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**SECOND EXPERT GROUP MEETING
ON COMPUTERISED MAINTENANCE SYSTEM IN METALLURGY**

CAIRO, EGYPT. 6-12 MARCH 1988



**INTRODUCTION OF CMMS
IN DEVELOPING COUNTRIES**

(CASE STUDY IN INDIA)

**STEEL AUTHORITY OF INDIA LIMITED
ROURKELA STEEL PLANT**

ROURKELA : ORISSA : INDIA

592

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INTRODUCTION OF COMPUTERISED MANAGED MAINTENANCE SYSTEM IN DEVELOPING COUNTRY (CASE STUDY OF INDIA)

1.0 INTRODUCTION

Over the past 3 decades of Steel Plant Operation, Rourkela Steel Plant (RSP) under Steel Authority of India Limited (SAIL) has evolved a systematic approach towards the maintenance of Steel Plant equipment and facilities. It has been a long journey from the time when German technical personnel were available to guide and help in designing the suitable system and methods to the present decade when RSP engineers are on their own to develop the most advanced concept - Computer Managed Maintenance System. Rourkela Steel Plant as practised now is not only a well documented and a clear cut procedure oriented system but also a time tested one. In fact when a UNIDO team came here on a fact finding mission for a possible transfer of knowhow of Computer based system, it found Rourkela to be the best among SAIL Plants as regard maintenance system. Consequently Rourkela could win the coveted UNDP/UNIDO financial assistance amounting to US \$ 1 million for Computerisation of maintenance system. This paper studies in depth the present system as practised by Rourkela and suggest further improvement through computerisation.

2.0 INPUTS OF THE PROJECT.

There is a UNDP assistance of US \$ 1.06 million subject to the confirmation of Govt. of India input through SAIL of Rs. 90,00,000/- in kind.

The details of UNDP/UNIDO inputs includes the following:

- Providing International experts
- Providing hardware (imported components)
- Study tour & training abroad.

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The details of Govt. of India inputs include the following:

- Providing National manpower for development of Computer Managed Maintenance System.
- Training & study tour within India.
- Office & Transport facilities.

OVERVIEW OF THE PRINCIPLES OF MAINTENANCE IN
ROURKELA STEEL PLANT, STEEL AUTHORITY OF INDIA LIMITED

1.0 ORGANISATION

The primary function of the maintenance organisation is to maintain costly plant equipment and facilities. To carry out this function, expertise in various fields are required. These are broadly classified as follows:-

- Maintenance services attached to the production centre.
- Utility services like water, steam, oxygen & power etc.
- Shop services like Captive repair shop.
- Field service which provides additional manpower.
- Facilities like earthmoving equipment, cranes, Dumpers, Trucks etc.
- Staff services like material planning, maintenance planning, design etc.

Further maintenance organisation is also divided into technical disciplines like Mechanical, Electrical, Repair Shop, Power generation and Design and Project under functional head.

2.0 CENTRALISED MAINTENANCE UNDER FUNCTIONAL HEAD.

While the centralised maintenance concept is practised at RSP, the departments have sufficient flexibility and freedom to carry out their day-to-day maintenance activities. Certain functions like indent control, shutdown planning, maintenance monitoring, failure analysis, shop planning are controlled from Central level. Since several repair shops exist alongwith Captive foundry (both ferrous and non-ferrous), the planning of shop loading is done by a single agency. Material planning activities are initiated by the dept., scrutinised and control by Central agency, who incidentally control the budget also and are supported by Store and Purchase departments. Capital Repair activit-

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ies and shutdown planning are co-ordinated by a central agency. Failure analysis, delay analysis, maintenance monitoring is carried out by a specialised agency.

3.0 DEPARTMENTAL MAINTENANCE.

The department is headed by Supdt./Manager who is assisted by a Planning cell, Repair group and Shift co-ordination group. The Planning group initiate the maintenance planning and material planning activities. The Shift co-ordination group execute the job. The Repair group assist Shift group in making sub-assemblies and assemblies ready to be replaced in snutdown. When extra manpower is needed they request departments like Repair and Construction (RC-M) who meet the demands of various departments as well as Capital Repair Organisation(CRO) who mainly help in Capital Repair activities through sub-contracting. The Planning cell takes care of material, specifically spares only required for that dept. Repeat parts required by more than one Dept. are centrally procured. Stock items and General Stores are procured by Stock control dept. under Store organisation. Repair request are directed to the Captive shops and receive back by the department after repair /manufacture. For emergency, material requirement of small value , the department directly procure. To carryout these different functions various subsystems are evolved which are briefly described below.

4.0 CATALOGUING & EQUIPMENT CLASSIFICATION

To identify the spare parts, consumables and general store items by assigning a number, codification system has been evolved in the early sixties. This is generally called cataloguing in RSP. An eight digit number code is allotted for identifying the parts.

The first part is the zone. The first three digits are allotted by a central staff group for each department. For example 401 to 425 is for Blast furnace where 4 indicates Coke and Iron zone and 01 to 25 are the catalogue group allotted to Blast furnace department.

The fourth digit indicate the different stage of Steel Plant development eg. 0 is for 1 Million Ton stage and 5 means 1.8 MT stage etc. (5th, 6th digits for drawing No, 7th & 8th digits for item No.). The department is free to use last four digits to identify the spares.

A second system was developed in late sixties. Under the 11 digits system the equipment classification is as follows:-

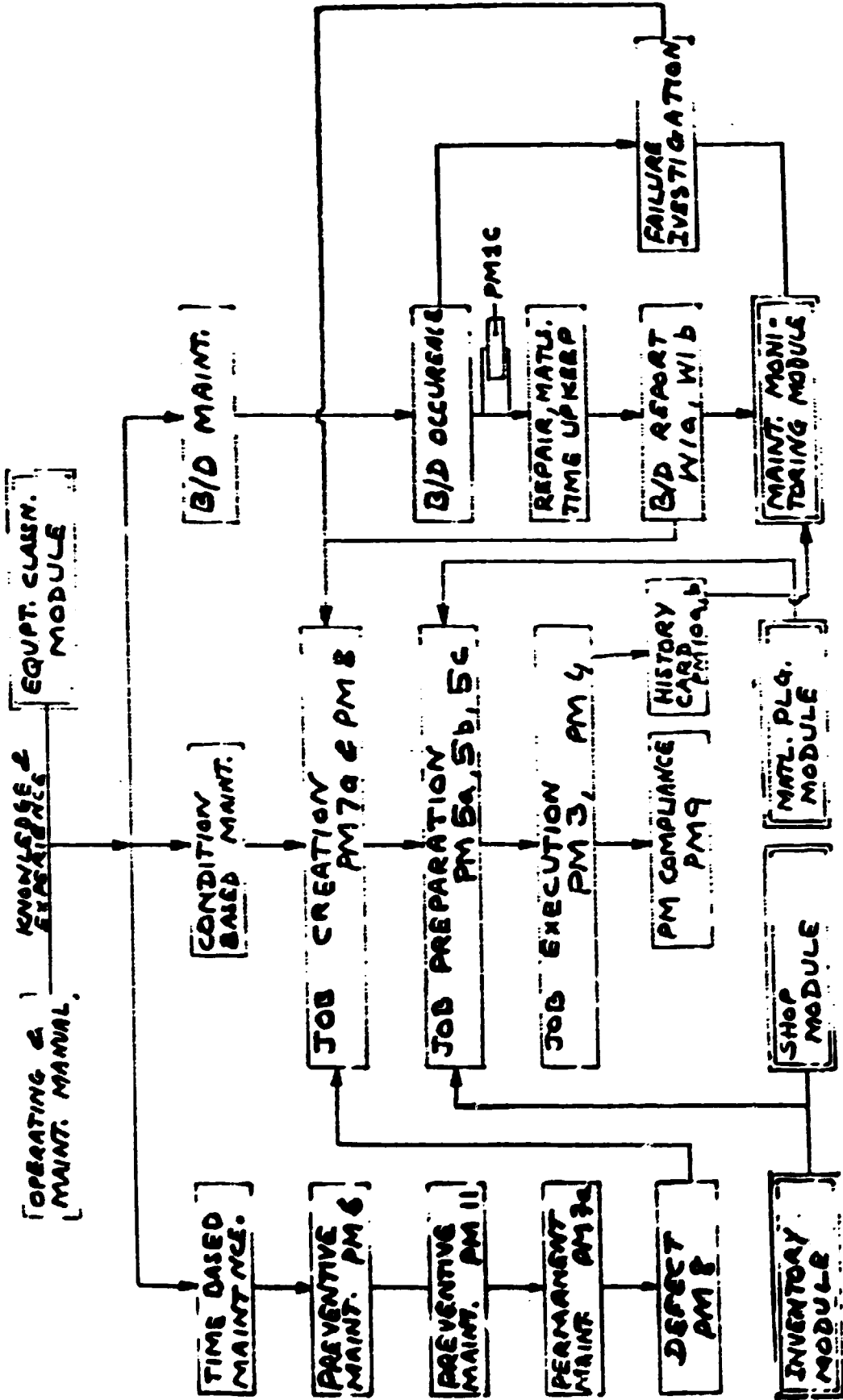
- 1st digit - Expenditure A/c /Steel Plant
- 2ns digit - Responsibility code- Mechanical, Electrical etc.
- 3rd & 4th - Department identification digits
- 5th & 6th - Cost Centre within a department digits
- 7th & 8th - Group of equipment digits
- 9th digit - Sub group of equipment
- 10th&11th - Machine parts digits

The eleven digits are more versatile and rationalised system which can be used for Computer application.

