4

The Data-Flow Graph, A Functional Network View of the CIM Reference Model

INTRODUCTION

There is need in the CIM Reference Model to have a mechanism to show the interconnection and precedence of the several tasks assigned to the overall mill-wide control system. An excellent method for showing this is the so-called Data-Flow Graph or Information-Flow Graph using a technique known as Structured Analyses [43] also known as the Yourdon-DeMarco technique.

This Chapter will develop such a representation for the CIM Reference Model. The basis for this work will be a Data-Flow Model entitled, *Information Flow Model of Generic Production Facility,* contributed to this project by The Foxboro Company in August 1986 [15]. The original document has been considerably modified by the Workshop CIM Committee to match the nomenclature, etc., of other parts of the model's documentation.

As noted above this method diagrams the interconnection of the several tasks carried out by the control system and allows the potential for an ever greater detailing of these tasks in the form of subtasks and the resulting interconnections of these subtasks with each other and the main tasks. These diagrams are restricted to the model as defined in Chapter 1 (i.e., the definable scheduling and control system for the manufacturing facility and including only interfaces to the external influences). For a discussion of the data flow between the several external influences please see the material of Chapter 2.

The set of diagrams begins with the interconnection of the influencing external entities on the factory itself (Figure 4-1). In the present model one very important external influence on the factory is the company management itself. As noted in Figure 4-2, management interfaces through the staff departments who provide services to the factory itself or express managements' policies in sets of requirements to be fulfilled by the factory.

Tables 4-I and 4-II present the functions and tasks listed on the diagrams of Figures 4-1 to 4-15. Table 4-III makes a comparison of the tasks listed in Tables 3-VI to 3-X versus those on Figures 4-1 to 4-15.

SOME INADEQUACIES OF THE DATA-FLOW-GRAPH-MODEL

Foundation functional entities cannot be shown on the data flow diagram, i. e., the data flow diagram mainly shows the interconnection of manufacturing-specific functional entities.

The data-flow graph will accommodate all functional entities which exhibit the principle of locality. Those which are diffuse cannot be accommodated because of the number of lines involved. The principle of locality may be a virtual location for the functional entity (i.e., real or virtual consolidation of operations for the sake of the diagram).

Most foundation functional entities are diffuse, e.g., database, communications, management, etc.

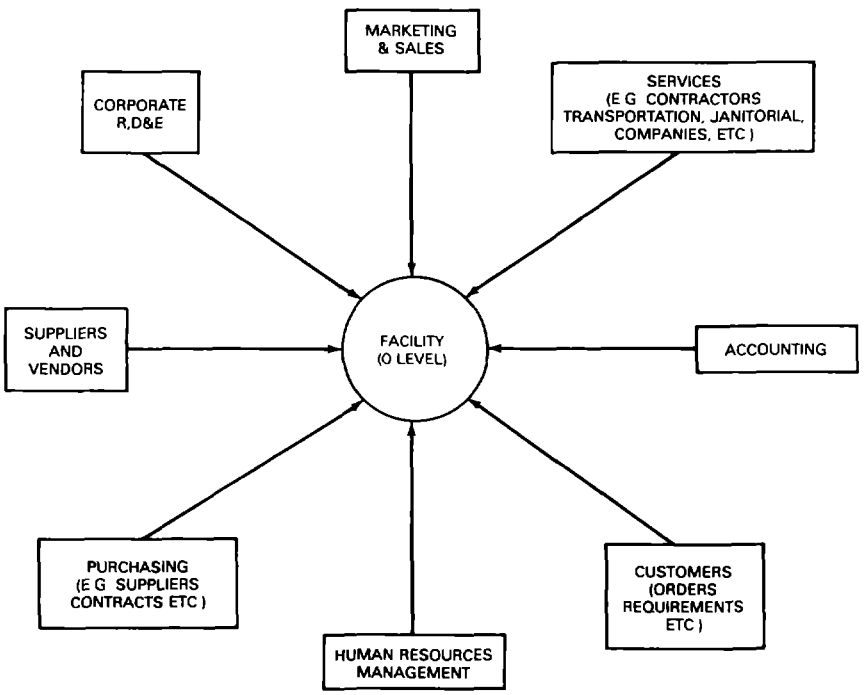


Figure 4-1 Major external influences.

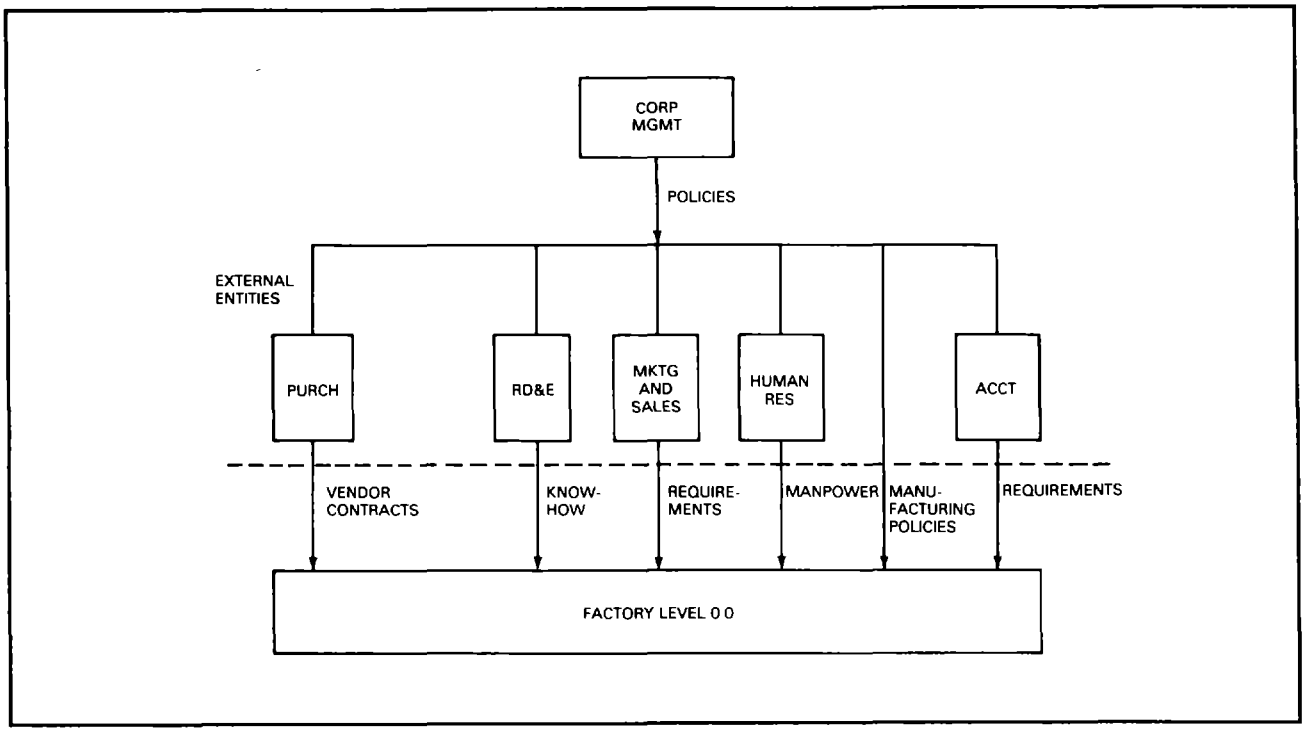


Figure 4-2A Requirements interfacing of corporate management and staff functional entities to the factory.

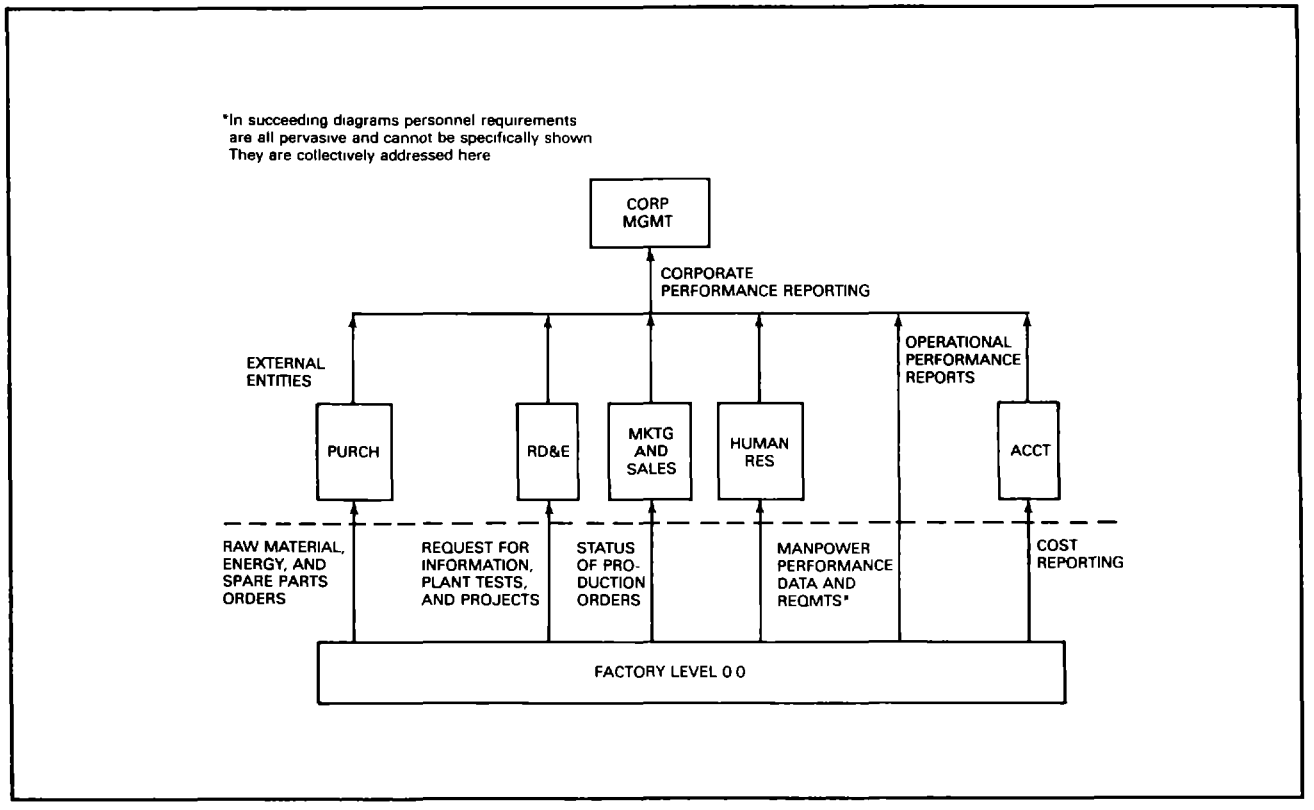


Figure 4-2B Report interfacing to corporate management and staff functional entities from the factory.

