16BEME5E02 COMPUTER INTEGRATED MANUFACTURING 3 0 0 3 100

OBJECTIVE

1. To understand the application of computers in various aspects of Manufacturing viz., Design, proper planning, Manufacturing cost, Layout & Material Handling system.

UNIT I INTRODUCTION 9

The meaning and origin of CIM– the changing manufacturing and management scene – External communication – islands of automation and software–dedicated and open systems–manufacturing automation protocol – product related activities of a company– marketing engineering – production planning – plant operations – physical distribution– business and financial management.

UNIT II GROUP TECHNOLOGY 9

Group technology– – part families – Classification and coding – Approaches to computer aided process planning –variant approach and generative approaches

UNIT III SHOP FLOOR CONTROL AND INTRODUCTION OF FMS 9

Shop floor control–phases –factory data collection system –automatic identification methods– Bar code technology–automated data collection system. FMS–components of FMS – types –FMS workstation – material handling and storage systems– FMS layout –computer control systems–application and benefits.

UNIT IV CIM IMPLEMENTATION AND DATA COMMUNICATION 9

CIM and company strategy – system modeling tools –IDEF models – activity cycle diagram – CIM open system architecture (CIMOSA)– manufacturing enterprise wheel–CIM architecture – Product data management–CIM implementation software. Communication fundamentals– local area networks – topology – LAN implementations – network management and installations –MRP, ERP concepts

UNIT V OPEN SYSTEM AND DATABASE FOR CIM 9

Open systems–open system inter connection – manufacturing automations protocol and technical office protocol (MAP /TOP).

Development of databases –database terminology– architecture of database systems–data modeling and data associations –relational data bases – database operators – advantages of data base and relational database.

TOTAL 45

TEXT BOOKS

S. No.	Author(s) Name	Title of the book	Publisher	Year of Publication
1	Mikell.P.Groover	Automation, Production Systems and computer integrated manufacturing	Pearson Education, Delhi	2015

REFERENCES

S. No.	Author(s) Name	Title of the book	Publisher	Year of Publication
1	Yorem koren	Computer Integrated Manufacturing system	McGraw-Hill, New York	2005
2	Kant Vajpayee S	Principles of computer integrated manufacturing	Prentice Hall India, New Delhi	2003
3	Radhakrishnan P and Subramanyan S	CAD/CAM/CIM, 2nd Edition	New Age International (P) Ltd, New Delhi	2011

WEB REFERENCES

1. http://en.wikipedia.org/wiki/Computer-integrated_manufacturing
2. http://www.technologystudent.com/rmprp07/intman1.html
3. http://www.computerintegratedmanufacturing.com/

KARPAGAM ACADEMY OF HIGHER EDUCATION

COIMBATORE – 21

FACULTY OF ENGINEERING

DEPARTMENT OF MECHANICAL ENGINEERING

LESSON PLAN

Subject Name : **Computer Integrated Manufacturing**
Subject Code : **16BEME5E02 (Credits - 3)**
Name of the Faculty : **P. M. Gopal**
Designation : **Assistant Professor**
Year/Semester/Section : **III / V / A Section**
Branch : **B.E. – Mechanical Engineering**

Sl. No.	No. of Periods	Topics to be Covered	Support Materials
UNIT – I : INTRODUCTION			
1.	1	The meaning and origin of CIM– the changing manufacturing and management scene	**T(1)**
2.	1	External communication	**T(1)**
3.	1	Islands of automation and software	**T(1)**
4.	1	Dedicated and open systems	**T(1)**
5.	1	Manufacturing automation protocol	**T(1)**
6.	1	Product related activities of a company	**T(1)**
7.	1	Marketing engineering	**T(1)**
8.	1	Production planning	**T(1)**
9.	1	Plant operations – physical distribution	**T(1)**
10.	1	Business and financial management.	**T(1)**
Total No. of Periods Planned for Unit - I			**10**

Sl. No.	No. of Periods	Topics to be Covered	Support Materials
UNIT – II : GROUP TECHNOLOGY			
11.	1	Group technology	**T(1) R(2)**
12.	1	Part families	**T(1) R(2)**
13.	1	Part families	**T(1) R(2)**
14.	1	Classification and coding	**T(1) R(3)**
15.	1	Classification and coding	**T(1) R(3)**
16.	1	Approaches to computer aided process planning	**T(1) R(3)**
17.	1	Variant approach	**T(1) R(3)**
18.	1	Variant approach	**T(1) R(3)**
19.	1	Generative approaches	**T(1) R(3)**
20.	1	Generative approaches	**T(1) R(3)**

Total No. of Periods Planned for Unit - II	**10**

Sl. No.	No. of Periods	Topics to be Covered	Support Materials
UNIT – III : SHOP FLOOR control AND INTRODUCTION OF FMS			
21.	1	Shop floor control–phases	**T(1)**
22.	1	Factory data collection system	**T(1)**
23.	1	Automatic identification methods	**T(1)**
24.	1	Bar code technology	**T(1)**
25.	1	Automated data collection system.	**T(1)**
26.	1	FMS–components of FMS – types	**T(1) R(1)**
27.	1	FMS workstation	**T(1) R(1)**
28.	1	Material handling and storage systems	**T(1)**
29.	1	FMS layout –computer control systems	**T(1)**
30.	1	Application and benefits	**T(1)**
Total No. of Periods Planned for Unit - III			**10**

Sl. No.	No. of Periods	Topics to be Covered	Support Materials
UNIT – IV : CIM IMPLEMENTATION AND DATA COMMUNICATION			
31.	1	CIM and company strategy – system modeling tools	**T(1)**
32.	1	IDEF models – activity cycle diagram	**T(1)**
33.	1	CIM open system architecture (CIMOSA)	**T(1)**
34.	1	Manufacturing enterprise wheel–CIM architecture	**T(1)**
35.	1	Product data management - CIM implementation software	**T(1)**
36.	1	Communication fundamentals– local area networks	**T(1)**
37.	1	Topology – LAN implementations	**T(1)**
38.	1	Network management and installations	**T(1)**
39.	1	MRP concepts	**T(1)**
40.	1	ERP concepts	**T(1)**
Total No. of Periods Planned for Unit - IV			**10**

Sl. No.	No. of Periods	Topics to be Covered	Support Materials
UNIT – V : OPEN SYSTEM AND DATABASE FOR CIM			
41.	1	Open systems–open system inter connection	**R(1) R(3)**
42.	1	Manufacturing automations protocol (MAP)	**R(1) R(3)**
43.	1	Technical office protocol (TOP).	**R(1) R(3)**
44.	1	Development of databases	**R(1) R(3)**
45.	1	Database terminology	**R(1) R(3)**
46.	1	Architecture of database systems	**R(1) R(3)**
47.	1	Data modeling and data associations	**R(1) R(3)**
48.	1	Relational data bases	**R(1) R(3)**

49.	1	Database operators	**R(1) R(3)**
50.	1	Advantages of data base and relational database	**R(1) R(3)**
51.	2	**Discussion on Competitive Examination related Questions / University previous year questions**	**GATE, ESE QP**
		Total No. of Periods Planned for Unit - V	**12**

TOTAL PERIODS : 52

TEXT BOOKS

S. No.	Author(s) Name	Title of the book	Publisher	Year of Publication
1	Mikell.P.Groover	Automation, Production Systems and computer integrated manufacturing	Pearson Education, Delhi	2015

REFERENCES

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1. http://en.wikipedia.org/wiki/Computer-integrated_manufacturing
2. http://www.technologystudent.com/rmprp07/intman1.html
3. http://www.computerintegratedmanufacturing.com/

UNIT	Total No. of Periods Planned	Lecture Periods	Tutorial Periods
I	10	10	0
II	10	10	0
III	10	10	0
IV	10	10	0
V	12	12	0
TOTAL	**52**	**52**	**0**

I. CONTINUOUS INTERNAL ASSESSMENT : 40 Marks

(Internal Assessment Tests: 30, Attendance: 5, Assignment/Seminar: 5)

II. END SEMESTER EXAMINATION : 60 Marks

TOTAL : 100 Marks

FACULTY **HOD / MECH** **DEAN / FOE**

UNIT 1 - INTRODUCTION

1.1 INTRODUCTION

Computer Integrated Manufacturing (CIM) encompasses the entire range of product development and manufacturing activities with all the functions being carried out with the help of dedicated software packages. The data required for various functions are passed from one application software to another in a seamless manner. For example, the product data is created during design. This data has to be transferred from the modeling software to manufacturing software without any loss of data. CIM uses a common database wherever feasible and communication technologies to integrate design, manufacturing and associated business functions that combine the automated segments of a factory or a manufacturing facility. CIM reduces the human component of manufacturing and thereby relieves the process of its slow, expensive and error-prone component. CIM stands for a holistic and methodological approach to the activities of the manufacturing enterprise in order to achieve vast improvement in its performance.

This methodological approach is applied to all activities from the design of the product to customer support in an integrated way, using various methods, means and techniques in order to achieve production improvement, cost reduction, fulfillment of scheduled delivery dates, quality improvement and total flexibility in the manufacturing system.

CIM requires all those associated with a company to involve totally in the process of product development and manufacture. In such a holistic approach, economic, social and human aspects have the same importance as technical aspects. CIM also encompasses the whole lot of enabling technologies including total quality management, business process reengineering, concurrent engineering, workflow automation, enterprise resource planning and flexible manufacturing. A distinct feature of manufacturing today is mass customization. This implies that though the products are manufactured in large quantities, products must incorporate customer-specific changes to satisfy the diverse requirements of the customers. This requires extremely high flexibility in the manufacturing system. The challenge before the manufacturing engineers is illustrated in Fig.1.1.

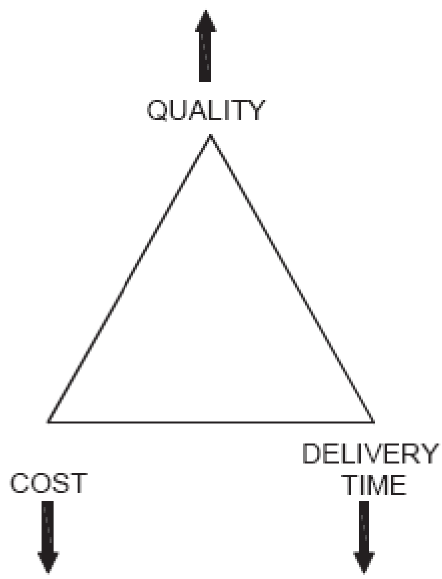


Fig.1.1 Challenges in Manufacturing

Manufacturing industries strive to reduce the cost of the product continuously to remain competitive in the face of global competition. In addition, there is the need to improve the quality and performance levels on a continuing basis. Another important requirement is on time delivery. In the context of global outsourcing and long supply chains cutting across several international borders, the task of continuously reducing delivery times is really an arduous task. CIM has several software tools to address the above needs. Manufacturing engineers are required to achieve the following objectives to be competitive in a global context.

• Reduction in inventory
• Lower the cost of the product
• Reduce waste
• Improve quality

Increase flexibility in manufacturing to achieve immediate and rapid response to:

• Product changes
• Production changes
• Process change
• Equipment change
• Change of personnel

CIM technology is an enabling technology to meet the above challenges to the manufacturing. The advances in automation have enabled industries to develop islands of automation. Examples are flexible manufacturing cells, robotized work cells, flexible inspection cells etc. One of the objectives of CIM is to achieve the consolidation and integration of these islands of automation. This requires sharing of information among different applications or sections of a factory, accessing incompatible and heterogeneous data and devices. The ultimate objective is to meet the competition by improved customer satisfaction through reduction in cost, improvement in quality and reduction in product development time.

CIM makes full use of the capabilities of the digital computer to improve manufacturing. Two of them are:

i. Variable and Programmable automation

ii. Real time optimization

The computer has the capability to accomplish the above for hardware components of manufacturing (the manufacturing machinery and equipment) and software component of manufacturing (the application software, the information flow, database and so on). The capabilities of the computer are thus exploited not only for the various bits and pieces of manufacturing activity but also for the entire system of manufacturing. Computers have the tremendous potential needed to integrate the entire manufacturing system and thereby evolve the computer integrated manufacturing system.

1.2 TYPES OF MANUFACTURING

The term “manufacturing” covers a broad spectrum of activities. Metal working industries, process industries like chemical plants, oil refineries, food processing industries, electronic industries making microelectronic components, printed circuit boards, computers and entertainment electronic products etc. are examples of manufacturing industries. Manufacturing involves fabrication, assembly and testing in a majority of situations. However, in process industries operations are of a different nature. Manufacturing industries can be grouped into four categories:

i. Continuous Process Industries

In this type of industry, the production process generally follows a specific sequence. These industries can be easily automated and computers are widely used for process monitoring, control and optimization. Oil refineries, chemical plants, food processing industries, etc are examples of continuous process industries.

ii. Mass Production Industries Industries manufacturing fasteners (nuts, bolts etc.), integrated chips, automobiles, entertainment electronic products, bicycles, bearings etc. which are all mass produced can be classified as mass production industries. Production lines are specially designed and optimized to ensure automatic and cost effective operation. Automation can be either fixed type or flexible.

iii. Batch Production (Discrete Manufacturing) The largest percentage of manufacturing industries can be classified as batch production industries. The distinguishing features of this type of manufacture are the small to medium size of the batch, and varieties of such products to be taken up in a single shop. Due to the variety of components handled, work centres should have broader specifications. Another important fact is that small batch size involves loss of production time associated with product changeover.

As mentioned earlier, integration of computer in process industries for production automation, process monitoring and control and optimization is relatively easy. In the case of mass production and batch production computer integration faces a number of problems as there are a large number of support activities which are to be tied together. Automation of manufacture has been implemented using different techniques since the turn of the 20th Century. Fixed automation is the first type to emerge. Single spindle automatic lathe, multi spindle automatic lathe and transfer lines are examples of fixed automation. Fixed automation using mechanical, electrical, pneumatic and hydraulic systems is widely used in automobile manufacturing. This type of automation has a severe limitation - these are designed for a particular product and any product change will require extensive modifications to the automation system. The concept of programmable automation was introduced later. These were electrically controlled systems and programs were stored in punched cards and punched tapes. Typical examples of programmable automation are:

i. Electrical programme controlled milling machines

ii. Hydraulically operated Automatic lathes with programmable control drum

iii. Sequencing machines with punched card control /plug board control

Development of digital computers, microelectronics and microprocessors significantly altered the automation scenario during 1950-1990. Machine control systems are now designed around microprocessors and microelectronics is part and parcel of industrial drives and control. The significant advances in miniaturization through integration of large number of components into small integrated chips and the consequent improvement in reliability and performance have increased the popularity of microelectronics. This has resulted in the availability of high performance desktop computing machines as well as file servers which can be used for industrial control with the help of application software packages.

1.3 EVOLUTION OF COMPUTER INTEGRATED MANUFACTURING

Computer Integrated Manufacturing (CIM) is considered a natural evolution of the technology of CAD/CAM which by itself evolved by the integration of CAD and CAM. Massachusetts Institute of Technology (MIT, USA) is credited with pioneering the development in both CAD and CAM. The need to meet the design and manufacturing requirements of aerospace industries after the Second World War necessitated the development these technologies. The manufacturing technology available during late 40’s and early 50’s could not meet the design and manufacturing challenges arising out of the need to develop sophisticated aircraft and satellite launch vehicles. This prompted the US Air Force to approach MIT to develop suitable control systems, drives and programming techniques for machine tools using electronic control.

The first major innovation in machine control is the Numerical Control (NC), demonstrated at MIT in 1952. Early Numerical Control Systems were all basically hardwired systems, since these were built with discrete systems or with later first generation integrated chips. Early NC machines used paper tape as an input medium. Every NC machine was fitted with a tape reader to read paper tape and transfer the program to the memory of the machine tool block by block. Mainframe computers were used to control a group of NC machines by mid 60’s. This arrangement was then called Direct Numerical Control (DNC) as the computer bypassed the tape reader to transfer the program data to the machine controller. By late 60's mini computers were being commonly used to control NC machines.

At this stage NC became truly soft wired with the facilities of mass program storage, offline editing and software logic control and processing. This development is called Computer Numerical Control (CNC).

Since 70's, numerical controllers are being designed around microprocessors, resulting in compact CNC systems. A further development to this technology is the distributed numerical control (also called DNC) in which processing of NC program is carried out in different computers operating at different hierarchical levels - typically from mainframe host computers to plant computers to the machine controller. Today the CNC systems are built around powerful 32 bit and 64 bit microprocessors. PC based systems are also becoming increasingly popular.

Manufacturing engineers also started using computers for such tasks like inventory control, demand forecasting, production planning and control etc. CNC technology was adapted in the development of co-ordinate measuring machine's (CMMs) which automated inspection. Robots were introduced to automate several tasks like machine loading, materials handling, welding, painting and assembly. All these developments led to the evolution of flexible manufacturing cells and flexible manufacturing systems in late 70's. Evolution of Computer Aided Design (CAD), on the other hand was to cater to the geometric modeling needs of automobile and aeronautical industries. The developments in computers, design workstations, graphic cards, display devices and graphic input and output devices during the last ten years have been phenomenal. This coupled with the development of operating system with graphic user interfaces and powerful interactive (user friendly) software packages for modeling, drafting, analysis and optimization provides the necessary tools to automate the design process.

CAD in fact owes its development to the APT language project at MIT in early 50's. Several clones of APT were introduced in 80's to automatically develop NC codes from the geometric model of the component. Now, one can model, draft, analyze, simulate, modify, optimize and create the NC code to manufacture a component and simulate the machining operation sitting at a computer workstation.

1.4 CIM HARDWARE AND CIM SOFTWARE

CIM Hardware comprises the following:

i. Manufacturing equipment such as CNC machines or computerized work centres, robotic work cells, DNC/FMS systems, work handling and tool handling devices, storage devices, sensors, shop floor data collection devices, inspection machines etc.

ii. Computers, controllers, CAD/CAM systems, workstations / terminals, data entry terminals, bar code readers, RFID tags, printers, plotters and other peripheral devices, modems, cables, connectors etc.,

CIM software comprises computer programmes to carry out the following functions:

Management Information System

Sales

Marketing

Finance
Database Management
Modeling and Design
Analysis
Simulation
Communications
Monitoring
Production Control
Manufacturing Area Control
Job Tracking

Inventory Control
Shop Floor Data Collection
Order Entry
Materials Handling
Device Drivers
Process Planning
Manufacturing Facilities Planning
Work Flow Automation
Business Process Engineering
Network Management
Quality Management

1.5 NATURE AND ROLE OF THE ELEMENTS OF CIM SYSTEM

Nine major elements of a CIM system are in Fig 1.2. They are:

Marketing
Product Design
Planning
Purchase
Manufacturing Engineering
Factory Automation Hardware
Warehousing
Logistics and Supply Chain Management
Finance
Information Management

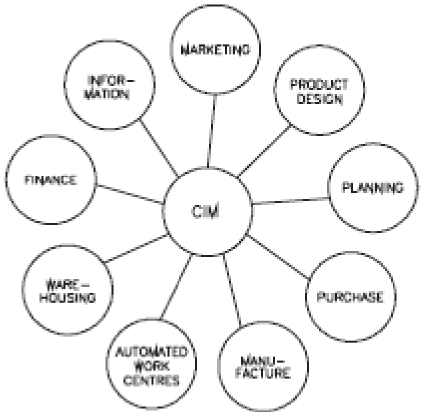


Fig.1.2 Major Elements of a CIM System

i. Marketing: The need for a product is identified by the marketing division. The specifications of the product, the projection of manufacturing quantities and the strategy for marketing the product are also decided by the marketing department.

Marketing also works out the manufacturing costs to assess the economic viability of the product.

ii. Product Design: The design department of the company establishes the initial database for production of a proposed product. In a CIM system this is accomplished through activities such as geometric modeling and computer aided design while considering the product requirements and concepts generated by the creativity of the design engineer. Configuration management is an important activity in many designs. Complex designs are usually carried out by several teams working simultaneously, located often in different parts of the world. The design process is constrained by the costs that will be incurred in actual production and by the capabilities of the available production equipment and processes. The design process creates the database required to manufacture the part.

iii. Planning: The planning department takes the database established by the design department and enriches it with production data and information to produce a plan for the production of the product. Planning involves several subsystems dealing with materials, facility, process, tools, manpower, capacity, scheduling, outsourcing, assembly, inspection, logistics etc. In a CIM system, this planning process should be constrained by the production costs and by the production equipment and process capability, in order to generate an optimized plan.

iv. Purchase: The purchase departments is responsible for placing the purchase orders and follow up, ensure quality in the production process of the vendor, receive the items, arrange for inspection and supply the items to the stores or arrange timely delivery depending on the production schedule for eventual supply to manufacture and assembly.

v. Manufacturing Engineering: Manufacturing Engineering is the activity of carrying out the production of the product, involving further enrichment of the database with performance data and information about the production equipment and processes. In CIM, this requires activities like CNC programming, simulation and computer aided scheduling of the production activity. This should include online dynamic scheduling and control based on the real time performance of the equipment and processes to assure continuous production activity. Often, the need to meet fluctuating market demand requires the manufacturing system flexible and agile.

vi. Factory Automation Hardware: Factory automation equipment further enriches the database with equipment and process data, resident either in the operator or the equipment to carry out the production process. In CIM system this consists of computer controlled process machinery such as CNC machine tools, flexible manufacturing systems (FMS), Computer controlled robots, material handling systems, computer controlled assembly systems, flexibly automated inspection systems and so on.

vii. Warehousing: Warehousing is the function involving storage and retrieval of raw materials, components, finished goods as well as shipment of items. In today's complex outsourcing scenario and the need for just-in-time supply of components and subsystems, logistics and supply chain management assume great importance.

viii. Finance: Finance deals with the resources pertaining to money. Planning of investment, working capital, and cash flow control, realization of receipts, accounting and allocation of funds are the major tasks of the finance departments.

Unit 1 - MCQ

	Question	Option 1	Option 2	Option 3	Option 4	Ans
1	Manufacturing department receives ______________ from research, design and product development as well as statistical process control	Outputs	Inputs	Income	Outcome	2
2	These engineering activities can be grouped under the ________________ heading	One	Two	Three	Four	2
3	The CIM wheel captures the concept of _______ all industrial function	Total production	Total process	Total integration	Total planning	3
4	First NC unimate robot was installed at the Ford motor company______________	1959	1969	1963	1960	4
5	CIM software application such as	FMS	TQM	LM	CAPP & MRP II	4
6	Business planning function include activities ___________________________	Process control	Material Handling	Inspection	Forecasting	4
7	MAP represents a set of rules for operating a	Network communication	DATA communication	External communication	Electronic data	2
8	CAPP involves the preparation and of the plans for manufacturing the products	Editing	Detailing	Documentation	Generating	3
9	The process of converting the raw material in to a finished product ___________	Manufacturing system	Process planning	CAPP	Manufacturing	4
10	A system which performs manufaturing operation _______________	Manufacturing system	Process planning	CAPP	Manufacturing	4
11	DNC is used for ____________	Operation control	Management control	workers control	Economy control	2
12	CIM is used for ____________	Operation control	Management control	Manage and control	Workers control	3
14	The General motors was started in the year ____________	1980	1968	1978	1958	1

15	CIM was developed by ____________	CASA/SME	CAPP	PPC	PPE	1
16	Full form of LM in CIM	Lean manufacture	Local manufacture	Lead manufacture	Lowest manufacture	1
17	G.T code is ___________ character	Liabol	correct	String character	Perfect	3
18	The NC systems were used in automation from the year__________	Early 1950's	1955	Early 1970's	1973	2
19	The approach of Island of atuomation is _____________	Global	International	National	Local	4
20	MRP II is an integrated information system that ____________	Integrate	Communicate	Synchronize	Performs	3
21	A Robot is a ____________ multi function manipulator	Programmable	Reprogrammable	Multi programmable	Reliable programmed	3
22	________________ is an manufacturing activity that involve in the effective use of computer and computer technology	FMS	CAM	CAD	CAPP	2
23	_____________ is an implementation of OSI model	CAPP	EDI	CAD	MAP	4
24	The term _____________ represents the various technologies that facilitates manufacturing automation is isolation, without having integratised with other manufacturing technologies	FMS	Islands of automation	CIM system	External communication	2
25	MAP represents a set of roles for operating a __________	Network communication	Data communication	External communication	Electronic data	2
26	CIM wheel consists _______________ aspect	21	23	10	3	1
27	ASRS is the abbreviation for	automatic storage and renewal system	automatic storage and resource system	automatic storage and retrieval system	automatic storage and robot system	3
28	___________ may be defined as the electronic data transfer from computer to computer	MAP	CAD	EDI	ISO/OSI	3
29	___________ is the process of discovering and translating	Material	Marketing	Engineering	production	2

	consumer works in to product and service specifications	handling			planning	
30	the second hierarchical level is the use of ___________ system	CNC	NC	DNC	FMS	3
31	Punched paper tape was generated in the year	1923	1909	1952	late 1960's	3
32	the concept of flexible manufacturing system was established in the year	1980's	late 1970's	early 1970's	1973	1
33	The phrase "Computer integrated manufacturing" was coined by	Burbidge	General motors	Ford	James Harrington	4
34	___________ is defined as the control and performance of manufacturing process with out human labour	CIM	FMS	CAPP	Automation	4
35	CIM is the _______________ of total manufacturing enterprise through the use of integral system and data communication	addition	multiplication	integration	differentiation	3
36	For ________________ CIM is a concept	low management	middle management	middle managers	top management	4
37	For ________________ CIM is technology	middle managers	line managers	both a&b	none of the above	3
38	CAD, CAM, CNC, FMS are ___________________ of CIM	components	integration	both a&b	none of the above	1
39	The order winning criteria is the _____________ level of operational capabilities that required to get an order	maximum	minimum	equal	none of the above	2
40	_______________ is a design activity that involves effective use of computers	FMS	CAM	CAD	CAPP	3
41	The responsibilities of __________ engineering include plant automation, planning the installation of new equipment planning material flow and related work handling equipments etc…	mechanical	production	facilities	electrical and electronics	3
42	The CIM is the integration of total manufacturing ___________ of integrated system	communication	enterprise	organizational	personnel efficiency	2
43	manufacturing system divided in to ______________	5	4	3	2	1

	groups					
44	The CASA is defined as	computation and automatic system association	computer automatic system association	computer and automated system association	none of these	3
45	The manufacturing of ________________ quality products at low cost	high	low	medium	none of these	1

2 marks

1. Define CIM.
2. What is the role of CIM is manufacturing?
3. What are the goals of automation in manufacturing industry?
4. What are the key functions of a manufacturing company?
5. Define automation.

14 marks

1. What is CIM? Explain briefly the meaning and concept of CIM and discuss the various benefits of implementing a CIM system.
2. Discuss the various changing manufacturing and management scene that led to the development of CIM
3. What do you understand by the term 'island of automation'? List and Explain any six
4. With a flow chart explain various engineering function carried out in a manufacturing company.
5. What is CIM wheel? Explain its different segments in relation to CIM's scope.
6. Briefly explain the nature and role of the elements of CIM System.
7. Describe the basic activities that must be carried at in a factory to convert raw materials into finished product.
8. Briefly explain the product related activities of a company with neat flow-chart diagram.
9. Explain briefly about the marketing engineering
10. What is meant by financial management and briefly explain business and financial management

UNIT-II

GROUP TECHNOLOGY-GT

Introduction

- Group technology was introduced by Frederick Taylor in 1919 as a way to improve productivity.
- One of long term benefits of group technology is it helps implement a manufacturing strategy aimed at greater automation.
- Group technology (GT) is a manufacturing concept in which similar parts are identified and grouped together in parts groups or families to take advantage of their similarities in manufacturing and design.
- By grouping similar parts into families, manufacturing personnel can improve efficiency.
- GT can also improve the productivity of design personnel by decreasing the amount of work and time involved in designing new parts by simply modifying the design of the already existing part.

GT viewed as:

- An essential step in the move toward factory automation.
- A necessary step in maintaining a high quality level and profitable production.

PART FAMILIES

- A part family is a collection of parts which are similar either because of geometric shape and size or because similar processing steps are required in their manufacture.
- It is possible for parts in the same family to be very similar in design yet radically different in the area of production requirements. The opposite may also be true.
- The part family concept is central to design-retrieval systems and most computer-aided process planning schemes.
- The parts which are similar in their design characteristics are grouped in a family referred
- to as a *design part family*.
- The parts which are similar in their manufacturing characteristics are grouped in a family referred to as a *manufacturing part family*.
- The characteristics used in classifying parts are referred to as "attributes".

There are three general methods for grouping parts into families

1. Visual inspection.
2. Route sheet analysis.
3. Parts classification and coding system.

Visual inspection

- The visual inspection method is the simplest and least sophisticated method.
- It involves looking at parts, photos of parts, or drawings of parts and arranging them into similar grouping.

- This is the easiest approach, especially for grouping parts by design attributes.