5.0 MAINTENANCE PLANNING

REP follows a system of preventive maintenance schedules for checking and servicing the Plant equipments. Regular inspection are carried out as preventive maintenance. Inspection result in defect reports which act as a signal for job planning. Both these are combined and job creation is done which are normally carried out during weekly shutdown. The job planning indicate job title, the shift in which it is to be done, manpower allotted including loaned workers. After the job is carried out, important job are entered into the History cards which are maintained for critical equipments.

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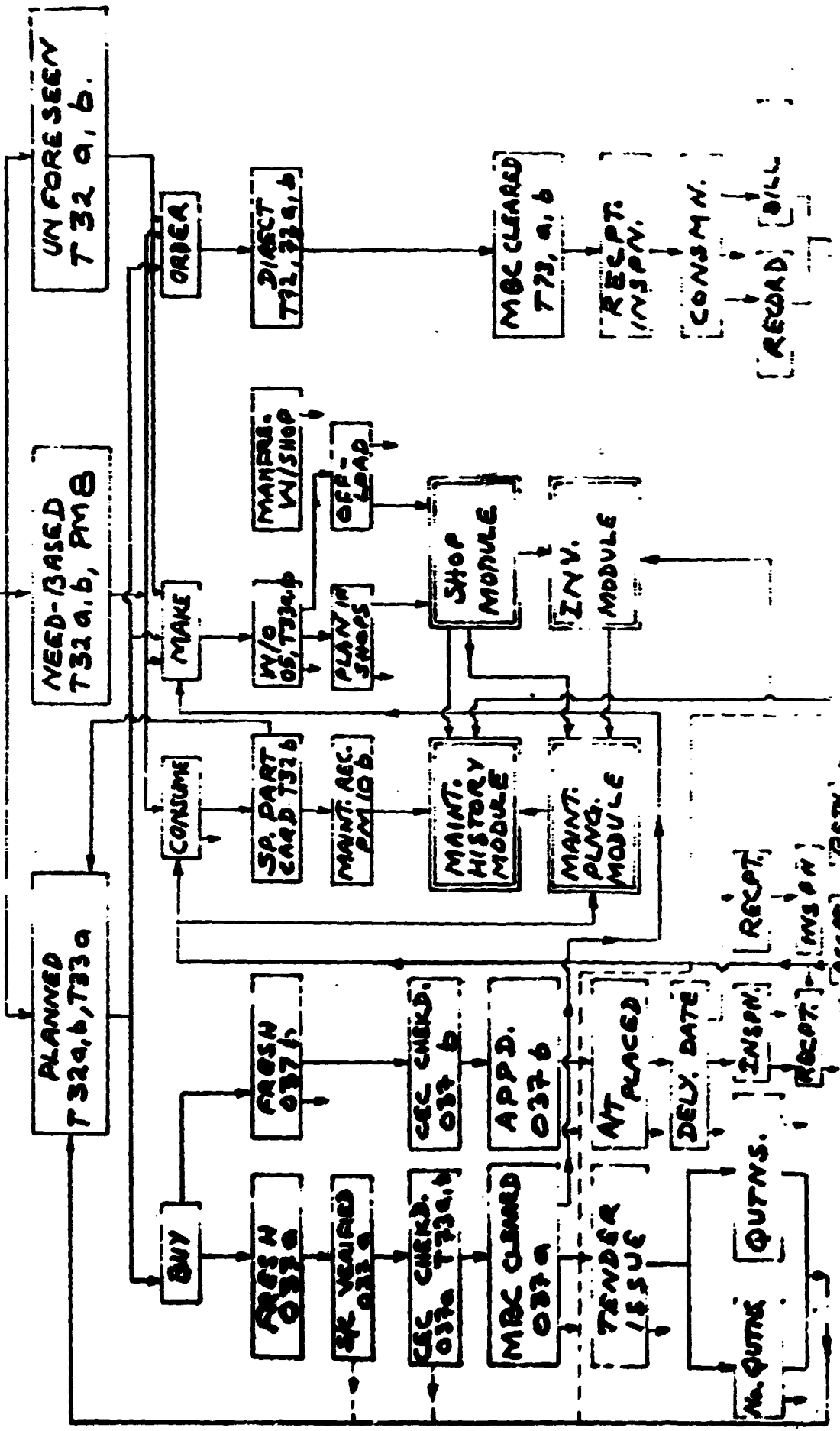


MORE FOR PLANNING MODULE

DEGS. < B.O.M.

EQUIPT. CLASSN. T33 MODULE

MATLS. PLNG.



For critical job detail sequence of jobs exist with Man-power requirement, special tool and facilities requirement. This is a useful document for repetitive jobs.

For capital repairs separate procedure with Network planning and bar charts etc. are used.

Breakdown jobs are attended then and there and important events are recorded in the History cards. Delays of equipment downtime are reported daily in different performa affecting/not affecting production.

6.0 MATERIAL PLANNING.

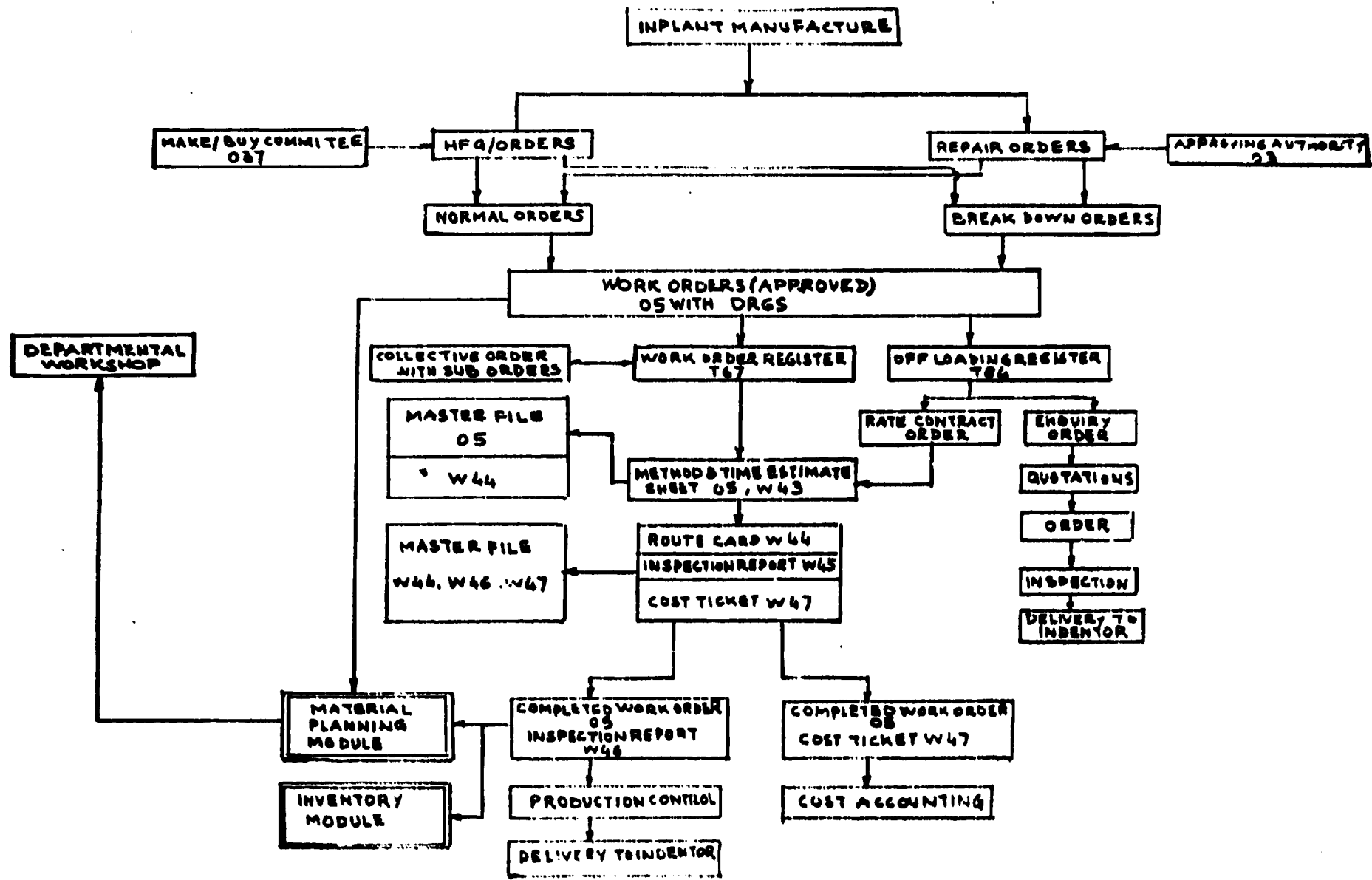
The requirement of spares is planned on an annual basis. The budget is allocated for each department. The planning cell maintain the spare parts card for each and every parts used by the department. The indent is raised depending on the stock position.

The planning cell keep track of Indents, Purchase order till the materials are received in the Central Stores. Acceptance or rejection of the spares are done both before use or during use depending on performance.

7.0 MANUFACTURE AND REPAIR OF SPARES.

When a department wants to repair a sub-assembly e.g. pump or gear box a work order is placed on planning and co-ordination agency (PC-S) for repair shop. Also when it is decided to manufacture an item in the Captive shop, a work order is raised. These orders are planned in one or more Captive shops. The job progress is followed during different stages. Necessary spares are supplied by the user department. The various shops are Repair Shop (Mech) Structural & Welding Shop, Mechanical Shop, Foundry (Ferrous & Non-ferrous). Elaborate facility exists in these shops alongwith expertise and specialised skill craftsmen to handle skill and precision jobs. Once the jobs are completed they are inspected & cleared. The user will collect the material to their department.