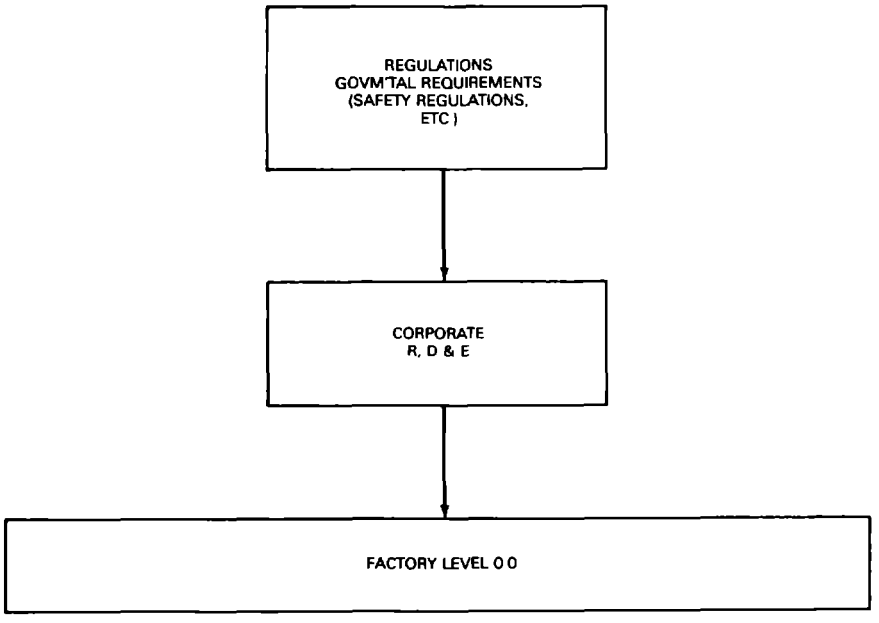


Figure 4-2C Interface of government regulations etc. to the factory

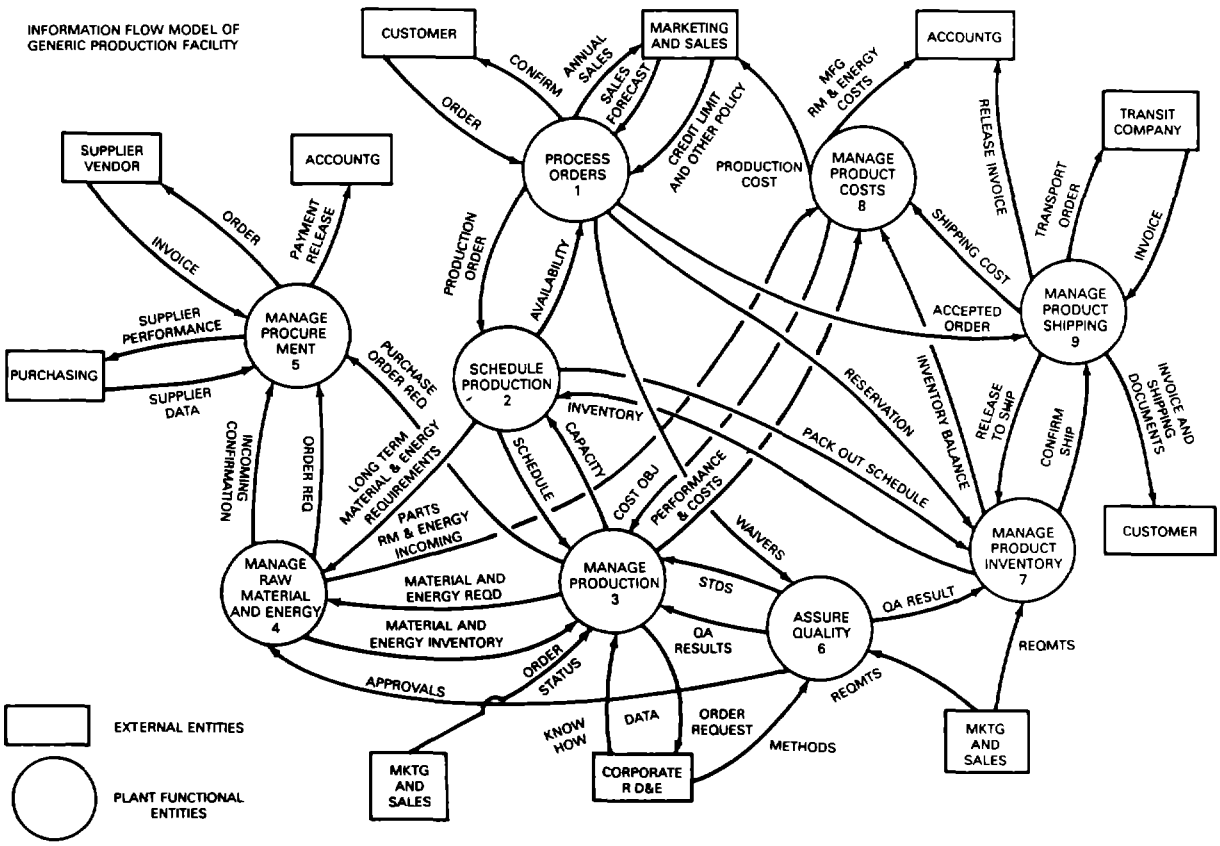


Figure 4-3 0.0 Facility Model

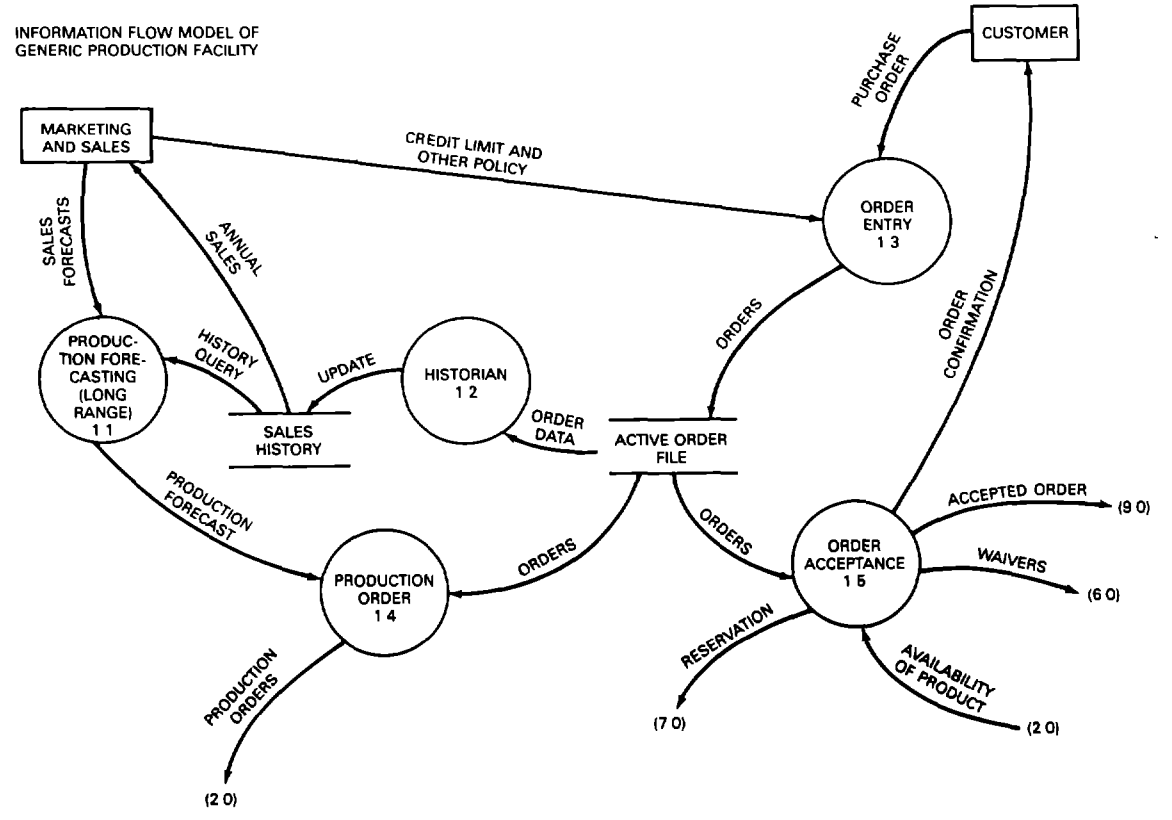


Figure 4-4 1.0 Order Processing.

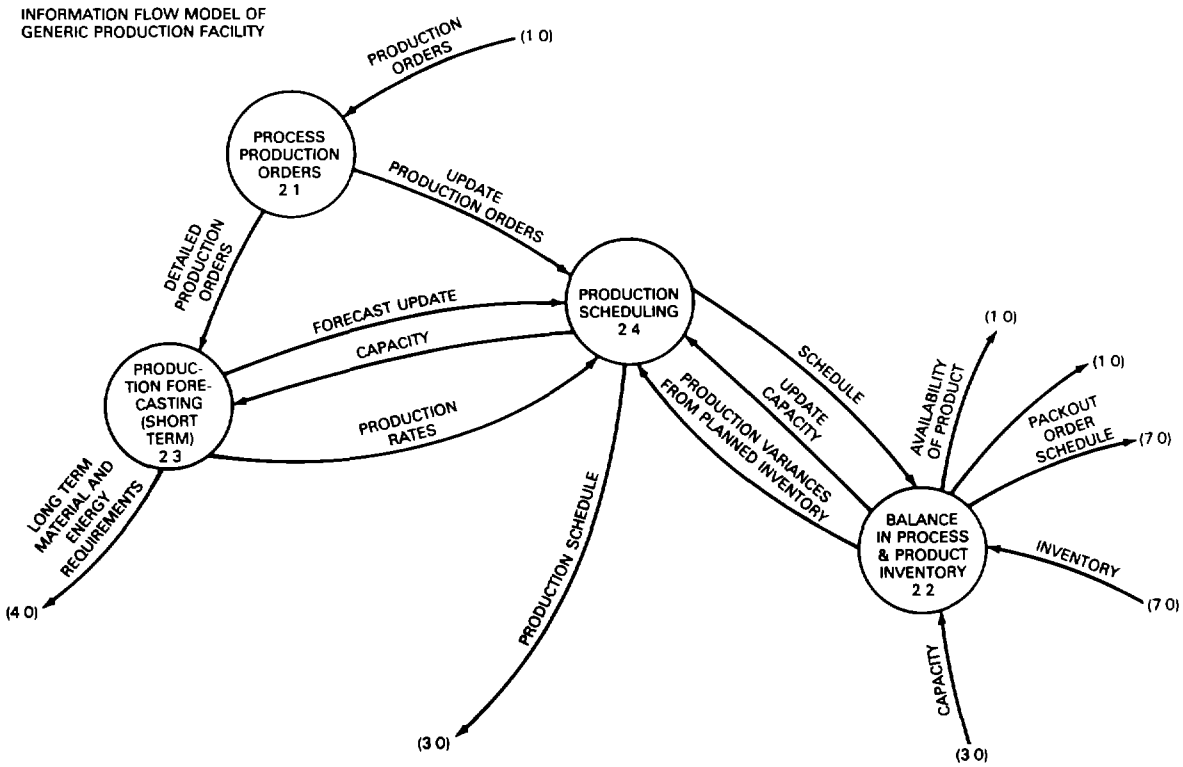


Figure 4-5 2.0 Production Scheduling.

