                          MAH00755
      KISS=0                                                            MAH00760
  599 RETURN                                                            MAH00765
  564 FORMAT (44X,':',2X,'REFERENCE',3X,':',18X,'REPORT TITLE',18X,':') MAH00770
  565 FORMAT (44X,':',2X,'---------',3X,':',18X,'------------',18X,':') MAH00775
  566 FORMAT (3X,':--------------------:------------------::------------MAH00780
     1--:-----------------------------------------------:')             MAH00785
  567 FORMAT (3X,':                    :                  ::             MAH00790
     1  :                                                :')             MAH00795
  568 FORMAT (3X,':                    :    REQUIREMENT   ::   ',A1,I2,IMAH00800
     12,'       :    ',10A4,'    :')                                    MAH00805
  569 FORMAT (3X,':   REPORT TITLES    :                  ::             MAH00810
     1  :                                                :')             MAH00815
  570 FORMAT (23X,'REQUIREMENT REPORT CLASSIFICATIONS COMPLETELY SATISFIMAH00820
     1ED BY FOLLOWING AVAILABLE REPORTS')                               MAH00825
```

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  539 FORMAT (23X,'----------------------------------------------------------MAH00830
     1--------------------------------')                                     MAH00835
  572 FORMAT ('1')                                                          MAH00840
  573 FORMAT (120X,'PAGE',I4)                                               MAH00845
  574 FORMAT (3X,':                    :      AVAILABLE     ::   ',A1,I2,':MAH00850
    .12,'       :     ',10A4,'     :')                                      MAH00855
  594 FORMAT ('-')                                                          MAH00860
  652 FORMAT (44X,':--------------:-------------------------------MAH00865
     1-----------:')                                                        MAH00870
  653 FORMAT (44X,':',2X,'          ',3X,':',18X,'             ',18X,':') MAH00875
 1528 FORMAT (17X,'REQUIREMENT REPORT CLASSIFICATIONS SATISFIED BY ALL EMAH00880
     1XCEPT ONE CLASSIFICATION IN FOLLOWING REPORTS')                       MAH00885
 1529 FORMAT (17X,'----------------------------------------------------MAH00890
     1----------------------------------------')                          MAH00895
      END                                                                   MAH00900


      SUBROUTINE REVERT                                                     RET00005
      COMMON /KCMMON/                                                       RET00010
     1LEV(100),TITL(100,10),KLA(25),KOUNT,MAC(10,5),TITLE(10),NW,KLASS(2RET00015
     25),SABLE(5),TAB(5,63),REQMAT(10,5),REQTIT(10),CLASS(25),RECTIT(10)RET00020
     3,BC,CD,AVAIL(100,10,5),KUSED,MUSED(100),MUSED(100),K2,K3,K9,P,S,  RET00025
     4DE,EF,FG(4),JKL,NPAGE,LEVEL(100,10),CONV(100,10),NK,G2,NCLASS(100)RET00030
     5,KKK,JMAT,MATREQ(100),MATAVA(100),RTITLE(100,10),MLA(10,25),       RET00035
     6CLA(10,25),K,W,REQ(100,10),SYSTEM(100,10),IKK,IEF,KKX,KKY,KKZ,    RET00040
     7MTREQ1(100),MAVALI(100),XTITL(100,10),YTITL(100,10),NKOUNT,NUMB(10RET00045
     80),NNLEV(100),M2,M3,M6,M7,M12,M13,MUMB(100),KISS                   RET00050
      INTEGER REQ,SYSTEM                                                    RET00055
      INTEGER F,FA,FB,CLA,TABLE,TTT,U,TAB,FC,SABLE                          RET00060
      INTEGER DE,EF,FG,G2,G3,CONV,W                                         RET00065
      DO 604 FC=1,K3                                                        RET00070
      DO 605 F=1,5                                                          RET00075
      IF (F-1) 606,607,606                                                  RET00080
  606 TTT=MAC(FC,F)+SABLE(F-1)                                              RET00085
      GO TO 608                                                             RET00090
  607 TTT=MAC(FC,F)                                                         RET00095
  608 DO 605 FA=1,5                                                         RET00100
      FB=FA+(5*(F-1))                                                       RET00105
      CLA(FC,FB)=TAB(FA,TTT)                                                RET00110
  605 CONTINUE                                                              RET00115
  604 CONTINUE                                                              RET00120
      U=FC                                                                  RET00125
      RETURN                                                                RET00130
      END                                                                   RET00135
```