Route sheet analysis

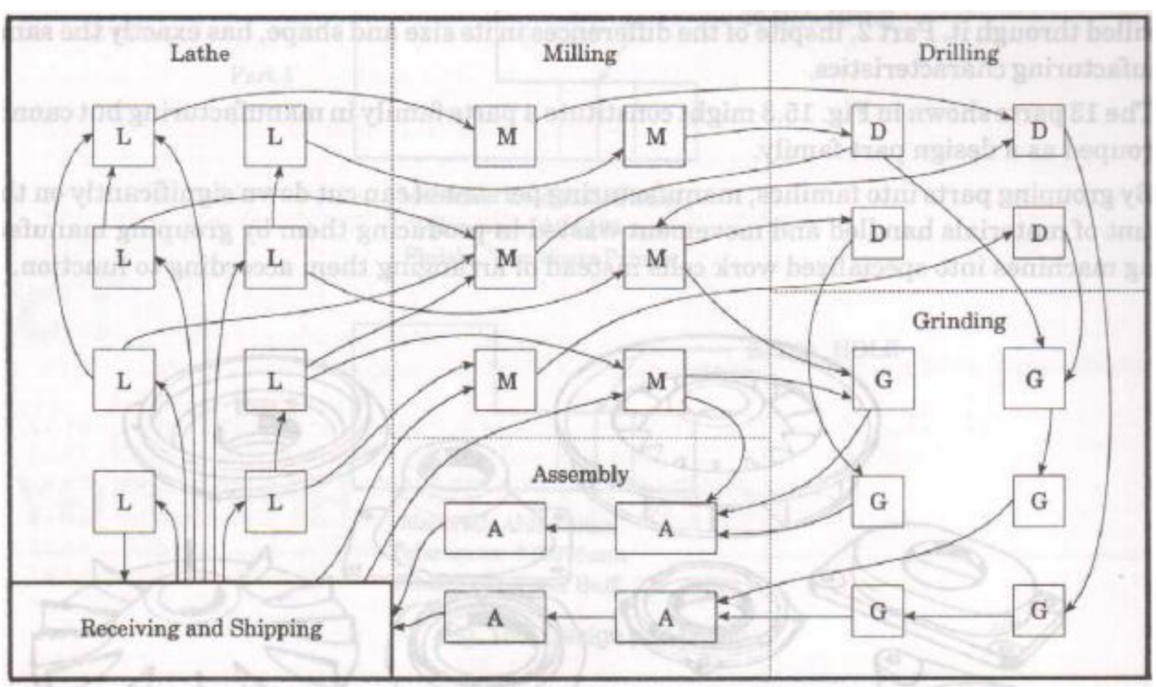
- In the route sheet inspection method, the route sheets used to route the parts through the various operations to be performed, are inspected.
- This can be an effective way to group parts into manufacturing part families, provided the routing sheets are correct.
- This method is sometimes referred to as the Production Flow Analysis (PFA) method.
- PFA is carried out in three stages: Factory Flow Analysis, Group Analysis, and Line Analysis.

Parts classification and coding system.

- The most widely used method for grouping parts is the parts classification and coding method.
- This is also the most sophisticated, most difficult, and most time-consuming method.

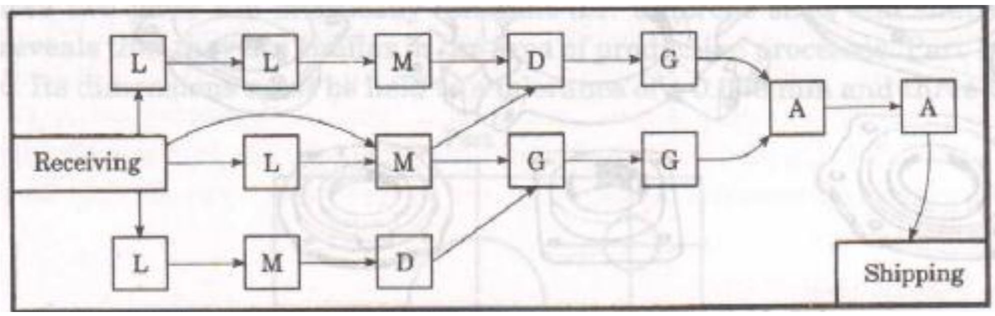
Comparison of functional layout with GT layout.

- Group technology (GT) is a manufacturing philosophy that seeks to improve productivity by grouping parts and products with similar characteristics into families and forming production cells with a group of dissimilar machines and processes.
- By grouping parts into families, manufacturing personnel can cut down significantly on the amount of materials handled and movement wasted in producing them by grouping manufacturing machines into specialized work cells instead of arranging them according to function.



Process-type layout

- The above figure shows a process-type layout for batch production in a machine shop.
- The process machine tools are arranged by function.
- During the machining of a given part, the workpiece must be moved between sections, with perhaps the same section being visited several times.
- This results in a significant amount of material handling, a large in-process inventory, usually
- more setups than necessary, long manufacturing lead times, and high cost.



Group technology layout

- The above figure shows a production shop of equivalent capacity, but with the machines arranged into cells.
- Each cell is organized to specialize in the manufacture of a particular part family.
- Advantages are gained in the form of reduced workpiece handling, lower setup times, less in-process inventory, and shorter lead times.

Production Flow Analysis – PFA

- Production flow analysis is a technique for forming part families and/or machine groups/cells by analyzing the operation sequence and the routing of a part through the machines and workstations in the plant.

The following steps are involved in carrying out the PFA by group analysis technique:

- The route sheet of all the components to be manufactured in the shop is examined.
- A matrix showing the operation numbers and the components number is prepared, showing which component requires which operations.
- Any particular part is included only in one group. For facility grouping, one machine type should be only in one group.
- If any operation is required by only one or very few components, or if some operation is required by all (or nearly all) the components, then these operations should not be taken note of while deciding the groups.

Let us consider an example of an assembly requiring 16 parts to be operated on 4 machines, as shown in Table

Machine	Part Number															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
L	X	X		X		X	X	X	X	X	X			X	X	X
M	X		X	X	X	X	X		X		X	X	X			X
D	X	X	X	X		X	X	X	X	X	X	X	X	X	X	
G	X	X	X		X		X	X	X	X	X		X		X	X

Original data· Before grouping.

L = Lathe; *M* = Milling Machine; *D* = Drill Machiue ; G = Grinding Machine

- We find that parts I, 7, 9, 11,4,6, and 16 require almost all the four machines;
- parts 2, 8,l0,15, and 14 require nearly all the L, D, G machines; and
- parts 3, 13, 12, 5 require nearly M,D,G machines.

After grouping, the part families/machines are shown in Table

Machine	Part Number															
	1	7	9	11	4	6	16	2	8	10	15	14	3	13	12	5
L	X	X	X	X	X	X	X									
M	X	X	X	X	X	X	X									
D	X	X	X	X	X	X										
G	X	X	X	X			X									
L								X	X	X	X	X				
D								X	X	X	X	X				
G								X	X	X	X					
M													X	X	X	X
D													X	X	X	
G													X	X		X

Part families/machine groups-after grouping.

- To use this method successfully, one should ensure that a reliable data source of routing or operation sheets are available. Part families can be formed with or without a classification and coding system, since production flow-analysis requires only operation sheets and production data.

Selection of a Coding System

Ham lists several factors that should be considered in selecting a suitable classification-and· coding system:

• Objective. What is the major objective of the classification system? Why is a system needed? Is it primarily for design retrieval or part-family manufacturing or both?

• Scope and application. What departments are involved in using the system? What are the specific needs and information to be coded? How wide is the range of products and how complex are the parts, shapes, process operations, tooling, etc.?

• Costs and time. How much expense will be involved in installation, training, and system maintenance? What is the cost estimate for consultant fees, in-house design, training, etc.? How long will it take to install and train the staff needed? How long will it take to realize the effects of the system in all areas of application, from design to production?

• Adaptability to other systems. Is the system easily adaptable to the computer system and database being used in the company? Can the system be easily integrated with other systems, such as process planning, NC programming, management information systems, etc. ?

• Management problems. Are all involved management personnel informed and supportive about installation of the system? Is there any union problem? Can good cooperation among the involved departments be obtained?

Some typical engineering objectives are:

1. Provide an efficient retrieval system for similar parts.
2. Provide part information in a standard form.
3. Provide an efficient means to determine manufacturing capability and producibility.

From the manufacturing viewpoint, some typical objectives are :

1. Provide information required to form part families.
2. Provide for efficient retrieval of process plans.
3. Provide an efficient means to form machine groups or cells for part families.

The following are the additional factors that should be kept in mind when selecting a coding system:

• Robustness----capability of handling all parts now being sold or planned to be sold by the firm.
• Expandability-to cope up with future demands.
• Differentiation-to distinguish between different part families.
• Automation-for computer use.
• Efficiency-the number of digits required to codes a typical part should not be too small.
• Cost-including initial, modifying, interfacing and operational costs.
• Simplicity-ease of use and training.

PARTS CLASSIFICATION AND CODING

- Parts classification and coding is a method in which the various design and/or manufacturing attributes of a part are identified, listed, and assigned a code number.

The different classification and coding systems may be grouped as:

1. Design attribute group.

Commonly used design attributes include:

- Dimensions
- Shape
- Tolerances
- Surface finish
- Material
- Function

2. Manufacturing attribute group.

Commonly used manufacturing attributes include:

- Production processes
- Production time
- Operational sequence
- Tools required
- Fixtures required
- Batch size
- Machine tool
- Annual production

3. Combined attribute group.

This system combines the best characteristics of both the design and manufacturing attributes.

CODING SYSTEMS

The coding systems widely used are:

1. RNC (Brisch-Birn Type developed for General Motors) 6-digit monocode.
2. CODE (Manufacturing Data Systems) 8-digit hexadecimal semipolycode.
3. MICLASS (TNO) 12-digit decimal semipolycode.
4. DCLASS (Design and Classification Information System) 8-digit hybrid code.
5. OPITZ (Dr. H Opitz, Aachen, West Germany) 9-digit decimal semipolycode version.

The CODE System

– The CODE system has eight digits.
– For each digit there are 16 possible values (zero through 9 and A through F) which are used to describe the part's design and manufacturing attributes.
– The initial digit position indicates the basic geometry of the part and is called the Major Division of the CODE system.
– This digit would be used to specify whether the shape was a cylinder, flat piece, block, or other.
– The interpretation of the remaining seven digits depends on the value of the first digit, but these remaining digits form a chain type structure.

2nd and 3rd digits	Basic geometry and principal manufacturing process.
4th, 5th and 6th digits	Secondary manufacturing process, *e.g.* threads, grooves, slots, etc.
7th and 8th digits	Overall size of the part

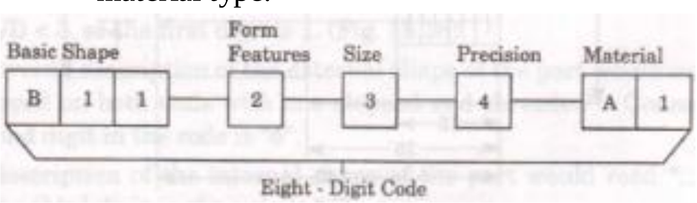
The MICLASS (Metal Institute Classification) System:

– The MICLASS classification number can range from 12 to 30 digits.
– The first 12 digits are a universal code that can be applied to any part.
– Upto 18 additional digits can be used to code data that are specific to the particular company or industry.
– The work part attributes coded in the first 12 digits of the MICLASS number are as follows:

1st digit	Main shape
2nd and 3rd digits	Shape elements
4th digit	Position of shape elements
5th and 6th digits	Main dimensions
7th digit	Dimension ratio
8th digit	Auxiliary dimension
9th and 10th digits	Tolerance codes
11th and 12th digits	Material codes.

DCLASS Coding System

- The DCLASS part family code is comprised of eight digits partitioned into five code segments, as shown in Figure.
- The first segment, composed of three digits, is used to denote the basic shape.
- The form features code is entered in the next segment; it is one digit in length. This code is used to specify the complexity of the part, which includes features (such as holes and slots) heat treatments, and special surface finishes. The complexity is determined by the number of special features.
- The one-digit-size code is the third segment of the part family code.From the value of the code, the user will know the overall size envelope of the coded part.
- The fourth segment denotes precision; it is one digit in length.
- The final two digits, which comprise the fifth segment of the part family code, are used to denote the material type.



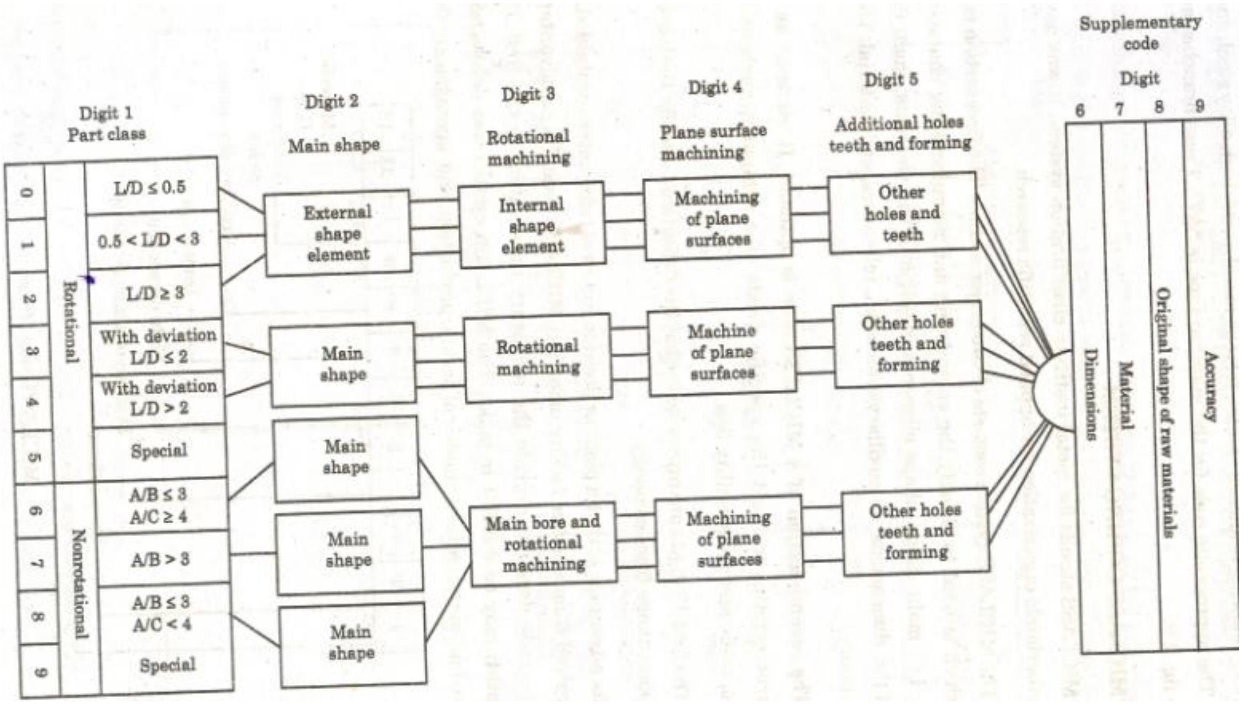
D-Class Part code segment

The Opitz Classification System

- Classification and coding systems use alphanumeric symbols to represent the various attributes of a part.
- The opitz system uses characters in 13 places to code the attributes of parts, and hence, to classify them. These digit places are represented as follows:

12345 6789 ABCD

- The first five digits (12345) code the major designs attributes of a part and are called the "form code". The next four digits (6789) are for coding manufacturing-related attributes and are called the "supplementary code".
- The letters (ABCD) code the production operation and sequence and are referred to as the "secondary code".
- The secondary code can be designated by the firm to serve its own particular needs.



Basic structure of opitz system

	Digit 1: Part class	Digit 2: External shape, external shape elements	Digit 3: Internal shape, internal shape elements	Digit 4: Plane surface machining	Digit 5: Auxiliary holes and gear teeth
0	Rotational parts: L/D ≤ 0·5	Smooth, no shape elements	No hole, no breakthrough	No surface machining	No auxiliary hole
1	0·5 < L/D < 3	Stepped to one end or smooth: No shape elements	Smooth or stepped to one end: No shape elements	Surface plane and/or curved in one direction, external	No gear teeth: Axial, not on pitch circle diameter
2	L/D ≥ 3	Thread	Thread	External plane surface related by graduation around a circle	Axial on pitch circle diameter
3		Functional groove	Functional groove	External groove and/or slot	Radial, not on pitch circle diameter
4		Stepped to both ends: No shape elements	Stepped to both ends: No shape elements	External spline (polygon)	Axial and/or radial and/or other direction
5		Thread	Thread	External plane surface and/or slot, external spline	Axial and/or radial on PCD and/or other directions
6	Nonrotational parts	Functional groove	Functional groove	Internal plane surface and/or slot	With gear teeth: Spur gear teeth
7		Functional cone	Functional cone	Internal spline (polygon)	Bevel gear teeth
8		Operating thread	Operating thread	Internal and external polygon, groove and/or slot	Other gear teeth
9		All others	All others	All others	All others

Form code(digit 1through 5) for rotational parts in the opitz system

BENEFITS OF GROUP TECHNOLOGY

Group technology, when successfully implemented, offers many benefits to industries. GT benefits can be realized in a manufacturing organization in the following areas:

1. Product design,
2. Tooling and setups,
3. Materials handling,
4. Production and inventory control,
5. Process planning, and
6. Management and employees.

These benefits can be summarized as follows:

i. In product engineering, GT can help reduce part proliferation, encourage design standardization, provide manufacturing feedback, and help with cost estimating.

ii. GT can help manufacturing engineering with process selection, tooling selection (and grouping), machine procurement, facilities planning, materials flow, and materials handling. It can also help to bring new technology to the attention planners by automatically offering newly acquired equipment or capabilities as processing alternatives.

iii. In production, GT can reduce lead-time, production delays, and setup times and can help with asset utilization, materials handling, communication, product quality, and Production **supervision.**

iv. Production control can use group technology for group scheduling, stock accountability, expediting, and reducing WIP inventory. Ultimately; group technology can affect customer support by providing better handling of dealer inventory and shorter deliveries. Group technology can help to bridge the CAD/CAM functions and provide a key element in the computer-integrated manufacturing system.

Advantages of Group Technology

As discussed earlier, GT applications have many advantages.

1. GT facilitates *(a)* efficient retrieval of similar parts, *(b)* development of a database containing effective product design data, and *(c)* avoidance of design duplication.
2. GT encourages standardization of designs, tooling, fixturing, and setups.
3. GT facilitates *(a)* development of a computer-aided process planning (CAPP) system, *(b)* retrieval of process plans for part families, and *(c)* development of standard routings for part families.
4. Times and costs for material handling and waiting between stages are reduced.
5. Production planning and control is simplified.
6. Setup time and setup cost for each job are reduced, because several jobs are grouped and processed in sequence.
7. Machining cells can reduce work-in-process inventory, resulting in shorter queues and shorter manufacturing throughput times.
8. Part and product quality are improved.
9. GT facilitates better employee involvement and increases workers satisfaction.
10. Management can be more effective because the environment has been simplified.
11. Purchasing can be more effective. It is easier to choose the proper vendor because the many different parts and materials have been grouped into families, which reduces the complexity of the problem.

DISADVANTAGES OF GT

1. Installing a coding and classification system requires a large amount of time and effort; it is expensive.
2. If communication between design engineering and manufacturing is poor, as is often the case, difficulties may be encountered in installing a coding and classification system. It may not be very successful.
3. There are no accepted GT standards. Consequently, there is no common implementation approach, and implementation is often difficult.
4. Groupings of machines may lead to poor utilization of some machines in the group.This is difficult for management to accept even through overall costs are reduced.
5. Large costs may be incurred in rearranging the plant into machine cells or groups.
6. GT concepts require changing how people work; therefore, employee resistance may be encountered.
7. Without strong support from top management, implementation of GT will be difficult.

CELLULAR MANUFACTURING

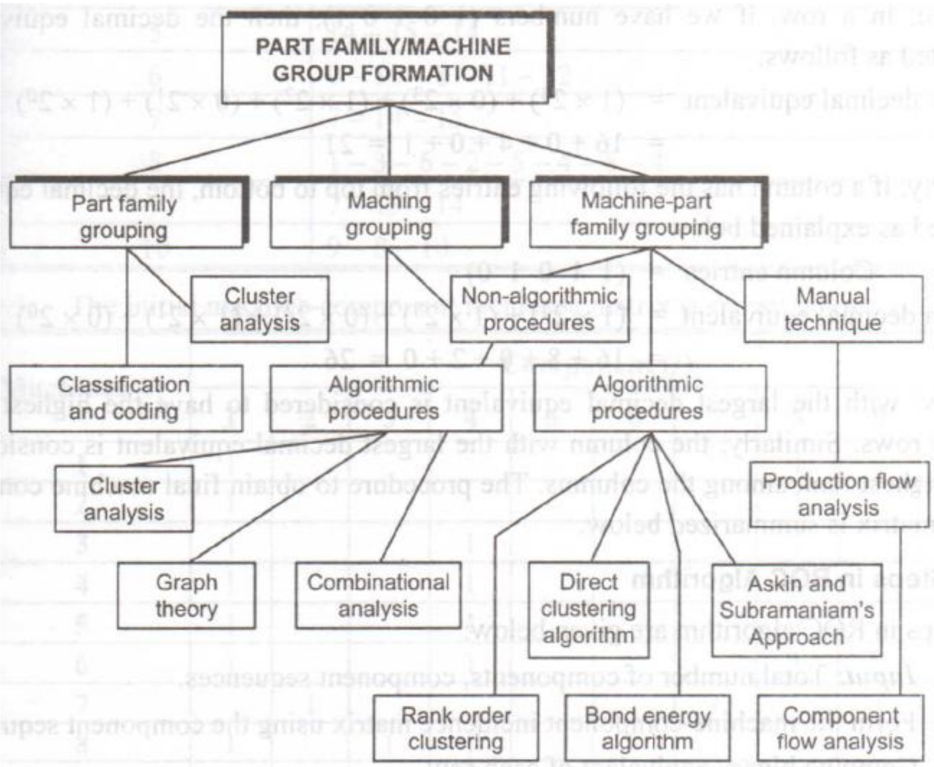
- *Cellular manufacturing (CM) is an application of group technology in which dissimilar machines have been aggregated into cells, each of which is dedicated to the production of part family*.
- The primary advantage of CM implementation is that a large manufacturing system can be decomposed into smaller subsystems of machines called cells. These cells are dedicated to process part families based on similarities in manufacturing requirements.
- Parts having similar manufacturing requirements can be processed entirely in that cell. In addition, cells represent sociological units conducive to team work which lead to higher levels of motivation for process improvements.
- The potential benefits associated with the application of CM include improved market response, more reliable delivery promises, reduced tooling and fixtures, and simplified scheduling.

Benefits of Cellular Manufacturing)

- Reduce manufacturing lead time
- Reduce work-in-process
- Improve part and/or product Quality
- Reduce response time for customer orders
- Reduce more distances/more times
- Increase manufacturing flexibility
- Reduce unit costs
- Simplify production planning and control
- Facilitate employee involvement
- Reduce set-up times
- Reduce finished goods inventory

Design of Cellular Manufacturing

Group technology, machines used to produce a family of parts should be grouped together in a cell. The procedure of forming cell is known as *machine-component grouping formation.*



Taxonomy of part family/machine group formation techniques

PROCESS PLANNING

INTRODUCTION

- The task of process planning consists of determining the manufacturing operations required to transform a part from a rough (raw material) to the finished state specified on the engineering drawing.
- Process planning, also known as *operations planning*, is the systematic determination of the engineering processes and systems to manufacture a product competitively and economically.
- Process planning consists of preparing set of instructions that describe how to manufacture the product and its parts.
- *Process planning* can be defined as "an act of preparing a detailed processing documentation for the manufacture of a piece part or assembly."
- According to the American Society of Tool and Manufacturing Engineers, *"process planning is the systematic determination of the methods by which a product is to be manufactured, economically and competitively. "*
- ***Process planning*** is concerned with the engineering and technological issues of how to make the product and its' parts. It answers the question: 'What types of equipment and tooling are required to fabricate the parts and assemble the product?'

- ***Production planning*** is concerned with the logistics issues of making the product. That is, production planning is concerned with ordering the materials and obtaining the resources required to make the product in sufficient quantities to satisfy demand for it.

Computer Aided Process Planning (CAPP)

Process planning with the aid of computer

• Process planning is concerned with the preparation of route sheets that list the sequence of operations and work centers require to produce the product and its components.

• Manufacturing firms try to automate the task of process planning using CAPP systems due to many limitations of manual process planning.

These includes:

– Tied to personal experience

– and knowledge of planner of production facilities, equipment, their capabilities, process and tooling. This results in inconsistent plans.

– Manual process planning is time consuming and slow.

– Slow in responding to changes in product design and production.

• The experience of manufacturing of different engineers, who are likely to retire, can be made available in future by CAPP.

• CAPP is usually considered to be part of CAM, however this results CAM as stand alone system.

• Synergy of CAM can be achieved by integrating it with CAD system and CAPP acts as a connection between the two.

• Readymade CAPP systems are available today to prepare route sheets.

APPROACHES TO PROCESS PLANNING

There are basically two approaches to process planning which are as follows :

(i) Manual experience-based process planning, and

(ii) Computer-aided process planning method.

Manual Experience-based Process Planning

The steps mentioned in the previous section are essentially same for manual process planning. Following difficulties are associated with manual experienced based process planning method :

- It is time consuming and over a period of time, plan developed are not consistent.
- Feasibility of process planning is dependent on many upstream factors (design and availability of machine tools). Downstream manufacturing activities such as scheduling and machine tool allocation are also influenced by such process plan.

Therefore, in order to generate a proper process plan, the process planner must have sufficient knowledge and experience. Hence, it is very difficult to develop the skill of the successful process planner and also a time consuming issue.

Computer-Aided Process Planning

Computer-aided process planning (CAPP) helps determine the processing steps required to make a part after CAP has been used to define what is to be made. CAPP programs develop a process plan or route sheet by following either a variant or a generative approach. The variant approach uses a file of standard process plans to retrieve the best plan in the file after reviewing the design. The plan can then be revised manually if it is not totally appropriate. The generative approach to CAPP starts with the product design specifications and can generate a detailed process plan complete with machine settings. CAPP systems use design algorithms, a file of machine characteristics, and decision logic to build the plans. Expert systems are based on decision rules and have been used in some generative CAPP systems.

CAPP has recently emerged as the most critical link to integrated CAD/CAM system into inter-organizational flow. Main focus is to optimize the system performance in a 18 **CIM Modelling and Operations**

global context. The essentiality of computer can easily be understood by taking an example, e.g. if we change the design, we must be able to fall back on a module of CAPP to generate cost estimates for these design changes. Similarly for the case of the breakdown of machines on shop floor. In this case, alternative process plan must be in hand so that the most economical solution for the situation can be adopted. Figure 9.2 is one such representation, where setting of multitude of interaction among various functions of an organization and dynamic changes that takes place in these sub functional areas have been shown. Hence, the use of computer in process planning is essential.

APPROACHES TO COMPUTER-AIDED PROCESS PLANNING

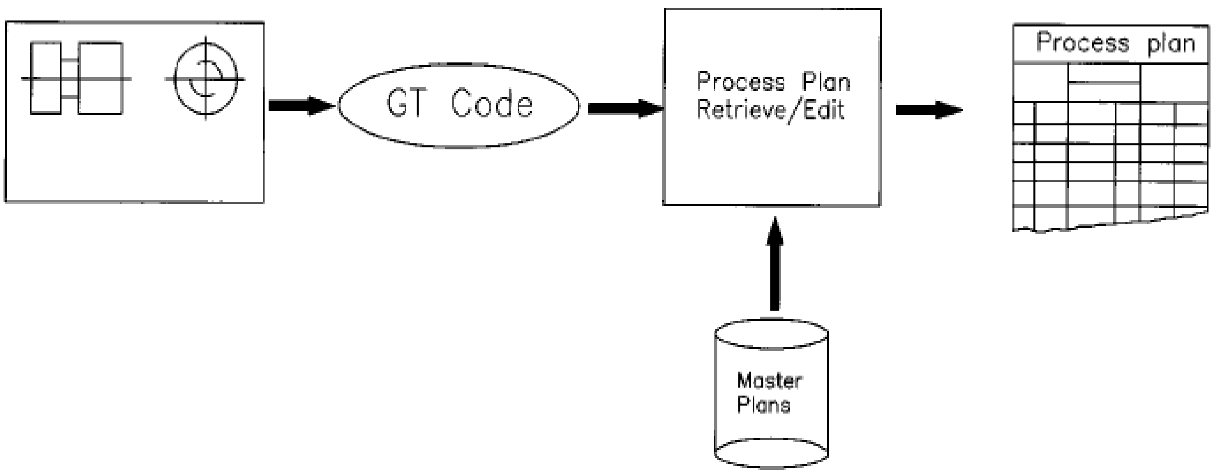
In recent days, several computer-aided process planning systems are available for use for a variety of manufacturing operation.

These systems can broadly be clarified into two categories :

(i) Variant computer aided process planning method.

(ii) Generative computer aided process planning method.

The Variant approach of CAPP



- The variant approach, which is also called retrieval approach, uses a group technology (GT) code to select a generic process plan from the existing master process plans developed for each part family and then edits to suit the requirement of the part.
- Variant approach is commonly implemented with GT coding system. Here, the parts are segmented into groups based on similarity and each group has a master plan.

Variant Process Planning, Advantages and Disadvantages

Variant process planning approach is sometimes referred as a data retrieval method. In this approach, process plan for a new part is generated by recalling, identifying and retrieving an existing plan for a similar part and making necessary modifications for new part. As name suggests a set of standard plans is established and maintained for each part family in a preparatory stage. Such parts are called master part. The similarity in design attributes and manufacturing methods are exploited for the purpose of formation of part families. Using coding and classification schemes of group technology (GT), a number of methods such as coefficient based algorithm and mathematical programming models have been developed for part family formation and plan retrieval. After identifying a new part with a family, the task of developing process plan is simple. It involves retrieving and modifying the process plan of master part of the family.

The general steps for data retrieval modification are as follows :

Establishing the Coding Scheme

A variant system usually begins with building a classification and coding scheme. Because, classification and coding provide a relatively easy way to identify similarity among existing and new parts. Today, several classification and coding systems are commercially available. In some extreme cases, a new coding scheme may be developed. If variant CAPP is preferred than it is useful for a company to look into several commercially available coding and classification systems (e.g. DCLASS, JD-CAPP etc.). Now, it is compared with companies before developing their own coding and classification system. Because using an existing system can save tremendous development time and manpower.

(i) **Form the Part Families by Grouping Parts**

The whole idea of GT lies into group numerous parts into a manageable number of part families. One of the key issues in forming part families is that all parts in the same family should have common and easily identifiable machined features. As a standard process plan are attached with each part family, thereby reducing the total number of standard process plans.

(ii) **Develop Standard Process Plans**

After formation of part families, standard process plan is developed for each part families based on common part features. The standard plan should be as simple as possible but detailed enough to distinguish it from other.

(iii) **Retrieve and Modify the Standard Plans for New Parts**

Step1 to step 3 are often referred as preparatory work. Each time when a new part enters the systems, it is designed and coded based on its feature, using the coding and classification scheme, and than assigned to a part family. The part should be similar to its fellow parts in the same family. Also, family's standard plan should represent the basic set of processes that the part has to go through. In order to generate detailed process routes and operation sheets to this part, the standard plan is retrieved from the data 21 **Computer Aided Process Planning**

base and modified. Modification is done by human process planar. After this stage parts are ready for release to the shop.