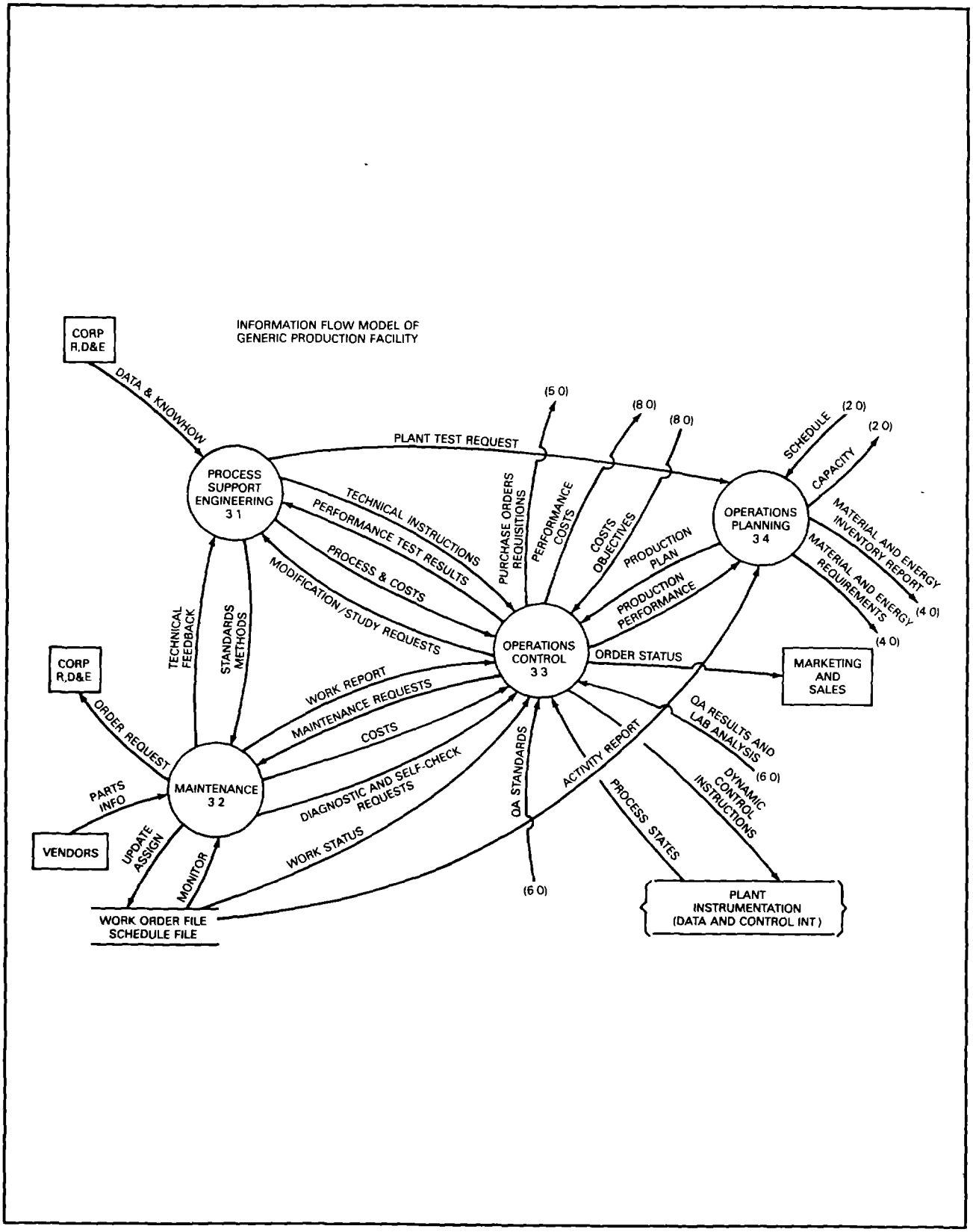


Figure 4-6 3.0 Production Control

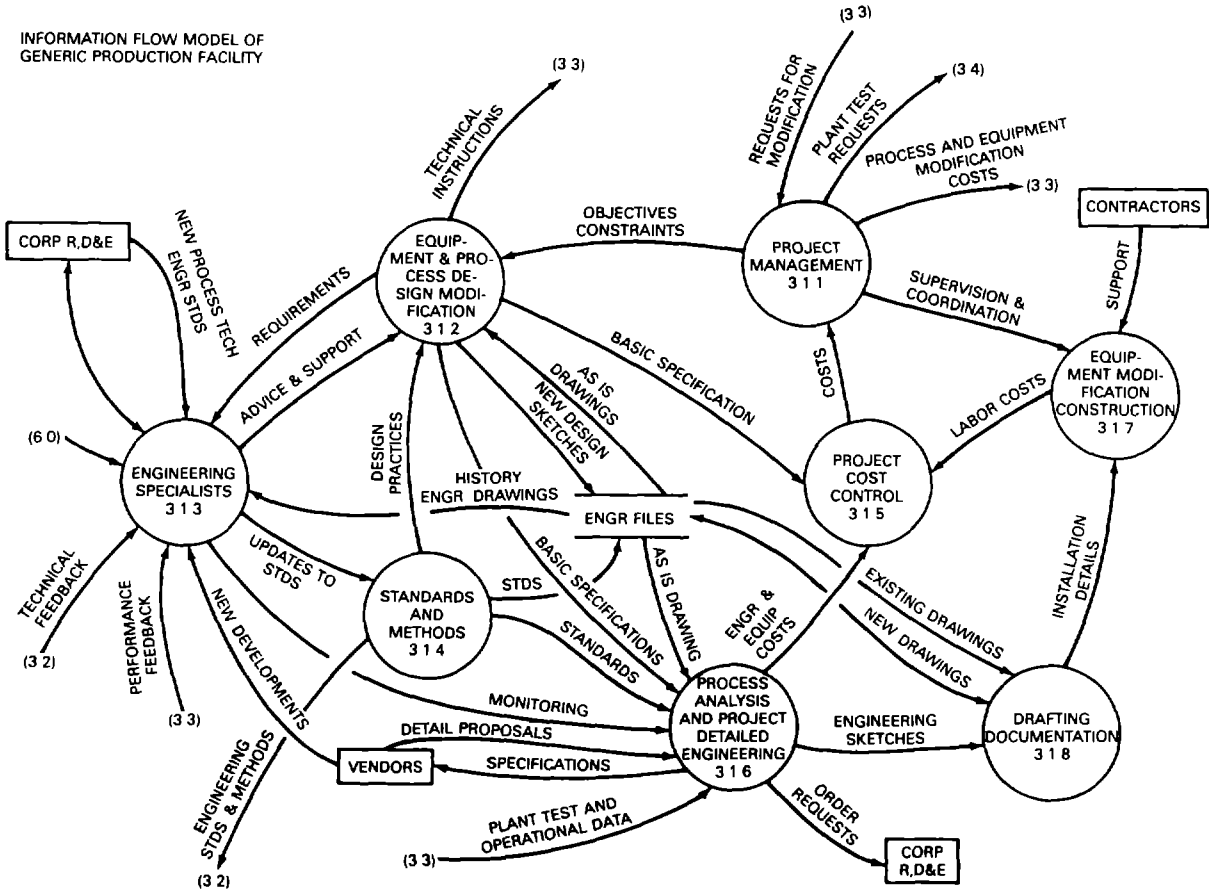
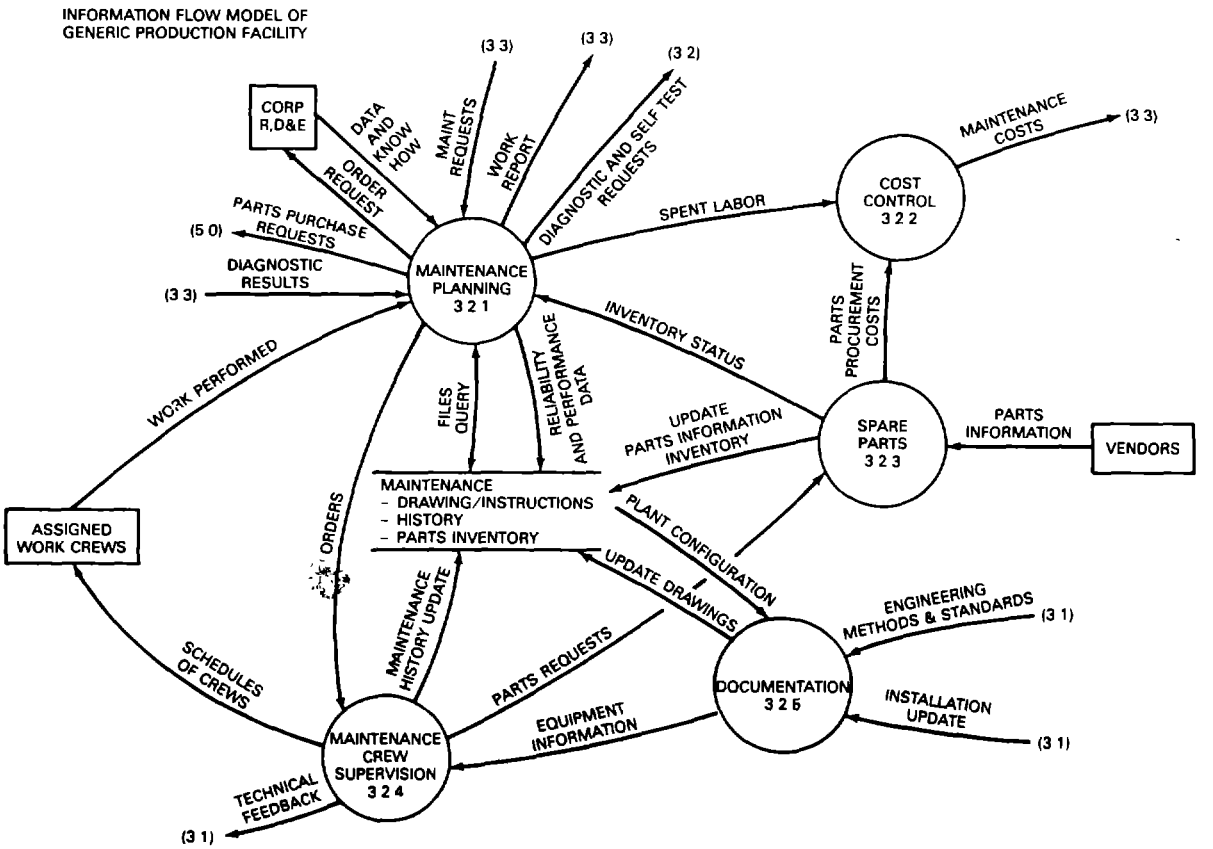
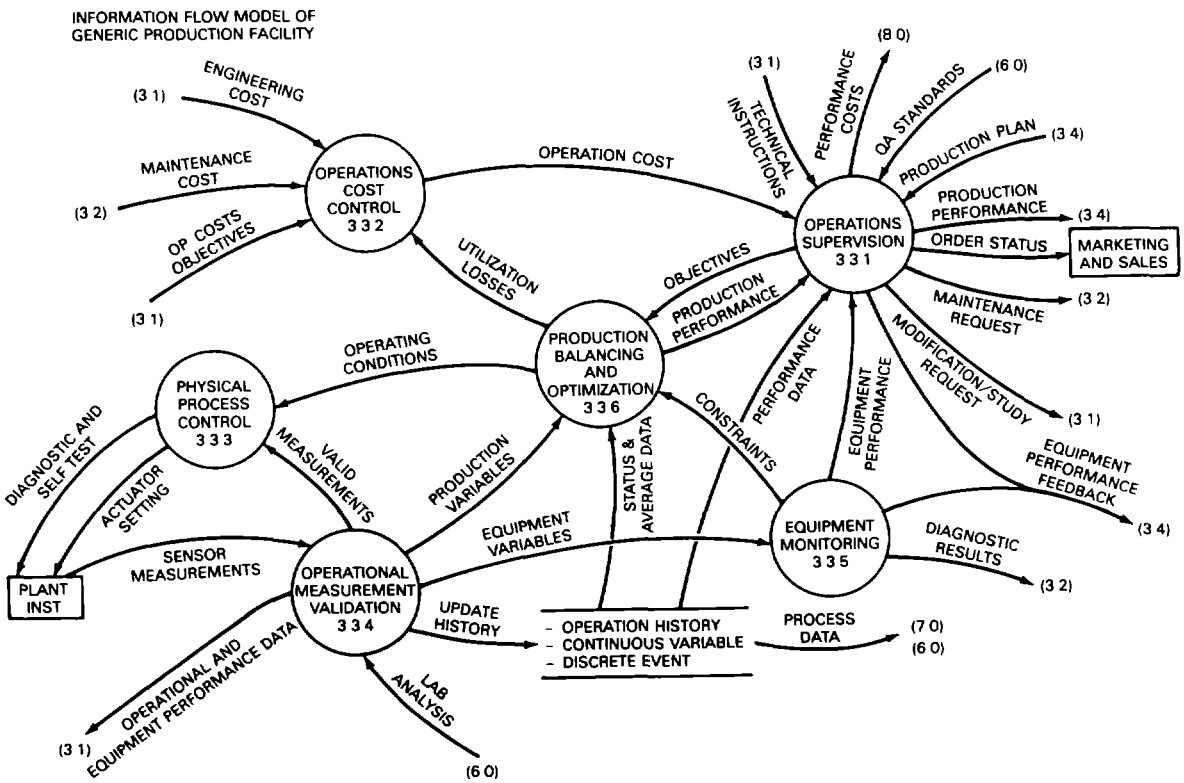