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Machine loading and job scheduling are the important task of the group. When the breakdown work orders are received, they are given the priority by the Chief of maintenance.

A separate Repair shop exists for the repair of motor and other electrical equipments.

Big departments have an Area work shop attached to them also. Emergency repair and machining are carried out in these shops by department themselves. Their performance is reported monthly to the monitoring group.

8.0 INVENTORY, STORE & PURCHASE

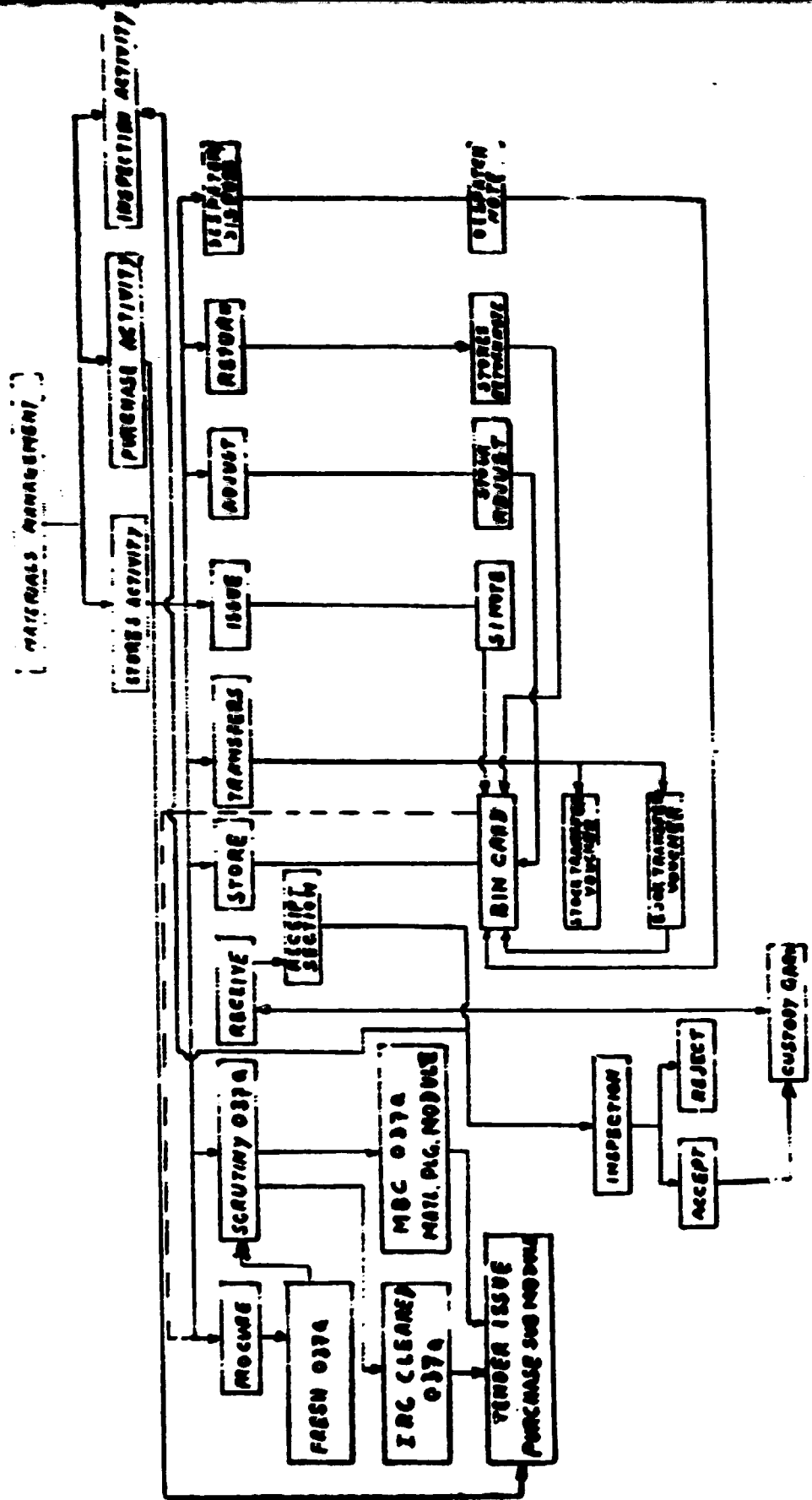
The organisation pertaining to these functions exist outside the maintenance organisation. However to perform these functions, all activities are initiated by maintenance department and in most cases maintenance is the end user of the material received at the Central Store. When an enquiry is raised by a user department and is cleared by scrutinising committee and despatched to Purchase, then the Purchase first enquiry calling for quotations. Then the quotations are received by the department through Purchase Department. The department raises the Indent. The Central material planning staff checks the budget allocation and send it to the Purchase. The Purchase department place the order with the approval of finance department. When the deliveries are effected after inspection these are received in Central Store. The receipts are documented and are available for the user.

9.0 INVESTIGATION AND EVALUATION

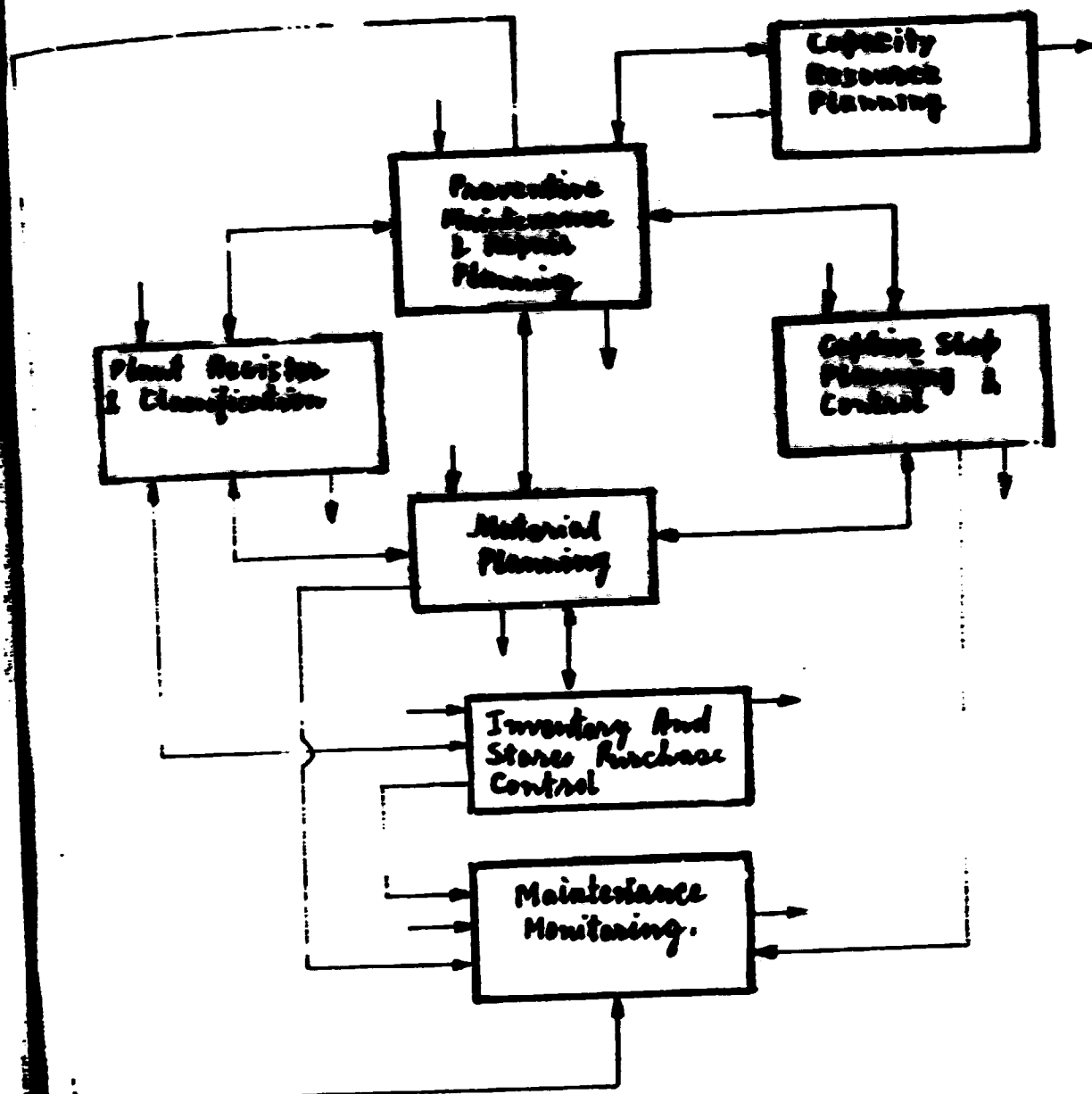
When such diverse activities are carried out by various departments they need systematic and periodical monitoring. A special staff group looks after this needs. Delay analysis of the departments are reported with equipment availability and norms set by SAIL Corporate Office. Performance of all the departments under maintenance head are reported. In short the group fulfills the function of maintenance monitoring.

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OVERALL SYSTEM DESIGN STRUCTURE FOR
CMMS PROJECT



COMPUTER MANAGED MAINTANACE SYSTEM
ROURKELA STEEL PLANT

Investigation of the major breakdowns are carried out by this group. Failure analysis is made and recommendations are submitted. Maintenance expenditure is monitored.