The success of aforementioned process planning system is dependent on selection of coding scheme, the standard process plan and the modification process, because the system is generally application oriented. It may be possible that one coding scheme is preferable for one company and same is not for other company.

Due to use and advancement of computers, the information management capability of variant process planning is much superior. Otherwise it is quite similar to manual experience-based planning.

Advantages and Disadvantages of Variant CAPP

Following advantages are associated with variant process planning approach:

(i) Processing and evaluation of complicated activities and managerial issues are done in an efficient manner. Hence lead to the reduction of time and labour requirement.

(ii) Structuring manufacturing knowledge of the process plans to company’s needs through standardized procedures.

(iii) Reduced development and hardware cost and shorter development time. This is an essential issue for small and medium scale companies, where product variety is not so high and process planner are interested in establishing their own process planning research activities.

Disadvantages of Variant Process Planning Approach

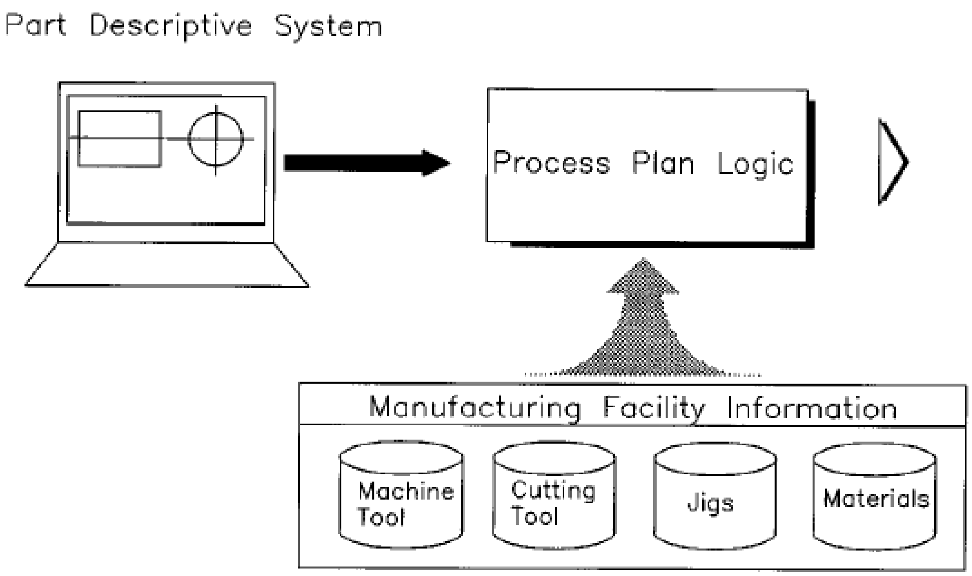
Following disadvantages are associated with variant process planning approach

(i) It is difficult to maintain consistency during editing.

(ii) Proper accommodation of various combinations of attributes such as material, geometry, size, precision, quality, alternate processing sequence and machine loading among many other factors are difficult.

(iii) The quality of the final process plan largely depends on the knowledge and experience of process planner. The dependency on process planner is one of the major shortcomings of variant process planning.

The Generative approach of CAPP



- In a generative approach, a process plan for each component is created from scratch without human intervention. These systems are designed to automatically synthesize process information to develop a process plan for a part
- Generative CAPP systems contain the logic to use *manufacturing data bases*, *knowledge bases* and suitable *part description* schemes to generate a process plan for a particular part.

Advantages of Generative approach of CAPP

1. Consistent process plans can be generated rapidly.
2. New components can be planned as easily as existing components.
3. It has potential for integrating with an automated manufacturing facility to provide detailed control information.

Unit 2 - MCQ

	Question	Option 1	Option 2	Option 3	Option 4	Ans
1	Attribute code is also known as ______________________________	Polycode	Chain code	Discrete code	All the above	4
2	Reason for using a coding scheme is________________________	design retrieval	Automated process planning	Machine cell design	All the above	4
3	The first five digits (12345)code the major design attributes of a part and are called the____________________	Supplementary code	Form Code	Secondary code	None of the above	2
4	The letters(ABCD) code the production operation and sequence and are referred as the ___________________	Supplementary code	Form Code	Secondary code	None of the above	3
5	Rank order clustering (ROC) algorithm is a simple algorithm using to form machine part group. It was developed by________________	J.R.King	Burbridge	MC.Auley	Michigan	1
6	The way to arrange m/c in a shop using group technology is______________________	Line (or product) Layout	Functional (or process) Layout	Group (or combination) layout	All these above	4
7	Visual inspection method. It involves looking at parts are______________________	Photo's & drawing	free eye's	using special equipmant	All these types	1
8	The____________________ general method of grouping parts into families are	three types	two types	Four types	None	1
9	The Production equipment is arranged into machine group is called_____________________	Cells	Production Parts	Plant	None	1
10	Drawbacks of retrievel CAPP system__________________________	Editing is Difficult	Low Development time	Easy to learn	Final Plan	1
11	___________________is collection of parts	attributes	process	part family	none of these	3
12	OPITZ classification system was developed by__________________	H.Opitz	Newton	Burbridge	Opitz	1

13	Production planning is concern with the logistics issue of making the_________________	planning	product	process	technology	2
14	Manual process planning is developed by a_______________________	Planner	Manager	supervisor	Skilled planner	4
15	Which is reason for CAPP	const process plane	flow plane	none	process plan	1
16	CAPP automaticaly generate the process plane based on desition logics and preloaded____________	Process	algorithem's	Description	General	2
17	Which is comertial software for generative type_______________________	CAPP	CAM	CAD	LOCAM	2
18	In________________the products are made in small batches and in large variety	Group Technology	Batch production	Job shop production	Mass production	2
19	Manufacturing of a single complete unit as per the customer's order is______________________	Job shop Production	Group Technology	Batch production	Mass production	1
20	Manufacturing only one type of product or maximum 2 or 3 types in large quantities is ________________________	Group Technology	Batch production	Job shop Production	Mass production	4
21	The characteristics used in classifying part family is called_____________________________	Design part family	Design	CAPP	Attributes	4
22	____________________is the simplest and least expensive method	Group Technology	Visual inspection method	CAPP	Attributes	3
23	___________________Code are also called as monocodes	Attributes	Decision	Hierarchical	Group	3
24	___________________is the simplest and Least expention metod in part family formation	Part classification	Coding System	Visual inspection	Production Flow Analysis	3
25	The part which are similar in their design characteristics are grouped in a family referred to as_________________	Design part family	Manufacturing part family	production part family	None of the above	1
26	The part which are similar in their manufacturing	Design part	Manufacturing	production	None of the	2

	characteristics are grouped in a family referred to as__________________	family	part family	part family	above	
27	What are the benefits of Group technology	Product design	Material Handling	Process planning	All of the above	4
28	____________________is the systematic determination of the method by which a product is to be manufactured economically and competitively	Production Planning	Process Planning	Flow Chart	None of these above	2
29	How many methods for part family formation	one	four	three	seven	3
30	What is PFA	Process flow analysis	Production flow analysis	Planning flow analysis	Perform flow analysis	2
31	How many general approaches of process planning	four	two	five	three	2
32	What is CMPP	Computer manufacturing process planning	Computer managed process planning	computer machine process planning	Computer method process planning	2
33	The _____________general method of grouping parts into families are	Three Types	Two types	Four Types	None	1
34	Cellular manufacturing is a component of	CAPP	Mfg technology	P.P	Group Technology	4
35	D CIASS stands for _________________	Development & Classification information system	Design & Classification information system	Document & Classification information system	All of These	3
36	Process Planning is usually accomplished in _____________________ department	Manufcturing	Design	Inspection	Other	1
37	A detailed process plan usually contains rout , process , ____________ and m/c and tial selections	Manufacturing parameters	Process Parameter	Flow control parameters	Design parameters	2
38	A group layout is a combination of _____________________ layout	Product layout and process	product design layout	MFG and design layout	process and design layout	1

		layout				
39	Group Technology is a manufactruing philosophy to increase ______________ efficiency	Production efficiency	Mechanical efficiency	Chemical efficiency	Thermal efficiency	1
40	In many plants where GT has been implemented the production equipment is arranged into _______	Machine groups	Design Groups	Manufacturing groups	Material groups	1
41	GT concepts have evolved in ____________ century	20th Century	50th Century	30th Century	60th Century	1
42	Attribute code is also known as ___________________	Polycode	mono code	Hierachical code	None of the above	1
43	In document process planning, the operation sheet is also called as _______________	route sheet	Manufacturing sheet	design sheet	None of the above	1
44	In traditional process planning systems the process plan is prepared __________________	Manually	Automatically	Both manually and Automatically	None of the above	1
45	_________________ is the similer parts are identified and group of together to take advantage of their similarities in design and production	Group technology	production	components	batun type production	1
46	How many type of coding system normally used	100 coding system	150 coding system	99 coding system	101 coding system	1
47	Benefits of group technology	Production design	Tooling and setups	Material handling	all these's above	4
48	___________ is an application of CIM	Cellular manufacturing	Material system	Group technology	Material handling	1
49	______________________ system automatically generates the process plan based on decision logics and pr coded algorithms	Generative type CAPP	Retranial type	Visual Inspection	Rote sheet method	1
50	______________________ is a collection of parts which are similar process planning as technical attributes	Machine family	Part Family	Process family	Group family	2
51	_____________________ is the systamatic determination of the methods by which a product is to be many action economically and competitively	Production planning	process planning	process recetings	process control	2

52	A retrivel CAPP system also called as ________________ system	Sub system	Variant CAPP system	General CAPP system	Control CAPP Syatem	2
53	In ________________ manufacturing the dissimilar machine have been arranged into cells	Celluar manufacturing	Automatic manufacturing	Integrates manufacturing	stationary manufacturing	1
54	___________________ is one of the general methods for gouping parts into tamilies	Stageing Rellch	visual inspection	machine inspection	final inspection	2
55	Family layout was also known as _____________ layout	product layout	process layout	Manufacturing layout	plan layout	4
56	______________________ is are at the code structure at in a GT application	M/c code	G codes	M-codes	Attribute code	2
57	A Group technology is a __________________ philoshy	Manufacturing Design	Production	Process	none of the above	1

2 marks

1. List out the stages in Group Technology.
2. What are the methods available for solving problems in GT?
3. What is meant by CAPP?
4. Define Part family
5. Differentiate variant approach and generative approaches of process planning.

14 marks

1. List out the various coding system widely used in group technology and explain any two classification system with neat sketch.
2. Explain the manual approach to process planning. What are its advantage and limitations?
3. Explain with flow chart Opitz classification system.
4. Explain Retrieval CAPP system and Generative CAPP system.
5. Discuss about MICLASS and OPITZ classification and coding systems.
6. Describe the general procedure of retrieval CAPP System.
7. Explain composite part concept in cellular manufacturing.
8. Discuss the benefits of computer aided process planning (CAPP) and explain CAPP Approaches details.
9. Briefly discuss the various benefits of implementing a GT in a firm. Also bring out the advantages and limitations of using GT.
10. Explain with flow chart about drawbacks of generative CAPP system and retrieval CAPP system.
11. Explain the parts classification and coding method in detail.

UNIT-III

SHOP FLOOR CONTROL AND INTRODUCTION OF FMS

WHAT IS PPC?

- Production planning and control (PPC) may be defined as the direction and coordination of a firm's material and physical facilities towards the attainment of pre –specified production of goods ,with highest production efficiency.
- PPC deals with the logistics problems that are encountered in manufacturing. Logistics problems include the details of what and how many products include the details of what and how many products to produce and when, and obtaining the raw materials, parts and resources to produce those products.
- We know that , PPC = Production planning + production control

We shall discuss the various activitiesof in the following sections

What is production planning?

- Production planning isa pre- production activity. It is the pre –determination of manufacturing requirements such as man power , materials , machines , and manufacturing process.
- Production planning may be defined as the determination , acquisition and arrangement of all facilities necessary for future production of products.

Production planning is concerned with:

- Deciding with products to make , how many of each , and when they should be completed;
- Scheduling the production and delivery of the parts and products ; and
- Planning the manpower and equipment resources needed to accomplish the production plan.

Activities of production planning: production planning activities include

- Aggregate production planning;
- Master production planning
- Material requirements planning (MRP); and
- Capacity planning.

What is production control ?

- Production control is concerned with determining whether the necessary resources to implement the production plan have been provided or not.
- Production control , through control mechanism , tries to take corrective action to match the planned and actual production . Thus production control reviews the progress of the work, and takes corrective steps in order to ensure that programmed production takes place.
- Activities of production control: the four major activities within the scope of production control include
    1. Shop floor control,
    2. Inventory control,
    3. Manufacturing resource planning (MRP II), and
    4. Just – in -time (JIT) production systems.

What is SFC?

- A shop floor system is defined as a system for utilizing data from the shop floor as well as data processing files to maintain and communicate status information on shop orders and work centre.
- Shop floor control (SFC) is concerned with:
  (i) The release of production orders to the factory;
  (ii) Monitoring and controlling the progress of the orders through the various work centres; and
  (iii) Acquiring information on the status of the orders.
- In simpler terms, shop floor control deals with managing the work-in-process.

Functions of Shop Floor Control

The major functions of shop floor control are:

1. Assigning priority of each shop order (Scheduling).
2. Maintaining work-in-space quantity information (Dispatching).
3. Conveying shop-order status information to the office (Follow up).
4. Providing actual output data for capacity control purposes.
5. Providing quantity by location by shop order for work-in-process inventory and accounting purposes.
6. Providing measurement of efficiency, utilisation, and productivity of manpower and machines.

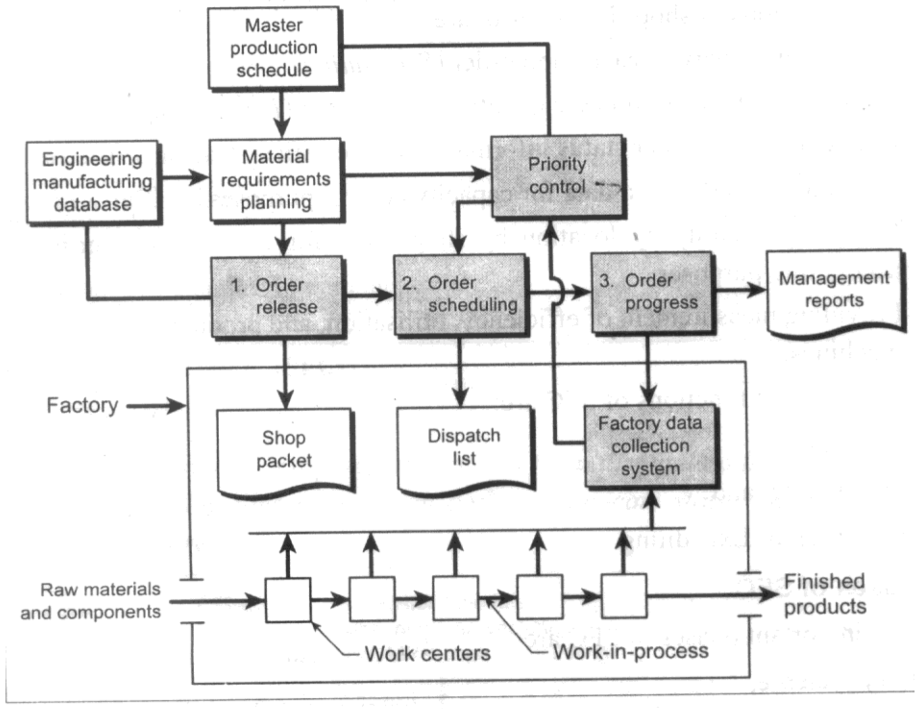


Fig. 3.7. Three phases in a shop floor control system

In other words, the functions of SFC are:

1. Order release,
2. Order scheduling, and
3. Order progress.

Fig. 3.7 depicts the three phases (enclosed part in dotted lines) and their relationship to other function in the production management system. In a computer integrated manufacturing system these phases are managed by computer software.

1. **Order Release**

This order release phase provides the documentation needed to process a production order through the factory. The collection of documents is sometimes referred as the shop packet. The shop packer for an order consists of:

(i) **Route sheet -** used to list the sequence of operations and tools required.
(ii) **Material requisitions -** used to get necessary raw materials from inventory.
(iii) **Job cards** – used to report the labour for each operation on the route sheet.
(iv) **Move tickets -** used to move the parts between the work centres.
(v) **Part lists- required** for assembly jobs**.**

- In a typical factory which works on manual processing of data the above documents move with the production order and are used to track the progress through the shop. In a CIM factory, more automated methods are used to track the progress of the production orders.
- As shown in Fig 3.7 two inputs are required to the order release module.

- The first input is the authorization too produces (that derives from master schedule). This authorisation proceeds through MRP which generates work orders with scheduling information.
- The second input is the engineering and manufacturing database. This database contains engineering data (such as the product design, component material specifications, bills of materials, process plans, etc.) Required to make the components and assemble the products. The database input provides the product structure and process planning information needed to prepare the various documents that accompany the order through the shop.

2. **Order Scheduling**

- The second phase of shop floor control is the order scheduling module, which follows directly from the order release module.
- In this phase, the order scheduling module assigns the production orders to the various work centres in that plant. In other words order scheduling executes their dispatching function in production planning and control.
- The order scheduling module prepares a dispatch list that indicates which production order should be accomplished at the various work centres. It also provides the information about relative priorities of the different jobs by showing the due dates for each job. By following the dispatch list in making work assignments and allocating resources in different jobs, the master schedule can be best achieved.

The two inputs required to the order scheduling are: (1) the order release, snd (2) the priority control information.

The term priority control is used in production planning and control to denote the function that maintains the appropriate levels for the various production orders in the shop.

Two elements of orders scheduling: The order scheduling module is used to solve the following two problems in production controls:

1. **Machine loading:** Allocating orders to work centres is known as machine loading. The term shop loading is used when loading of all machines in the plant is done.

2. **Job sequencing:** Determining the priority in which the jobs should be processed is termed as job sequencing. In most cases, each work centre will have a queue of orders waiting to be processed. This queue problem can be

solved by job sequencing. To determinate the sequence, priorities are given to the jobs in the queue, and the jobs are processed in the order of their relative priorities. Priority sequencing rules, also known as dispatching rules, have been developed to establish priorities for production orders in the plant.

QR (queue ratio): This is calculated as the slack time remaining in the schedule divided by the planned remaining queue time. Orders with the smallest QR are run first.

FCFS (first-come, first-served): Orders are run in the order they arrive in the department.

LCFS (last-come. First-served): As orders arrive, they are placed on the top of the stock and are run first. When an order is completed at one centre, then it enters at the next work centre in its process routing. Now, again priority control is used to determine the sequence of processing among the jobs at the work centre. The relative priorities of the different orders may change time to time, because of many reasons such as fluctuations in market demand, equipment breakdown, cancellation of the order by customer, defective raw material, or delay in the receipt of materials. The priority control function reviews the relative priorities of the orders and adjusts the dispatch lot accordingly.

3. Order Progress

The third and final phase of SFC is order progress phase.

The order progress phase monitors the status of the various orders in the plant, work-in- progress (WIP), and other characteristics that indicate the progress and performance of production.

Order progress collects data from shop floor and generates reports to assist production management. In other words, the function of order progress module is to provide information that is useful in managing the factory based on data collected from the factory.

The three forms of order progress reports that are presented to production management are

1. **Work order status reports:** These reports indicate the current status of each shop through the shop. It provides information on the current work centre where each order is located, processing hours remaining before completion of each order, whether the job is on-time or behind schedule, and priority level.

2. **Progress reports:** These reports indicate the performance of the shop during a certain time period (say, week or month in the master schedule). Typical information listed in these reports include how many orders were completed during the period, how many orders that should have been completed during the period were not completed, and so on.
3. **Exception reports:** These reports indicate the deviations from the production schedule (e.g. overdue jobs (, and similar exception information. The above reports are useful to production management in making the decisions about allocation of resources, authorisation of the overtime hours, and other capacity issues, and in identifying areas of problems in the plant that adversely affect the implementation of the master production schedule.

Factory data collection system

- Shop floor control depends on analysing of regularly generated data, which forms the basis of control decisions. Factory data collection and analysis are important tasks within shop floor control.
- There is several data collection techniques used to collect data from the shop floor. These techniques require the employees to gather the data and later the data are gathered on a fully automated system that requires no human participation. These data collection methods are identified by the term 'factory /shop data collection systems'.
- The factory data collection (FDC) system consists of various paper documents, terminals, and automated devices throughout the plant for collecting data on shop floor operations. Also FDC is the means or compiling and processing these collected data.
- As could be seen from Fig.3.7, the factory data collection system serves as an input to the order progress module in shop floor. FDC also provides input to the priority control, which affects order scheduling.
- Types of data collected by FDC: the types of data collected by the FDC system on shop floor operations include.

    - Number of pieces completed at a certain work centre,
    - Direct labour time spent on each order,
    - List and number of parts that are scrapped.
    - List and number of parts requiring rework.
    - Equipment downtime, and
    - Time clocks used by employees to punch and out of work.

Objectives of FDC system: The three main objections/purposes of the factory data collection system is:

1. To supply status and performance data to the shop floor control system.
2. To provide up-to-data information to the production supervisors and production control personnel.
3. To enable the management to monitor implementation of master schedule.

To achieve these three objectives, the factory data collection system should input data to the computer system in the plant.

It may be noted that FDC is not a cost-saving tool; rather, it is a tool for making timely decisions to enhance resource utilisation.

Types of data collection systems

The shop floor collection systems can be classified into two groups as:

1. On-line data collection systems, and
2. Off-line data collection systems.

1. **On-line data collection systems**

- In an-online system, the data are entered directly into the plant computer system and are immediately available to the order progress module.
  - Advantage the data file representing the shop is always kept at the current state as and when the changes in the order module are reported they can be fed to computer and in turn to the status file. Thus the production personnel can always have the most up-to-date information with this on-line data collection system.

2. **Off-line data, collection system**

- In an off-line data collection system, the data are collected temporarily in a storage device or in a standalone computer system to be entered and processed by plant computer in a batch mode.
- This off-line data system is also known by the term batch data collection system.
- Advantage: the off-line data collection system is easier to install and implement when compared to on-line data system.

Limitation:

- The off-line data collection system cannot provide real time information of shop floor status, because there is a delay in the entry and processing of the data.
- Another disadvantage of batch system is that it requires a separate data storage system.

Automatic Identification Methods

Introduction

- CIM oriented plants depend more and more on automated data collection. Automatic data collection is essential for streamlining the flow of information in CIM environments.
- The term automatic identification refers to various technologies used in automatic or semiautomatic acquisition of product data or entry intoa computer system.
- Automatic identification technologies are mostly sensor-based methods that provide a means of reading data that are coded on a document, product, component, container, and so on. Many of these technologies require no human involvement in the data capture and entry process.
- However, some automated identification applications require works to be involved in the data collection procedure, usually to operation the identification equipment in the application. These techniques are known as semi automated methods.
- Applications of Automatic Identification Systems
- Automatic identification systems are being used increasingly to collect data in material handling and manufacturing applications.
- In manufacturing, the applications include shipping and receiving, storage, serration, order picking, and kitting of parts for assembly.
- In manufacturing, the applications include monitoring the status of order processing, work-in-process, machine utilisation, worker attendance, and other measures of factory operations and performance.

- Also automatic identification systems have much important application outside the factory. Some of the applications include:

  (1) Retail sales and inventory control,

  (2) Warehousing and distribution centre operations,

  (3) ail and parcel handling,

  (4) Patient identification in hospitals,

  (5) Cheque processing in banks, and

(6) Security systems.

- However, our interest h re is to emphasize on manufacturing applications.
- Reasons for Using Automatic Identification Techniques
- The three main reasons for using automatic identification techniques are:
    1. To improve the accuracy of the data collected.
    2. To reduce the time required by human workers to make the data entry.
    3. To save substantial labour cost spent for data collection and entry.
- Basic Components of Automatic identification Technologies
- According to Cohen, almost all the automatic identification technologies consist of three principal components. They are:

1. Encoded data: A code is nothing but a set of symbols or signals, usually representing alphanumeric characters. When data are encoded, the characters are translated into a machine-readable code. A label or tag containing the encoded data is attached to the part/item that is to be later identified.

2. Machine reader or scanner: As the name suggests, machine reader is a device that reads the encoded data. For this purpose, usually encoded data are converted into an electrical analogy signal.

3. Decoder: Decoder transforms the electrical signal into digital data and finally back into the original alphanumeric characters.

Types of Automatic Identification Technologies

The most widely used automatic identification technologies/methods in the factory are:

1. Bar codes,
2. Radio frequency systems,
3. Magnetic stripe,
4. Optical character recognition, and
5. Machine vision.

1. Bar Codes Technology

Bar code technology is rapidly replacing the keyboard and other data-entry devices for recording manufacturing information and data.

2. Radio Frequency Identification

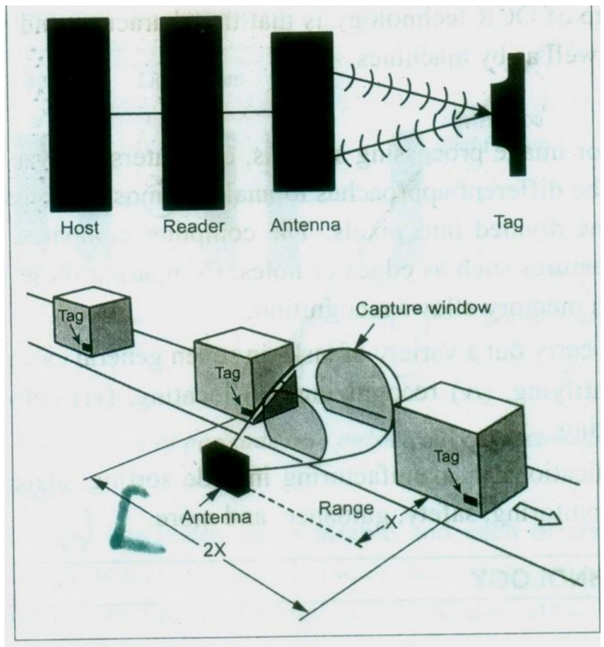


Fig. 3.9. Principle of radio frequency identification

In radio frequency identification (RFID), the item being tracked has a transponder that transmits a specific radio frequency, representing a unique signature or data stream that the transmitter or reader can interrogate. The antenna then picks up the signal.

RFID systems are based on transmission of a radio signal and its obstruction by the object is in the capture window. Fig.3.9. illustrates the principle of RFID.

- The RFID system consists of three basic components (Fig, 3.9.): (1)control unit (reader), (2) antenna, and (3) coded identification tag. The antenna continuously transmits a low-wattage (1-7 mill watts) microwave signal. When a tag enters the field of view, the reflected signal gets frequency-modulated. The radio frequency (RF) signals from the identification tag to a reader that decodes and validates the signal prior to transmission of the associated data to the data collection computers system.

3. Magnetic Identification

- Magnetic identification systems are based on magnetic stripes, similar to those on the back of most credit/debit cards.
- Magnetic stripe is a thin plastic film containing small magnetic particles whose pole orientations can be used to encode bits of data into the film. Electromagnetic charges encode the information on the stripe, which is then decoded for the computer.
- Magnetic stripes attached to the product/container are used for item identification in factory and warehouse applications.
- Also this technology is in wide use for ID badges and time and attendance records, since large amounts of data can be stored in a single stripe.

4. Optical Character Recognition

- Another form of automatic identification is optical character recognition (OCR).
- OCR refers to the use of specially designed alphanumeric characters that are machine readable by an optical reading device.
- Like bar codes, ODR recognize and process symbols. But unlike the bar code system, which interprets data coded in a series of bars and spaces, OCR devices interpret human readable characters for computers.
- The main advantage of OCR technology is that the characters and associated text can be read by human as well as by machines.

5. Machine Vision

- In machine vision or image processing systems, computers analyze and interpret images. Though there may be different approaches to analysis, most vision systems begin the task with a camera scene divided into pixels. The computer compares the pixels to identify prominent object features such as edges or holes. Comparing these features with those of the images stored in memory allows recognition.
- Vision system applications in manufacturing include sorting, material handling, process control, machine monitoring, safety, guidance, and more.

BAR CODE TECHNOLOGY

Introduction

- Bar code technology is the most popular method of automatic identification in factory data collection.

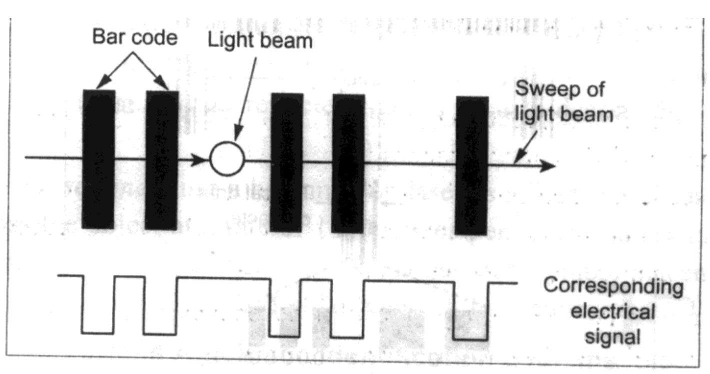


Fig. 3.10. Conversion of bar code into pulse train of electrical signals

- Sophisticated automation on the shop floor uses bar code technology to provide the information for material resource planning, statistical process control, production program selection, and other CIM system applications.
- Bar code technology was invented in 1949 by Norman J. Woodland and Bernard Silver of USA.

- The symbols used in bar coding correspond to specific combinations of digits, letters, or punctuation marks. Scanners read the symbols (code) by shinning light at them and monitoring the reflected light.

Bar Codes

- A bar code is symbols composed of parallel bars and spaces with varying widths. The individual widths of these bars and the spaces contain the coded information; their heights carry no interpretive information. The purpose of bar heights is merely to ensure that the scanning device does not miss the barred area.
- The pattern of bars and spaces is coded to represent alphanumeric characters. Bar code readers interpret the code by scanning and decoding the sequence of bars. The scanner emits a beam of light that is swept past the bar code and senses light reflections to distinguish between the bars ad spaces. The light reflections are sensed by a photodetector, which converts the spaces into an electrical signal and the bars into absence of an electrical signal. The width if the bars and spaces are indicated by the duration of the corresponding signals. Fig.3.10 depicts this procedure. The decoder analyzes the pulse train to validate and interpret the corresponding data.