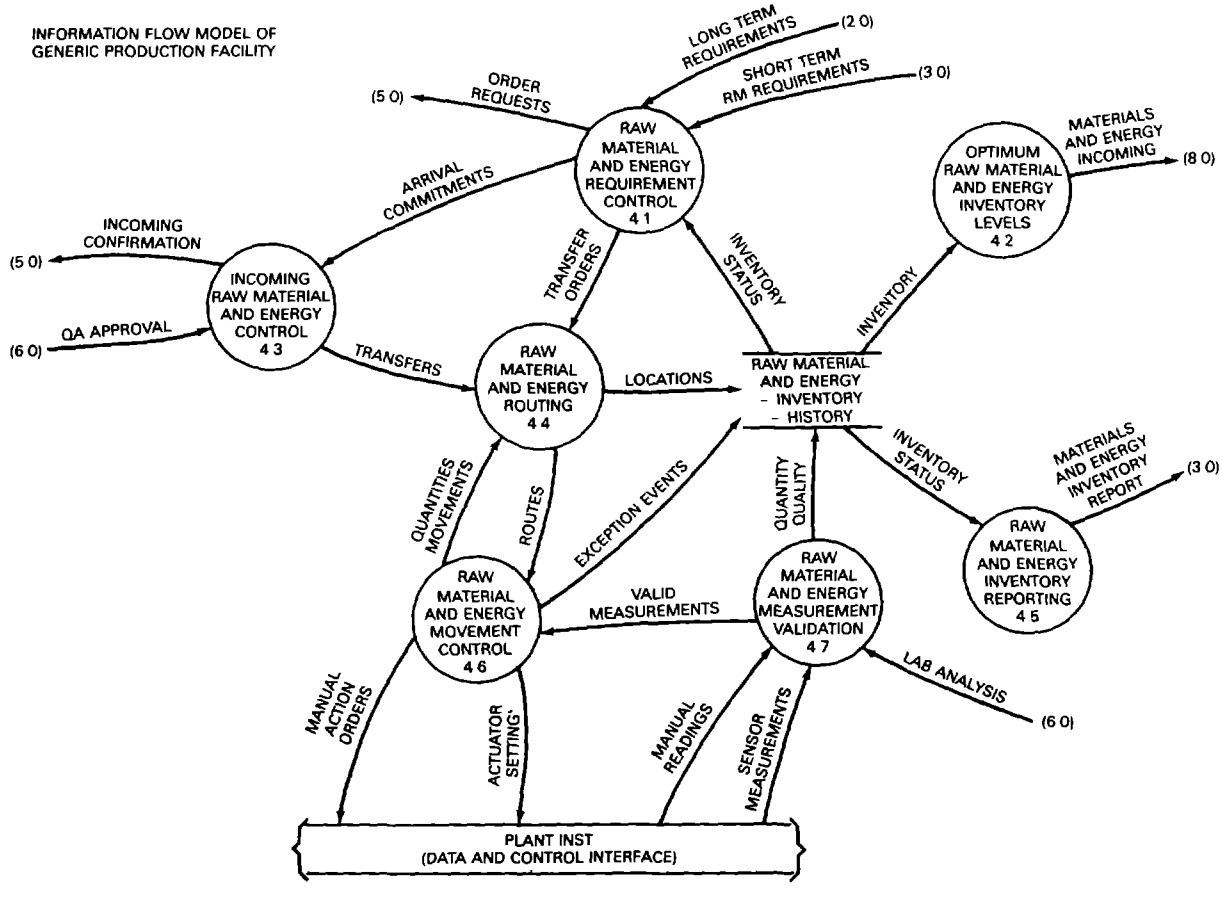
Figure 4-7 3.1 Process Support Engineering.



Filgure 4-8 3.2 Maintenance.



Filgure 4-9 3.3 Operations Control.



gure 4-10 4.0 Materials and Energy Control.

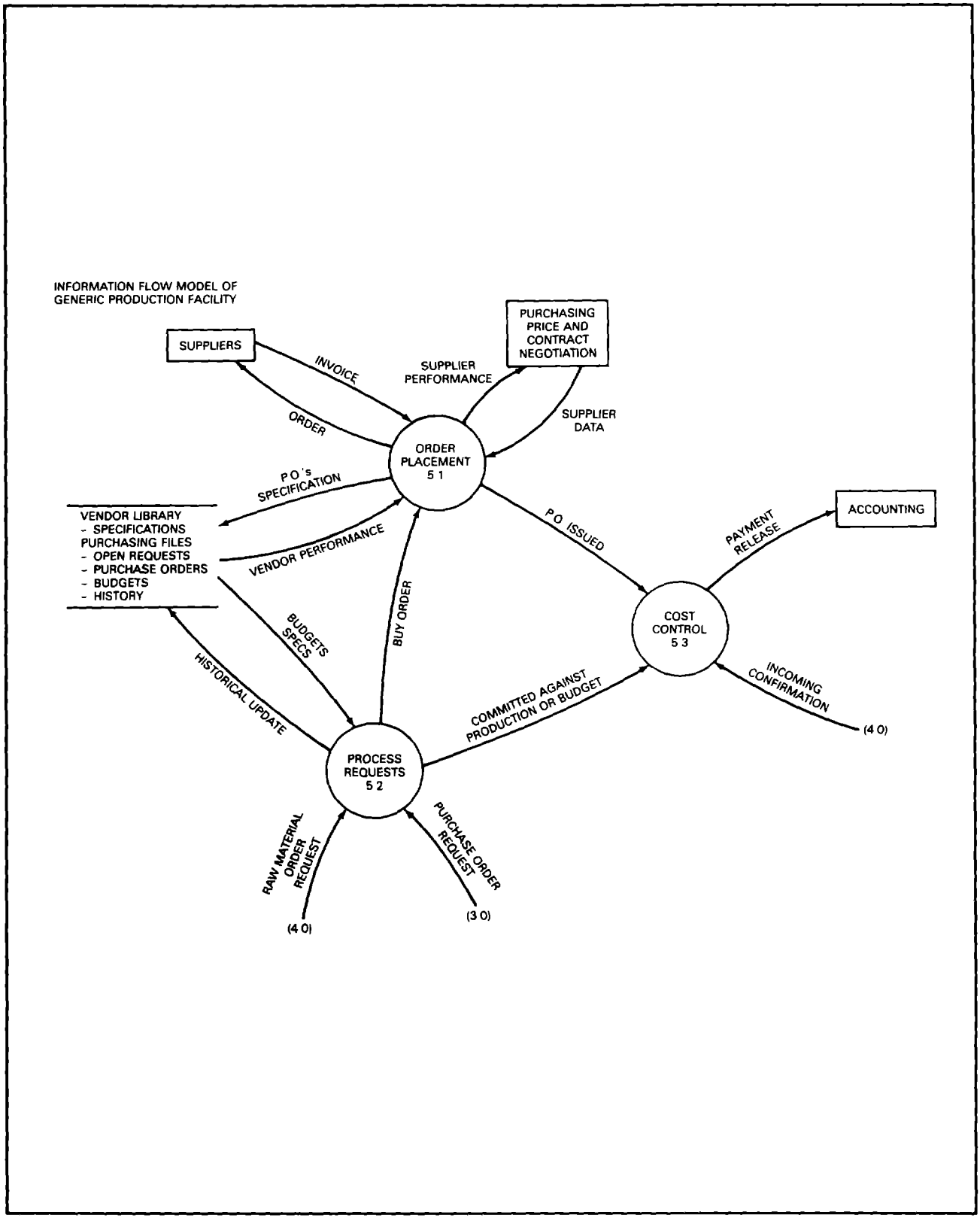


Figure 4-11 5.0 Procurement.

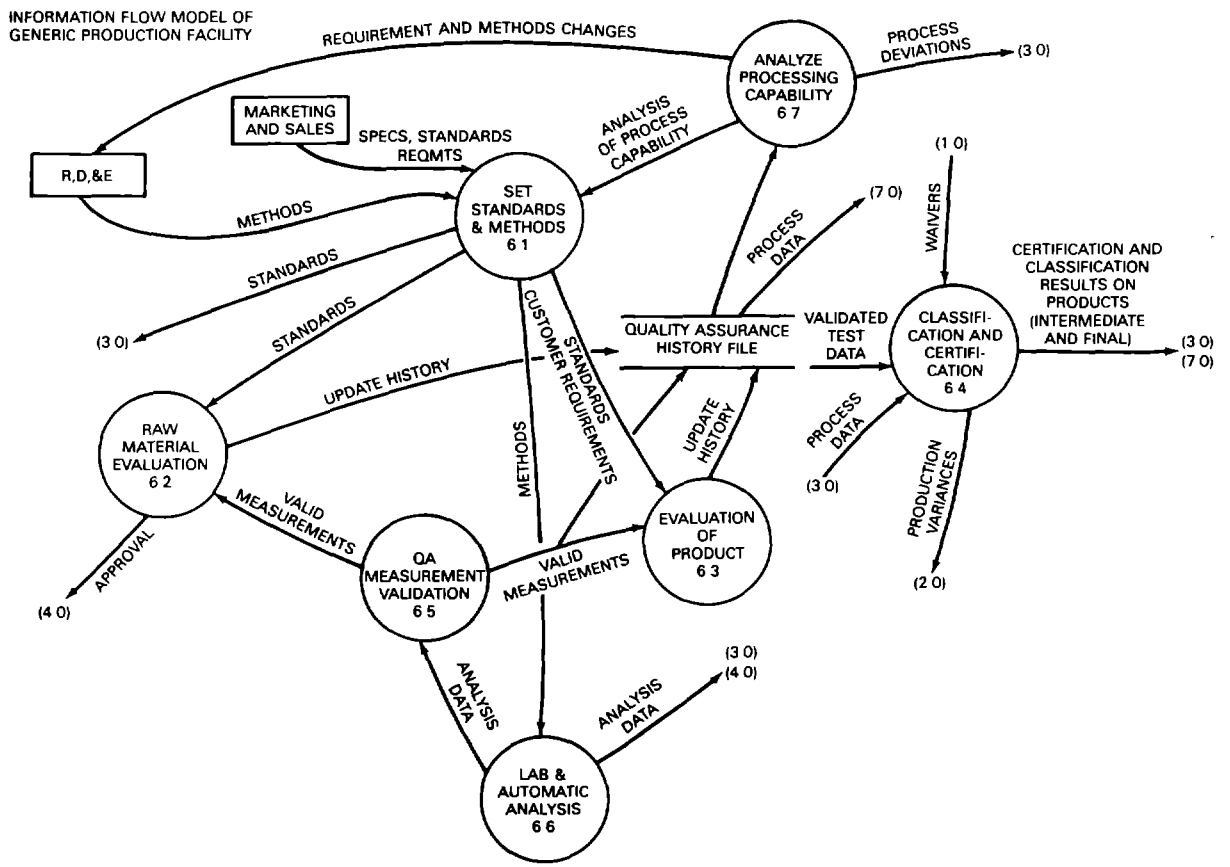


Figure 4-12 6.0 Quality Assurance.