10.0 OTHER FEATURE

Design and Project engineering departments which provide all design and engineering services. Project Engg. dept. takes up the project assigned to them.

A lubrication and hydraulic group exist which control the used oil quality in service and reclaim oil. Hydraulic and Pnumatic group proves specialised service in the field of oil hydraulic.

Field Machinery department maintain the earth moving equipment, mobile cranes, dumpers and dozers, Transportation help is provided to the department. Civil Engineering work and structural inspection are carried out by Civil Engg. and Structural inspection department respectively.

11.0 SYSTEM MODELLING:-

Before we proceed for computerisation we have to identify the various sub-systems which will form the total maintenance system. From Rourkela Steel Plant practices the following sub- systems are established.

1. Equipment classification
2. Planning of P.M. job and repair
3. Material planning
4. Captive shop scheduling
5. Inventory control & purchase
6. Maintenance monitoring & history.

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EQUIPMENT CLASSIFICATION

OUTPUTS

- E50 LIST OF PRODUCTION CENTRES
- T1 LIST OF COST CENTRES
- T2 LIST OF GROUP OF EQUIPMENTS
- T3 LIST OF SUB-GROUP OF EQPTS
- LIST OF DEPARTMENTS
- LIST OF SUB-ASSEMBLIES IN A SUB-GROUP OF EQUIPMENT
- T30 MACHINE PART REGISTER
- WHERE USED TABLE FOR AN ITEM (IMPLOSION FACILITY)
- ASSEMBLY LINK TABLE
- C34 REQUIREMENT OF SPARES FOR AN ASSEMBLY CATALOGUE NO.

1.0 PREVENTIVE MAINTENANCE & REPAIR PLANNING MODULE

1.1 SYSTEM OBJECTIVE

To improve the health of equipment and increase equipment availability by means of providing accurate & timely information to the planners of maintenance activities at all levels.

1.2 SYSTEM FUNCTIONS

Preventive maintenance & Repair planning module has got following main functions:- (Refer to Annexure -II)

- i) Inspection activity
- ii) Pending job activity
- iii) Shutdown activity
- iv) Major & Capital Repair activity
- v) Costing
- vi) Downtime analysis
- vii) Supporting Data Management.

We have provisioned for creating a job catalogue for Blooming & Slabbing Mill (M) and Blooming & Slabbing Mill (Elec). This has been made ready. This has two portions. The first part includes all time based jobs & the other one includes all condition based jobs. Time based jobs include all jobs from short & long term inspection schedules and those repair/replacement activities for which by now a periodicity has been established with past experience. Condition based jobs include those jobs which we expect will be done on the basis of defect report.

We have planned for a computer to give Running inspection schedules for each week day. These will be printed once for one month period. Execution report on Running inspection schedule is to be fed back to computer each day. Idle inspection are being planned through weekly job schedules. Defect report generated during the process of Running inspection & Idle inspection are to be fed to the computer on ON-LINE mode through the process of job conversion.

The job catalogue will be called on screen and the field of Defect Data will be filled up against the particular

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PREVENTIVE MAINTENANCE & REPAIR PLANNINGMAIN MENU

DEPARTMENT CODE - 251

- | | |
|---|--------|
| 1. INSPECTION ACTIVITY | SR 100 |
| 2. CONVERSION OF DEFECTS (PMB)
TO JOBS | SR 200 |
| 3. SHUTDOWN PLANNING | SR 300 |
| 4. CAPITAL & MAJOR REPAIR PLANNING | SR 400 |
| 5. CCST ANALYSIS | SR 500 |
| 6. DOWN-TIME REPORTING | SR 600 |
| 7. SUPPORTING DATA MANAGEMENT | SR 700 |

INDICATE SELECTION HERE ▶ ◀

PREVENTIVE MAINTENANCE AND REPAIR PLANNING MODULE

OUTPUTS

DAILY RUNNING INSPECTION

PM-11 INSPECTION SCHEDULE FOR 3-MONTHS

TOTAL LIST OF PENDING JOBS

PENDING JOBS FOR A GROUP OF EQUIPMENT AND
FOR DURATION SHUT DOWN

PM3 JOB PLANNING FOR MAINTENANCE REPAIR

PM5 PREPARATION WORK - JOB DETAILS

PM4 REQUIREMENT OF SPARE PARTS

PM1 MONTHLY SHUTDOWN PLANNING (AFF. PRODUCTION)

PM4 MONTHLY SHUTDOWN PLANNING (NOT-AFF. PRODUCTION)

PM9 MONTHLY PERFORMANCE REVIEW OF
PREVENTIVE MAINTENANCE

PM16 TENTATIVE /REVISED ONE YEAR PLANNING
(CAPITAL AND MAJOR REPAIRS)

PM16 PLANNING MAINTENANCE AND REPAIRS (BAR CHART)

job which may be required to be done to eliminate the defect mentioned on defect report. This particular job will be added to the pending job file. In case of subgroup of equipments which are expected to be down for longer period (eg. Shear entry guide, Shear gauge, Skid-II in Blooming & Slabbing Mill) an information is to be fed to Computer to bye-pass Running inspection jobs for these areas. Depending upon shutdown duration & manpower available, jobs will be selected for creation of job schedule for the specified date of shutdown. Job schedule will be printed out on 132 characters sheets and the proforma will be same as existing one except a field of JOB NO. will be added. Preparation of work (material) (or Requirement of spare parts) if available with computer will also be printed alongwith job schedule. After execution of jobs feed back will be given to Computer. Additional jobs & Breakdown jobs will also be fed to computer. History will also be recorded against each Job No. by Computer. Outputs of Preventive maintenance and Repair planning module are given in annexure 3. Delay report will be fed by PPC for whole plant. Monthly delay analysis will be printed out at end of month. Breakdown report will be fed by the maintenance Dept. and 3 types of reports will be prepared by Computer & printed out. Capital/Major Repair plans will be prepared manually on the basis of pending jobs, and fed to Computer. Monthly shutdown plans also will be prepared manually with the the help of information available on VDU regarding pending jobs. Information regarding selection for its execution will be available against each pending job. Existing Codes for cause of failure will be utilised and another two digit code has been evolved for nature of failure. These codes (1+2) will be used for reporting feedback on each & every job and will be maintained in History file. Outputs from History file can be obtained for a particular equipment as desired. Failure analysis for MTBF, cause wise failure, Nature wise failure analysis can be obtained. Formats for all these are being designed List of outputs of Down time & History monitoring module is given in Annexure-4.

DOWN-TIME & HISTORY MONITORING

OUTPUTS

- DELAY ANALYSIS
- W16 DAILY BREAKDOWN REPORTS
- PM10 JOB-WISE HISTORY
- HISTORY ANALYSIS
 - CAUSE/NATURE-WISE HISTORY
 - GROUP OF EQUIPMENT-WISE HISTORY
 - CLUSTER OF JOBS-WISE HISTORY
 - MEAN TIME BETWEEN FAILURES (MTBF)

1.0 MATERIAL PLANNING MODULE

This module envisages the development and implementation of a system for planning, initiating and tracking of material requirements till the order is placed. To realise these functions source data on items to be procured has to be prepared. The system also envisages budget requirements compilation and utilization. The system objectives are as follows:-

2.0 SYSTEM OBJECTIVES

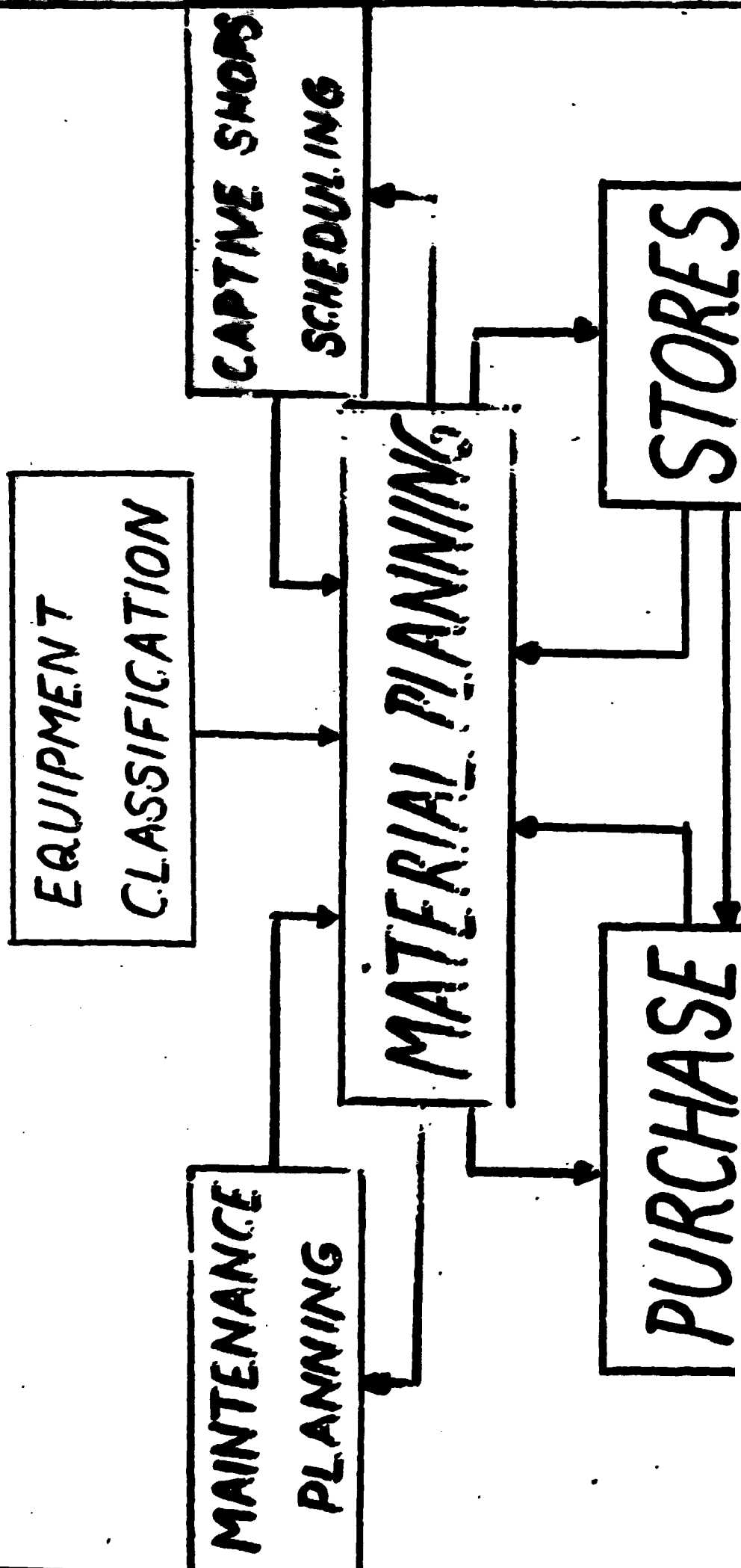
- To ensure timely availability of spares for planned repair activities.
- To avoid stock out situations.
- To reduce internal lead time.
- To provide methods to meet unforeseen requirements.
- To provide corrective measures for system disturbances.
- To regularise & control issues.
- To provide checks and balance to avoid excess inventories.
- To optimise inventory holdings.
- To interact with other modules to achieve overall CMMS objectives.