Bar Code Symbols

There are more than fifty bar codes are available and each offers one or more of the following code

Characteristics: robust character set, structural simplicity, generous tolerances for printing and reading, and a high density-to-size ratio.

Some of the most commonly used bar codes are:

1. Code 39
2. Interleaved Two-of-Five (ITF)
3. Universal Product Code (UPC)
4. Code 93
5. Code128
6. Post net
7. Coda bar
8. Plessey

However, the two most popular bar codes in the industry are the code 39 and the interleaved two-of- five.

Code 39

- Code 39, developed by David Allais and Ray Sterns in 1975, is the most widely and accepted industrial bar code symbol.
- The code, illustrated in Fig.3.11, has become the defacto industrial standard for item identification.
- Code 39, also called a three –of-nine-code*, is a complete code system.

- The code can represent the twenty six letters of the alphabet, the ten digits, and seven additional characters. The code has unique start and stop bits and can vary in length. All characters are self-checking, and as a discrete code, the inter character space is not part of the code.
- Major advantages of this code are the high level of date security provided by the self-checking feature and the wide tolerance for printing and scanning. As a result of this high security, code 39 was added to standards developed by health care and automotive industries and by the department of defence.

Bar Code Scanner

The scanners used to read bar codes have three major components:

(i) A light source to illuminate the code,

(ii) A photo detector to sample the light reflected from the code, and

(iii) A microcomputer to convert the photo detector output into the series of letters and numbers represented by the code.

Operation: A some of light from a laser, light-emitting diode (LED), or incandescent lamp is aimed at the bar code symbol. The dark absorb the light and the spaces reflect the light back to the photo detector. From these data, the widths of the bars and spacing's are determined by a microcomputer. In addition, the computer decodes the bar code and provides a serial data output of the code in ASCII format. This output is passes to another computer or programmable logic controller to use in a host of production applications.

Types of bar code scanners: Bar code scanners are either contact type or non-contact type.

- Contact type scanners physically touch the symbol or the protective covering over the symbol. Such scanners are typically wands (pens) or slot readers.
- Non-contacts scanners are activated even when held from some distances away from the symbol.

Types of non-contact scanners: Non-contact scanners are classified as fixed beam and moving beam scanners.

- Fixed-beam scanners are stationary units that use a fixed beam of light. The fixed beam requires that the bar code be moved past the scanner to generate signals required by the photo detector. Again, reflected light is used to decode the information in the code.

- Moving-beam scanners use a helium-neon laser as a light source and sweep the laser beam across the object at a rate of 1440 passes per second in search of the bar code. The advantage of this type of scanner is that bar code symbol placement is not critical as long as the code falls into the field of view of the scanner.

Flexible Manufacturing System (FMS)

Introduction

In today's competitive global market, rapid response and production flexibility in manufacturing are identified as a very important order-winning criterion. Both of these criteria, necessary to maintain or increase market share, are affected by the design of the production area. Group technology is focused on the design of production cells to handle a family f parts with common production characteristics. Also it is realised that integrated production cells are elements of CIM. Realising the benefits of CIM and the integrated enter [prise in many product areas requires implement of flexible manufacturing systems (FMSs) on the shop floor.

A flexible manufacturing system (FMS) is nothing but a highly automate GT machine cell. A FMS is an individual machine or group of machines served by an automated materials handling system that is computer controlled and has a tool handling capability. FMS is the result of integrating CNC, DNC, GT and automated materials handling systems into one system.

Now, we shall discuss the concept, components, types, application and benefits of FMS, in the following sections.

What is an FMS?

An FMS is defined by the Automation Encyclopaedia as follows:

"A flexible manufacturing system is one manufacturing machine, or multiple machines that are integrated by an automated material handling system, whose operation is managed by a computerized control system. An FMS can be reconfigured by computer control to manufacture various products."

According to Mikell P. Groover, a FMS can be defined as "a highly automated GT machine cell, consisting of a group of processing workstations (usually CNC machine tools), interconnected by an automated material handling and storage system, and controlled by a distributed computer system."

A review of the above two definitions indicate some common elements of FMS, such as:

(1) NC, CNC, or smart production machine tools,
(2) Automatic material handling,
(3) Central computer control, and
(4) Data integration.

COMPONENT/ELEMENTS OF FMS

As pointed out in the definitions (Section 3.9.2.), four basic components/elements of a FMS are:

1. Workstations,
2. Material handling and storage system,
3. Computer control systems, and
4. Human resources.

Now, we shall discuss these four components, in detail, in the following sections.

FMS WORKSTATIONS

The workstation/processing stations used in FMS depend upon the type of product manufactured by the system. In metal cutting/machining systems, the principle processing stations are usually CNC machine tools. In addition, a FMS requires other several machines for completing the manufacturing. The types of workstations that are usually found in a FMS are:

1. Load/unload stations,
2. Machining stations,
3. Assembly workstations,
4. Inspection stations, and
5. Other processing stations.

1. Load/Unload Stations

The load/unload station is the physical interface between the FMS and the rest of the factory. At loading stations, raw work parts enter the system. At unloading stations, finished parts exit the system. Both loading and unloading can be accomplished either manually or by automated handling systems. The load/unload station should include a data entry unit and monitor for communication between the worker and the computer system. Also the load/unload station should b designed ergonomically to permit convenient and safe movement of work parts.

2. Machining Stations/Centres

A machining centre is a multipurpose CNC machine tool that has an automatic tool changing capability. Predominantly CNC machine tools are used as FMS machining centres. CNC machining centres possess the features such as

(1) automatic tool changing, and tool storage,
(2) use of palletized work parts,
(3) use of CNC, and
(4) Capacity for distributed numerical control (DNC).

The above features of CNC machining centre make it very compatible with the FMS approach to production. That's why CNC machining centres are widely used in FMS.

Turning modules: For machining rotational parts, turning centres are used. For turning operations, special turning centres are used. For turning operations, special turning modules, (in which the single-point tool rotates around the work) can be designed for the FMS. These special turning modules are required in FMS because many of the work parts in FMS are held in a pallet fixture throughout processing, and hence these work parts cannot be rotated like in conventional turning.

Milling modules: Special milling machine modules are milling in FMS for achieving higher production levels. Various types of milling modules such as such as vertical spindle, horizontal spindle, and multiple spindles can be employed depending upon the work requirement.

Head changers: For specialised machining applications involving multiple tool cuts on the work part, head changers can be used as processing stations in an FMS. A head changer is a special machine tool with the capability to change tool heads. The tool heads, usually multiple-spindle tool heads. The tool heads, usually multiple-spindle tool modules, are used to perform more than one machining operations simultaneously.

Head indexers: Head indexers are mounted semi permanently to an indexing mechanism on the machine tool. Unlike head changers, head indexers can be rotated into position to perform the simultaneous machining operations on the part.

3. Assembly Work stations

Assembly operations are also performed by some FMSs; flexible automated assembly work stations are developed to replace manual labour in the assembly of products. Flexible automated assembly workstation is used in FMS for products made in batches. For this purpose, industrial robots are considered as the most appropriate automated assembly work stations.

4. Inspection Stations

Obviously FMSs include inspection operations. The inspection operations can be done either at machining work stations itself, or at specific inspection stations.

In FMS, the following three inspection methods/equipment is used:

1. Coordinate measuring machines (CMM),
2. Special inspection probes, and
3. Machine vision.

A coordinate measuring machine (CMM) consists of a contact probe and a means of positioning the probe in three-dimensional space relative to the surfaces and features of a work part. Inspection probes are contact inspection methods that use tactile probes as on-line inspection systems for machine tool applications. These probes are mounted in holders, inserted into the machine tool spindle, stored in the tool drum, and handled by the automatic tool changer. Machine vision is the acquisition of image data, followed by the processing and interpretation of this data by computer for industrial inspection.

Other Processing Station

In addition to machining centres, a FMS often has sheet metal processing machines and forging stations. Sheet metal processing work stations consists of press working operations such as punching, shearing, bending and forming processes. The forging processing stations consists of the heating furnace, the forging press, and a trimming station. In addition to the above work stations, FMS also include other work stations to accomplish general other operations and functions. The other stations include:

(1) Stations for cleaning part and/or pallet fixtures,

(2) Central coolant delivery systems for the entire FMS, and

(3) Centralised chip removal systems.

FMS layout Configurations

The material handling system establishes the FMS layout. The types of layout configurations commonly found in today's FMSs are:

1 In-line layout, 2 Loo layouts,

3 Ladder layout, 4 Open-field layout, and

5 Robot- cantered Cell.

1 In-line Layout

As the name suggests, the materials and handling systems are arranged in a straight line in the in-line layout.

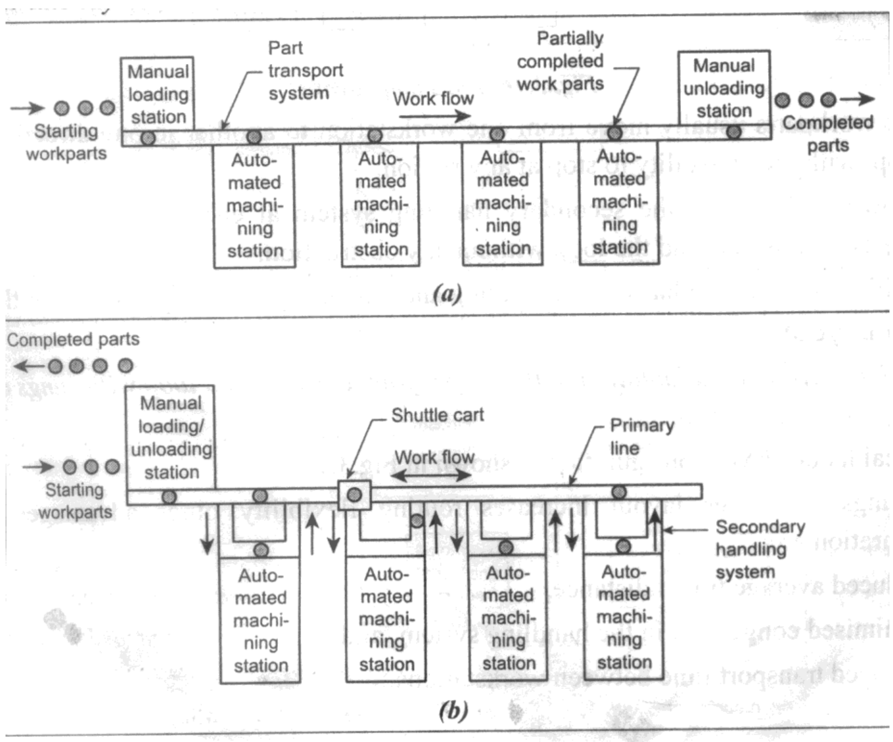
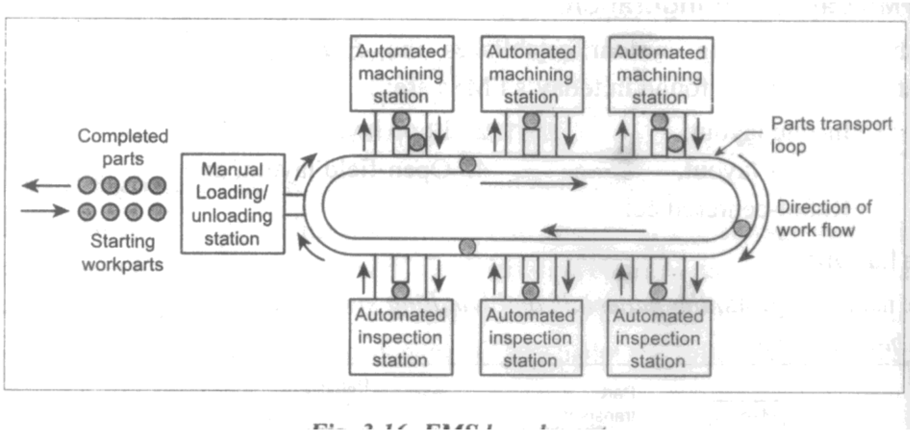


Fig. 3.15. In-line FMS layouts

The two possible in-life configurations presented by Grover are depicted in Fig.3.15 (a) and (b). Fig.3.15 (a) shows the basic in-life configuration with one direction work flow. This configuration is very much similar to a transfer line, in which the parts move from one workstation to another in a well-defined sequence4 with no back flow. Fig.3.15 (b) shows the in-line configuration with workflow in two directions. In this, linear transfer system with secondary part handling system at each workstation facilitates the workflow in two directions. Thus this configuration provides greater routing flexibility.

2 Loop layouts

In the loop layout, the workstations are arranged in a loop, as shown in Fig.3.16.



In this, work parts usually move from one workstationto another in one direction around the loop, with the capability to stop at any station.

As shown in Fig.3.16, the secondary handling system at each workstation allows the work parts to move around the loop without any obstruction. Also, this configuration has manual loading and unloading station at one end of the loop.

3 Ladder Layouts

The ladder layout, an adaption of the loop layout, consists of a loop with rungs on which workstations are located.

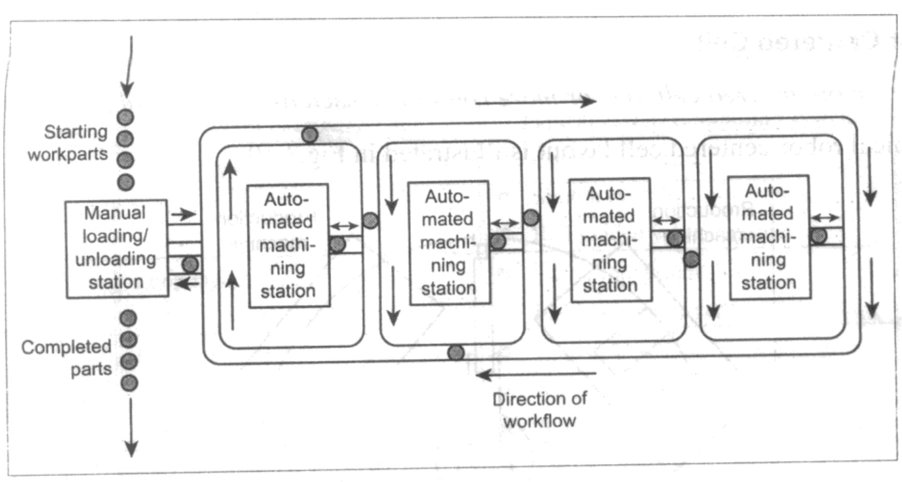


Fig. 3.17. FMS ladder layout

A typical ladder FMS configuration is shown in Fig.3.17.

The rungs in ladder Layout increases routing flexibility other advantages of this configurations are:

- Reduced average travel distance,
- Minimised congestion in the handling system, and
- Reduced transport time between workstations.

4 Open-Field Layouts

The open field layout, also an adaption of the loop configuration, consists of multiple loops, ladders, and sliding organised to achieve the desired processing requirements.

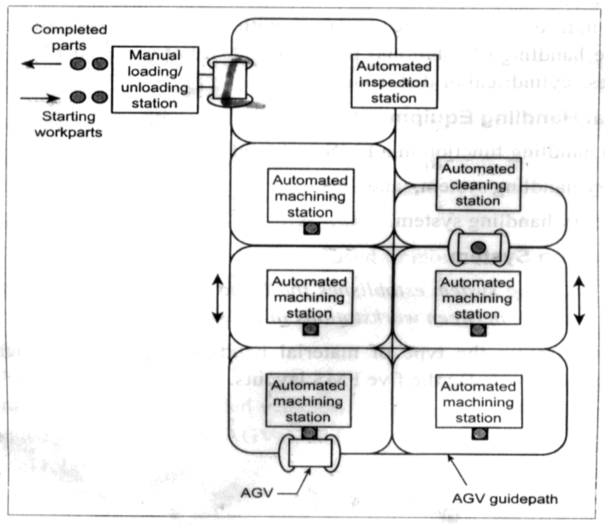


Fig. 3.18. Open field FMS layout

Fg.3.18 illustrates a typical open-field layout as outlined by Grover. This open-field configuration is generally preferred for processing a large family of parts. In this, the number of different workstation types is usually limited. Also parts can be routed to different workstations depending on which one becomes available first.

5 Robot-cantered Cell

In the robot-cantered cell, one or more robots are used as the material handling system.

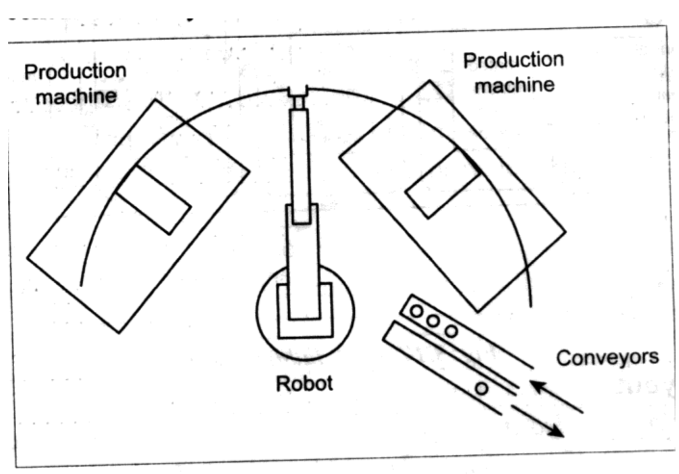


Fig. 3.19. Robot-centered workcell layout

A typical robot-cantered cell layout is illustrated in Fig.3.19. In this layout, the work is organised so that work parts are presented to the robots by the transport system, and each robot performs some processing or assembly operation on each part. Now-a-days industrial robots are designed with special grippers that make them well suited for the handling of rotational parts. In fact, robot-cantered FMS layouts are often used to process cylindrical or disk-shaped parts.

MATERIAL HANDLING EQUIPMENT

The material handling function in a FMS is shared between two systems:

1 Primary handling system, and

2 Secondary handling systems.

1 Primary Handling Equipment

The primary handling system establishes the basic layout of the FMS and is responsible for moving work parts between workstations in the system.

Table 3.7 summarizes the type of material handling equipment typically used as the primary handling system for the five FMS layouts.

2 Secondary Handling System

The secondary handling system consists of transfer devices, automatic pallet changers, and similar mechanisms located at the workstations in the FMS.

- *The functions of the secondary handling systems* are:

(i) To transfer work parts from the primary system to the machine tool or other processing station;

(ii) To position the work parts with sufficient accuracy and repeatability at the workstation for processing;

(iii) To provide buffer storage of work parts at each workstation, if required; and

(iv) To reorient the workparts,if necessary, to present the surface that is to be processed.

Types of Material Handling Equipment

The material handling equipment commonly used to move parts between stations can be grouped under five categories, as listed below:

1. Conveyors,

2. Cranes and hoists,

3. Industrial trucks,

4. Monorails and other rail guided vehicles,

5. Automated guided vehicles (AGVs), and

6. Industrial robots.

1. Conveyers

Conveyors primarily perform the movement of uniform loads between fixed points. Conveyors are useful when:

- ♣ Loads are uniform
- ♣ Materials move continuously.
- ♣ Routes do not vary.
- ♣ Movement rate is relatively fixed.
- ♣ Movement is from one point to another point.

Types of conveyors commercially available are:

1. Belt conveyors, 2. Road conveyors,

3. Skate wheel conveyors, 4. Chain conveyors,

5. Alt conveyors, 5. In-floor towline conveyors,

7. Overhead trolley conveyors, 8. Car-on-track conveyors,

9. Screw conveyors, 10. Other conveyor types such as chutes, Ramps and tubes.

2. **Cranes and Hoists**

Cranes are overhead devices capable of moving materials vertically and laterally in area of limited length and width and height.

Cranes are employed for lifting and lowering heavy objects and moving Them from one point to another.

Types of cranes commonly found in factories are:

1. Overhead travelling cranes

2. Jib cranes, and

3. Electric hoists.

Hoists are used for loading and unloading of heavy objects and they are also used for raising and lowering heavy and long objects.

Types of hoists are:

1. Chain hoists,

2. Pneumatic hoists, and

3. Electric hoists.

The cranes and hoists are most commonly used when:

- Movement is within fixed area.
- Moves are intermittent.
- Loads vary in size and weight.
- Loads handled are not uniform.

Industrial Trucks

Hand or Powered vehicles are used for movement of mixed or uniform loads intermittently over varying paths which have suitable running surfaces and clearances and where the primary function is transporting. Types of industrial trucks commonly used n a factors are:

- Forklift truck,
- Platform truck and
- Tractor truck.

Industrial trucks are generally used when:

- Materials are moved intermittently.
- Movement is through changing routes and distances.
- Loads are uniform, mixed in size and weight.
- Materials can be put into unit load.

Monorails and other Rail Guided Vehicles

Rail guided equipment consists of motorized vehicles that are guided by a fixed rail system. The rail system may have either one rail (called a monorail) or two parallel rails. Mono rails that are used in factories and warehouses are usually suspended overhead from the coiling. In rail guided vehicle system using fixed rails, the tracks generally protrude up from the floor. Routing variations can be done in rail guided vehicle systems through the use of switches, turntables, and other specialised track systems. Rail guided vehicles are generally used;

- For moving single assemblies, products or pallet loads along variable routes in factory or warehouse
- For moving large quantities of items over fixed routes in a factory or warehouse.

5. Automated guided vehicles

AVGs are modern material-handling and conveying systems that are more appropriate for FMS applications and automation. An AGV is a computer controlled, driverless vehicle used for transporting materials from point-to-point in a manufacturing setting.

Automated guided vehicles (AVGs) are modern material-handling and conveying systems that are more appropriate for FMS applications and automation. An AGV is a computer controlled driverless vehicle used for transporting materials from point-to-point in manufacturing setting. AGVs are powered by means of on-board batteries that allow operation for several hours between recharging.

Technology: about 90% of all AGVs are wire-guided vehicles. A wire, embedded about an inch deep in the floor, emits low-level signal (0.5 ampere current0, which the antenna of the carrier picks up and the on-board controller analyzes to determine the route. Wire-guided systems work best on floors with uncomplicated paths and limited distances.

Some recent developments are tapped or stripped paths with painted line or metal film defining the route. The carrier's ultraviolet (UV) light source illuminates the painted line and reads the brightness of the reflected light to estimate its distance from the path. Another recent technology is a chemical strip that is laid over any surface and needs little maintenance.

Painted taped or chemical-have no distance limit. Route changes can be made easily without interrupting production.

In a FMS/SIM plant, AGVs are integrated with other plant resources and equipment through their controllers. The controller links the vehicle with the guide path and is thus the 'brain' of the entire AGV system.

The various types of AGVs are:

1. Driverless trains
2. AGVs pallet trucks, and
3. AGVs unit load carriers

AVGs is generally used:

- For moving pallet loads in factory or warehouse.
- For moving work-in-process variable routes in low and medium production.

Industrial Robots

- A robot is basically an automated arm that can be programmed to carry out certain tasks of material handling within its geometric and power constrains,
- According to the Robotic Institute of America (RIA), a robot is a reprogrammable multi-functional manipulator designed to move material, parts tools, or specialized devices through variable programmed motions for the performance of a variety of tasks.
- The 'reprogrammable' feature offers the robot flexibility, making it a CIM-conducive material handling device.
- To accomplish the material handling function, the robots are equipped with a gripper type end effectors. Also the grippers are designed to handle the specific parts that are to be moved in the application.
- In material transfer applications, the robot picks up parts at one location and places them at a new location.

- In palletizing function, the robot retrieves parts, cartons, or other objects from one location and deposits them onto a pallet or other container with multiple positions.

- In depalletizing, the robot removes parts from an ordered arrangement in a pallet and places them at one location.
- In stacking operations, the robot places flat parts on top of each other.
- In insertion operations, the robot inserts parts into the compartments of a divided carton.

(i) In machine loading and/or unloading applications, the robot transfers parts into and/or from a production machine.

HUMAN RESOURCES

The fourth and final component in the FMS is human labour. Like in any other manufacturing approaches, the operations of the FMS are also managed by human labours.

In FMS, human labours are needed to perform the following functions:

1. To load raw work parts into the system.
2. To unload finished work parts from the system.
3. For tool changing and tool setting.
4. For equipment maintenance and repair.
5. To furnish NC part programming in a machining system.
6. To program and operate the computer system.
7. To accomplish overall management of the system.

APPLICATIONS OF BENEFITS OF FMS

1. Machining`
2. Assembly,
3. Sheet-metal press working.
4. Forging.
5. Plastic injection moulding.
6. Welding
7. Textile machinery manufacture,
9. Semiconductor component manufacture.

Economics of FMS

The following savings of using FMS are typical:

1. 5-20% reduction in personnel
2. 15-30% reduction in engineering design cost,
3. 30-60% reduction in overall lead time,
4. 30-60% reduction in work-in-process,
5. 40-70% gain in overall production,
6. 200-300% gain in capital equipment operating time,
7. 200-500% gain in product quality, and
8. 300-500% gain in engineering productivity.

Advantage of FMS (Benefits of FMS)

Successfully implemented FMS offers several advantages. Some of them are given below.

1. Increased machine utilization. Several features of FMS (such as automatic tool/pallet changing, dynamic scheduling of production, so on).
2. Reduced inventory. Following the GT concept, FMS process different parts together. This tends to reduce the work-in-process inventory significantly.
3. Reduced manufacturing lead time. Because of reduced setups and more efficient materials handling, manufacturing lead times are reduced.
4. Greater flexibility in production scheduling. A FMS has a greater responsiveness to change. It means, FMS has the capability to make

adjustments in the production schedule on day-to-day basis to respond to immediate orders and special customer requests.

5. Reduced direct labour cost. Reduced (manual) material handling and automation control of machines make it possible to operate an FMS with less direct labour in many instances. Thus the direct labour cost is reduced considerably.
6. Increased labour productivity. Due to higher production rates and reduced direct labour cost, FMS achieves greater productivity per labour hour.
7. Shorter response time. Setup time is relatively low with FMS as majority of the work is done automatically. The lead time of production is hence very low and the response time will be shorter.
8. Consistent quality. Human error is minimised, as there is maximum automation. In the absence of human interface, the quality is consistent.
9. Other FMS benefits include:

(1) Reduced factory floor space,
(2) Reduced number of tools and machines required,
(3) Improved product quality, and

(4) Easy expandability for additional process added capacity.

Disadvantage of FMS

The major limitations of implementing a FMS are given below:

1. Very high capital investment is required to implement a FMS.
2. Acquiring, training, and maintaining the knowledgeable labour pool requires heavy investment.
3. Fixtures can sometimes cost much more with FMS, and software development costs could be as much as 12-20% of the expense.

4. Tool performance and condition monitoring can also be expensive since tool variety could undermine efficiency.

5. Complex design estimating methodology requires optimizing the degree of flexibility and finding a trade-off between flexibility and specialization.