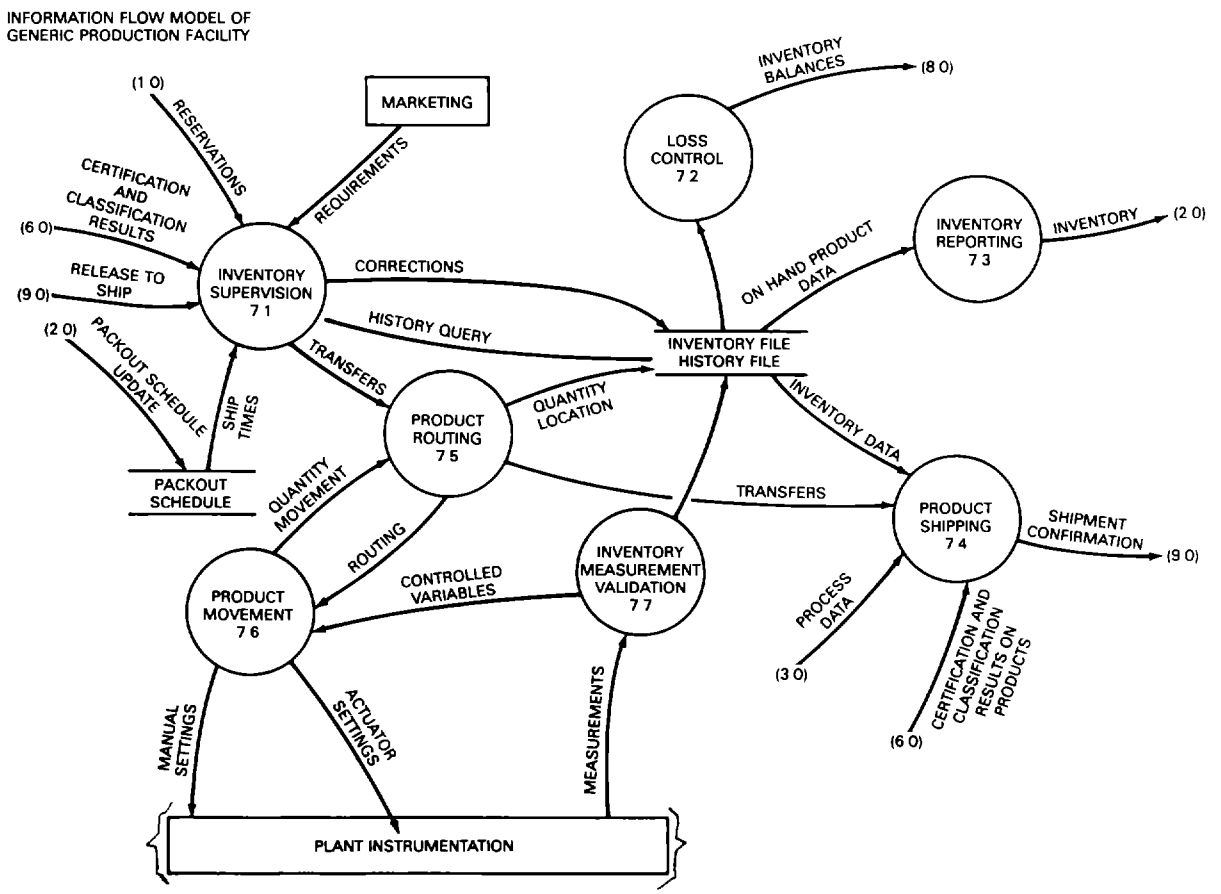


Figure 4-13 7.0 Product Inventory.

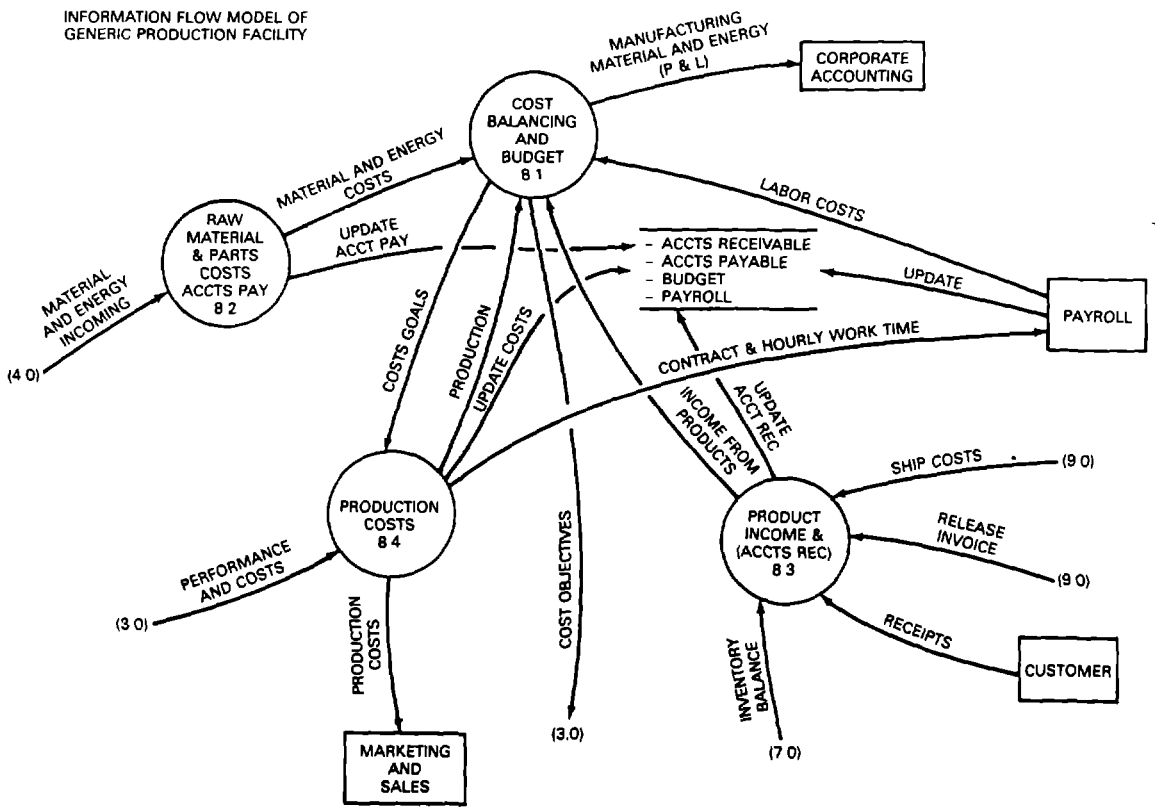


Figure 4-14 8.0 Cost Accounting.

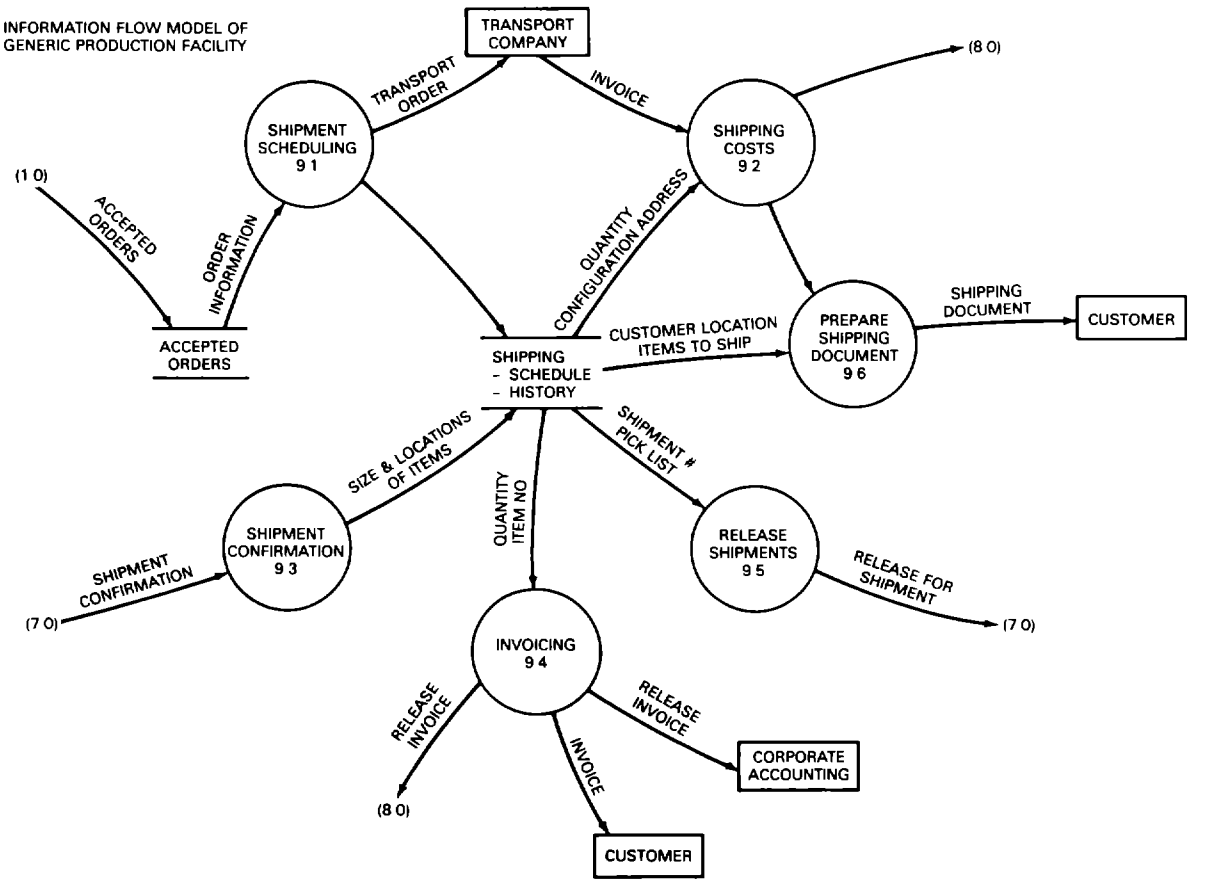


Figure 4-15 9.0 Product Shipping Administration.

TABLE 4-I

INFORMATION FLOW MODEL OF GENERIC PRODUCTION FACILITY MINI-SPECS (DEFINITION OF FUNCTIONS) FIRST ORDER ENTITY DIVISIONS

0. FACILITY MODEL CONTEXT

    Marketing and Sales

    Corporate R. D. & E.

    Suppliers

    Vendors

    Customers

    Transport Companies

    Accounting

    Purchasing

1. ORDER PROCESSING

    Customer Order Handling, Acceptance and Confirmation

    Sales Forecasting

    Waiver and Reservation Handling

    Gross Margin Reporting

    Determine Production Orders

2. PRODUCTION SCHEDULING

    Determine Production Schedule

    Identify Long Term Raw Material Requirements

    Determine Packout Schedule for End Products

    Determine Available Product for Sales

3. PRODUCTION CONTROL

    Control of Transformation of Raw Materials Into End Product in Accordance With Production Schedule and Production Standards.

    Maintenance of Processing Equipment

    Plant Engineering and Updating of Process Plans, etc.

    Issue Requirements for Raw Materials

    Produce Reports of Performance and Costs

    Evaluate Constraints to Capacity and Quality

    Self Test and Diagnostics of Production and Control Equipment

4. RAW MATERIALS CONTROL

    Keep Stock of Raw Materials

    Reorder Raw Materials According to Production Requirements

    Accept Delivery of Raw Materials, Request QA Tests and Release for Utilization After Approval

    Reporting on RM and Energy Utilization

    Reporting on RM Inventory to Production

5. PROCUREMENT

    Place Orders With Suppliers for RM Supplies, Spare Parts, Tools, Equipment and Other Required Materials

    Monitor Progress of Purchases and Report to Requisitioners

    Release Incoming Invoices for Payment After Arrival and Approval of Goods

6. QUALITY ASSURANCE

    Testing and Classification of Incoming Material and End Products

    Set Standard for Production QA in Accordance With Market and Technology Requirements

    Assist Production With Exceptional and Effective QA Tests

7. PRODUCT INVENTORY CONTROL

    Keep Stock of Produced End Products

continued

Table 4-1 continued

Make Reservation for Specific Product on List in Accordance With Product Selling Directives

Pack-out End Product in Accordance With Schedule

Report on Inventory to Production Scheduling

Report on Balance and Losses to Product Cost Accounting

Arrange Physical Loading/Shipment of Goods in Coordination With Product Shipping Administration

8. PRODUCT COST ACCOUNTING

Calculate and Report on Total Product Cost

Report Cost Results to Production for Adjustment

Set Cost Objectives For Production

9. PRODUCT SHIPPING ADMINISTRATION

Organize Transport for Product Shipment in Accordance With Accepted Orders Requirements

Negotiate and Place Orders With Transport Companies

Accept Freight Items on Site and Release Material for Shipment

Prepare Accompanying Documents for Shipment (BOL, Customs Clearance)

Confirm Shipment and Release for Invoicing to General Accounting

Report on Shipping costs to Product Cost Accounting

SECOND-ORDER ENTITY SUBDIVISIONS

1.1 FORECASTING

The Orders Expected Within the Next Period of Time are Predicted

The Prediction is Based on the Sales History and Function of the Market Expectation

Forecasting Makes Use of the Traditional Statistical Techniques (Smoothing, Seasonal Indices, etc.)