3.0 SYSTEM FUNCTIONS

- Creation of source data.
- Planned procurement of spares.
- Procurement of emergency requirements & material shortages.
- Reservations & issue control.
- Requirement status monitoring
- Budget requisition & utilisation.

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INTERFACE RELATIONSHIPS DEFINED IN MANUS



1.0 SYSTEM DESCRIPTION

- Creation of source data:

This sub module provides basic technical and commercial data which form the basis and starting point for material planning activities. At first the catalogue groups into which the Department's equipments are broadly divided. Next on line information on spare part card details which are in the range of 3000/5000 cards for an average size department. Each card which will be displayed on the screen will provide some fifty different attributes of the spare parts. This will cover technical details, consumption pattern, inventory policy, production and procurement criticality, proprietary nature as well as Make/Buy and repair possibilities. By simply keying in the stock No. the user will have access to these spare part cards. This is the starting point for planning activity. Another screen provide details specifications in free format running into 10 lines. This is used when the one line description of the part is not sufficient for ordering purpose. Total stock balance of any spare parts including "Ready for use" and "Repairable" as well as quantities available on shop floor, Stores, Captive Shops and outside orders will be displayed by another screen.

- Planned procurement:

Pending procurement at all stages including indent stage, order recommendation stage, purchase order stage, work orders and direct orders will be displayed by another screen for any specific item enquired by the user by keying in these stock No. Provision exists for direct entry of material requirement for any job order/work order.

Gross requirements are generated as per the above keyed in data by the Indentor e.g for Capital Repair or any other requirement in addition to Computer's own scanning programme through inventory position and generating nil stock, alarm stock and low stock levels of spare parts. These gross requirements are balanced against available stock and pending procurement to arrive at net requirement.

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While doing this exercise the Computer will take into account the replenishment level/ re-order level and will arrive at "recommended order quantity". The requirement balancing screen does this exercise and will recommend order quantity for any stock No. enquired. There is provision for manually revising the quantity. A report will be generated which is actually computer recommendations for indenting and budgeting. The net requirement can be sorted as per priority levels taking into account such factors as import/indigenous, fast/slow moving, ABC class of items. Thus the budget is created.

MATERIAL PLANNING

MAIN MENU

Sl.No	Title of Screen	Screen No
1	CREATION OF SOURCE DATA	MP10
2	PLANNED PROCUREMENT	MP20
3	BUDGETARY CONTROL	MP30
4	EMERGENCIES AND SHORTAGES	MP40
5	STATUS MONITORING	MP50

The net requirement report is printed at the beginning of the financial year and will be updated every month for additional items. These recommendations form the basis for indenting. The Indentor selects the items from this report and keys in the Indent item entry screen. He has to key in only the required stock Nos. From this, the indent will be printed, the Computer taking care by itself to print some fifty additional data to complete the indent by itself. Thus the indents are generated by the Computer.

There is provision for Make/Buy Committee to see the indent on the screen by keying in indent No. The Indentor can also see make/buy decisions, quantity changes and item deletions on his screen. Another screen is provided for order recommendation and cumulative budget utilisation.

- Budgetary control:

Provision exists for budget creation as mentioned above. Budget allotted, Budget utilised and the balance budget will be provided by separate screens. It is also possible to view the budget position from consumption and expenditure control department point of view for various categories like Iron & Steel, Rolling Mills, Mechanical and Electrical disciplines and departmentwise budgets.

- Emergencies and shortages:

This sub module takes care of direct orders to outside parties and direct repair orders on captive shops. The bulk of the work orders will be handled separately by Captive Shop Module.

- Status monitoring:

This sub module provides on line enquiries and printed outputs on status monitoring. The status of indent at any point of time can be known. List of indents cleared by Make/Buy Committee and list of orders placed etc. can be

OUTPUTS

SPAREPART DETAILS
STOCK BALANCE
PENDING PROCUREMENT
REQUIREMENTS GENERATION
REQUIREMENT BALANCING
BUDGET CREATION
BUDGETARY CONTROL
INDENT PRINTING
INDENT SCRUTINY
TRACKING OF INDENT
DIRECT ORDERS
PROCUREMENT HISTORY
STATUS MONITORING
INVENTORY ANALYSIS

Stores & Inventory Control

This module provides for the following sub-modules.

- Indenting & Reservation
- Stores Transactions
- Status monitoring.

All basic data regarding Stock-control items are displayed through a screen. Indent creation is done similar to Material planning by item entry and printing the indent. In addition there is provision for reservations of items for Capital Repairs, queries on reservation status and dereservation of items after a time period if they are not used.

The stores transactions sub-modules takes care of receipts (GARN entry), issue and other stores transactions.

Stock balance and pending procurement as well as inventory status of various categories are provided for in the status monitoring sub-module. This also covers reports like list of items below safety stock level, excess consumption report, excess stock report and list of overdue deliveries.

Purchasing

The Purchase module has the following sub-modules:

- Tender Enquiry Creation.
- Purchase Order Generation.
- Status monitoring.

The first sub-module provides for Supplier data, selection of Supplier for a specific item, requirements entry and commercial terms & conditions.

The second sub-module takes care of generation of Purchase order including commercial terms entry and item nomenclature entry.

The last sub module monitoring the order status, purchase order review, vendor deliveries review and P.O. amendments.

CMMS SHOP MODULE

SPARE PARTS MANUFACTURING & CONTROL SYSTEM.

1.0 SYSTEM DESCRIPTION

1.1 Spare parts manufacturing/repair & control system provides various types of mechanical spares and fabricated items for effective & timely maintenance of Plant & Equipments.

1.2 The various types of products include the following ones.

- New spare parts.
- Reconditioned spare parts
- New Assemblies/Sub Assemblies
- Repaired Assemblies/Sub assemblies
- Fabricated parts(New & old)
- Technological structures
- Small forgings
- Any other manufacturing activities needed for the maintenance.

2.0 SYSTEM OBJECTIVE.

The system objectives taken into account for the system design consists of the following factors.

- 2.1
- To adopt the manufacturing system to the maintenance requirement i.e. jobs required by the production units to be made in their sequence of requirement.
 - To increase the work productivity level in the shops.
 - Reduction of the routine activities.
 - Reduction of the manual documents distribution
 - Provide an accurate & actual information for both MIS & Shop working level.
 - Systematic accounting of the manufactured spares.
 - Provide an easy and authorised information selection.
 - The overall aim is to satisfy the needs of the maintenance process.

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FACTIVE SHOP MODULE

ENGINEERING & DATA CONTROL

CAPACITY PLANNING & SCHEDULING

MONITORING & FEED BACK

FILE & CAPACITY BIN & MAINT.

INPUT DATA PREPARATION

JOB STATUS MONITORING

W/O HANDLING & CONTROL

CAPACITY REQUIREMENT PLANNING

FEED BACK

MASTER MAINT. & M/T PRINTING

ROLLING MASTER PLAN CREATION

OPERATION LOADING & SCHEDULING

PRODUCTION REPORTS & OTHER M/S REPORTS

MATERIAL CREATION MAINT.

SPECIAL TOOL FILE MAINT.

SHOP MODULE



3.0 SYSTEM DESIGN

The spare parts manufacturing module consists of 3 basic sub modules.

- Production engineering & Data control
- Production capacity loading & scheduling
- Production monitoring & feed back.

Annexure I illustrates the sub modules with the basic functions.