Unit 3 - MCQ

	Question	Option 1	Option 2	Option 3	Option 4	Ans
1	Code 39 was developed by _______________ and Ray sterens.	MikellP. Groover	David allias	Dr.M. Eugene Merchant	Richard G. Abraham	4
2	Code 39, is also called as the ______________	Thirtynine code	Code of thirty nine	Three-of-nine code	Three in nine code	3
3	A Kanban system is a _____________	Pull system	Push system	Push and pull system	Push or pull sysytem	1
4	Allocating orders to work centres is known as _______________	Scheduling	Processing	work loading	Machine loading	4
5	To place orders that have been planned by the MRP is_____________	Rescheduling notices	Cancellation notices	Order release notice	Planned order release report	3
6	In MRP, which is the secondary output reports_______________	Inventory forecasts	Cancellation notices	Order release notice	Planned order release report	1
7	MPS stands for ____________	Manufactiring process schedule	Master processing schedule	Master production system	Master production schedule	3
8	The principle of ____________ makes the FMS possible	MRP II	GT	CAPP	JIT	2
9	The primary handling system establishes the basic layout of _________	FMS	CAM	CAD	CAPP	1
10	________________ file contains the codes of the cutting tools stored at each workststion	Part production file	station tool file	Tool life file	Routing file	2
11	MRP II stands for_______________	Manufacturing reduction planning	Manufacturing requirement planning	Manufacturing restore planning	Manufacturing resource planning	4
12	Objectives of JIT is	Zero defects	Zero handling	Lot size of one	All of these	4
13	Production management is concerned with	Planning and	Production and	esign and	Maintanance	1

	both______________	control	control	control	and control	
14	Production planning and control=__________________	Production planning + Production control	Production planning + Production Design	shop floor control + Production control	Production management + poduction control	1
15	PPC deals with_______________	Production problem	Machine problem	Material problem	Logistics problem	2
16	SFC is also called as ___________	Production planning control	Data acquisition system	production activity control	Flexible manufacturing system	3
17	Order scheduling is ___________	First phase	Second Phase	Three phase	None of these	2
18	Among this which is not is required for Bar code scanner	Light source	Photo detector	Microprocessor	Micro computer	3
19	To provide an instantaneous 'snapshot' of the present condition of the FMS, the report used are_________	status report	Tool report	Utilisation reports	Production performance report	1
20	According to Groover, the FMS has	Three or four machines	Two or three machines	One or two machines	station tool fail	2
21	Flexible manufacturing system mainly consists of _________________ sub-system	Two	Three	Four	Sven	2
22	Code 39 developed in _________________	1970	1949	1950	1975	4
23	Among this which is not required for bar code scanner	Light source	Photo detectors	Microprocessor	Micro copmuter	3
24	The advantages or benefits of FMS are	Increased machine utilization	Reduced inventory	Reduced manufacturing lead time	All the above	4
25	Order scheduling is __________	First phase	Second phase	Third phase	None of these	2
26	FMS produces ______________	Limited part family	Multi part family	1100 part family	None of these	1
27	Computer processing monitoring is known as	Computer	Computer	Computer	All the above	1

	__________	production monitoring	scheduling monitoring	production & Schedule monitoring		
28	JIT is known as __________	Lean or Stockless production	Inventory production	Quantitative production	None of these	1
29	TPS means ____________	Time production system	Two production system	Toyoto production system	None of these	3
30	Expansion of OSI	Outer system interconnection	Open system interconnection	Operation system interconnection	None of these	2
31	Productio nplanning is _____________ activity	Pre-planning	Post planning	Route planning	None of these	1
32	MRP is ___________________ technique	design	planning	control	inspection	1
33	______________ machines are used to produce small volume of parts at low production rates but have high flexibility.	Conventional	CNC	DNC	VMC	2
34	An FMS can produce __________ volume of parts at medium production rates with medium flexibility.	high	low	medium	Very low	3
35	In FMS the metal cutting systems the machine are usually	Automatic	Conventional	CNC	DNC	3
36	Systems with linear tracks usually have only ____________ vehicle	one	Two production system	three	more than three	1
37	In Flexible manufacturing module (FMM), automatio nis effected by a _____________ robot	Five	Three	Double	Single	4
38	An __________ provides the material handling facility fpr different types of products and processes	Robot	AGV	crane	hoist	2
39	The work flow either in one direction (or) with back flow is known as ____________	In-line configuration	Loop configuration	Ladder configuration	Open-field layout	1

40	_______________ reduces the average travel distance to transfer components between workstations	Loop configuration	In-line configuration	Open-field layout	Ladder configuration	4
41	If a sequence of operations follow one after another & completion of the last one initiates the first one, then the ________ structure is formed among these operations	cyclic	sequential	concurrent	None of these	1
42	JIT were developed by Toyoto in the year ___________	1955	1952	1950	1953	3
43	Off-line data system is also known by the term ___________	data collection system	batch data collection system	batch system	collection system	2
44	Code 39 developed by _________________	David Allais	Toyoto	Ray Sterens	David Allais & Ray Sterens	4
45	Code 39 also called as _________________	One -of- nine code	Two - of - nine code	Three - of - nine code	Four - of - nine code	3
46	FMS applications	Grinding	Forging	Welding	both b&c	4
47	FMS is called	Flexible Manufacturing code	Flexible Manufacturing Cell	Flexible Manufacturing Control	None of these	2
48	FMS is nothing but highly automate _________	CNC machine cell	DNC machine cell	NC machine cell	GT machine cell	4
49	Bar code technology was invented in the year	1945	1949	1952	1950	2
50	______________ is concern with both planning & control of the manufacturing operation.	Manufacturing planning	Manufacturing operation	Production planning	Production management	4
51	_______________ manages the detail flow of materials inside the production facility	Shop floor control	schedule	Control	Measure	1
52	___________translates the Master Production Schedule(MPS) of end product in to a detailed schedule for the raw materials	Material Requirement Planning	Capacity Planning	Shop floor control	Inventory control	1
53	__________ reports indicate the performance of	Exception reports	Progress reports	Work order	Written report	2

	the shop during a time period			report		
54	_____________ concern with purchase order and work order release	Financial function	Management Planning	Operations planning	Operation execution	3
55	There are _________ types of Material Handling Equipment	1	5	2	3	3
56	How many types of conveyers commercially availabel	10	6	5	4	1
57	There are _________ types of data collection terminals.	6	5	3	7	3
58	Production planning & control (PPC) deals with __________	Material problem	Logistics problems	Machine problem	Production problem	2
59	Production Planning & control (PPC) = __________	Production planning + Production control	Production planning + Production design	Production Management + Production control	Shop floor control + Production control	1
60	Objectives of JIT is	Zero defects	Lot size of one	Zero handling	All the above	4
61	Functions of Shop floor control is ___________	Scheduling	Dispatching	Follow up or expanding	All the above	4
62	Route sheet is used to __________	sequence of operations & tools required	get necessary raw material from inventory	report the labour for each operations	required for assembly jobs	1
63	Benefits of JIT	Lower inventory cost	increased productivity	introduce new design	both a&b	4
64	Which one is manual techniques	Route sheet	Bar codes	Employee time sheet	None of these	3
65	What is MPS?	Master Process Schedule	Mass Production Statement	Master Production Schhedule	Master Plan Schedule	3
66	What are activities in a PPC system	Master Production Schedule	MRP	Capacity Planning	All the above	4

67	What are the phases of SFC?	Order program	Order Follow	Route sheet	Job card	1
68	What is the other name of JIT?	Just In Theory	Toyoto Production System	Production Theory	MRP	2
69	Bar Code Technology was invented in the year of__	1947	1968	1949	1972	3
70	Which is the FMS lay out configuration	Robot centered cell	Turning module	Assembly station	None of these	1
71	Benefits of FMS	Increased M/C utilization	Shorter response time	Both 1&2	None of these	3
72	What are the categories in material handling equipment	Conveyors	Computers	Mechanical devices	None of these	1
73	Which is the modern material handling machine	AGV	Trucks	Monorails	Conveyors	1
74	FMS is the result of integerations	CNC	DNC	GT	All of these	4
75	In pull system the product is made to___	Order	Stock	Delivery	Dispatch	1
76	Highly automated GT machine cell is knowm as__	FMS	AGV	ADCS	None of these	1
77	___ is one of the basic component in FMS	Data logger	Barcode scanner	Data acqistion	Work station	4
78	Types of FMS layout configurations are __	2	4	5	6	3
79	The material handling system control has two components.They are__	Tool control&Tool location	Work station&distribution of control	Traffic & shuttle control	All of above	3
80	The combination of Production Planning and Production control is	PPC	SFC	PAC	None	1
81	Production control includes____types of major activities	4	6	7	None of these	1
82	Execution of the dispatching function in PPC is known as	order scheduling	Route sheet	Job cards	None of these	1
83	The advantages of FMS are	Increased M/C utilization	Reduced inventory	Reduced manufacturing lead time	All the above	4

84	According to GROOVER, an FMC has___ machines	2 or 3	3 or 4	1 or 2	More than 2	1
85	Random ordered FMS is preferred when	there is no part family	The part family is large	The part family is small	All the above	2
86	The file which contains the list of workstations through which each workpart has processed is called	Part production file	Routing file	Tool life file	Station life file	2
87	To provide an instantaneous Snapshot of the present condition of the FMS, the report used are	Station reports	Tool reports	Utilization reports	production performance reports	1
88	The function of computer control system is to detect and possibly reject defective work produced by	Failure diagnosis	Quality control	Safety monitoring	Workpiece monitoring	2
89	The term which refers to various technologies used in automatic or semiautomatic acquisition of product data for entry into a computer system is	Retrieval system	Automatic identification	FMS	Product planning	2
90	MRP system is a	Push system	FMS system	Pull system	None of these	1
91	There are ___ categories of matetial handling equipment	5	6	7	4	2
92	Manufacturing resource planning also known as	MRP	MRP II	PPC	None of these	2
93	The collection of documents as referred as	Shop packet	Scheduling	Dispatching	None of these	1
94	The bonafit of MRP	Incraased cost	Reduced cost	Both a & b	None of the abore	2
95	______ Completes shortest time to run a job	Slack time remaining	Critical ratio	Shortest operating time	None of above	3
96	Order scheduling executes the dispatching function in	Production planning and control	Production activity control	Production management	None of above	1
97	_______ is a technology of automatic identification	Barcode technology	Magnetic identification	Machine vision	All of above	4
98	Activities of production control include	Shop floor control	Inventory control	Manufacturing	All of the	4

				resourice planning (MRP - II	above	
99	Inventory record file should contain following segment	Item master data segment	Inventory status data	subsidiary data segment	All of the above	4
100	There are ___ phases in shop floor control	2	4	3	5	3
101	Difference between the time remaining before the due data minus the processing time remaining is ___	Slack time remaining	Stock time remaining	Critical ratio	None of above	1
102	The basic elements of JIT were developed by	General motors	Toyoto	Ford	None of the above	2
103	Transport or conveyance kanban production control system also called as	Withdrawal kanban	production kanban	Two-card kanban	None of the above	1
104	Bar Code Technology was developed by _______ and _____ in USA	Norman J.Woodland,Bernard silver	General motors, Toyoto	Opitz, Bernard silver	CASA/SME, OPITZ	1
105	The materials and handling systems are arranged in straight line is known as	Ladder layout	Loop layout	Open field lay out	None of these	4
106	_______________ is a computer controlled, driverless vehicle used for material transporting from point-to-point	AGV	FMS	JIT	None of these	1

2 marks

1. List the applications of FMS.
2. What is BOM?
3. What are the functions of SFC?
4. List out the advantages of bar code technology.
5. What is SFC?

14 marks

1. Write short notes on Aggregate production planning.
2. Write short notes Material requirement planning.
3. What are AGVs? How do they operate?
4. Describe in detail the various components of FMS.
5. Explain in detail the phases of shop floor control system.
6. List out the various material handling equipment and explain any three with Neat sketch.
7. What is MRP? Explain the inputs to MRP and various MRP outputs. also list the various benefits of MRP.
8. Explain three phases of shop floor control.
9. Write notes on bar code technology.
10. Explain the components of FMS and FMS layout configurations.
11. Explain about the shop floor control (SFC)
12. Explain about the Flexible manufacturing system and the components and elements of FMS.

UNIT-4

CIM IMPLEMENTATION AND DATA COMMUNICATION

CIM AND COMPANY STRATEGY

The starting point for CIM is a company‘s business strategy. Generally it may appear that the starting point for CIM is either networking to link all the existing islands of automation and software or it is the integration of the existing departmental functions and activities as suggested by the CIM wheel (Fig.1.1). But in reality, it is the company‘s business strategy which actually forms as the starting point for CIM. This is because the company's business strategy is the one which identifies the company's markets, its customers, its products, its key technologies and where it is to gain its competitive advantage.

As pointed out in Chapter, 1, CIM results in various benefits including reduced costs and lead times, the potential, ability to exploit concurrent engineering through instant communications and the benefit of managing the company's data. In order to enjoy these benefits, top management of the company must realise CIM as a strategic investment. Also top management of the company must sponsor and implement it as a management policy. To do so, it is important for the top management to analyse how CIM is important to the company, to its markets and its strategy in tacking those markets. Therefore, for CIM implementation, the needs of the business must be identified first and CIM must be analysed to find its most appropriate applications.

CIM implementation can also be viewed as fitting the main process of the CIM jigsaw shown in Fig.4.1. Thus the objective of CIM is to ensure the pieces of the jigsaw fit together well.

In Fig.4.1, the piece labelled 'information and data' is more important of all from CIM perspective. For any company, the 'information and data' piece represents a very large number of descriptive, qualitative and quantitative items related to its business and its products. One of the main challenges of CIM implementation is to organise and coordinate the company's data into a useful, accessible and logical form. In this regard, computerisation also facilitates simultaneous engineering.

In order to implement a CIM, the company needs to decide how to distribute data across various databases and computer systems. There are two strategic approaches that are widely adopted for tackling the problem of organising data:

1. Creation of a model, and

2. Use of CIM architecture.

Company models characterise a company in different ways to analyze the various characteristics such as the complexity of their operation, the large amount of data involved, their cyclic operation uncertain or variable behaviour of certain parts, etc. The path to company modelling starts by analysing the operations of companies in terms of their functional activities and the necessary communications between them. These were already discussed in Section 1.23, Chapter 1, CIM architecture refers to the design of CIM and it covers both the external configuration and the internal configuration of the CIM. The CIM architecture is presented separately in this chapter.

Now we shall focus on company modelling first.

SYSTEM MODELLING TOOLS

Introduction

There is several system modelling tools available. However, the SADT (Structured Analysis and Design Technique) for analysing and specifying software systems is considered as the landmark system modelling tool. In fact, the SADT was conceived trough the United States Air Force's Integrated Computer Aided Manufacturing (ICAM) in 1977. This further led to the development of family of ICAM Definition Language/Modelling Techniques. This development is known by the acronym IDEF.

IDEF

The acronym IDEF stands for ICAM Definition i.e., integratedcomputer aided manufacturing Definition.

IDEF	0	Function modelling *(It shows the overall high-level activities of the process)*
	1	Information modelling *(It captures conceptual views of the industry information)*
	1X	Data modelling *(It captures of logical view of industrial data based on ER model)*
	2	Simulation model design *(It presents time varying behavioural of resources in a factory)*
	3	Process description capture *(It captures physical aspects of a factory system)*
	4	Object-oriented design *(It captures application of computer language in part design stage)*
	5	Ontology description capture *(It capture initial specification of the parts in a factory)*
	6	Design rationale capture *(It represents various design attributes about the parts)*
	7	Information system auditing *(It captures component manufacturing auditing parameters)*
	8	User interface modelling *(It represents description about the interfacing methods in factory)*
	9	Scenario driven IS diagram *(It represents all the inputs status in factory)*
	10	Implementation modelling *(It captures all the implementation methods in part manufacturing)*

The IDEF modelling tools are frequently used for manufacturing system and are considered as potential modelling tools for CIM systems.

The IDEF modelling tolls cover a range of uses from function modelling to information, simulation, object-oriented analysis and design and knowledge acquisition.

Different Types of IDEF Models

Fig.4.2 presents the different modelling methods provided by IDEF. However, the study of first three IDEF modelling methods is important from our subject point of view.

IDEF F0: Used for describing the activities and functions of a system.

IDEF F1: Used for described the information and its relationships.

IDE F2: Used for describing the dynamics of a system.

Now we shall brief them below.

IDEF0

As stated already, IDFE0 is used for describing the activities and functions of a system.

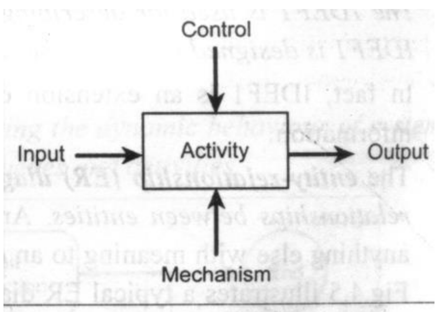


Fig. 4.3. The IDEF0 building block

It provides a formalised modelling notation for representing the type of functional analysis (that was presented in Section 1.23, in product-related activities in a company, Fig 1.25)

Fig.4.3 shows the building block of IDEFO. As shown in Fig.4.3, the IDEF0 building block consists of a rectangle specifying the activity and four arrows input, output, control, and mechanism) representing the resources.

The resources can be any aspect of company's operation, expect its activities, it may be machine, material data, information, people, product, method, etc.

It may be noted that the activities in an IDEF0 model are usually specified using the imperative of a verb (e.g., plan, prepare, find) to emphasize that an action is taking place.

Example of IDEF0 model

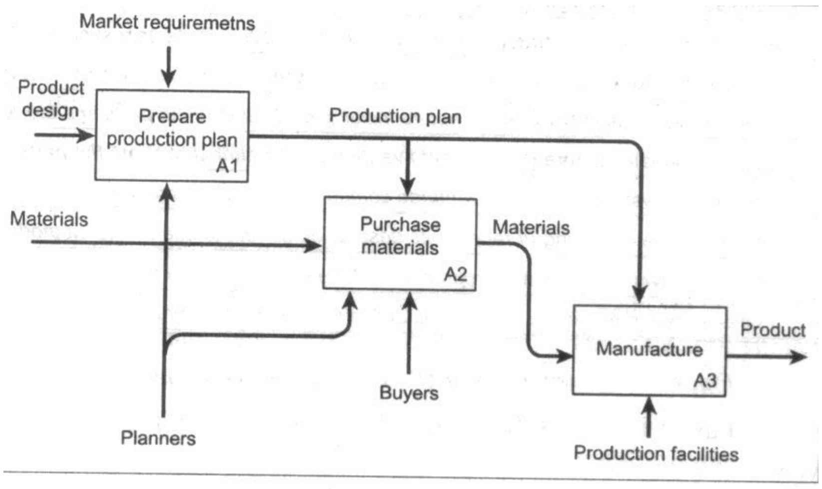


Fig. 4.4. Example of an IDEF0 model

Fig 4.4 illustrates a typical IDEF0 model which consists of three hierarchy levels designated A1, A2, and A3. Thus, as shown in Fig.4.4, the IDEF0 overcomes the complexity of activity details by adopting hierarchy levels, with the lower levels giving progressively greater detail. Also, it should be noted that there consistency between the arrows specifying the inputs, outputs, controls, and mechanisms at one level to those for the complete diagram at the next level down.

IDEF1

The IDEF1 is used for describing the information and its relationships. In other words, IDEF1 is designed to specify the relationships between data.

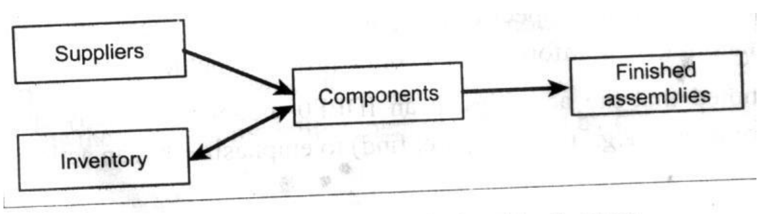


Fig. 4.5. A typical entity-relationship diagram

In fact, IDEF1 is an extension of entity-relationship diagram (ER) for manufacturing information. The entity-relationship (ER) diagrams, as their name suggests, are used to capture the relationship between entities. An entity can be an object, activity, function, person or anything else with meaning to an organisation about which there is a need to record data. Fig.4.5 illustrates a typical ER diagram showing the relationship between four entities-suppliers, inventory, components, and finished assemblies.

Example of IDEF1 model:

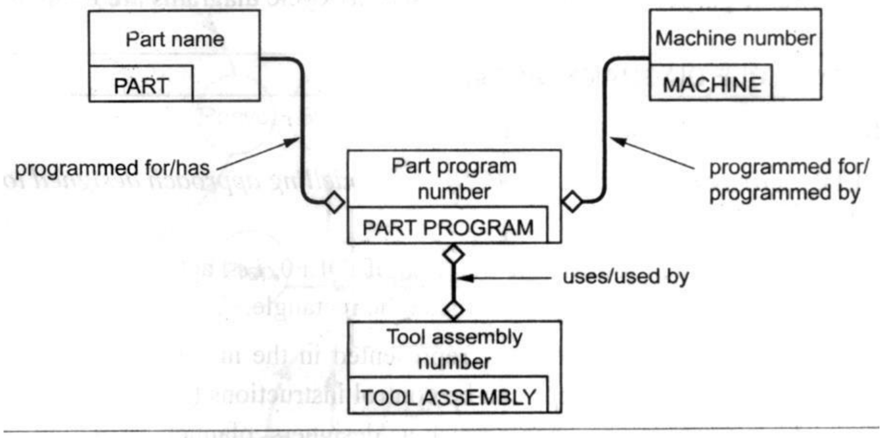


Fig. 4.6. Example of an IDEF1 model

Fig.4.6 illustrates a typical IDEF1 model. As with ER diagram, in IDEF1 model the data is characterised in terms of entity classes and these are specified in a rectangle, with the entity class (shown in capital letters in Fig.4.6) specified in a title box to the bottom left of the rectangle (see Fig.4.6). The entity class specified within the box is uniquely identified by an attribute. The lines in Fig.4.6 indicate relationship between entities. The relationship can be one-to-one type, one-to-many, many-to-many, or many-to-one type. In Fig.4.6, a diamond at the end of lines indicate a 'many' relationship. Also a description of the relationship has to be placed adjacent to the line (see Fig.4.6).

Nowadays the acronym IDEFIX is used instead of IDEF1. IDEF1X is the general term used to refer various additional versionsof IDEF1 that are being developed.

IDEF2

IDEF2 is used for describing dynamics of a system.

IDEF2 provides a modelling notation for representing the dynamic behaviour of systems in terms of entities which pass through a series of queues and activities.

The IDEF2 notation uses an oblong to represent a queue and an arrow to represent an activity (Sec Fig.4.7)

Example of IDEF2 model:

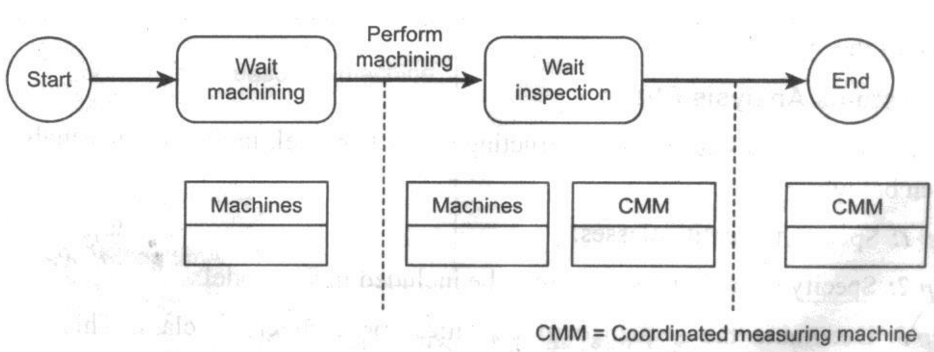


Fig. 4.7. Example of an IDEF2 model

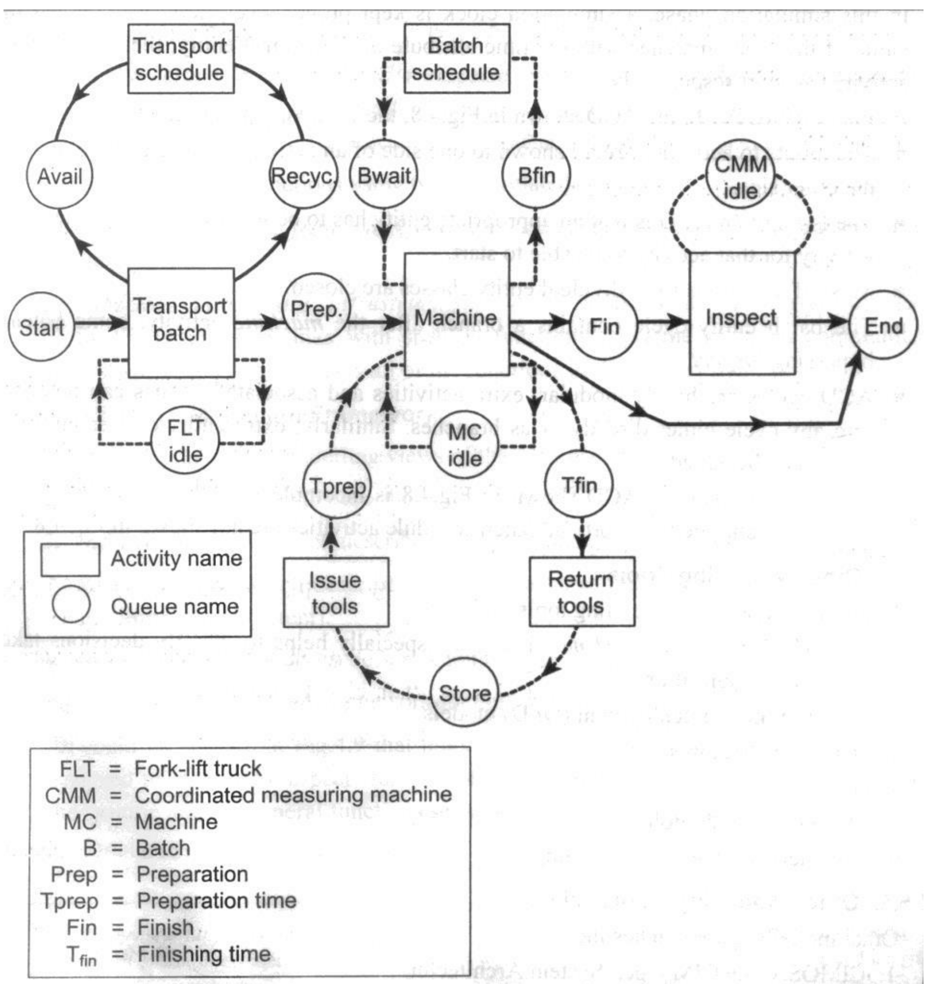
Fig .4.7 illustrates a typical IDEF2 model. As shown in Fig.4.7, the IDEF2 model indicates the resources required for the activity to start (i.e., for queuing too finish) and the resources to make it through to completion.

Demerit: IDEF2 model is criticised because it follows the approach of process-based simulation languages, with distinguish between the entities and the resources they use. Thus for the same purpose of IDEF2 model, activity cycle diagrams are being used.

ACTIVITY CYCLE DIAGRAMS (ACDs)

What is Activity Cycle Diagram?

Like IDEF2, activity cycle diagram (ACD) is a modelling approach designed to represent the dynamics of a system.



ACD modelling approach follows the notation of IDEF0, i.e., activities is represented as rectangles and the actions are specified inside the rectangle.

In ACD, all resources which are to be represented in the model are classified as entity classes. For example, the resources can be control instructions (such as purchasing orders or CNC machining programs), people (such as designers, planners, machine operators or inspectors), equipment (such as machines, or an AGV), or parts and raw material which have operation carried out on them. This use of entity classes matches the IEDF1 approach and the ER diagrams of IDEF1 X.

With IDEF2, the feature of the dynamic model i.e., the desirability for it to be executable was done through process-based simulation languages or packages. With ACD, the dynamic model feature is done through activity-based simulation languages or packages. Thus, in ACDs, entities are distinguished within their class by having attributes.

ACD modelling has two phases: (i) the systems analysis phase, and (ii) the simulation phase of the system.

System Analysis Phase

The step by step procedure o9f constructing an ACD model, in the systems analysis phase, is given below:

Step 1: Speci8fy the enti8ty classes.

Step 2: Specify the activities that are to be included in the model.

Step 3: Determine the sequence of activities for each class. This can include branches at decisions points.

Step 4: Generate activity cycles for each entity class. This requires that consecutive activities in each entity class sequence have a named sequence inserted between them.

Step 5: Link the individual cycles for each entity class together so they join at the activities they share.

Fig.4.8 illustrates a typical activity cycle diagram and its features (which itself is an extract from a larger model).

In Fig.4.8, the various entity classes represented are machines, tools, fork-lift trucks (FLTs) and a coordinate measuring machine (CMM) as physical equipment; batches as the material to be processed; and transport and batch matching machining schedule controls. It is essential that the controls in each case need to be matched to a particular batch through attributes. Also the controls have a time attribute which specifies when the activity (such as transport or machine) is to take place.

Simulation Phase of the System

In this simulation phase, a simulation clock is kept progressively advanced. When the value of the clock matches with the time attribute of the control entity, then the relevant activity can start respectively.

Features of ACDs: In the AACD shown in Fig.4.8, the following points can be noted.

- The inputs to activities are all shown to one side on an activity rectangle, the output to the other side.

- The logic of an ACD is that an appropriate entity has to be in all the input queues to an activity for that activity to be able to start.
- Most of the cycles for individual entity classes are closed.
- The batch entity cycle contains a branch after the machine activity, some batches bypassing inspect.
- ACD cycles are highly modular, extra activities and associated queues can be added into any cycle either directly or as branches. Similarly, extra entity classes and their cycles can be added.

It may be noted that the ACD shown in Fif.4.8 is incomplete; in the sense that human entity classes, and the transport and batch schedule activities are not shown in Fig.4.8.

Other Modelling Tools

The other noteworthy modelling tools include:

1. The GRAI grid and GRAI net. The gri8d especially helps to identify decisions taken within an organisation
2. Quality function deployment (QFD) models
3. Data flow diagrams
4. Game
5. The NIAM methodology
6. Petri-nets for dynamic modelling

Other modelling Approaches

Other modelling approaches include:

1. CIMOSA, the CIM Open System Architecture;
2. The SME's new manufacturing enterprise wheel; and
3. The Yourdon approach.

Now we shall describe the first two modelling approaches below.

CIMOSA

- ✓ CIMOSA was developed for ESPRIT (European Strategic Program for Research and Development in Information Technology) by AMICE.
- ✓ ESPRIT is an industrially oriented R&D program with the aim of improving the competitiveness of the European Community Industries. The ESPIRT strategy has been the creation of an environment in which multi-vendor production system can be implemented at reasonable cost.
- ✓ CIMOSA defines a model-based enterprise method which categorizes manufacturing operations into generic and specific functions. These functions

are combined to create a model which can be used for process simulation and analysis.

CIMOSA separates functions using two interrelated concepts:

1. CIMOSA modelling framework, which separates the specific and the generic functions clearly; and
2. CIMOSA integrating infrastructure, which supports the execution of generic functions and also links with specific functions. It is the effective communication system, which interconnects all of the functions in the CIM system.

CIMOSA Modelling Framework

✓ CIMOSA defines four modelling views of the enterprise functions. They include:

1. Functional view, which describes workflows.
2. Information view, which describes the inputs and outputs of function.
3. Resource view, which describes the structure of resources (human, machines, control, and information system).
4. Organisation view, which defines authoriti8es and responsibilities.

Fig.4.9 depicts a CIMOPSA framework for enterprise modelling, which itself a model. As could be seen from Fig.4.9 that the CIMOSA framework for has three orthogonal axes, designed to include all aspects for enterprise modelling and more importantly presenting the specific and the general functional separately in a clear cut way.

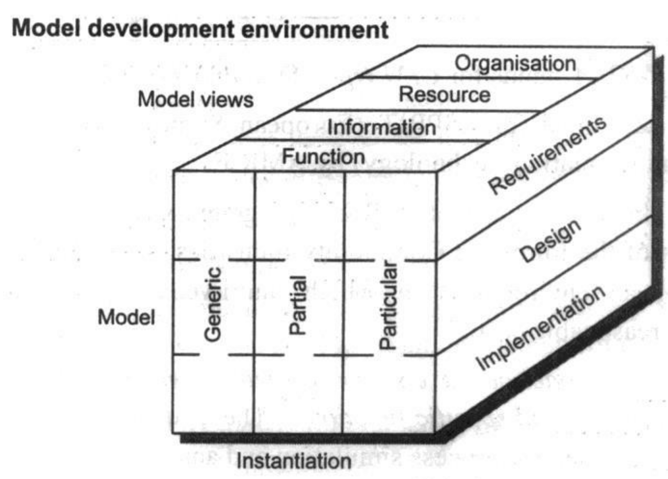


Fig. 4.9. The CIMOSA framework

✓ The three orthogonal axes (Fig.4.9) are:

1. Instantiation or generosity axis,
2. Derivation or model axis, and
3. Model-view axis.

- ✓ The instantiation axis, also known as generosity axis, suggests the use of generic models being progressively tailored to specific applications.
- ✓ The deviation axis, also known as model axis, covers various aspects of CIM implementation approaches discussed so far in this chapter.
- ✓ The model-views axi8s picks up some of the elements of IDEF0 (on functions and activities) and IDEF1 (on information) together with resource and organisation views.
- ✓ Thus the CIMOSA modelling framework provides the user with architectural constructs and guidelines for the structured description of business requirements and their translation into CIM system design and implementation.