The Forecasting Period is Set by the Confidence of Market Expectations

Market Expectations are Influenced by Outside Factors, e.g., Economical or Political Situation, or by Inside Factors, e.g., Long Term Contracts, Production Problems

1.2 HISTORIAN

Create and Update a Sales History File with Clarification of Product, Customer, Shipping Method...

1.3 ORDER ENTRY

Main Interface With Customer for Enquiries and Orders

Supply Product Price and Availability

Handle Order Entry and Amendments

Give Confirmation and Progress of Entered Orders

1.4 PRODUCTION ORDER

Based on Active and Forecasted Orders Determine the Required Production

1.5 ORDER ACCEPTANCE

Handle the Acceptance for Delivery of Entered Orders

Acceptance Is Based on Ability to Manufacture and Availability of Product Customer Credibility Is Checked

In Specific Cases the Product Specifications Can be Waived in Accordance With Marketing Policies to Ratify a Particular Customer or Market Need

continued

Table 4-I continued

2.1 PROCESS PRODUCTION ORDERS

Produce Detailed Production Requirements From Sales Production Orders

Highlight Specification Requirements for Non-Standard Requests

Produce Production Order Entry in Scheduling File and Append Shipment Requirements

2.2 BALANCE INPROCESS PRODUCTION INVENTORY

Identify Ordered Quantities Against Produced Products and Initiate Packout of Specific Shipments

Identify Availability of On-Hand Product

Highlight Variance in Production Schedule

Maintain Capacity Estimates for Production Facility in Terms of Products

2.3 PRODUCTION FORECASTING

From Existing Production Orders and Known Capacity, Produce Specific Schedule Entries for Production Rates and Specifications

Set Long Term Raw Material Order Rates to Meet Production Schedule

Produce a Long Term Forecast Report

2.4 PRODUCTION SCHEDULING

Produce Formal Production Schedule

Modify Production Schedule to Account for Production Variances and Interruptions

Modify Production Schedule to Account for Inventory and Shipments

3.1 PROCESS SUPPORT ENGINEERING

Issue Request for Modification or Maintenance

Coordinate Maintenance and Engineering Activities

Provide Technical Standards and Methods to Maintenance Function

Follow-up on Equipment and Process Performance

Provide Technical Support to Operators

Follow-up on Technological Developments

Provide Specifications for Purchase Order Requests

3.2 MAINTENANCE

Provide Maintenance for Existing Installations

Provide Preventative Maintenance Program

Provide Equipment Monitoring Program to Anticipate Failure Including Self-Check and Diagnostic Programs

Place Purchase Order Request for Materials and Spare Parts

Develop Maintenance Cost Reports

Coordinate Outside Contract Work Effort

3.3 OPERATIONS CONTROL

Supervise the Operations of Production Process

Keep Track and Report on Production Costs and Performance

Interpret the Production Plan in Terms of the Setpoints to Individual Units

Diagnostics and Self-Check of Production and Control Equipment

3.4 OPERATIONS PLANNING

Set up a Daily Production Plan as Function of the Production Schedule

Check Schedule Against Raw Material Availability and Product Storage Capacity

continued

Table 4-1 continued

Determine Percent of Capacity Status

Modify Production Plan Hourly to Account for Equipment Outage, Manpower and Raw Materials Availability

4.1 MATERIAL AND ENERGY REQUIREMENTS CONTROL

Determine Supplier of New Materials Based on Short and/or Long Term Requirements From Planning or Manufacturing Taking Existing Inventory Into Account

Set Up Transfers of Materials and Energy to Manufacturing

Issue Purchase Request for New Material and Energy Supplies

Notify Incoming Material and Energy Control on Expected Incoming Orders

4.2 OPTIMUM MATERIAL AND ENERGY INVENTORY LEVELS

Continuously Calculate and Report Inventory Balance and Losses of RM and Energy Utilization

4.3 INCOMING MATERIAL AND ENERGY CONTROL

Receive Incoming Material and Energy Supplies and Request QA Tests

Transfer Material and Energy to Storage and/or Classify for Use After QA Approval

Notify Purchasing of Accepted Material and Energy Supplies to Release Payment

4.4 MATERIAL AND ENERGY ROUTING

Set up and Monitor the Movement of Material and Energy in Storage

Update Inventory of All Movements and Changes

4.5 MATERIAL AND ENERGY INVENTORY REPORTING

Reporting of Inventory to Production

4.6 MATERIALS AND ENERGY MOVEMENT CONTROL

Control and Monitor Transfer of Materials

4.7 MATERIALS AND ENERGY MEASUREMENT VALIDATION

See 3.3.4

5.1 ORDER PLACEMENT

Order Preparation for Raw Materials, Spare Parts, etc., for Presentation to the Vendors Based on Procurement Contracts Negotiated by Company Purchasing

Updating of Vendor Library and Purchasing Files of Vendors Performance on Orders

5.2 PROCESS REQUESTS

Collection and Processing of Unit Requests for Raw Materials, Spare Parts, etc., for Order Placement to Vendors

Checking of Requests for Those Materials Versus Historical Files and Budgets to Assure Correctness of Requests

5.3 COST CONTROL

Certification of Invoices on Raw Materials and Spare Parts Based on Satisfactory Receipt of Requested Materials or Parts

6.1 SET STANDARDS AND METHODS

Issue Standards to Manufacturing and Testing Laboratories in Accordance With Requirements From Technology, Marketing and Customer Services

6.2 RAW MATERIALS EVALUATION

Testing of Incoming Raw Materials and Approval for Use if in Accordance With Set Standards

Collect and Maintain Quality Control File for Data for Quality Control Analysis

continued

Table 4-I continued

6.3 EVALUATION OF END PRODUCT

Test of Final Product and Report Results to Classification

Collect and Maintain Quality Control File for Data for Quality Control Analysis

6.4 CLASSIFICATION AND CERTIFICATION

Classify Quality and Properties of End Product in Accordance With Set Marketing Standards

Waiver Classification on Exceptional Basis as Per Request from Product Selling

Report QA Results and Classification to Finished Product Inventory Control

Certify that Product was Produced According to Standard Process Conditions

Report Process Data and Certification to Finished Product Inventory Control

6.5 QA MEASUREMENT VALIDATION

Checking of Product Data Versus Customer's Requirements and Statistical Quality Control Routines to Assure Adequate Quality Before Shipment

Maintenance of Quality Statistics on Each Item Checked for Continuing Quality Control Studies.

6.6 LABORATORY AND AUTOMATIC ANALYSIS

Conduct of Metric, Chemical and Physical Tests on Sample Product Items to Obtain Data for On-Going Quality Control Tests

Transmission of This Data to Analysis Facilities and Quality Control Systems to Assure Future Quality of Product

6.7 ANALYZE PROCESS CAPABILITY

Use SQC Methodology to Examine Product Data to Determine Process Capability of Meeting Product Specifications

Relay Process Deviations to Process Engineering for Reevaluation to Upgrade Process

Relay Methods Deviation to Standards and Methods Group for Corrective Action

7.1 INVENTORY SUPERVISION

Coordinate All Activities in Product Inventory Control

Set up Transfers of Material to Packing Unit in Accordance to Packout Schedule

Request Replenishment of Packing Materials

Handle Reservations and Update Inventory Accordingly

7.2 LOSS CONTROL

Continuously Calculate and Report on Inventory Balance and Losses

7.3 INVENTORY REPORTING

Generate Daily, Weekly ... Reports on Actual Amounts of Materials in Storage

7.4 PRODUCT SHIPPING

Set up and Monitor Transfers of Products to Customer in Accordance With Requirements From Shipping Administration

Report Confirmation of Shipment for Release of Invoicing

7.5 PRODUCT ROUTING

Set up and Monitor the Routes of Product Transfer
Update Inventory on Changes

7.6 PHYSICAL PRODUCT MOVEMENT CONTROL

See 4.6

7.7 MEASUREMENT VALIDATION

See 3.3.4

8.1 BALANCING AND BUDGET

Establishment of Criteria and Tests to Assure That Operational Budget is Being Followed

continued

Table 4-1 continued

Collection of Raw Material, Labor, Energy and Other Costs for Transmission to Accounting

8.2 RAW MATERIAL AND PARTS COSTS (ACCOUNTS PAYABLE)

Collection of Cost Data on All Raw Materials and Spare Parts in Inventory or Procured for the Plant

8.3 PRODUCT INCOME (ACCOUNTS RECEIVED)

Collection of Data of Product Shipped or in Inventory

Release Invoice Data to Cost Accounting at Standard Cost

8.4 PRODUCTION COSTS

Collection of Data on Costs of Production in the Plant - Labor, Energy, Raw Material Usage, Spare Parts Usage, etc.

9.1 SHIPMENT SCHEDULING

Classify Accepted Order and Produce Shipping Schedule

9.2 SHIPPING COSTS

Calculate and Report Cost of Shipping

9.3 SHIPMENT CONFIRMATION

Update Shipping Schedule to Indicate That Shipping has Been Done and Configuration of Shipments

9.4 RELEASE FOR INVOICING

Notify Accounting of Shipment in Order to Release Invoice

9.5 RELEASE SHIPMENT

Send Information for Shipment to Product Shipping

9.6 PREPARE SHIPPING DOCUMENTS

Issue Bill of Lading, Customer Clearance, Documents That are Required with Shipment

THIRD-ORDER ENTITY SUBDIVISIONS

3.1.1 PROJECT MANAGEMENT

Management of Engineering Function

Coordination of Equipment and Process Modification

Cost and Progress Reporting

Project Planning

Design Follow-up With Corrective Action

3.1.2 EQUIPMENT AND PROCESS DESIGN MODIFICATIONS

Establish Design Basis of New Project

Supply Necessary Information to Allow Cost Estimating

Report and Coordinate Specialists' Assistance

Provide Technical Information to Operators

3.1.3 ENGINEERING SPECIALISTS

Provide Support and Advice in Special Area

Follow-up on State of the Art in Technology

Assess Plant Process and Equipment Performance

Adjust Standards and Methods to Needs and Progress

Monitor the Interpretation of Design Basis During Detailed Engineering

3.1.4 STANDARDS AND METHODS

Establish Standards for Process Equipment, Design Techniques and Process Operational Methods (Practice Files)

Promulgate Such Standards Within the Process Support Engineering Functions and Within the Operational Groups of the Factory

continued

Table 4-I continued

3.1.5 PROJECT COST CONTROL

Provide Cost Estimates of Planned Projects

Follow-up and Report on Costs of Projects in Execution

3.1.6 PROCESS ANALYSIS AND PROJECT DETAILED ENGINEERING

Conduct Plant Performance Studies

Provide Details for the Construction of Equipment or Process Modification Project in Accordance to Design Basis

Issue Report for Ordering of New Equipment

Issue Specifications to Vendor

Report on Engineering and Committed Equipment Costs

3.1.7 EQUIPMENT MODIFICATION CONSTRUCTION

Provide for Construction of Project

Report on Cost and Labor

3.1.8 DRAFTING DOCUMENTATION

Maintain Master Copies of All Plant Drawings for Units Under Its Cognizance

Responsible for Updating Drawings and Associated Documentation as Units Are Modified