3.1 Production engineering & Data control provides facilities for preparation of all technical information and data maint. required for Production capacity loading & scheduling sub module. It also provides all material & special tools requirement. The main functions in this sub-module are as follows:-

- Work centre & capacity Bin File creation & maint.
- Work order handling & control
- Routing preparation
- Master plan creation
- Material preparation
- Special tools preparation
- Drawing master file creation & maint.
- Shop calendar creation & printing.

3.2 Production capacity loading & scheduling and /or rescheduling of the Work orders, parts and operations. It gives long term scheduling to infinite capacity and a fixed time period. The medium & short term scheduling is produced to finite capacity of production resources to achieve maximum capacity utilisation and required due date. The various functions of this sub-modules are as follows:

- Input data preparation
- Capacity requirement planning
- Parameter file creation & maintenance
- Operation scheduling & loading

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IMPORTANT OUTPUTS FOR USERS

- CAPACITY BALANCE REPORT - WEEKLY
- ROUTE CARDS AND COST TICKETS - DAILY
- MASTER PLAN - MONTHLY
- MATERIAL REQUIREMENT FOR M. PLAN - MONTHLY
- WORK CENTRE /CAP. BIN STATUS REPORT - - do -
- MASTER PART LIST - - do -
- MASTER PROD. STRUCTURE LIST - - do -
- PENDING WORK ORDER STATUS REPORT - - do -
- WORK CENTREWISE SCHEDULE SHORT TERM - WEEKLY
- WORK ORDERWISE SCHEDULE SHORT TERM - - do -
- WORK CENTRE LOAD PROFILE SHORT TERM - - do -
- WORK CENTRE LOAD REPORT LONG TERM - QUARTERLY
- WORK CENTRE LOAD PROFILE LONG TERM - - do -
- DEPARTMENTWISE W/O FULFILL REPORT - MONTHLY
- SHOP PERFORMANCE REPORT - MONTHLY

CASTING DATE M50 1.1.5

3.3 The production monitoring & feed back provides manufacturing process monitoring and feed back. The functions of this sub module are:-

- Manufacturing status monitoring
- Feed back
- Bulk of month production

3.4 The list of outputs envisaged from the Shop module are shown in Annexure-II.

4.0 The system design is based on the modern approaches in application such as.

- Integrated Data base utility
- Teleprocessing & monitoring system utility
- Modularity principle application
- on line & batch transaction utility.

CMMS DATA BASE

1.0 SYSTEM OBJECTIVES

The objectives of the CMMS Data base are:-

- i) to provide up-to-date and accurate on line information to the agencies involved for planning and controlling the maintenance material planning activities.
- ii) To provide an integrated design for Computer based information system covering all the system modules.
- iii) To ensure that there is no data redundancy and there are no maintenance anomalies.
- iv) To provide for easy retrieval of data for different end-user views.

2.0 SYSTEM MODULES

Data base integrates the following system modules.

- i) Equipment classification/Plant register module.
- ii) Preventive maintenance planning & repair.
- iii) Material planning
- iv) Inventory & Purchase control
- v) Captive shops planning & control.
- vi) Maintenance monitoring.

3.0 AGENCIES USING THE DATA BASE

3.1 AGENCIES INTERACTING WITH THE DATA BASE ARE:

1. Maintenance Planning of the respective departments.
2. Material Planning of the respective departments.
3. Stores/ Stock control.
4. Purchase
5. Accounts
6. Consumption & Expenditure control
7. LU OP/ HP OP
8. PC(S)
9. Captive Shops (RS(M), WRS, MECH. SHOP)
10. P.P.C.
11. IE(OP)/ MP(OP)

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DUAL PROCESSOR CPU
6 MB
- MAIN MEMORY
A* K

ODT.1
ODT.2

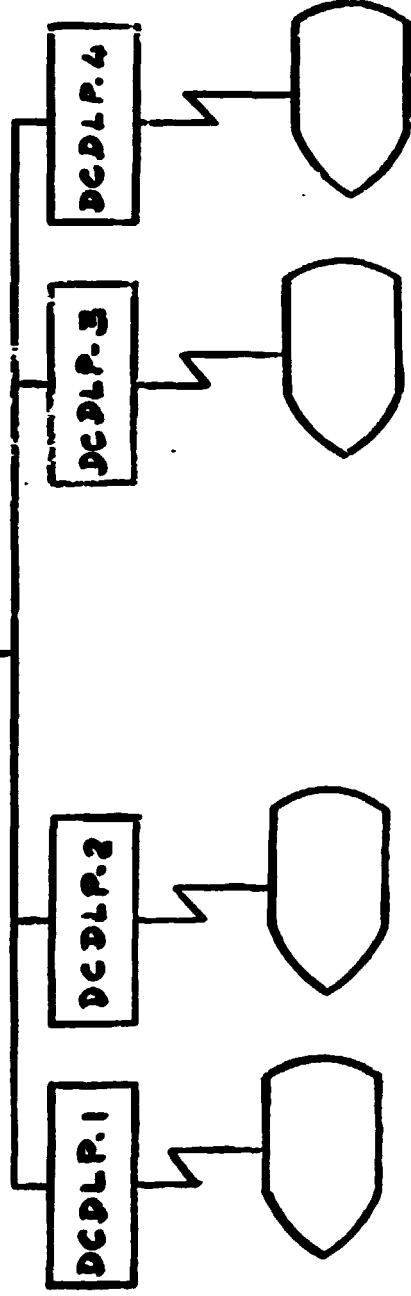
5x122.8
MB DISK

TAPE

3x122.8
MB DISK

PRINTER

— Executed
— Planned



PILOT

NON-PILOT

4.0. HARDWARE ENVIRONMENT

It is proposed to cover all these agencies in the pilot implementation stage itself in which the system will be made operational for use by BSM & HSM to start with. For total implementation it is planned to provide terminals at all the user locations to have direct link with the CMMS A3K mainframe Computer where the data/base would reside. 35 locations have been identified and a total of 42 terminals will be provided. 23 of these terminals will be provided with Hard copy units to enable print-out to be taken right at the user location.

5.0 SOFTWARE ENVIRONMENT

The Data base will be created using Burroughs LINC-II, DMS-II data base & COMS (Communication) packages available with the A3K system. It is envisaged that in view of the limited on-line storage capacity available at present with the A3K (614 MB as against 1000 MB required it would be possible to implement the system only in few pilot areas as mentioned earlier. For total implementation enhancement of A3K capacity for on line storage by atleast 400MB is a must.

PRACTICAL RECOMMENDATION FOR THE DEVELOPMENT OF CMMS
IN DEVELOPING COUNTRY

- 1.0 A task force group consisting of maintenance and Computer Engineers should be formed at the beginning under the head of the CMMS Project. This group should have interacting among themselves to appreciate the each other problem.
- 2.0 This group should prepare an "Approach Paper" with the following details.
 - a) Description and documentation of the existing manual system as practised.
 - b) Identifying of the problem areas and pin pointing lacunae in the system and analysing weak points while translating from manual to computerised system. Time, cost, manpower are the parameters.
 - c) Suggesting improvement, modifying procedure, minimising problem encountered for smooth change over.
 - d) Evaluate computerisation in terms of advantages and benefits.
 - e) Examining the suitability and compatibility of computerisation with the prevailing environment. Adopting the system to suit the local needs.
 - f) Outlining the project schedule time and cost estimation.
- 3.0 The overall approach should follow the above guide lines.

The next logical step in a project of this nature is to spell out the term of reference and circumscribe the boundaries within which the system will operate. This can be stated as follows

- a) Objective of the study, technical, financial goal
- b) Application specifying particular discipline- Mechanical, Electrical, etc. etc.
- c) Areas to be covered
- d) Strategic goal in the field of computerisation/back up facilities/development of in house skills.
- e) Organisation
- f) Finances
- g) Time limits

A clear understanding and spelling out in the above areas will make easier to all concerned what is to be expected. It is also important for the task force group to foresee and understand the extent of coverage. Also by focussing our efforts and energies in a specific area, implementation of the system will be better over a time frame. A Pilot department can be chosen and model can be tested there. Strategic goal in the field of computerisation, standardisation of hardware, languages, software is to be considered. Long term policy decision are involved in choosing between buying software outright or developing in house skills.

1.1 STAGES IN THE EVOLUTION OF APPROACH PAPER

The following stages are to be gone through.

- a) Exhaustive study and thorough understanding of the present working system- even though one may be experienced in the line for many years, it is necessary to take a fresh look at the system in a detached and dispassionate manner.
 - Discuss thread bare the feature of the system, brainstorming sessions between maintenance manager; system analysts is a must for thorough grasp of each other requirement and limitations.
 - Study the literature available within the Plant, study the proforma.
 - Interact with end users. The purpose is to educate about the new system, a little bit of public relation work, understand the apprehensions and reservation of the user, his needs, problem, difficulties while implementing.
 - Conduct meetings, seminars, workshop to disseminate the new philosophy.
- b) Data collection and spade work in the department.
 - What are the data available?
 - How it is being used at present?
 - How do you propose to use while computerising?

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- What are the inter-departmental differences?
- What preliminary work is to be done before computerisation?
- Which formats are crucial?
- How the department personnel can help?
- What guidance can be given to the department?
- What resources are being used at present? How can it be reduced?
- What results are achieved now? How it can be improved upon?

c) Computer man interface.