CIMOSA Integrating Infrastructure

- ✓ The CIMOSA integrating infrastructure provides the effective communication system which interconnects all of the functions in the CIM system.
- ✓ Fig.4.10 shows the CIMOSA integrating infrastructure.
- ✓ Since activities, information, and control are treated as three different entities, it is possible to make charges in one entity without greatly affecting another one. The dynamic feature of the model enhances the flexibility of an enterprise to quickly adapt to changing material and information flow.

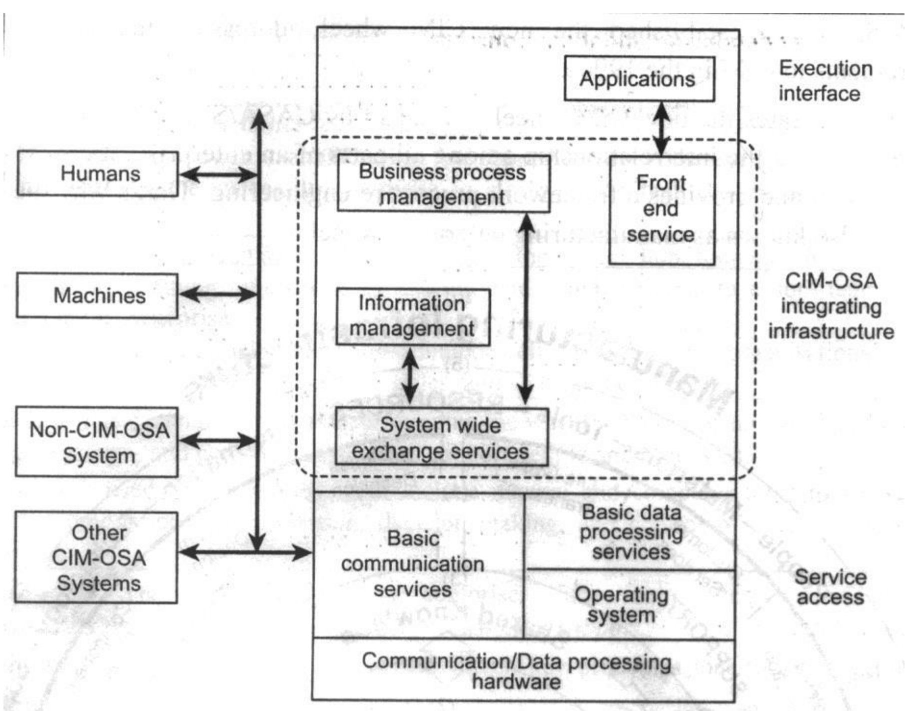


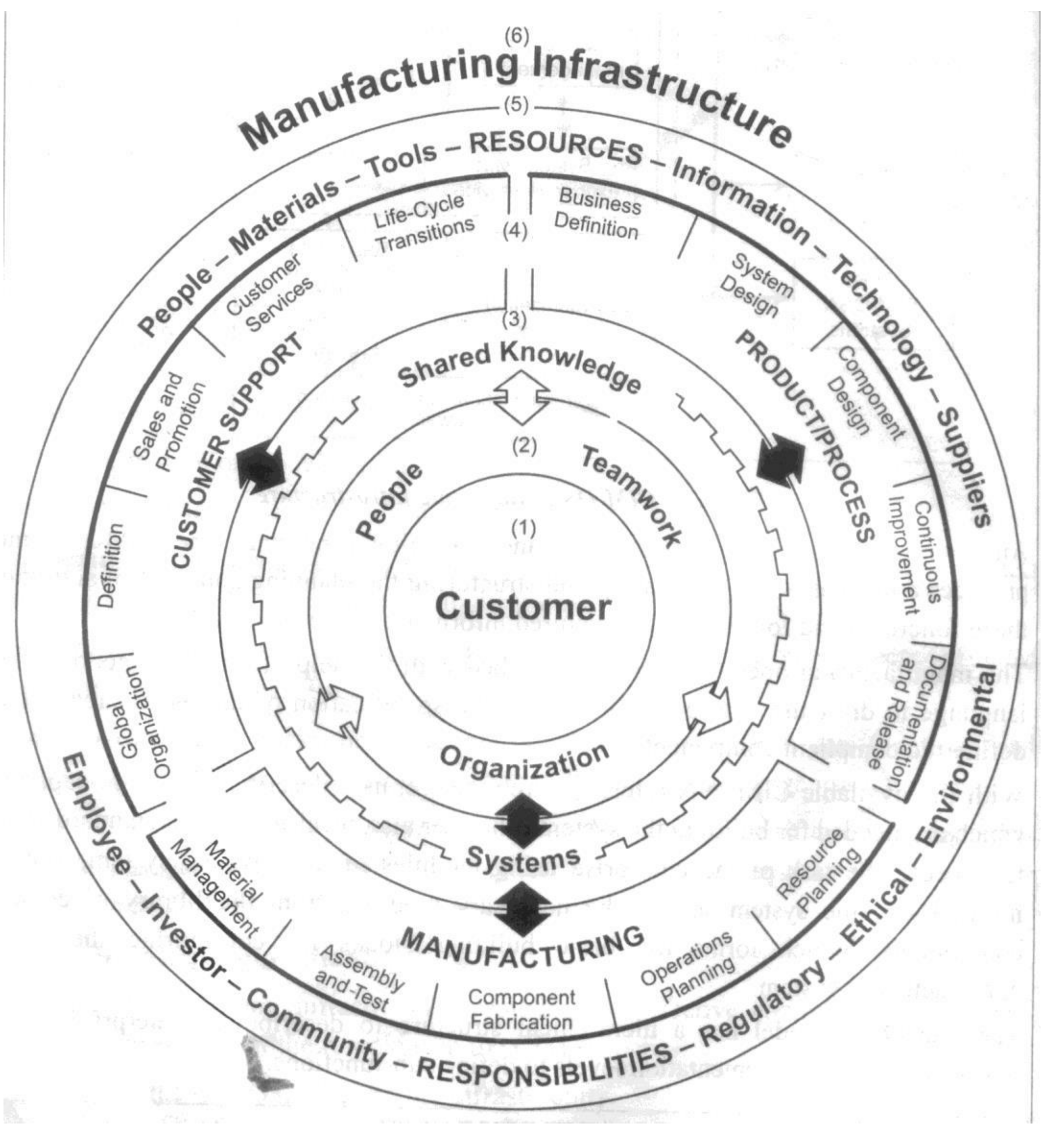
Fig. 4.10. CIM-OSA integrating infrastructure

- ✓ An enterprise consists of engineering and operation functions. The CIMOSA model provides a mechanism for preparing and structuring the planning and control activities of these functions and for changing structured information between them.

- ✓ The manufacturing operation can be described with the help of requirements description define the compliant components.
- ✓ With the available CIMOSA reference architecture, user describes the basic capabilities which are needed for building the system. The user also specifies a set of standard services to execute the task of the enterprise using modules of the physical system. With this information, the system selects the necessary modules from the library of compliant components, which forms the basic building blocks for configuring the physical manufacturing system.
- ✓ The CIMOSA model has a hierarchical structure to describe an enterprise, and the intermediate and implementation levels to define sub-Functions.

THE NEW MANUFACTURING ENTERPRISE WHEEL

[CASA/SME Manufacturing Enterprise Wheel]



- ✓ It may be noted that the CIM wheel introduced in Chapter 1 (Fig.1.1) was devised by the Computer and Automated Systems Association of the
- ✓ Society of Manufacturi8ng Engineers (CASA/SME) in the 1980s. Since the manufacturi8ng world is always changing, the CASA/SME has established the new CIM wheel addressing the changi8ng needs/requirements to CIM in the 1990s.

- ✓ Fig.4.11 illustrates the new CIM wheel developed by CASA/SME. The new CIM wheel, besides showing the interrelationship among all parts of an enterprise, focuses on process improvement and provides a framework process re-engineering. That's why the new CIMO wheel is also known as manufacturing enterprise wheel.
- ✓ For better understanding readers are suggested to study all the segments present in the CIM wheel (Fig.4.11). The CIM wheel has six major areas/sections/segments, as shown in parenthesis in Fig.4.11.

Segment 1: Obviously customer is the hub of the CIM wheel, because customer is the primary target or all marketing, design, manufacturing, and support efforts in the enterprise. It is essential for the successful enterprise to clearly understand the market place and the customer.

Segment 2: The first radial sector surrounding the wheel hub focuses on the means of organizing, hiring, training, motivating, measuring and communicating to ensure team work and cooperation in the enterprise. The techniques used to achieve this goal include self-directed teams, organisational learning, leadership, standards, rewards quality circles and a corporate culture.

Segment 3: the second radial sector surrounding the wheel hub focuses on the shared corporate knowledge, systems and common data used to support people and processes. This sources used to achieve this goal include manual and computer tools to aid research, analysis ,innovation ,documentation, decision making and control of every process in the enterprise.

Segment 4: The third radial sector comprises three main categoriesof processes: product /process definition, manufacturing, and customer support. As shown in Fig. 4.11, this group includes fifteen key processes that form the product life cycle.

A. Product/Process definition
1. Business definition
2 System design
3 Component design
4 Continuous improvements
5 Documentation and release

B. Manufacturing
6. Resource planning
7. Operations planning
8. Component fabrication
9. Assembly and rest

10. Material management

C. Customer support

11. Global organisation

12. Definition

13. Sales and promotion

14. Customer services

15. Lifestyle transitions

Segment 5: The next radial sector represents the resources and the responsibilities of the enterprise. The enterprise has resources that include capital, people, materials, management, information, technology, and suppliers. The enterprise also has responsibilities to employees, investors, and the community, as well as regulatory, ethical, and environmental obligations.

Segment 6: The outer rim of the CIM wheel is the manufacturing infrastructure. This infrastructure includes customers and their needs, suppliers, competitors, prospective workers, distributors, natural resources, financial markets, communities, government, and educational and research institutions. As the wheel illustrates, CIM encompasses all aspects of the manufacturing enterprise and its management, including those of personnel and finance. Thus the new manufacturing enterprise wheel justifies its inclusion here as a modelling method for CIM and as means of moving from an as is model.

CIM ARCHITECTURE

Analogy between Building Architecture and CIM Architecture

The Oxford Dictionary defines the term ‘architecture’ as the art or science of designing and construction of buildings. It covers the internal configuration, the external configuration and utilities of the building.

CIM is also described as having architecture. It is more appropriate to treat CIM implementation as analogous to the design and construction of a building. Because, like in architecture (of building), CIM also has an internal configuration, an external configuration, and utilities. The analogy between ‘building’ architecture and ‘CIM’ architecture is illustrated in Fig.4.12. The analogy concept is more useful to easily understand how the various building blocks of CIM have to be organised into a structure. From Fig.4.12, the following important points with respect to CIM architecture may be noted: The building regulations are analogous to the CIM concepts and standards. The building materials (input to the building) are analogous to the data and company information which have to be organised into a structure.

The data structures from the internal configuration. The utilities are the networks which are the means for making the data become accessible and for allowing a company to operate. The external configuration is perceivable to the user computer terminals, user interfaces and through other user support tools. In Fig.4.12, the architect's plan (the input) is analogous to CIM architecture (design templates). The term 'CIM architecture' often applied to a template which can be used for the design and implementation of a CIM system.

The CIM designer, like the architect, has standards to work for some aspects of the design. But unlike building plans, the CIM architecture provides a template for a flexible and adaptable structure.

The design template (CIM architecture) can have three levels:

(1) Conceptual level (which provides the design philosophy),

(2) Design level, and

(3) Implementation level.

PRODUCT DATA MANAGEMENT: CIM MPLEMENTTION SOFTWARE

What is Product Data Management?

Usually manufacturing companies are good at systemically recording component and assembly drawings. But often they do not keep compressive records of attributes such as 'size', 'weight', 'where used', etc. As a result, engineers often have problems assessing the information they need. This leaves an unfortunate gap in their ability to manage their product data effectively. Thus PDM is the system to manage attribute and documentary product data, as well as relationships between them, through a relational database system.

PDM software manages, organizes, and controls engineering design information (through the transformation from prototype design to a product in full production). Good PDM systems provide flexible product assembly structures, supporting complex relationships between parts, drawings, supporting documents, metadata, and teams. In other words, PDM is concerned with the management of the life –cycle data of products.

FUNCTIONS OF PDM Software

According to CIM data Inc, the PDM software functions can be grouped into two categories:

1. User functions, and
2. Utility functions.

1. **User Functions**

The PDM user functions include:

1. **Data vault and document management:** This function provides the management of the storage security, access, version control, etc. of all product-related data.
2. **Process and workflow management:** this function provides the management and control of the business processes and associated workflows associated with the definition, revision, and sign-off and scheduling of documents.
3. **Product structure management:** it provides parts list and bill of materiel functions, parts definitions, and parts relationship attributes.
4. **Data classification and retrieval:** it provides tools to search for and retrieve standard parts and existing design data.
5. **Project (or program) management:** it creates work breakdown structures and schedules resources.

2. Utility functions

PDM utility functions include:

1. **Data communication and notification:** Its function is to handle all data communication between the various applications subsystems and also to external systems.
2. **Data transport:** it provides mechanisms to move data among users, as well as applications and PDM functions to and from other products.
3. **Data translation:** it provides access to tools that translate data between applications such as CAD and CAM.
4. **Image services:** these provide a "viewing: capability for reviewing graphical images and may provide redline mark up.
5. **System administration:** it provides functions which enable PDM users to setup, customize, and manage the PDM system.

Benefits of PDM systems

The various benefits of implementing the PDM system are:

(i) Improved design productivity.
(ii) Improved design and manufacturing accuracy.
(iii) Fewer design changes.
(iv) Better management of engineering change.
(v) Reduced development time.
(vi) Better audit trails.

(vii) Improved communications between team members.

(viii) Faster customer response.

(ix) Reduced overheads.

(x) Better use of creative team skills.

(xi) Data integrity safeguarding.

(xii) Better control of projects.

(xiii) Comfortable and easy use of produce information.

NETWORK COMMUNICATIONS

Why Enterprise Networks are Necessary?

- ✓ A communication network is the backbone of enterprise organisation. Networks help to unify a company by linking together all the computerized devices irrespective of their physical location. Through networks, the whole enterprises, including suppliers and customers, can be integrated.
- ✓ For any successful CIM environment, a well-developed enterprise networks are necessary. For example, sales and marketing department send customer requirements/expectations to design engineering department, where a CAD system generates a bill of materials (BOM)

NETWORKS

What is a Network?

- ✓ A communication network is a collection of equipment and physical media that interconnects two or more computers.
- ✓ In other words, a communication network is a system of interconnected computers, telephones, or other communications devices that can communicate with one another and share applications and data.
- ✓ Networking is a convenient technique for tying together the various 'islands of automation' (discussed in Chapter 1) and makes CIM – 'integration' possible through high speed data exchange between different automated segments.
- ✓ Networks use distributed processing, in which a task isdivided among multiple computers/workstations. Instead of a single large machine being responsible for all aspects of a process, each separate computer (usually a personal computer or workstation) handles a subset

Advantage of Networks

Some of the important advantages of networking are given below.

1. Networks allow more efficient management of resources. For example, multiple users can share a single top-quality printer, rather than putting

duplicate, possibly lesser-quality printers on individual desktops. Also, network software licenses can be less costly than separate stand-along licenses for the same number of users.

2. Networks help keep information reliable and up-to-date. A well managed, centralized data storage system allows multiple users to access data from different locations and too limits access to data while it is being processed.
3. Networks help speed up data sharing. Transferring files across a network is almost always faster than other, non-network means of sharing files.
4. Networks allow workgroups to communicate more efficiently. Electronic mail and messaging is a staple of most network systems, in addition to scheduling systems, project monitoring, on-line conferencing, and groupware. All of these things help work teams to be more productive.
5. Networks help business service their clients more effectively. Remote access to centralised data allows employees to service clients in the field and clients to communicate dire4ctly with suppliers.
6. Networks greatly expand a business's marketing and customer service capability. Using Internet technology, a business can automate its ability to inform customers about its products and services, take orders directly from customers and provide up-to-the-minute facts and figures to be accessed at the customer's wish, any time day or night.

Types of Networks

Networks are generally classified into three categories based on the geographic area as:

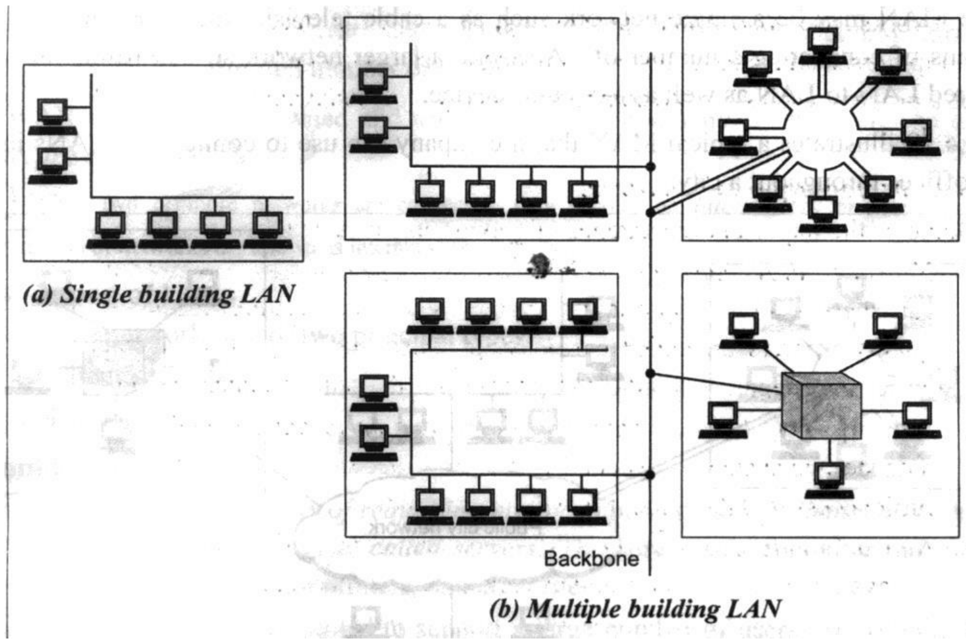
1. Local Area Networks (LANs),
2. Metropolitan Area Networks (MANs), and
3. Wide Area Networks (WANs)

1. **Local Area Networks (LANs)**

✓ A local area network (LAN) is a privately owned communications network that serves users within a confined geographical area.

✓ The range is usually within a mine—perhaps one office, one building, or a group of buildings close together, as a college campus. The typical LAN systems are illustrated in F.g 4.18.

✓ The LAN is usually privately owned and links the devices in a single office, building, or campus. Depending on the needs of an organisation and the type of technology used, a LAN can be as a simple as two PCs and a printer in someone's home office, or it can extend throughout a company and include voice, sound, and video peripherals.



- ✓ LANs are designed to allow resources to be shared between personal computers or workstations. The resources to be shared can include hardware (e.g. a printer), software (e.g., an application program), or data.
- ✓ In many business environments, a LAN links a work group of task-related computers, for example, engineering workstations or accounting PCs. One of the computers may be given a large-capacity disk drive and become a server to the other clients. Software can be stored on this central server and used as needed by the whole group.
- ✓ Traditionally, LANs have data rates in the 4 to 16 Mbps (megabytes per second) range. Today, however, speeds are increasing and reached 100 Mbps with gigabit systems.
- ✓ The main advantage of LAN is to enable organisations to realize large productivity gains and cost savings through the inherent efficiencies of resource sharing.

Metropolitan Area Networks (MANs)

- ✓ A metropolitan area network (MAN) is a communications network covering geographic area the size of a city or suburb.
- ✓ Thus MAN is designed to extend over an entire city.
- ✓ The MAN may be a single network such as a cable television network, or it may be a means of connecting a number of LANs into a larger network so that resources may be shared LAN-to-LAN as well as device-to-device.
- ✓ Fig illustrates a typical MAN that a company can use to connect the LANs in all of its offices throughout a city.

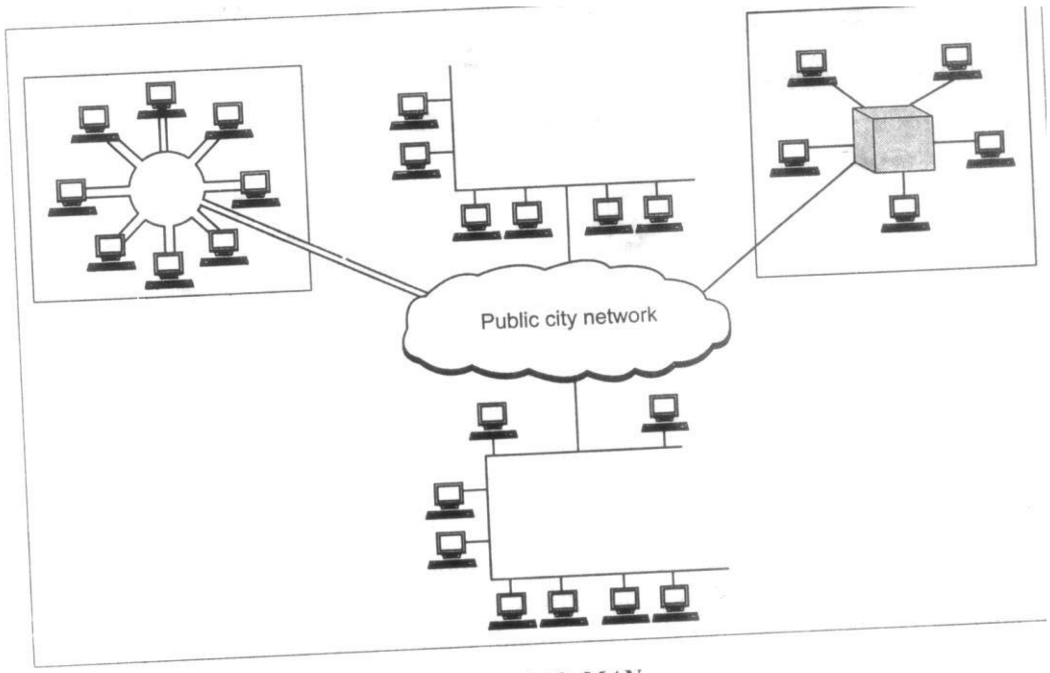


Fig. 4.19. MAN

✓ A MAN may be wholly owned and operated by a private company, or it may be a service provided by a public company.

Wide area Networks (WANs)

A wide area network (Wan) provides long-distance transmission of data, voice image, and video information over large geographical areas that may comprise a country, a continent, or even the whole world.

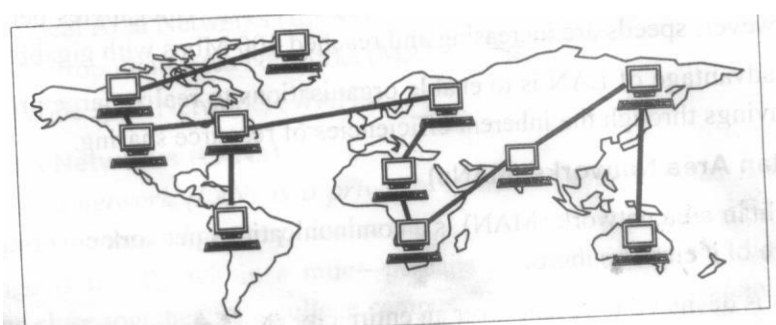


Fig. 4.20. WAN

A typical WAN system is illustrated in fig.4.20. In contrast LANs (which depend on their own hardware for transmissions) WANs may utilize public, leased, or private communication devices, usually in combinations, and therefore span an unlimited number of miles. A WAN that is wholly owned and used by a single company is often referred to as an enterprise network.

Note: When two or more networks are connected, they become an internetwork or internet. That is, interconnection of networks is known as internetwork.

Types of LANs

Local area networks are of two principal types:

1. Client/server, and
2. Peer-to-pear.

1. Client/Server LANs

A clients/server LAN consists of requesting microcomputers, called clients, and supplying devices that provide a service, called servers. The server is a computer that manages shared devices, such as laser printers, or shared fields.

This type of network is designed to support a large number of users and users dedicated server/s to accomplish this. Clients log on to the server/s in order to run applications obtain files. One or more administrators can manage security and permissions.

This type of network also allows for convenient backup services, reduces network traffic and provides a host of other services that come with the network operating system.

2. Peer-to-Peer

The word peer denotes one who is equal in standing with another. A peer-to-peer LAN is one in which all microcomputers on the network communicate directly with one another without relying on a server.

Thus the peer-to-peer network lacks a dedicated server and every computer acts as both a client and a server.

This is a good networking solution when there are 10 or less users that are in close proximity to each other. It is only recommended in situations where security is not an issue.

NETWORK TOPOLOGY

What is Network Topology?

Topology is a term used to describe the way in which computers/workstations are connected in a network. The physical topology describes the actual layout of the network hardware; the logical topology describes the behaviour of the computer on the network, from the perspective of its human operators.

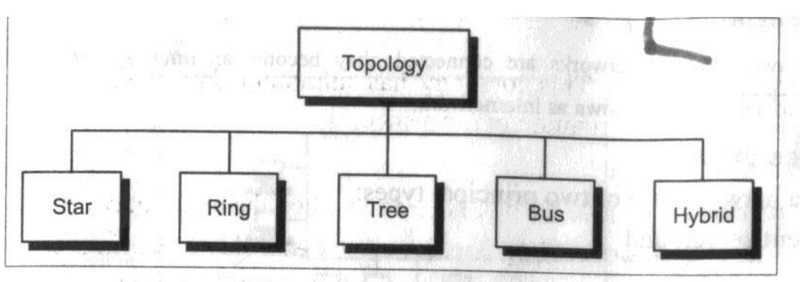


Fig. 4.21. Categories of topology

The topology of a network is the geometric representation of the relationship of all the links and linking devices (usually called nodes) to each other. Thus the logical layout, or shape, of a network is called a topology. Topology defines the physicals or logical arrangement of links in a network.

Categories of Topology

There are five basic topologies possible, as shown in Fig.4.21.

1. Star (or Radial) Topology

In a star topology, each device has a dedicated point-to-point link only to a central controller, usually called a hub, as shown in Fig.4.22.

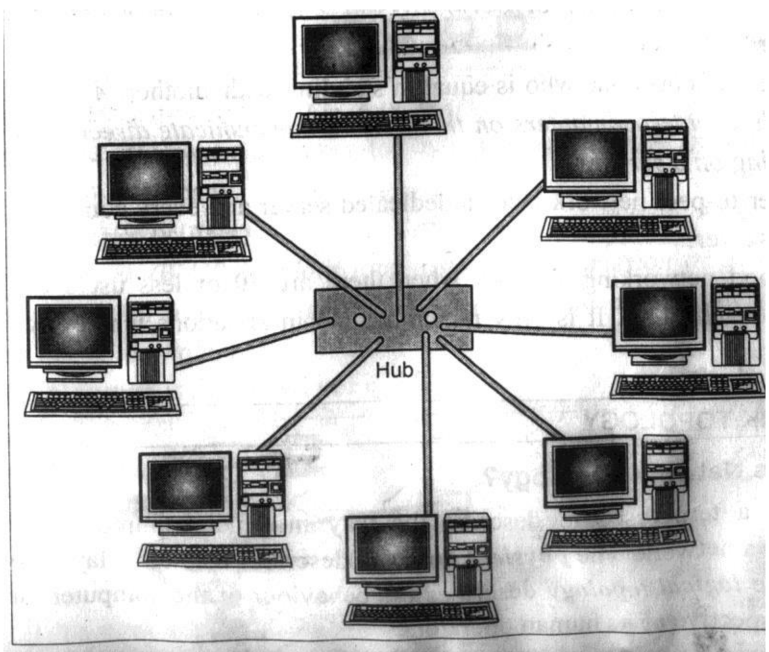


Fig. 4.22. A star topology

This topology does not allow direct traffic between devices. If one device wants to send data to another, it sends the data to the hub, which then relay to the other connected devices.

Advantage of star topology

1. Ease of service. In a star, each device needs only one link and one I/O port to connect it to any number of others. This factor makes it easy to install and reconfigure.
2. Robustness. It is very robust. Because each device has an independent connection to the central hub, the network can continue to function if any of the individual nodes fails.
3. Simple access protocol. This topology has minimum data traffic along the cables (node-to-hub only), for optimum performance.

Disadvantages of star topology

1. Central hub dependency. If the hub goes down, then the entire network will fail.

2. Long cable length. More cabling is required in a star than tree, ring, or bus topology. This is because each device in star directly connected to the centre.
3. Difficult to expand. The addition of a new device to a star network involves a connection all the way to the central hub.

The star topology has found extensive application in areas where intelligence in the network is concentrated at the central node.

2. Tree Topology

A tree topology is a variation of a star. As in a star, nodes in a tree are linked to a central hub that controls the traffic to the network. However, not every device plugs directly into the central hub. The majority of devices connect to a secondary hub that in turn is connected to the central hub, as shown in Fig.4.23.

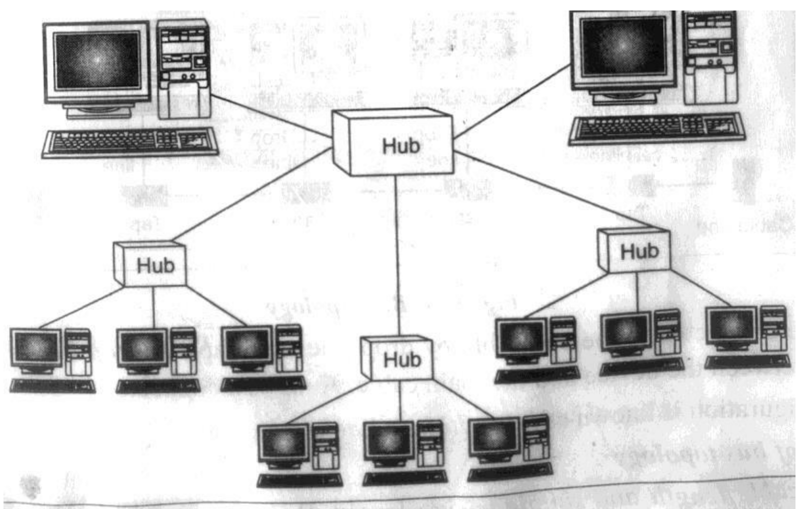


Fig. 4.23. Tree topology

The central hub in the tree is an active hub. An active hub contains repeater, which is a hardware device that generators the received bit patterns before sending them out. Repeating strengthens transmissions and increases the distance a signal can travel.