Supply Copies as Needed

3.2.1 MAINTENANCE PLANNING

Organization and Supervision of Requested Maintenance

Reporting on Performed Maintenance

Coordinate Planned Work With Operators and Plant Supervision

Monitor and Update Maintenance History File

3.2.2 MAINTENANCE COST CONTROL

Follow-up on Used Spare Parts, Report Maintenance Labor and Report on Maintenance Costs

3.2.3 SPARE PARTS

Supervise Spare Parts Warehouse

Supply Necessary Parts to Maintenance Crews

Report on Inventory to Planning for Reordering

Report to Cost Control on Used Parts

Accept and Control New Delivered Parts From Vendors

3.2.4 MAINTENANCE CREW SUPERVISION

Perform Requested Maintenance Work

Supervise and Coordinate With Outside Contractors

Report on Technical Activities to Files

Report on Installation and Equipment Performance to Engineering

3.2.5 DOCUMENTATION

See Item 3.1.8

3.3.1 OPERATIONS SUPERVISION

Set Objectives for Process Operation

Supervise People in Operation of the Process and Equipment

Deal Directly in the Resolution of Exception Conditions

Issue Modification or Maintenance Requests

Set and Report Production Capacity Limits

Monitor and Report on Production Cost and Performance

3.3.2 OPERATIONS COST CONTROL

Calculate Total Operating Costs

continued

Table 4-I continued

Maintain Short Term Economic Balances of Energy and Materials

Capture Maintenance and Engineering Costs Chargeable to Operations

3.3.3 PHYSICAL PROCESS CONTROL

Stabilize Process Variables to Defined Operating Setpoints

Alarming of Operating Variables for Exceptional Conditions

Maintain Operation Against Constraints or at Specifications

Response to Operators and Process Engineers Requests

Response to Emergencies

3.3.4 OPERATIONAL MEASUREMENT VALIDATION

Assess the Validity of the Measurements for Further Use Within Their Limits of Confidence

Tag Measurement Data With Quality and Time

3.3.5 EQUIPMENT MONITORING

Assess the Operating Performance and Limits of Process Equipment

Alarming of Equipment Status Variables Against Constraints

Indicate Performance Against Expected Equipment Life Cycles

3.3.6 PRODUCTION OPTIMIZATION AND BALANCING

Optimization of Production Process to Set Objectives Within Equipment Constraints

Maintain Material and Energy Balance to Indicate Exceptional Conditions

Perform Performance Tests Where Necessary to Determine Capacity

Monitor Product Quality Against Specifications and Standards

TABLE 4-II

INFORMATION FLOW MODEL OF GENERIC PRODUCTION FACILITY

DATA DICTIONARY

ACCEPTANCE

=*Updating of Active Order to Indicate Acceptance of Order*

ACTIVE ORDERS

=*Details of all Entered Orders (Customer ID, Product Type, Quantity, Delivery Date, Shipping Requirements ...)*

ACTUATOR SETTINGS

=Output to Process Equipment, Valve Position, Motor Status

ADVICE SUPPORT

=Assistance From Engineering Specialists*

AVAILABLE PRODUCT

=*Inventory + Planned Production - Accepted Orders*

CONSTRAINTS

=Actual Operating Limits of Process Equipment

CONTACTS

=Inquiries, Orders, Information, Confirmation

CONTRACTOR PLANNING

=Schedules of Requests for Outside Contractor Assistance

CONTROLLED VARIABLES

=Validated Measurements for Direct Control of Pressure, Temperature, Flow, etc.

COST OBJECTIVES

=Cost Goals Determined by Product Cost Accounting

continued

Table 4-II continued

COST SPECIFICATIONS

=*Details to Allow Cost Estimating, Gross Layout, Preliminary Equipment List....*

COSTS POLICIES

=Marketing Costs + Profit Margin

CREDITS AND LIMITS

=*Information on Credibility of Customer, Financial Situation...*

CUSTOMER DETAILS

=*Customer Information (Name, Address, Shipping Address, Credibility, Special Needs....*

DATA KNOWHOW

=*Technical Information on State-of-the-Art of Technology, RD

DESIGN BASIS

=*Document That Contains the Basis of a Design to Allow Further Detailed Engineering

DESIGN PRACTICES

=*Engineering Methods, Standards, Practices*

DETAILS

=Technical Details of New Equipment

DIAGNOSIS REPORT

=Technical Report on Malfunction Reasons

ENGINEERING EQUIPMENT COSTS

=Total Cost of Engineering and Purchased Equipment

ENGINEERING DETAILS

=*Documents and Information to Vendors or Contractors

ENTRY

=Order Details (Customer ID + Product Type and Quantity + Required Delivery Date + Special Requirements, etc...)

EQUIPMENT INFORMATION

=Drawings, Instructions, Data on Installed Equipment

EQUIPMENT ORDER REQUEST

=Purchase Order Request for New Equipment

EQUIPMENT PERFORMANCE

=Actual Operating Performance of Process Equipment, Power, Temperatures, Overall Condition

EQUIPMENT VARIABLES

=Validated Measurements Related to Equipment Performance, Vibration, Displacement, Pressures, Temperatures, Corrosion Analysis

EXCEPTION POLICIES

=*Rules and Guidelines FromMarketing to Handle Waiver and Special Requirements When Accepting an Order

FORECASTED ORDERS

=*Expected Orders to Deliver Within a Period of-Time*

GROSS MARGIN

=Selling Price – ProductCost

INCOMING CONFIRMATION

=Updating of Incoming Material Status to Release Payment

INSTALLATION DETAILS

=Documentation, Drawing Information and Instructions for Construction

INSTALLATION UPDATES

=Documentation, Drawing Information and Instruction for New Installed Equipment

INVENTORY

=Actual Quantities, Specifications, Location of Materials in Storage

continued

Table 4-II continued

INVOICE

=Invoice of Performed Transport, of RM or Other Supplies

LABOR COSTS

=Cost and Labor Reporting on Construction Activities

MAINTENANCE COSTS

=Total Calculated Maintenance Cost Report by Work Order, Time Period...

MAINTENANCE HISTORY

=Technical Details on Performed Work, Diagnosis, Used Parts, etc.

MAINTENANCE REQUEST

=Request for Repair of Equipment Identification Systems, Reason...

MARKET EXPECTATIONS

=*Assessment of the Market Situation of the Products*

MEASUREMENTS

=Data From Process Sensors

MODIFICATION REQUESTS APPROVALS

=Requests, Approval, Basic Information for Modification of Equipment or Design of New Facilities

MONITORING

=Follow up of Engineering Work to Ensure Adherence to Standards and CorrectInterpretation of Design Basis

OBJECTIVES

=Throughput, Yield, Rates, Quality

OBJECTIVES CONSTRAINTS

=*Basic Information and Limits of New Projects, Project Adjustments, Cost Control Adjustments*

OPERATING CONDITIONS

=Calculated Optimum Process Operating Conditions and Targets

OPERATING COSTS

=Total Operating Costs=Maintenance + Engineering + Operation + RM + Energy + Looser Costs

ORDER INFORMATION

=*Information on Accepted Order (Confirmation, Due Date, Changes...)*

ORDERS INQUIRIES

=*Request for Information on Product or Formal Purchase Order*

OVERHEAD COSTS

=*Costs of Non-Productive Services (Accounting, Administration, Management...)*

PART SUPPLIES

=Delivery of Parts to Maintenance Crews

PARTS ORDER REQUEST

=Purchase Order Request for Spare Parts Replenishment

PARTS REPLENISHMENTS

=Supply of Reordered Parts to Replenish Inventory

PARTS REQUEST

=Request to Spare Parts Warehouse for Parts by Work Order

PERFORMANCE AND COSTS

=Operating Performance and Cost Reporting, Rates, Utilization, Yield, Quality...

PERFORMANCE FEEDBACK

=Feedback on Plant Equipment and Process Performance

PERFORMED WORK

=Time Reports per Work Order

PRICE

=Product Cost and Marketing Cost

continued

Table 4-II continued

PRODUCT COST

=*Total Manufacturing Cost of Product Excluding Sales, Marketing and Company Overhead*

PRODUCT INFORMATION

=*Product Related Sales Information (Price, Availability, Documentation...)

PRODUCTION LIMITS

=Actual Rate of Production Capacity by Unit, per Product

PRODUCTION ORDERS

=Forecasted and Accepted Orders

PRODUCTION PERFORMANCE

=Throughput, Yield, Rates, Quality

PRODUCTION PLAN

=Detailed Production Planning by Unit, Equipment, Product...

PRODUCTION VARIABLES

=Validated Measurement Related to Production Performance Weights, Rates, Analysis, Levels

PROGRESS COSTS

=*Progress Cost Reporting of Running Projects*

PROJECT COSTS

=*Project Costs, Estimates, Projected Cost*

PROJECT PLANNING

=Project Schedule Work Planning*

QA APPROVALS

=Classification of QA Results After Testing

QA RESULTS

=Classification and Test Results for Finished Product

QA STANDARDS

=Limits, Specifications and Standards for In-Process Quality Control

QUANTITIES LOCATIONS

=Updates to Inventory of Locations, Quantity, Specification of RM

QUANTITIES MOVEMENTS

=Actual Quantities and Status of Transfer

RELEASE FOR SHIPMENT

=Quality, Location, Destination of Product to be Shipped

REPORTING

=Customer Credit Limits, Gross Margin Reporting Overhead Costs Reports

RM ENERGY UTILIZATION

=Total of Raw Materials,

Parts, Tools and Incoming Energy, Consumed or Transferred on Hourly, Daily, Monthly Basis

RM ORDER REQUEST

=Request to Order Raw Materials, Quality, Type Specifications, Special Requirements...

ROUTES

=Routing and Commands to Initiate a Physical Transfer of Materials

SALES HISTORY

=*Sales Performance of the Product Over the Past

SAMPLES

=Samples of Materials Sent to QA for Testing

SHIPMENT CONFIRMATION

=Signal to Product Administration That Actual Shipment Has Been Done

SHIPPING COSTS

=Total and Actual Cost of Transport per Shipment, per Month, etc....

SHIPPING DOCUMENTS

=Bill of Lading, Customer Clearance.....

continued

Table 4-II continued

SPARES INVENTORY

=Inventory of Spare Parts

SPECIALIST REQUIREMENTS

=*Outlines of Needs for Specialist Assistance*

SPECIFICATIONS

=Technical Specifications for New Equipment

SPENT LABOR

=Total Spent Labor Per Work Order

STANDARDS

=Limits, Specifications, Standards and Testing Methods for Quality Control

STANDARDS UPDATES

=Updating of Standards, Methods and Practices to Actual Need and State-of-the-Art

STATUS

=Actual Values of Operating Variables, Flows, Pressures, Temperatures, etc..

SUPERVISION

=*Supervision and Coordination of Construction Activities*

SUPERVISION COORDINATION

=Supervision of Outside Contractors

SUPPORT

=Labor and Services Report From Outside Contractors

TECHNICAL FEEDBACK

=Feedback on Installation and Specific Equipment Performance

TECHNICAL INSTRUCTIONS

=Operation Instructions Data on Process and Equipment

TEST RESULTS

=Report on Performed Tests, Including Quality

TIME

=Time of Spent Work of Individual, by Work Order

TRANSFERS

=Source, Destination, Route, Quantity of Material to be Transferred

TRANSPORT ORDER

=Order to Transport Company to Arrange Transportation

UPDATE

=*Updating Information for Rates History File

USED PARTS

=Cost Report on Used Parts for Each Work Order

UTILIZATION LOSSES

=Utilization and Unbalances of Raw Materials and Energy

WAIVERS

=*Exceptional Changes to the Quality Classification of a Specific Quantity of an End Product*

WORK ORDER

=Transmittal to Maintenance of Order to Perform Work (Work Description, Symptoms, Special Precautions, Clearance Procedures...)

WORK REPORT

=Reporting on Performed Maintenance Time, Diagnosis, Used Parts...