- Which data will be fed to the computer
- Which form will be adopted
- Which is lacking at present for inputs? How that will be solved?
- What is beyond the control of Computer?
- How that is supposed to be tackled?

d) Security of information

- What will be available as output to end-user?
- What are the MIS reports?

e) Computer aspects

- Use of correct application packages. Scrutinise the system available in the market.
- Suitability of bought out package Vis-a-vis in home developed system, lock needs.
- Dedicated computer or main frame computer
- Effect of computerisation on the company, executives and workforce.

f) Qualification

- Data, input, output
- Files, layout, organisation
- Data base (how many, which are)
- Hardware (loading, requirement, capital cost, response time)

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- Software (development, availability, cost)
- Operation (Training & Skill)
- Maintenance & Benefits.

g) Advantages

- Reduction of paper work, proforma
- Increase of field work as opposed to desk work of staff.
- Management reports
- Simplifying decision making
- Quantity and quality of outputs
- Flexibility with changing time.

h) Evolve the computerised system by stating

- System design, model
- Hardware specification
- Software needs
- Organisation
- Benefits
- Finance.

Hence it is necessary to state for the benefit of those not fully familiar with computer system development work that they should pay attention to the following explanation of the nature of the system development. This will enable them to understand fully the project activities and achievements.

First of all we have to realise that the end product of the system development project is not a concrete product with physical dimensions but an "invisible" product namely "Developed system and acquired knowhow" supported by installed hardware and application software. Therefore, it is also more difficult to monitor and evaluate its progress and achievement of objectives. The only possible approach is to follow different stages of system development. Hence to translate again the concepts listed above to more tangible and perceptible form they can be summarised as follows:-

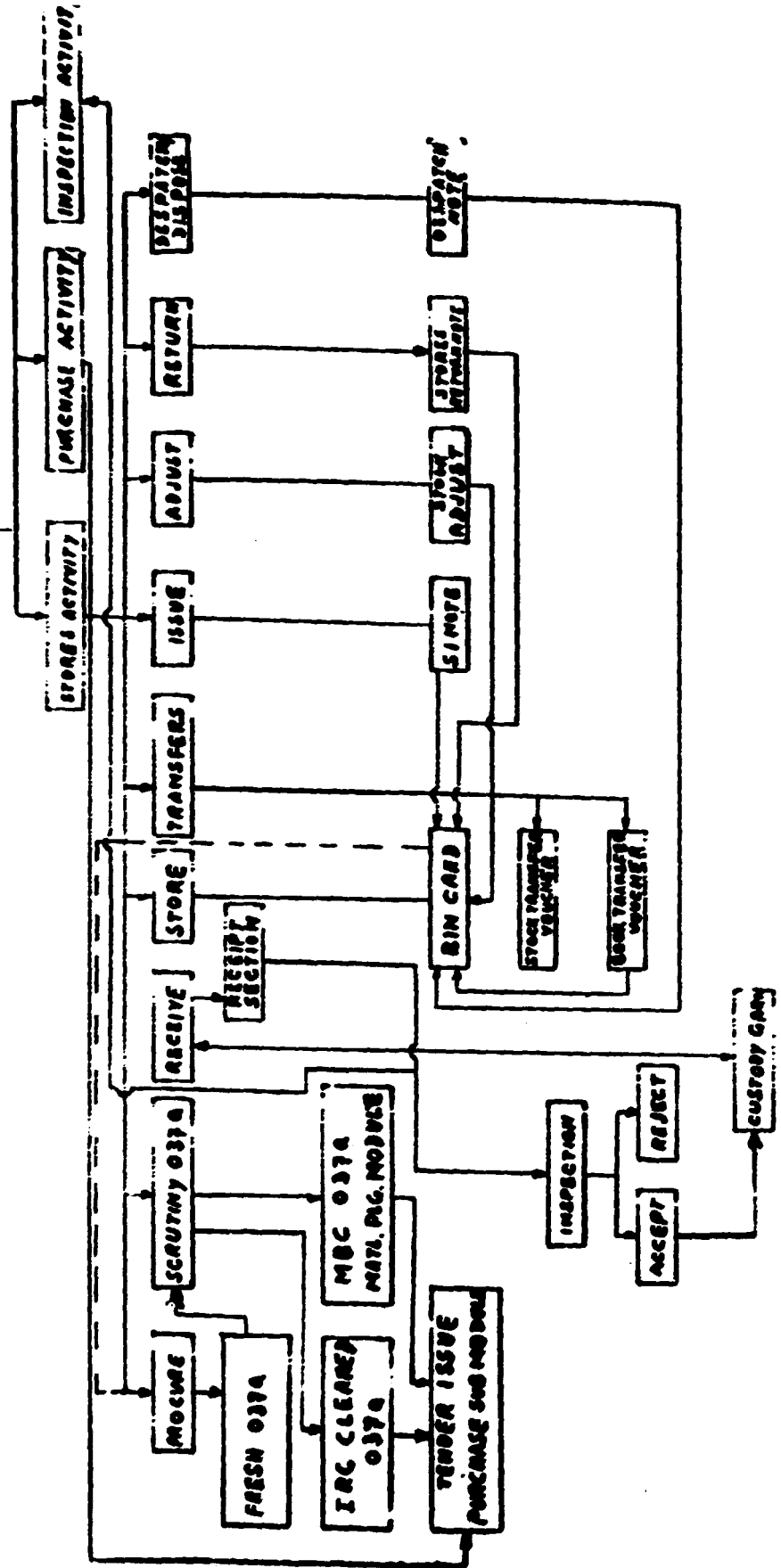
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- a) Fact finding - analysis of the current system operation.
- b) Feasibility study- where the basic concept of the new system are described and evaluated.
- c) System design specification, where all the algorithms: inputs and outputs are fully specified.
- d) Programming phase - the system specifications are translated i.e. coded into the language of the computer.
- e) Programme testing and debugging, data collection.
- f) Introducing system implementation/testing and user training and documentation.
- g) System implementation
- h) System operation and maintenance/including improvement of running programs and updates.

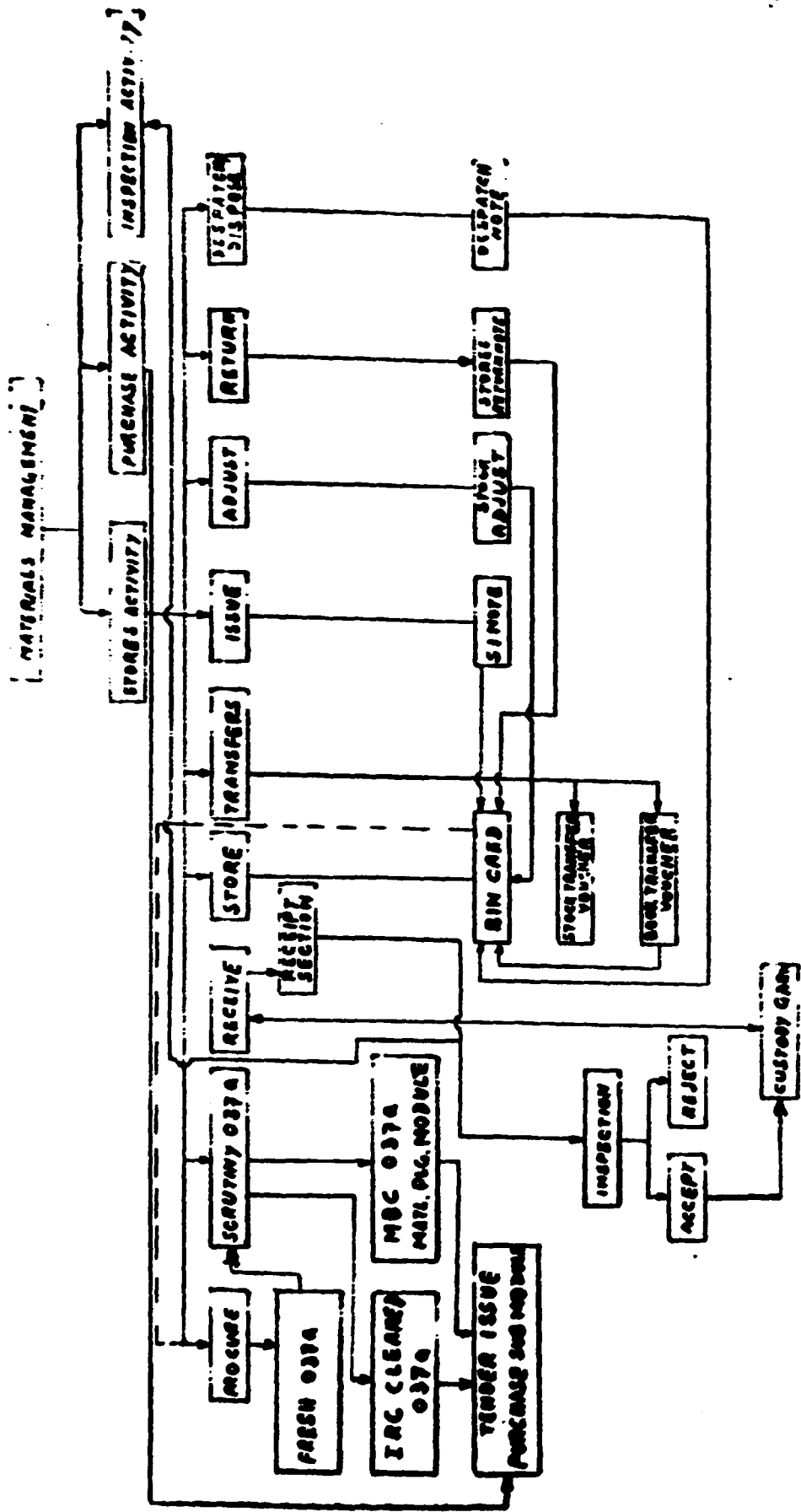
All these stages are part of system development and in fact continuous process with feed back from any stage to the previous stage. From this view point, it is necessary to evaluate activities. Since phase 1-3 until programming phase could be carried out without Computer facility or without actually running any computer programmes. Stages 4-5 is the actual programming phase and testing the model where EDP expertise will have to fully exploited. This phase is actually smooth change over from manual maintenance system to computer based system. Stage 6 is introducing the system in a pilot department, testing the system and training the personnel. Stages 7 & 8 are system implementation and improvement phase.