The secondary hub may be active or passive hubs. A passive hub provides a simple physical connection between the attached devices.

Advantages of tree topology

The advantages and disadvantages of a tree topology are generally the same those of a star. But there are some extra advantages and disadvantages due to the addition of secondary hubs.

1. Easy to extend. Because of the nature of the tree topology, it is easier to add new nodes or branches to it.
2. Fault isolation. It is possible to disconnect whole branches of the network from the main structure. This makes it easier to isolate a defective node.

Disadvantages of tree topology

1. Dependent on the root. If the 'hub' device fails to operate, the entire network fails. In this respect, the tree suffers from the same reliability problems as the star.

3. Bus Topology

The bus network works like a bus system at rush hour, with various buses pausing in different bus zones to pick up passengers. The bus topology consists of a single length of the transmission medium (i.e., cable) onto which the various nodes are attached, as illustrated in Fig. 4.24.

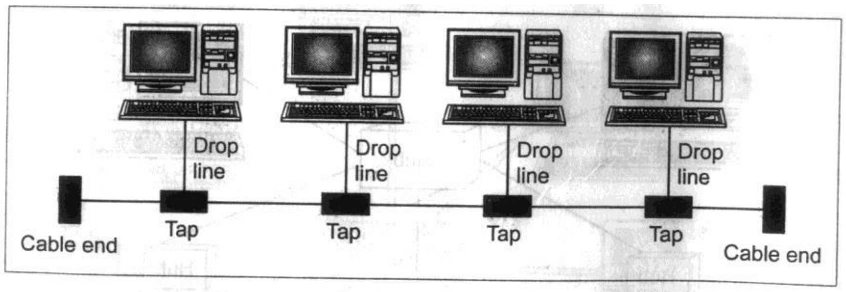


Fig. 4.24. Bus topology

Nodes are connected to the bus cable by drop lines and taps. A drop line is a connection running between the device and the main cable. A tap is a connector. This configuration is known as a '**multi drop line**'.

Advantages of bus topology

1. Short cable length and simple wiring layout. Because there is a single common data path connecting all nodes, the bus topology allows a very short cable length to be used. This decreases the installation cost, and also leads to a simple, easy to maintain, wiring layout.
2. Resilient architecture. The bus architecture has an inherent simplicity that makes it very reliable from a hardware point of view.
3. Easy to extend. Additional nodes can be connected to an existing bus network at any point along its length.

Disadvantages of bus topology

1. Fault diagnosis and fault isolation is difficult.
2. Slow performance. Because a single cable is dedicated to all the information traffic, performance can be slow at times.

Ring Topology

In a ring topology, each device is connected to two andonly two neighbouring devices. Each node passes information along to the next, until it arrives at its intended destination, illustrated in Fig.4.25.

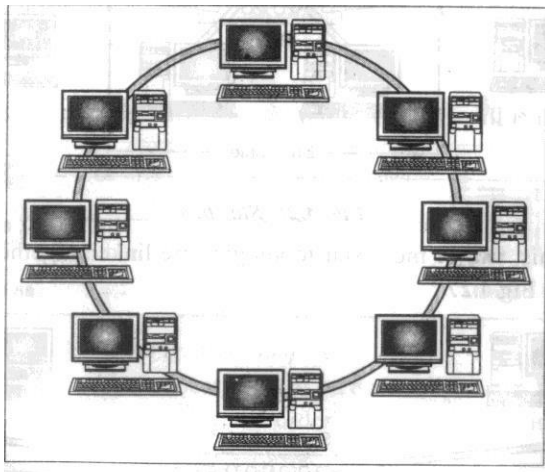


Fig. 4.25. A ring topology

Thus in the ring topology information travels in one direction only, from node to node around the ring.

Advantages of ring topology

1. Relatively easy to install and reconfigure.
2. Short cable length. The amount of cabling involved in a ring topology is comparable to that of a bus and is small relative to that of a star.
3. Faster performance. Performance can be faster on this system because each portion of the cabling system is handling only the data flow between two devices.
4. No wiring closet space required.
5. Suitable for optical fibres.

Disadvantages of ring topology

1. Node failure causes network failure. The failure of one device can affect the entire network.
2. Difficult to diagnose faults.
3. Network reconfiguration is difficult.

5 .Hybrid Topologies

By modifying or combing some of the characteristics of the 'pure' network topologies, a more useful network may be obtained. These combinations are called hybrid topologies.

Two such hybrid topologies are: Star bus and star ring.

NETWORK MANAGEMENT AND INSTALLATIONS

Network management can be defined as OAM&P (operations, administration, maintenance, and provisioning) of network and services. The operations group is connected with daily operations are providing network services.

Network administration is concerned with establishing and administering the overall goals, policies, and procedures of network management. The installation and maintenance group handles function that includes both installation and repairs of facilities and equipment. Provisioning involves network management is to ensure that the users of a network receive the information technology services with the quality of service that they expect.

The goal of network management is to ensure that the users of a network receive the information technology services with the quality of service that they expect. From a business administration point of view, network management involves strategic and tactical planning of the engineering, operations, and minimum overall. Well-established communication and interaction among the various groups is necessary to perform these functions.

Functions of Network Management

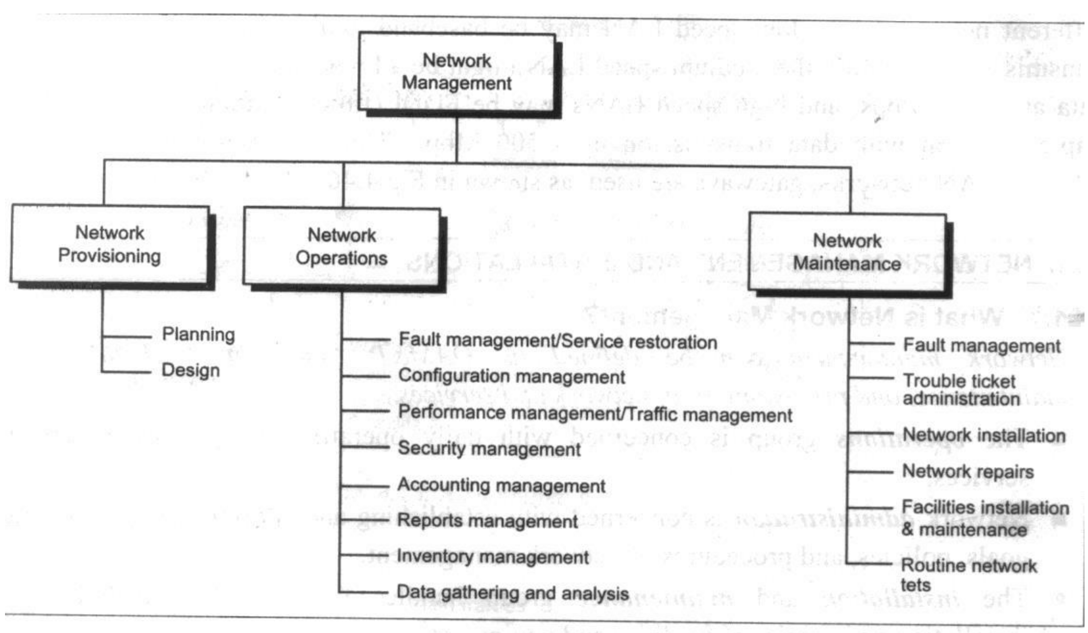


Fig. 4.47. Network management functional groupings

Fig.4.47 presents a top-down view of network management functions. It comprises three major groups:

1. Network provisioning,
2. Network operations, and
3. Network installation and maintenance (I&M)

It is useful to consider the different functions as belonging to specific administrative groups.

Network provisioning is the primary responsibility of the engineering group.

Network I&M is the primary responsibility of the plant facilities group.

The normal daily operations are the network operation group, which controls and administers and administers a network operations centre (NOC).

The NOC is the nerve centre of network management operations. The functions of the NOC are concerned primarily with network operations; its secondary responsibilities are network provisioning and network I&M.

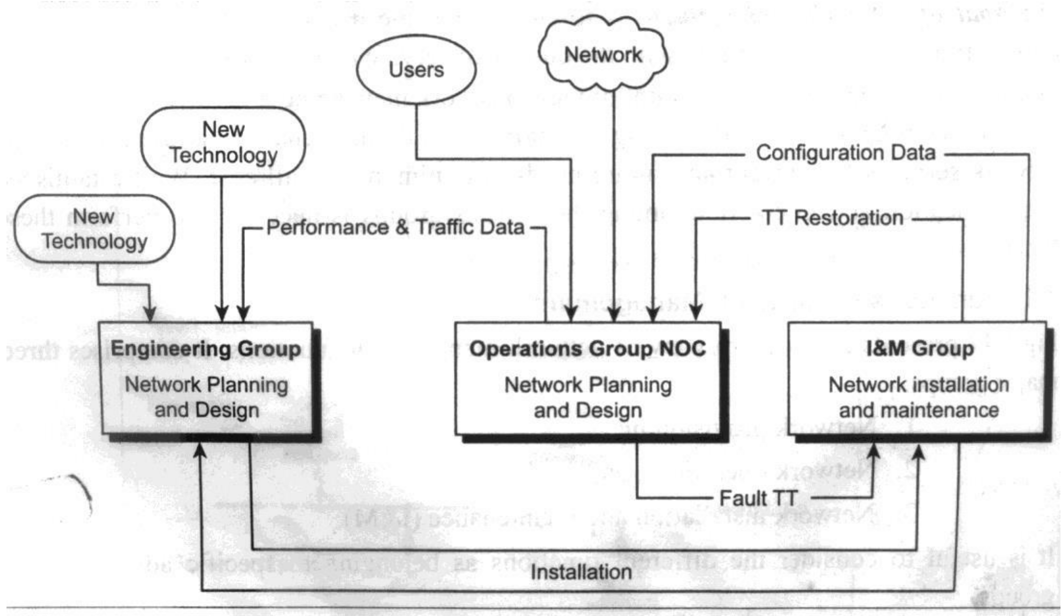


Fig. 4.48. Network management functional flowchart

1. Network Provisioning

Network provisioning consists of network planning and design. It is the responsibility of the engineering group. The engineering group keeps track of new technologies and introduces them as needed. Determination of what is needed and when is made through analysis of the traffic and performance data provided by the network operations. Modifications to network provisioning may also be initiated by management decisions. Planning and efficient use of equipment can be achieved with good inventory management of modifications of network configuration by the network-provisioning group.

Network management tools are helpful to the engineering group in gathering statistics and studying the trends of traffic patterns for planning purposes. Automated operations systems help in the design of circuits and measurements of the performance tune-up.

2. Network Operations

Network operations are concerned with daily operations of the network and providing network services. The functions of network operations, listed in Fig.4.47, are administrated by the network operations centre (NOC). The NOC is also responsible for gathering statistics and generating reports for management, system support, and users. A network management system and tools are a necessity for NOC operations.

The International Organisation for Standardisation (ISO) has defined five network management applications:

1. Fault management;
2. Configuration management;
3. Performance management;
4. Security management; and
5. Accounting management.

1. Fault Management/Services Restoration

Fault management facilities deal with detecting managed resource faults and alerting the appropriate administers.

Fault management 1. Provides isolation, 2. Examines error logs, 3. Accepts and acts upon error detection notification, 4. Traces faults, and 5. Corrects faults arising from abnormal operation.

Fault management frequently includes automatic execution to fix or bypass faults as and when an end-user or program reports that a certain system function is not available.

The responsibility to fix the problem usually rests with the I&M group. The tracking of a trouble involves several groups and the administration of it generally belongs to the network maintenance group.

Trouble ticket administration: Trouble ticket administration is the administrative part of fault management and is used to track problems in the network. All problems are to be tracked until resolved.

(i) Configuration Management

- ✓ Configuration management facilities deal with the addition, detection, modification, distribution and browsing of managed resources. That is, it enables a network manager to exercise control over the configuration of a communication system.
- ✓ There are three configurations of the network:
  - The front configuration is the static configuration and is the permanent configuration of the network. The static configuration is one that would come up if the network is started from idle status.
  - The second configuration of a network is the current running configuration.
  - The third configuration is the planned configuration of the future when the configuration data will changes as the network is changed. This information is useful for planning and inventory management.
- ✓ The configuration data is gathered automatically as much as possible, and is stored by network management systems.

(ii) Security Management

- ✓ Security management facilities provide for the protection of the network resources. It includes authorization facilities, access controls, encryption, authentication, maintenance and examination of security legs.
- ✓ Security management can over a very broad range of security, which includes physically securing the network, as well as controlling access to the network by the users.
- ✓ A security database is established and maintained by the NOC for access to the network and network information.
- ✓ An example of security management might be assigning and checking the privileges of a person who wants to use a printer. The category also deals with putting 'fire walls' around sensitive resources-for instance, securing a host to prevent remote log-ins.

(iii) Performance Management

- ✓ Performance management facilities evaluate the behaviour of network and layer entity resources and the effectiveness of communication activities. It can also adjust operating characteristics and generate network utilization reports by monitoring a station's performance.
- ✓ In other words, performance management is to measure and make available various aspects of network performance so that network performance can be maintained at an acceptable level.
- ✓ Example of performance variables that might be provided includes network throughput, user response times, and line utilization.
- ✓ The network statistics such as data on traffic, network availability and network delay are usually gathered by NOC.
  - Traffic statistics are helpful in detecting trends and planning future needs.
  - Performance data on availability and delay is useful for tuning the network to increase the reliability and to improve its response time.

Accounting Management

- ✓ Accounting management facilities calculate the amount of network time used by each segment of the network and facilities a billing system for the usage of resources.
- ✓ In other words, accounting management measures network utilization parameters so that individual or group uses on the network can be regulated appropriately.

- ✓ Examples of accounting management include keeping track of how many licenses have been granted to users, enforcing network licenses, and accounting for CPU usage on a server machine.
- ✓ SNMP (Simple Network Management Protocol), and Internet management protocol, is the most popular protocol to acquire the data automatically using the protocol and performance-analysing tools.

Reports Management

- ✓ Reports management is a part of implementing the above five application.
- ✓ There are, in general, three classes of reports: systems, management, and user.
  1. System reports are needed for network operations to track the activities.
  2. Management reports go to the management of the network management group to keep them informed about the activities and performance of the NOC and the network.
  3. The user reports are distributed to the users on a periodic basis to let them know the status of network performance.

Network Installation and Maintenance

- ✓ The network I&M group takes care of all installation and maintenance of equipment and cables. This group is the service arm of the engineering group for installation and fixing troubles for network operations.
- ✓ The I&M group works closely wi8th the Help Desk in responding to the problems reported from the field.

Network Installation

The first step in any network installation is planning and building a trial network so as to learn about the system and to carefully analyse the network. One should build his network in testable sections, making sure each one functions according to his expectations before continuing with the installation. For example, he may install one sever and its workstations and make sure they work together before adding another server.

The order of installation may be dictated by the network vendor, but it typically follows a sequence such as:

1. Set up the server and workstation hardware.
2. Make sure the combination works stand-alone.
3. Install the network cards and cables and connect them.
4. Install the system on the server and test it.

5. Install the system on the workstation and test it.
6. Bring up your applications and test them.

It may be noted that the order of implementation is practically the reverseof the order of planning and design. Thus one should start implementation with the lowest-level components of his network, make sure they work and then build on that foundation, testing each successive layer to make sure it works.

Unit 4 - MCQ

	Question	Option 1	Option 2	Option 3	Option 4	Ans
1	How diagram a type of ________________ uses various graphical symbols to represent activities and relationship with in system.	Geometrical Model	Graphical Model	2D- Model	3-D Model	2
2	The_________________is used for describing the information and it's relationships.	IDEF 2	IDEF 3	IDEF 4	IDEF 1	4
3	The perparotory phase of analysing a company problem and its soloution is called ____________________	Flow Analysing	Thermal Analysing	System Analysing	Aircraft Analysing	3
4	The transmission___________________ is the physical path which a message travels from sender to reciver.	Medium	High	Reciver	Sender	1
5	Number of signals per second_______________.	Band	Database	Heritz	Baseband	1
6	Number of cycle per second____________	Data Rale	Transmission	Band With	None Of These	4
7	The____________Communication is the transfer of data from out device to another device	Net Work	System	Address	Data	4
8	CIMOSA was developed by____________________	ESPRIT	CIM	ACD	FLT'S	1
9	The word NOC means___________________	Net Work Operation Centre	National Organisation Commity	NST Of Computer	National Optimize Centre	1
10	The term_____________________refer function that are performed in every enterprise independent of its size,organisation and business area.	Generic Function	Specific Function	Production Function	Design Function	1
11	A________________-Like most other dutionaries,is a catalogue of all the data in the database.	Data Dictionary	Book Dictionary	Program Dictionary	None Of These	1
12	A______________-Is a set of rules that govern data communictions.	Protocal	Medium	Receiver	Massage	1

13	A_____________________Area network is a communictions network covering a geographic area the size of a city or suburb.	LAN	WAN	MAN	CAD	2
14	A_______________Is a variation of a star	Tree Topology	Bus Topology	Ring Topology	Hybrid Topology	1
15	CIM Implemation can also be viewed or fitting the main process of________________________	The CIM Modes	The CIM Jigsaw	The CIM Architecture	All Of These	2
16	"FLOW DIAGRAM" a type of_______________user various graphical symbols to represet activities and relationships within the system	Graphical Model	SADT Model	ICAM	IDEF	1
17	Net Work Management can be defined as____________________of net work and servcies	FDDI	CIMOSA	LAN	OAM SP	4
18	a___________________________-Is The Preparatory phase of analysing "A Company Problem" and its Solutions	Network installation	System analysies	Reports Management	Refermance Management	2
19	Select any one shootable functions of Network Management_________________________	Network Prouisionning	Tooken Passing	Network Analysis	Hybrid Topologing	1
20	What are the benefit of "PDM SYSTEM"________________	Fewer design changes	Better audit teraily	Reduced overheads	All of These	4
21	Why do we need product Data management______________________	Product data has to be maintained for years	Product Person Communication	Product Machine Communication	Person To Person Communicat ion	1
22	The "OXFORD DICTIONARY" definer the team________________________as the art of designing and constauction of building.	ARCHITECTURE	INFRASTRUCTU RE	ORGANIZATI ON	PROCESSE S	1
23	Name of the most commonly used IDEF method________________-	Function Modding	Create Modding	Process Modding		1
24	Name Of The ESPRIT_____________________-	European Skategic	Eropean strategic			1

		program for research and development information Technology	program for releated and Discuses Information Technology			
25	Computer integrated production system concept by___________________	Sales And Marketing	Forecasting	Quality	Any These	4
26	What is the frame work policy___________________	Manefacturing	Strategic	Database	All of thes	3
27	Europe heavy Government funding will be needed finance research project implemented in new technology------------------------------	CIM	MAP	Robotics	None Of These	1
28	_______________ model is convertible into operating software to run the computerised implementation.	static model	dynamic model	model	executable model	4
29	SADT stands for ___________.	System analysis&design technique	structured analysis &design technique	system analysis&dynamic technique	static analysis&design technique.	2
30	It is used to capture the relationship between entities.	Enter-relationship(ER)diagrams	Entry-relationship(ER)diagrams	Entire-relationship(ER) diagrams.	Entire-relationship(ER)diagrams.	2
31	The instartiation axis,also known as__________	Genericity axis	deviation axis	model axis	model-views axis	1
32	The common utilities make up one of a series of layer in a software configuration & lead to the overall design being termed as a __________	Data struture	CIM architecture	layered structure	buliding structure	1
33	It is subject to different interpretations by different people.________________	product data	desigh data	data structure	data communicati	1

					on	
34	It provides part list&bill of material functional, part definitios, &parts relationship attributes.______________	Product structure management	Project management	data &document management	data classificatio &retrieval	1
35	The international orgaganation for starndardisation (ISO) has __________ network management application.	Network planning	network provision	network design	fault management	4
36	_________ is to ensure that the users of a network recive the information technology services.	Goal of network management	installation	mani tenance	administratio n	
37	The installation and ________ group handles function that inculde both installation and repairs of facilities and equipment.	design	maintenance	network design	administratio n	2
38	The functions of network operation are administrated by the________	plan facilites group	report management	network operations center	fault management	3
39	LANs have sections of coaxial cable and ________ cable.	fiber_optic	gate way	tapping	bridges	1
40	________ mode, multiple data are sent with each clock pulse.	serial	horizontal	plane	none of these	4
41	________ one bit is sent with each clock pulse.	parallel mode	serial mode	plane	none of these	2
42	________ hybrid topologies.	star bus	ring bus	non of these	delta bus	1
43	Star topology, each divices has a eledicated point _to_point link only to a central controller, usually called a ________	star	ring	hybrid	hub	4
44	The batch antify cycle contains a branch after the ________ activity, some batches by passing inspect.	machine	computer	function	none of these	1
45	________ analysis is the analysis of a company problems and its solutions	system	data	network	functions	1

46	_______ communication is transfer of data form one devices to another device	Network	system	address	data	4
47	_________ is a data communications system covering an area that size of a twon or city.	WAN	Network	MAN	LAN	3
48	Which transmission lines and bits are sent sequentially.	parallel	serial	simplex	deplex	2
49	The popular guided media are ________	Twisted- pair cable	coaxial cable	optical fiber	all of these	4
50	The another name of the bus topology is ________	drop line	radial	multi drop line	hub	3
51	The deviation axis is also known as ___________	transtantiation axis	model axis	genericity axis	model- view axis	1
52	Unguided media, also known as _________	wireless communication	wire communication	data communication	networkcom munication	1
53	Accounting management is based on__ _______	system report	management report	user report	none of these	4
54	Which is the physical path of the message travel__________	sender	reciver	trnsmission medium	protocal	3
55	In _____ the signals are trnsmitted by varying one of the physical characteristic continuously as a function of time.	digital transmission	anolog transmission	parallel transmission	serial transmission	2
56	In digital transmission, the string of ________ are transmitted.	o	1	0" s and 1"s	none of these	3
57	A communication network is a _________ and physical media that interconnects two or more computers.	collection of equipement	collection of material	collection of chemical	none of these	1
58	A ________ that is whooly ownded and used by a single company is often reffered to as an enterprise network.	MAN	WAN	LAN	none of these	2
59	In a star topology each devices has a dedicated point to point link only to a central controller	cub	pub	cable	hub	4

	usually called.					
60	The bus network works like a bus system at rush hour, with various buses pausing in different bus zone to pick up _______	passengers	customers	buses	none of these	1
61	_______ cable is one of the oidest and still most commonly used transmission media.	fiber optic cable	co axial cable	twisted cable	free cable	3
62	The network ________ is connected with established and administering the overall goals, policies, and proceduers of mark	administration	installation	provisioning	all of these	1
63	The group of network management	operation	administration	provisioning	all of these	4
64	The _________ configuration of a network is the current running configuration management.	front configuration	second configuration	third configuration	fourth configuratio n	2
65	The modelling tool should convert the dynamics model into an __________	computer model	software model	executable model	all of these	2
66	__________ which describes the input and outputs of functions in CIMOSA modelling.	functional view	information view	resource view	all of these	2
67	The data items themselevs are viewed as being in a ____________	program store	data store	report store	all of these	2
68	In layered structure _________ contains the application and the users.	ldigher level	intermediate level	lower level	all of these	1
69	________ provides access to tools that translate data between applications uch as CAD/CAM.	data transport	data power	image services	system transport	1
70	The __________ is the device that send the data message in data communications.	message	sender	reciver	all of these	2
71	In _________ each devices is connected to two and only two neihbouring devices.	ring topology	tree topology	bus topology	none of these	1
72	________ is a privately owned communications network that serves user within a confined geographical area.	LAN	WAN	MAN	none of these	1

73	IDEFO is used to describing ___________	activities and functions= of a system	dynamics	relationship	information	1
74	An internet is a ___________	process of process	communications	data to data	networks of networks	4
75	Why do PDM?	improve the flow	quality	none of these	reduce cost	1
76	IDEF created by __________	united states of america	united states defence	great britian	all of these	1

2 marks

1. What is meant by data communication?
2. What is MRP? What is the function of MRP?
3. List out the different types of network topology.
4. What is meant by ERP?
5. List out the different types of network topology.

14 marks

1. Write short notes on LAN, MAN, WAN.
2. What is PDM? Explain its role in CIM implementation.
3. What is meant by CIM architecture? Explain the relationship between data dictionary, data repository, data store, public data and private data?
4. List out the different system modeling tools and explain any two modeling tools with neat sketch.
5. Describe product data management and its advantages.
6. Explain the CIMOSA model with a neat diagram.
7. Explain the components of a Local Area Network (LAN) and Network topologies.
8. Write short notes on
   - (i) Data dictionary.
   - (ii) Data repository.
   - (iii) Data store.
   - (iv) Private and public data.
9. What is network topology? Discuss briefly the four network topologies. Also give an advantage and a disadvantage for each type of network topology.
10. Explain the product Data management (PDM) CIM implementation software, functions of PDM software and benefits of PDM system.
11. Explain briefly about Network Management and installations with neat sketch.

UNIT-5

OPEN SYSTEMS AND DATABASES FOR CIM

What is Network Architecture?

Network architecture describes the components, the functions performed, and the interfaces and interactions between the components, the functions performed, and the interfaces and interactions between the components of a network.

The network architecture consists hardware, software, standards, data link controls, topologies, and protocols.

The network architecture defines the functions of the following three components:

1. Network hardware components: They include cables, modems, communications controllers, and adapter cards.
2. Communication software modules: They establish and monitor sessions between remotely located processes and allow exchange of data and control messages.
3. Application programs: They are nothing but user processes that use the networks.

Protocols in network architecture define the set of rules of information exchange between two devices (peers).

A protocol, in fact, specifies the message formed and the rule for interpreting and reacting to message.

OPEN SYSTEM INTERCONNECTION (OSI) MODEL
(ISO/OSI REFRENCE MODEL)

Introduction

The early network architectures developed y various computer vendors were not compatible with each other. This situation had the effect of looking in customers in customers with an angle vendor. As a result, there was pressure in the 1970s for an open system architecture that would eventually lead to the design of computer network equipment that could communications with each other. This desire led to an effort in the International Organisation for Standardization (ISO) first to develop a reference model for open systems interconnection (OSI) and later to develop associated standard protocols.

Open Systems Defined

According to the Institute of Electrical and Electronic Engineers (IEEE), "an open system is a that implements sufficient open specifications or standards for interfaces, services, and supporting formats to enable properly engineered applications software: to be ported from one or more suppliers; to inter operate with other applications on local and remote systems; to interest with people in a style which facilitates user portability."

In the above definition, the term 'open specification' may be defined as the specifications that are maintained by an organisation that uses an open, public consensus process to accommodate new technologies and user requirements over time. Also in that definition, the work 'system' refers to a computer system comprising hardware and software.

It may be noted that there are several interpretations of the term 'open system' used by various parts of the CIM industry. For, example, some major hardware supplier's uses the term 'open' relating to their standard hardware and/or a standard operating system.

In the definition, the terms 'software' and 'other applications' not only include functions provided by the operating systems; but also include graphics, networking, mail, disturbed computing facilities, data interchange and network management.

The various aspects of open systems environment includes in the definition can be easily remembered by using the acronym 'MUSIC'. The elements of MUSIC are:

M – Management

U – User interface

S – Service interface for programs

I – Information and data formats

C – Communication interfaces

What is the OSI Model

The International Standards Organisation (ISO) developed the Open System Interconnection (OSI) reference model. The ISO/OSI model is the most widely used model for networking. An open system is a model that allows any two different systems to communicate regardless of their underlying architecture.

The open System Interconnection (OSI) refers to the exchange of information among terminal devices, computers, people, networks, and processes. The systems are open to one another by virtue of their manual use of the standards developed from the original reference model. In other words, the purpose of the OSI model is to open communication between different systems without requiring changes to the logic of the underlying hardware and software.

The OSI model is not, by itself, a standard, nor is it a literal description of computer communication. While it defines where to perform tasks, it does not detail how to perform them. In OSI, individual services and protocols are not specified. Within the model, communication functions are addressed from the perspective of computer-to-communication network interconnection.

The OSI reference model is intended to provide a common basis for coordinating the development of standards aimed at systems interconnection, while allowing existing standards to be placed in perspective within a common framework.

Thus the OSI model is not a protocol or standard; it is a model for understanding and designing a network architecture that is flexible, robust, and interoperable.

Functions of the Layers

Fig.5.2 presents the seven layers of the ISO/OSI reference model.