TABLE 4-III
CORRELATION OF INFORMATION-FLOW TASK WITH THE TASKS OF THE SCHEDULING AND CONTROL HIERARCHY

DATA FLOW DIAGRAM LISTING		SCHEDULING AND CONTROL HIERARCHY	
FIGURE NO. AND LOCATION	TITLE	TABLE NO. AND ENTRY	TITLE
Figure 4-3 Task 1.0	Order Processing	Table 3VIII Item I(2)	Production Scheduling
Figure 4-3 Task 2.0	Production Scheduling	Table 3VII Item I (1-3, 5) Table 3VIII Item I (1,3)	Production Scheduling Same
Figure 4-3 Task 3.0	Production Control	Table 3VIII Item I (2) Table 3IX Item II Table 3X Item II	Area Optimization Control Enforcement Same
Figure 4-3 Task 4.0	Raw Material Control	Table 3VIII Item I (4) Item III (6,7)	Optimum Inventory Levels Procurement Order Entry
Figure 4-3 Task 5.0	Procurement	Table 3VII Item III (6,7)	Procurement Order Entry
Figure 4-3 Task 6.0	Quality Assurance	Table 3VIII Item III (9) Table 3VIII Item III (8)	Quality Control File Statistical Quality Analysis and Control Functions

TABLE 4-III cont.

DATA FLOW DIAGRAM LISTING		SCHEDULING AND CONTROL HIERARCHY	
FIGURE NO. AND LOCATION	TITLE	TABLE NO. AND ENTRY	TITLE
Figure 4-3 Task 7.0	Product Inventory Control	Table 3VII Item I (4) Item III (8)	Optimum Inventory Levels Goods in Process Inventory
Figure 4-3 Task 8.0	Product Cost Accounting	Table 3VII Item III (6-8) Table 3VIII Item III (4,6) Table 3IX Item III (3) Table 3X Item III (3)	Production and Raw Material, Energy Source and Spare Parts Use Data Plus Inventory Data Same Same Same
Figure 4-3 Task 9.0	Product Shipping Adm	Table 3VI Item III (1B, 2B) Table 3VIII Item III (8)	Product Inventory and Production Status and Data Same
Figure 4-4 Task 1.1	Production Forecasting	Table 3VII Item I (1)	Basic Production Schedule (See also Table 8-II and Figure 8-5)
Figure 4-4 Task 1.2	Historian	Table 3VII Item I (1)	Basic Production Schedule (See also Table 8-III and Figure 8-5)

TABLE 4-III cont.

DATA FLOW DIAGRAM LISTING		SCHEDULING AND CONTROL HIERARCHY	
FIGURE NO. AND LOCATION	TITLE	TABLE NO. AND ENTRY	TITLE
Figure 4-4 Task 1.3	Order Entry	Table 3VII Item I (1)	Basic Production Schedule (See also Table 8-III)
Figure 4-4 Task 1.4	Production Order	Table 3VII Item I (1-3, 5) Table 3VIII Item I (1-3)	Production Scheduling Same
Figure 4-4 Task 1.5	Order Acceptance	Table 3VI Items III (1B, 2B, 3)	Sales Coordination
Figure 4-5 Task 2.1	Process Production Orders	Table 3VII Items I (1,2)	Production Scheduling
Figure 4-5 Task 2.2	Balance In-Process and Product Inventories	Table 3VII Item I (4)	Inventory Management
Figure 4-5 Task 2.3	Production Forecasting	Table 3VII Item I (1)	Basic Production Schedule (See also table 8-II and Figure 8-5)
Figure 4-5 Task 2.4	Production Scheduling	Table 3VII Item I (1-3, 5) Table 3VIII Item I (1, 3)	Production Scheduling Same
Figure 4-6 Task 3.1	Process Support Engineering	Table 3VIII Item III (8)	Engineering Functions

TABLE 4-III cont.

DATA FLOW DIAGRAM LISTING		SCHEDULING AND CONTROL HIERARCHY LISTING	
FIGURE NO. AND LOCATION	TITLE	TABLE NO. AND ENTRY	TITLE
Figure 4-6 Task 3.2	Maintenance	Table 3VII Item I (3) Item III (10) Table 3VIII Item I (1)	Maintenance Scheduling Maintenance Data Immediate Production Schedule
Figure 4-6 Task 3.3	Operations Control	Table 3VIII Item I (2) Table 3IX Item II Table 3X Item II	Area Optimization Control Enforcement Same
Figure 4-6 Task 3.4	Operations Planning	Table 3VIII Item I (1, 3)	Production Scheduling
Figure 4-6 Task 3.1.1	Project Management	Table 3VIII Item III (8)	Engineering Functions
Figure 4-6 Task 3.1.2	Equipment and Process Design Modification	Table 3VIII Item III(8)	Engineering Function
Figure 4-6 Task 3.1.3	Engineering Specialists	Table 3VIII Item III(8)	Engineering Function
Figure 4-6 Task 3.1.4	Standards and Methods	Table 3VIII Item III(8)	Engineering Function

TABLE 4-III cont.

DATA FLOW DIAGRAM LISTING		SCHEDULING AND CONTROL HIERARCHY LISTING	
Figure 4-6 Task 3.1.5	Project Cost Control	Table 3VIII Item III(8)	Engineering Functions
Figure 4-7 Task 3.1.6	Project Detailed Engineering	Table 3VIII Item III(8)	Engineering Functions
Figure 4-7 Task 3.1.7	Equipment Modification Construction	Table 3VIII Item III(8)	Engineering Functions
Figure 4-7 Task 3.1.8	Drafting Documentation	Table 3VIII Item III(8)	Engineering Functions
Figure 4-8 Task 3.2.1	Maintenance Planning	Table 3VII Item I (3) Item III (10) Table 3VIII Item I (1)	Maintenance Scheduling Maintenance Data Immediate Production Schedule
Figure 4-8 Task 3.2.2	Cost Control	Table 3VII Item III (10, 11) Table 3III Item III (6, 10)	Cost Reporting Same
Figure 4-8 Task 3.2.3	Spare Parts	Table 3VII Item I (4) Item III (6)	Procurement Same

TABLE 4-III cont.

DATA FLOW DIAGRAM LISTING		SCHEDULING AND CONTROL HIERARCHY	
FIGURE NO. AND LOCATION	TITLE	TABLE NO. AND ENTRY	TITLE
Figure 4-8 Task 3.2.4	Maintenance Crew Scheduling	Table 3VIII Item III (10)	Personnel Functions
Figure 4-8 Task 3.2.5	Documentation	Table 3VII Item III (10) Table 3VIII Item III (6)	Maintenance Data Same
Figure 4-9 Task 3.3.1	Operations Supervison	Table 3VII Item I, III Table 3VIII Item I, III	Production Scheduling and Management Information
Figure 4-9 Task 3.3.2	Operations Cost Control	Table 3VII Item III Table 3VIII Item III (4, 6-10)	Cost Reporting Same
Figure 4-9 Task 3.3.3	Physical Process Control	Table 3IX Item II Table 3X Item III	Control Enforcement Same
Figure 4-9 Task 3.3.4	Operational Measurement Validation	Table 3IX Item II Table 3X Item II	Control Enforcement Same

TABLE 4-III cont.

DATA FLOW DIAGRAM LISTING		SCHEDULING AND CONTROL HIERARCHY	
FIGURE NO. AND LOCATION	TITLE	TABLE NO. AND ENTRY	TITLE
FIGURE NO. AND LOCATION	TITLE	TABLE NO. AND ENTRY	TITLE
Figure 4-9 Task 3.3.5	Equipment Monitoring	Table 3VII Item III (10) Table 3VIII Item III (1) Table 3IX Item II (1) Item IV Table 3X Item II (2) Item IV	Maintenance Data Immediate Production Schedule Emergency Response Reliability Assurance Emergency Response Reliability Assurance
Figure 4-9 Task 3.3.6	Production Balancing Opimization	Table 3VII Item I Table 3VIII Item I (2) Table 3IX Item II (2)	Production Optimization

TABLE 4-III cont.

DATA FLOW DIAGRAM LISTING		SCHEDULING AND CONTROL HIERARCHY	
FIGURE NO. AND LOCATION	TITLE	TABLE NO. AND ENTRY	TITLE
Figure 4-10 Task 4.1	Raw Material Requirement Control	Table 3VII Item I (4)	Raw Material Procurement
Figure 4-10 Task 4.2	Inventory Balancing	Table 3VII Item III Table 3VIII Item III (6)	Raw Material Use Data Same
Figure 4-10 Task 4.3	Incoming Raw Material Control	Table 3IX Item III (3)	Same
Figure 4-10 Task 4.4	Materials Routing	Table 3X Item III (3)	Same
Figure 4-10 Task 4.5	Inventory Reporting		
Figure 4-10 Task 4.6	Material Movement Control		
Figure 4-10 Task 4.7	Raw Material Measurement Validation		

TABLE 4-III cont.

DATA FLOW DIAGRAM LISTING		SCHEDULING AND CONTROL HIERARCHY	
FIGURE NO. AND LOCATION	TITLE	TABLE NO. AND ENTRY	TITLE
Figure 4-11 Task 5.1	Order Replacement	Table 3VII Item I (4)	Procurement
Figure 4-11 Task 5.2	Process Requests		
Figure 4-11 Task 5.3	Cost Control		
Figure 4-12 Task 6.1	Set Standards and Methods	Table 3VII Item III (9)	Quality Control Analysis
Figure 4-12 Task 6.2	Raw Material Evaluation	Table 3VIII Item III (8)	Quality Control Analysis
Figure 4-12 Task 6.3	Evaluation of Product		
Figure 4-12 Task 6.4	Classification		
Figure 4-12 Task 6.5	QA Measurement Validation		
Figure 4-12 Taske 6.6	Lab and Automatic Analysis		
Figure 4-12 Taske 6.7	Analyze Process Capability		

TABLE 4-III cont.

DATA FLOW DIAGRAM LISTING		SCHEDULING AND CONTROL HIERARCHY	
FIGURE NO. AND LOCATION	TITLE	TABLE NO. AND ENTRY	TITLE
Figure 4-13 Task 7.1	Inventory Supervision	Table 3VII Item I (4)	Product Inventory
Figure 4-13 Task 7.2	Loss Control	Table 3VII Item III (8) Table 3VIII Item III (6)	Product Inventory Same
Figure 4-13 Task 7.3	Inventory Reporting	Table 3IX Item III (3)	Product Inventory
Figure 4-13 Task 7.4	Product Shipping	Table 3X Item III (3)	Same
Figure 4-13 Task 7.5	Product Routing		
Figure 4-13 Task 7.6	Product Movement		
Figure 4-13 Task 7.7	Inventory Measurement Validation		
Figure 4-14 Task 8.1	Cost Balancing and Budget	Table 3VI Item III (2C)	Cost Reporting
Figure 4-14 Task 8.2	Raw Materials and Parts (Costs and Acct's Payable)	Table 3VII Item I (4)	Same

TABLE 4-III cont.

DATA FLOW DIAGRAM LISTING		SCHEDULING AND CONTROL HIERARCHY	
FIGURE NO. AND LOCATION	TITLE	TABLE NO. AND ENTRY	TITLE
Figure 4-14 Task 8.3	Product Income (Acct's Receivable)	Table 3VII Item III	Same
Figure 4-14 Task 8.4	Production Costs	Table 3VIII Item III (4, 6-10) Table 3IX Item III Table 3X Item III	Cost Reporting Same Same
Figure 4-15 Task 9.1	Shipment Scheduling	Table 3VI Item III (1B, 2B)	Product Inventory and Availability
Figure 4-15 Task 9.2	Shipping Costs	Table 3VII Item I	Production Scheduling
Figure 4-15 Task 9.3	Shipment Configuration	Table 3VII Item III (8)	Product Inventory and Availability
Figure 4-15 Task 9.4	Invoicing	Table 3VIII Item III (6)	Same
Figure 4-15 Task 9.5	Release Shipments	Table 3IX Item III (6)	Same
Figure 4-15 Task 9.6	Prepare Shipping Documents	Table 3X Item III (3)	Same