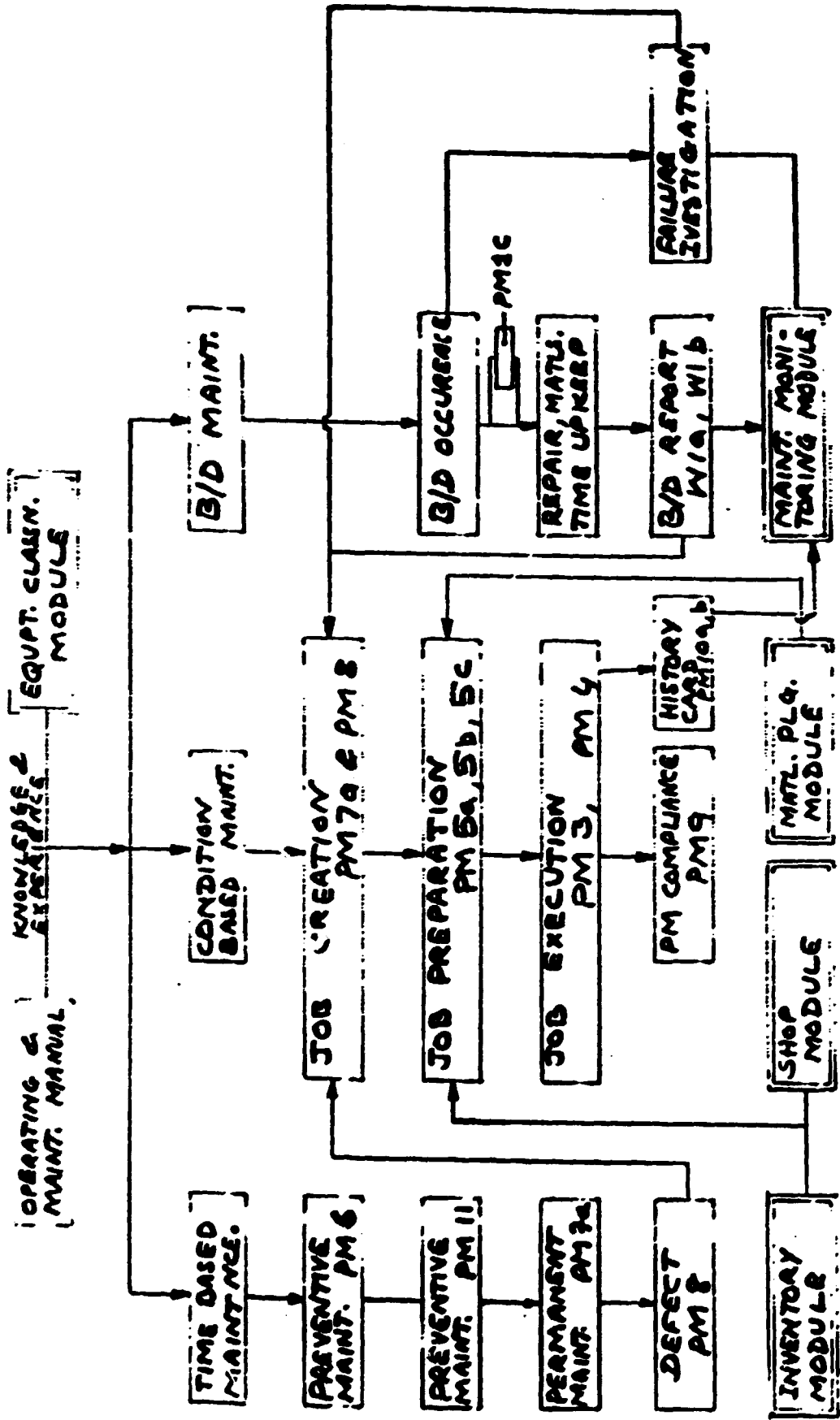
UNITED STATES GOVERNMENT

[MATERIALS MANAGEMENT]



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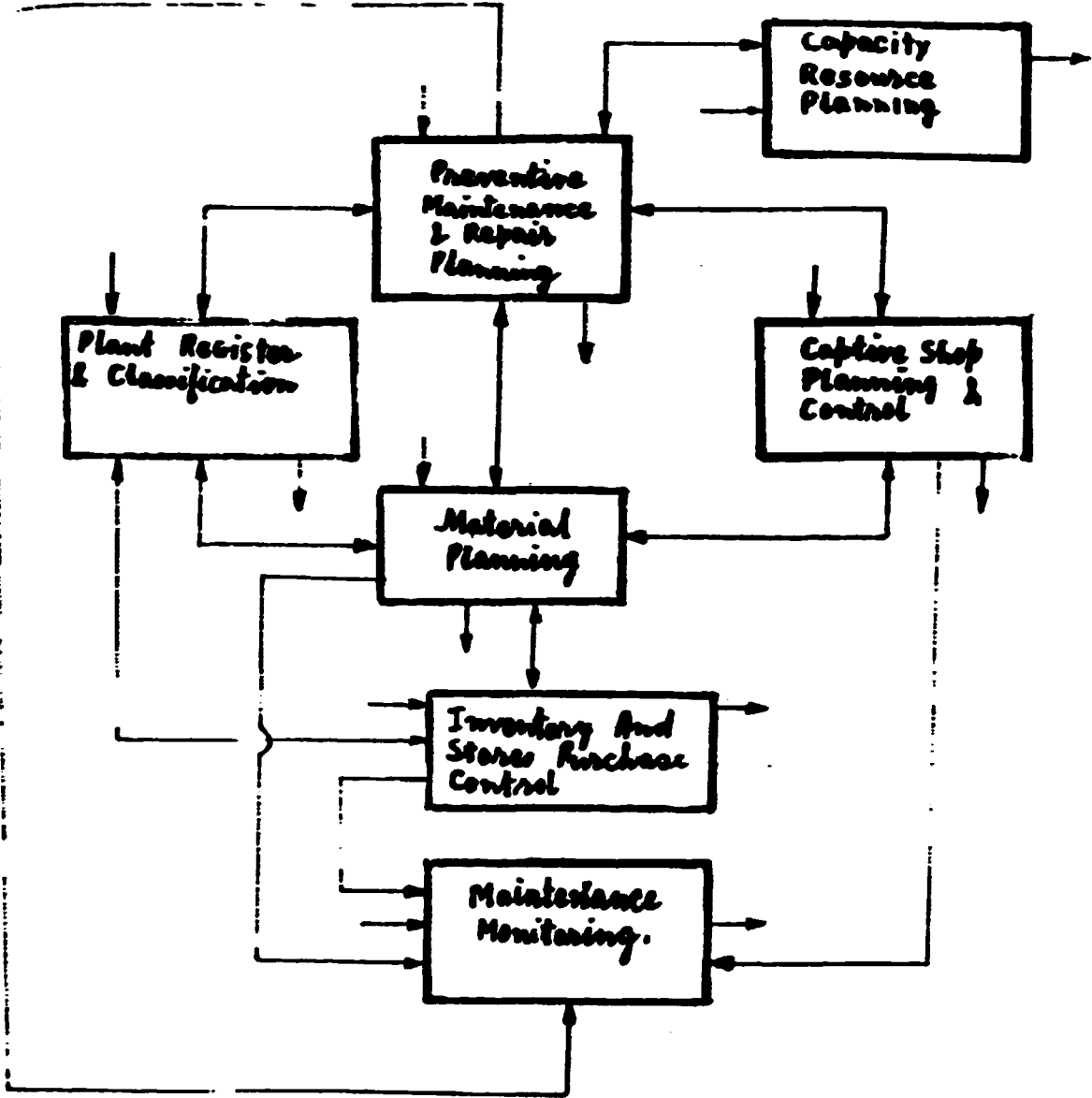


PREVENTIVE MAINTENANCE AND REPAIR PLANNING MODULE

INPUTS

- PM1 DAILY RUNNING INSPECTION
- PM-11 INSPECTION SCHEDULE FOR 3-MONTHS
- TOTAL LIST OF PENDING JOBS
- PENDING JOBS FOR A GROUP OF EQUIPMENT AND FOR DURATION SHUT DOWN
- PM3 JOB PLANNING FOR MAINTENANCE REPAIR
- PM5 PREPARATION WORK - JOB DETAILS
- PM4 REQUIREMENT OF SPARE PARTS
- PM1 MONTHLY SHUTDOWN PLANNING (AFF. PRODUCTION)
- PM4 MONTHLY SHUTDOWN PLANNING (NOT-AFF. PRODUCTION)
- PM9 MONTHLY PERFORMANCE REVIEW OF
PREVENTIVE MAINTENANCE
- PM16 TENTATIVE /REVISED ONE YEAR PLANNING
(CAPITAL AND MAJOR REPAIRS)
- PM16 PLANNING MAINTENANCE AND REPAIRS (BAR CHART)

OVERALL SYSTEM DESIGN STRUCTURE FOR
CMMS PROJECT



COMPUTER MANAGED MAINTANACE SYSTEM
ROURKELA STEEL PLANT