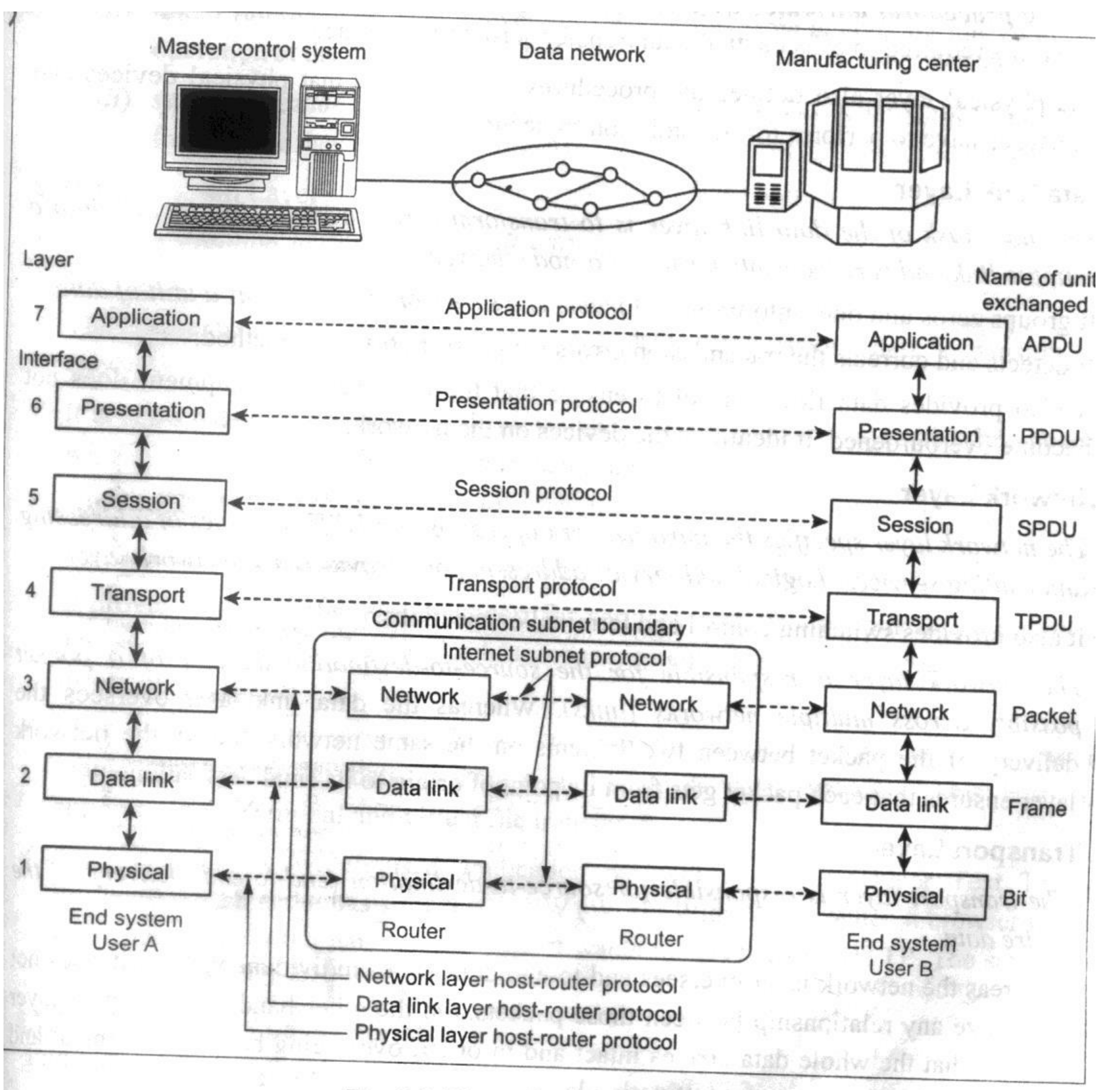


Fig. 5.2. The OSI reference model

1. Physical Layer

The physical layer is the lowest layer of the OSI model.

The physical layer is concerned with transmitting raw bits over a communication channel. The design issue of physical layer consider four factors: electrical, mechanical, functional and procedural attributes.

The electrical attributes describe the voltage level or current level. The mechanical attributes describe the connectors and the wires of the physical interface. The functional attributes describe the function to be performed by the physical interface. The procedural attributes describe what are connectors must do and the sequence of events required to effect actual data transfer across the interface.

The physical layer also defines the procedures and functions that physical devices and interfaces have to perform for transmission to occur.

2. Data Link Layer

The main task of the data link layer is to transform a raw transmission facility into a reliable link and is responsible for node-to-node delivery.

It groups zeros and ones into frames. A frame is a series of bits forms a unit of data. It detects and corrects the transmission errors using error correction method. It also provides data flow control to ensure that the data terminal equipment does not become overburdened. It identifies the devices on the network.

3. Network Layer

The network layer specifies the intra-network operations and different types of addressing and routing services. Logical and service addressing are provided from network layer. It also provides switching control and terminal connections.

The network layer is responsible for the source-to-destination delivery of a pocket possibly across multiple networks (links). Whereas the data link layers oversee the delivery of the packet between two systems on the same network (links), the network layer ensures that each packet gets from its point of origin to its final destination.

4. Transport Layer

The transport layer is responsible for source-to-destination (end-to-end) delivery of the entire data.

Whereas the network layer oversees end-to-end delivery of individual packets, it does not recognize any relationship between those packets. On the other hand, the transport layer ensures that the whole data arrives intact and in order, overseeing both error control and flow control at the source-to-destination level. The transport layer performs the service of sending and receiving segments of data to session layer. It also provides flow control, sequences numbering, and message acknowledgement.

5. Session Layer

The session layer allows users on different machines to establish sessions between them. The session layer is the network dialog controller. It establishes, maintains, synchronizes, and manages the interaction between communicating systems.

Thus the session layer offers various services include:

1. Analog control (i.e., keeping track of whose turn it is to transit);
2. Token management (i.e., preventing two parties from attempting the same critical operation at the same time); and
3. Synchronization (i.e., check pointing long transmissions to allow them to continue from where they were after a crash).

6. Presentation Layer

The presentation layer is concerned with the syntax and semantics of the information exchanged between two systems. The presentation layer is responsible for data compression, data expansion, data encryption and data decryption. It accepts data type i.e., integer, character, etc., from application layer and then negotiate with its peer layer as to the syntax representation.

7. Application Layer

The application layer enables the user, whether human or software, to access the network. It provides user interfaces and support for services such as electronic mail, remote file access and transfer, shared database management, and other types of distributed information services. This layer contains service element to support application process such as job management, financial data exchange and business data exchange. This layer also supports virtual terminal and virtual file transfer.

For example, one widely, one widely-used application protocol is HTTP (Hyper Text Transfer Protocol), which is the basis for the page it wants to server using HTTP. The server then sends the page back.

MANFACTURING AUTOMATED PROTOCOL (MAP)

Introduction

In the early 1980s, General Motors in USA began to realize that their car manufacturing operations were not competitive with their highly automated Japanese counterparts. In response to this, they adopted a policy of automating their plants to redress the imbalance. They realized that the equipment required for this purpose would come from a wide variety of vendors and that communication between machinery would be a problem. They further realized that to achieve integrated automation, a widely supported, non proprietary factory communication standard was necessary.

Standards work on protocols based on the open system interconnects (OSI) model was being undertaken at the time of International Standards of Organisation (ISO). The standards being produced covered the communications needs of the widest range of applications. This work formed the basis for standardisation in General Motors. During 1984, the manufacturing automaton protocol (MAP) users' group was formed to bring interested users and vendors together to form a broad base of support for MAP. The MAP standards are essentially an application-specific subset of the ISO protocols designed to meet the needs of factory automation. The objective of MAP is to establish one set of LAN protocols for communications between intelligent devices such as computer controlled machine tools, engineering work stations, process controllers, factory-floor terminals, and control rooms.

In June 1985, the MAP users' group released a public MAP specification which summarizes the standards specified by General Motors' MAP Version 2.1. System.

MAP Subset of OSI Protocols

We know that the OSI reference model specifies a seven layer model (see section 5.2.4) for subdividing communication functions. Each layer offers a number of alternative services, each suited to a particular range of applications. The MAP specification selects a subset of these options for use in the factory automation context.

1. Physical Layer

The operating environment for the physical layer in a factory automation context has a number of distinct characteristics. The network often covers a very large area. Within this area, conditions can be quite harsh in terms of electrical noise and other environmental pollution. Equipment is subject to relocation or replacement at regular intervals. Despite the hostile conditions, reliability is often a crucial factory as breakdowns in the system may lead to financial loss or serious safety risks.

A bus topology using broadband transmission techniques was chosen to be the MAP standard in this area. The use of broadband enabled the large areas involved to be covered by a single network. Other equipment, e.g., security monitoring, could share the same backbone cable, and suitably shielded coaxial cable with passive taps could survive the harsh environment.

2. Data-Link Layer

1. Media Access

When using the bus topology, a protocol is necessary to control access to the shared medium. Te two approaches that could be used are IEEF 802.3 (CSMA/CD) or IEEE 802.4 (Token bus).

In a factory environment several factors are present which determine the choice. The ability to determine the minimum time to access the network is important for monitoring applications.

For a given network configuration, access time on a token bus network is deterministic, whereas with CSMA/C, this is not the case. Priority traffic is also supported with four different levels in IEEE 802.4.

In the IEEE 802.4 token bus access a computer controller could supervise several simple machine tools without the need for each to be equipped with complex network interfaces. It is for this reason that in the factory floor environment, the IEEE 802.4 token bus access method is the preferred mode of operation.

2. Logical Link Control

The IEEE standard relating to the logical link component of the data-link layer is 802.2. Three possible classes of services are available: Class 1-connectionless, Class 2-connection oriented, and class 3-an immediate acknowledges service.

The connection-oriented service sets up a virtual circuit between the communicating parties and gives the ability to detect and recover from transmission errors.

The connectionless service involves communication using datagrams and can only detect and discard packets with parity errors.

The Class 3 service has its uses when used with fast response programmable devices, because of the associated higher throughput, it was felt that this feature should only be used on small subnets where message transfer and acknowledgement are critical.

Since one of the assumptions of transmission over LANs is that they have high reliability at the physical layer, the overhead of connection-oriented services was considered unjustified. End-to-end reliability constrains can be satisfied by having a connection-oriented serve at the transport layer. Accordingly, Class 1 service was chosen as the standard for the MAP backbone network.

3. Network Layer

- ✓ The network layer looks after the routing of messages from source to destination through intermediate systems.
- ✓ In a MAP context, the network layer means routing through separate token bus network segments, or through a wide area network. Performing routing of this kind implies a standardized, hierarchical addressing structure. The need for uniqueness of addresses between multiple organisations is acknowledged.
- ✓ As with the data-link layer, the ISO network layer standards offer a connection-oriented network service (CONS) and connectionless network service. (CLNS).
  - In the connection-oriented service, numbered messages are monitored and acknowledge between communicating systems. These guards against the danger of packets being delivered in an order other than that in which they were sent.
  - The connectionless service on the other hand can only detect missing message fragments based on a timeout, following which it discards the entire message.
- ✓ The MAP, the connectionless service is used.

The Transport Layer

✓ One of the overall goals of the MAP suite of protocol subsets is to ensure a reliable end-to-end connection between nodes. This is achieved by delegating the greater part of this overhead to the transport layer.

- ✓ The ISO transport specification gives 5 classes of service from Class 0, which is designed for simple telexes transmission up to Class 4 which has full error detection and recovery control.
- ✓ Place on top of the connectionless NETWORK AND DATA-LINK LAYERS, THE Class 4 service provides guaranteed delivery, message sequencing and full error detection. The time overhead for this function is concentrated in this layer, with a relatively speedy passage through the lower levels. Accordingly, the MAP group chose the Class 4 service. In certain cases, where speed is of the essence, a class 2 (multiplexing class) services may be used.

The Session Layer

- ✓ So far in our discussion of the various layers of the system, the emphasis has been on the reliable end-to-end transfer of packets of unspecified data. The upper three layers, session, presentation and application, are concerned with the interaction and synchronization between the communicating parties.
- ✓ The ISO session layer has been defied with 4 subsets; the Kernal, the basic combined subset (BCS), the basic synchronized set (BSS) and the basic activity act (BAS).
- ✓ The Kernel service has been included in the MAP 2.1 specification.
- ✓ This service allows for connection negotiation, establishment and release as well as duplex (2-way simultaneous) data transfer. Facilities for expedited data transfer are also included. As the demands of the higher level services increase, other capabilities such as synchronization, check pointing, error reporting etc., may be included in the MAP specification.

The Presentation Layer

- ✓ This layer is concerned with transforming local data representations into those agreed upon for interchange between nodes.
- ✓ The MAP Version 2.1, this layer has not been standardized by the MAP users' group. However in later versions, the ISO-specified presentation lay are used.

The Application Layer

- ✓ At this level in the layered model, a variety of protocols must be made available to cover the wide range of requirements of communicating systems. Realizing this, the ISO have divided the functionality of this layer into two broad categories.

The first of these is called the common application service elements (CASE). This consists of a body of primitives that are likely to be useful in providing any application layer service. Included in this set are calls to connect two parties, abort, and transfer data.

The second category of services is called the specific application elements (CASE). These are sets of primitives to be used in conjunction with those of CASE for particular application services examples of these sets include the file transfer service, virtual terminal service and job transfer manipulation service.

MAP as specified in Version 2.1 implements subset of the CASE primitives composed of actions that will establish a connection, release a connection, transfer data and abort.

As regards specific application service elements, those available to MAP users are file transfer and message passing. These services, coupled with the CASE primitives, provide a good foundation for communication.

The file transfer method chosen is again a subset of the ISO file transfer access and management (FTAM). This allows a user to open, read and write files on remote nodes. There is also a limited access to file descriptor information. This means that file attributes can be inspected from a remote location.

One of the main applications in a factory automation setting is the ability to communicate with programmable controllers, numerical control machines, bar code readers and robots. At the time no standard existed covering this specialized form of message passing. Accordingly, General Motors developed their own, known as manufacturing message format standard (MMFS). These protocols are divided into classes for the different applications and support simple message passing and limited file transfer. The primitives in this protocol are highly supplication-specific, e.g. enter upload/download mode, take/relinquish control etc. Fig.5.4 summarises the various layers/subsets of MAP.

THE TECHNICAL AND OFFICE PROTOCOL (TOP)

✓ At about the same time as MAP was being unveiled; a group spearheaded by Boeing Corporation was formed to develop a subset of the OSI standards for technical and office applications. The name given to these efforts was the technical and office protocol (TOP).

✓ In order to be able to communicate between the office and factory environment, efforts were made to be as compatible with MAP as possible.

✓ The differences between the physical environments of the factory and the office are marked. This is coupled with the fact that a different set of vendors are operating in each area.

✓ At the time when TOP was conceived, the dominant network system for office applications was Ethernet. Accordingly, the IEEE 802.3 (CSMS/CD) baseband standard was chosen as the preferred physical layer of TOP Version 1.0. This provided an upgrade path for Ethernet users and fitted well with the IEEE 802.2 data-link layer.

✓ Future developments in this area accommodated the use of IEEE 802.5 (token ring) as an alternative access method.

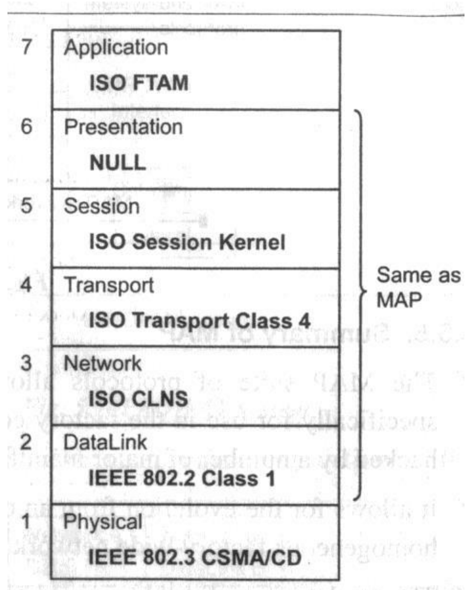


Fig. 5.10. TOP protocols

✓ Layers 2 (data-link) up to layer 6 (presentation) are identical in TOP and MAP, and it is only at Layer 7 (application) that significant differences arise, as show in Fig.5.10

✓ The applications required in an office environment will be more concerned with non real-time information transfer e.g. electronic mail, database access, etc.

✓ The only application service specified by TOP Version 1.0 is the subset of ISO FTAM file transfer service. Implementation of the CASE is not required by TOP in Version 1.0.

✓ In Version 3.0, an electronic mail facility based on the X.400 standard is provided together with a Virtual Terminal Protocol (VTP).

DATA AND DATA BASE

What is Data?

✓ According to American National Standards Institute, data is defined as a representation of facts, concepts, or instructions in a formalized manner suitable for communication, interpretation, or processing by humans or by automatic means.

- ✓ A data can be anything. It can be a number, word, a sentence, or anything.
- ✓ Data Vs Information: though the terms data and information are used synonymously, they have different meanings. In fact, the processed data is known as information. In other words, when a data is meaningful then it is known as information.
- ✓ Thus data represents information and we perform operations on data or data items to get information about an entity.

What is Database?

A database may be defined as a well-organized collection of data that are related in a meaningful way which can be accessed in different logical orders but are stored only once.

The four main **features of data's in a database,** as pointed out in the definition, are:

1. It is well organized.
2. It is related
3. It is accessible in different orders without great difficulty.
4. It is stored only once.

For example, the records of raw materials maintained by a purchase department in a manufacturing industry are a useful database.

Properties of a database: Any database should have the following implicit properties:

- A database represents some aspects of the real world application.
- A database is a logically coherent collection of data with some inherent meant. A random assortment of data cannot be referred to as a database.
- A database is designed and built with data for a specific purpose.
- It is assumed that operations (like update, insert, retrieve, etc.) on the database can be carried out in a simple and flexible way.

Why Companies Need Databases?

According to Date, companies need databases due to the following seven reasons:

1. The data can be shared.
2. Redundancy can be reduced.

3. Inconsistency can be avoided/ reduced.
4. Standards can be enforced.
5. Security restrictions can be applied.
6. Integrity can be maintained.
7. Conflicting requirements can be balanced.

Components of DBMS

A database system essentially consists of four components:

1. Data
2. Hardware,
3. Software, and
4. Users.

1. **Data**

✓ The data in the database should be integrated and shared.

✓ What is integrated data? A database can be considered to be a unification of several distinct data files and when any redundancy among those files are eliminated, the correctness of the data.

2. **Hardware**

✓ The second component of a database is hardware. A database can be run on conventional computers such as mainframes, PCs, and mini computers.

✓ A database can also run on dedicated database servers.

✓ The other hardware component is the secondary storage volumes such as magnetic disks that are used to hold the stored data.

3. **Software:**

✓ The third component of a database is software. The two types of software's in a database environment are:

1. DBMS software, and
2. Application software

✓ The DBMS software is the software that controls a database. The DBMS effectively acts as a layer between the physical data stored on the storage devices and the users' programs. It is used to create, manage and access a database. All access to data in a database is through this software.

✓ Application software utilizes DBMS software for data handling such as retrieval, creation, updating or deleting.

Users

✓ The final component in the database environment is users.

✓ Users of a database system can be categorized into three broad class

- End-uses interact with the database by operating application programs.

- Database administrators coordinate the activities of all users of the database and have ultimate control of the database.
- Application developers develop the programs for applications that process the data stored in the database.

End-User Applications

Some of the important end-user applications of databases are given below:

1. **Retrieval**: retrieval, also termed querying a database, is assessing already existing information in a database.
2. **Updating**: updating means changing existing data to anew value
3. **Insertion/deletion**: these involve enlarging or reducing a database.
4. **Ordering and sorting**: These facilitate keeping the data records in files into some form of logical order to speed up the retrieval process or an operation o the database.

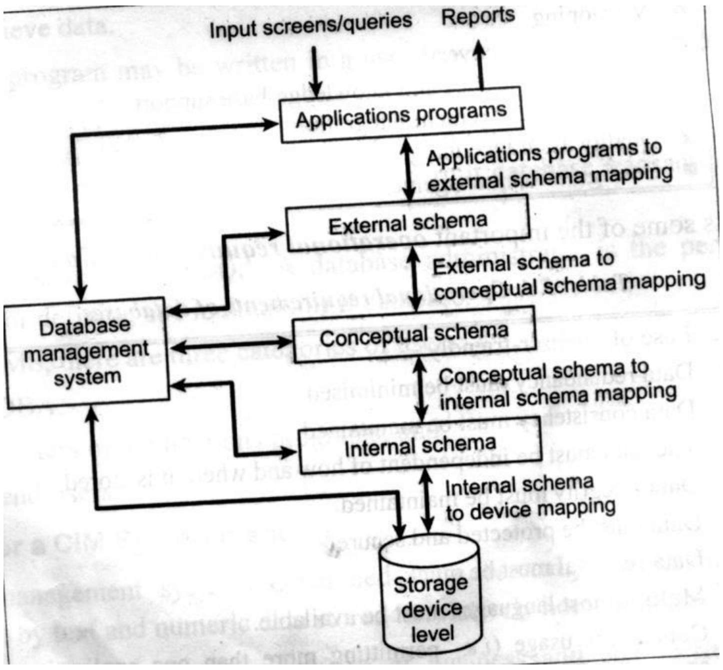
DBMS ARCHITECTURE

Introduction:

- ✓ In order to design a database or use a DBMS to create a database, one needs to have a clear understanding of the architectural framework for the DBMS.
- ✓ The DBMS architecture is developed based on the functions that the various components of the DBMS must provide its users.
- ✓ It may be noted that different users will have different purpose of using the database. In other words, users view the same data at different levels of abstraction and this has implications on the design and hence structure of DBMS.

DBMS Architecture

- ✓ Several different frameworks have been suggested over the last several years. For example, a framework may be developed based on the functions that the various components of a DBMS must provide to its users. It may also be based on different levels of abstraction of data that are possible within a DBMS. The later approach is generally preferred.
- ✓ A commonly used approach is the three level architecture suggested by ANSI/PARC (American National Standards Institute/Standards Planning and Requirements Committee).
- ✓ The ANSI/SARC three level architecture is presented in Fig.



- ✓ The DBMS architecture is divided into three levels.

1. Internal level, also known a physical level, is the one closest to physical storage. That is, it is the one concerned with the way the data is physically stored.
2. External level, also known as user logical level, is the one closest to the users. That is, it is the one concerned with the way the data is seen by the individual users.
3. Conceptual level, also known as community logical level, is a level of indirection between the external and internal levels.

These three levels are briefly discussed below.

The External Level

- ✓ The external level is the individual user level.
- ✓ A given user can be either an application programmer or an end user of any degree of sophistication.
- ✓ The database administrator (DBA) is an important special user. Unlike other users, DBA will be interested into the conceptual and internal levels also.
- ✓ Each user has a language at his/her disposal.
  - For the application programmer, the language will be either one of the conventional programming languages (such as c++, JAVA) or else a proprietary language that is specific to the system in question.
  - For the end user, the language will be either a query language or some special-purpose language, perhaps forms or menu-driven, tailored to user's requirements and supported by some online application program.

- ✓ An individual user will generally be interested in some portion of the total database. The ANSI/SPARC term for an individual user's view is an external view is thus the content of the database as seen by some particular user.
- ✓ For example, a user from the personnel department might regard the database as a collection of department and employee record occurrences; and he might be quite unaware of the supplier and part record occurrences seen by users in the purchasing department. For example user 1 may be interested in employee name and address, user 2 may be interested in his ID No. department and designation, as shown in Fig.
- ✓ Each external view is defined by means of an external schema, which consists basically of definitions of each of the various types of external record found in that external view.

The internal Level

- ✓ The third level of the architecture is the internal level.
- ✓ The internal view is a low-level consists of many occurrences of each many types of internal record. Internal record represents a stored record.
- ✓ The internal view is different from the physical level since it does not deal in terms of physical records nor with any device-specific considerations.
- ✓ The internal view is described by means of the internal schema, which not only defines the various stored record types but also specifies the indexes, how stored fields are represented, what physical sequence the stored re4cords are in, and so on.

The Conceptual Level

- ✓ The conceptual view is a representation of the entire information content of the database.
- ✓ Broadly speaking the conceptual view is intended to be a view of the data "as it is really is". Rather than as users are forced to see it by the constraints of the particular language or hardware they might be using.
- ✓ The conceptual view consists of many occurrences of ach of many types of conceptual record. For example, it might consist of a collection of department record occurrence plus a collection of employee record occurrences plus a collection of salary record occurrences, etc. Conceptual view for user 1 and user 2 external views is shown in Fig.

- ✓ The conceptual view is defined by means of the conceptual schema, which includes definitions of each the various conceptual record types.
- ✓ Thus the conceptual view is a view of total database content, and the conceptual include many additional features, such as the security and integrity rules.
- ✓ The ultimate objective of the conceptual schema is to describe the complete enterprise—not just its data but also how that data is used, how it flows from point to point within the enterprise, what it is used for at each point, what controls are to be applied at each point, and so on.

Mapping between the Three Levels.

- ✓ Two mapping as required in a database system with three difference views. They are:
    1. External /conceptual mapping, and
    2. Conceptual / internal mapping.
- ✓ The mapping between external and conceptual views gives the correspondence among the record and the relationships of the external and conceptual views. The external view is an abstraction of the conceptual view, which in turn is an abstraction of the internal view. The user sees and manipulates a record corresponding to the external view.
- ✓ The mapping between conceptual and internal views species the method of deriving the conceptual record from the physical database. The physical database is the data that is stored on secondary storage. Difference could exist between two views and are resolved in the mapping.

ADVANTAGES AND DISADVANTAGES OF A DBMS

Advantages of a DBMS

The disadvantages of the conventional file system are overcome by the database management system. The various advantages of DBMS are given below.

Reduced data redundancy

Instead of the same data fields being repeated in different files, in a DBMS the information appears just once. The single biggest advantage of a database is that the same information is available to different users. Moreover reduced redundancy lowers the expense of storage media and hardware because more data can be stored on the media.

Improved data integrity

Reduced redundancy increases the chances of data integrity-that the data accurate consistent and up to date-because each updating change is made in only one place.

More program independence

With a DBMS, the program and the file formats are the same. So that one programmer or even several programmers can spend less time maintaining files.

Increased user productivity

DBMS are fairly easy to use so that users can get their requests for information answered without having to resort to technical manipulations. In addition users don't have to wait for a computer professional to provide what they need.

Increased security

Although various departments may share data in common, access to specific information can be limited to selected users. Thus, through the use of password, various information in a database is made available only to those who have a legitimate need to know.

Improved flexibility of the system

Very often changes are necessary to the contents of the data stored in any system. These changes can be easily made in database than in a conventional file system because these changes do not have any impact on application programs.

Easier standards enforcement

Since all access to the database must be through the DBMS, it is easier to enforce standards in naming the data, the format of the data, the structure of the data, etc.

Better controls and reduced maintenance

Better controls can be achieved due to the centralized natureof the system. Also, due to the same reason, maintenance is less and easy.

DISADVANTAGES of a DBMS

Although there are clear advantages to having databases, there are still some disadvantages as given below.

Cost issues

Installing and maintaining a database is expensive, particularly in a large organization. In addition, there are associated with training people to use it correctly.

Security issues

Although databases can be structured to restrict access, it’s always possible unauthorized users will get past the safeguards. And when they do, they may have access to all the files.

In addition, if a database is destroyed by fire, earthquake, theft, or hardware or software problems, it could be fatal to an organisation’s business activities—unless steps have been taken to regularly make back-up copies of the files and store them elsewhere.

Privacy issues

Databases may hold information they should not and be used for unintended purposes, perhaps intruding on people’s privacy.

Enterprise vulnerability

Centralizing all data of an enterprise in one database may mean that the database becomes an indispensable resource. The survival of the enterprise may depend on reliable information being available from its database. The enterprise therefore becomes vulnerable to the destruction of the database or two unauthorized modification of the database.

Unit 5 - MCQ

	Question	Option 1	Option 2	Option 3	Option 4	Ans
1	The ______Operator selects columns rather than rows of a table.	Select operator	project operator	Join operator	None of these	2
2	_______ association maintain certain information about each employees such as names, date of birth, etc..	One-to-one association	one to many association	many to many association	None of these	1
3	A ______ is similar to a hierarchical DBMS.	Hierarchical model	Record based on data base	Network model	Relational model	3
4	Internal level is also known as _______	Physical level	Time level	Both a & b	None of these	1
5	The data are added to the _______ by inserting rows in the table.	Relational data model	Network data model	Both a & b	None of these	1
6	The ______ view is a representation of the entire information content of the data base.	External level	conceptual level	Internal level	None of these	2
7	Components of DBMS	Data	Hardware	Software	All of above	4
8	Levels DBMS	External level	Internal level	conceptual level	All of above	4
9	Data processing means	Punching of cards	Writing a program	collection of data	Manipulation of data	4
10	Set of related data items is known as a _______	Program	Field	Record	File	3
11	A collection related data field is called ______	File	Data base	Word-length	Record	4
12	A data arranged in intelligible form is called	Software	Program	Information	Processed data	3
13	Data structure include	Array	Exception statements	Iteration	All of above	1
14	DBMS Stands for	Data base marketing system	Data base management system	Data base management studies	Data base marketing strategies	2
15	Which of the following Is not a logical data base structure ?	Tree	Relational	Network	Chain	4
16	MAP Was developed by	ISO	General motors	Vendors	IEEE	2
17	Referance model for OSI developed by	ISO	General motors	Vendors	None of the	1

					above	
18	MAP designed to meet the weeks of	Manufacturing	Technical and office	Factory automation	Marketing	3
19	Expansion of OSI	Operation system Interconnection	Open system interconnection	Organisation system interconnection	None of the above	2
20	How many layer in the OSI	Six layers	Ten layers	Seven layers	One layer	3
21	What is a data system	Data interconnection system	Data base management system	Data base schedule system	All of above	2
22	What is the meaning for updating	Similar existing data to new value	Change exicting data to new value	Change exicting data to old value	None of these	2
23	Expansion of DBA	Direct base administration	Data base administration	Direct multibase administration	None of these	2
24	What is the TOP ?	DBA standard technical	OSI standard technical	TPS office application	All of the above	2
25	Find out the level of DBMS architecture	Internal level	External level	Conceptual level	All of the above	4
26	Find out data association	two-to-two association	one-to-one association	Four-to-Four association	Six-to-Six association	2
27	Representing entities it interested and their relationship in the data base.	Data modeling	Data modification	Data manipulation	Data management	1
28	Find out one feature of DBMS	Dat recovery	Data schudule	Data connection	Data presentation	1
29	In data base terminology the tables are called	Relations	Tuples	Attributes	None of these	1
30	The parent record at the top of the data base is called the _______	Child	Parent	Root record	None of these	3
31	The _______ is a low-level representation of the entire data base.	External view	Internal view	Both a & b	None of these	2

32	A data base system also called as ______	DBMS	DB	MS	None of these	1
33	The ________ involves communication using data grams and can only detect and discard packets with parity errors.	Connection oriented service	Connection less service	Class 3 service	None of these	2
34	The _______ is a network dialog controller.	Presentation layer	Session layer	Application layer	None of these	2
35	The _______ sets up a virtual circuit between the communicatng parties.	Connection oriented service	Connection less service	Class 3 service	None of these	1
36	The _______ is responsible for source to destination delivery of the entire data.	Network layer	Data link layer	Transport layer	None of these	3
37	OSI model stands for ________	International standard organisation	Industrial standard organisation	Both a & b	None of these	1
38	The ______ describe the function to be performed by the physical interface.	Electrical attributes	Mechanical attributes	Functional attributes	None of these	2
39	The physical data link and network layer is are the ________	User support layer	Transport layer	Network support layer	None of these	1
40	MAP users group was formed in the year of ________	1980	1984	1985	1988	2
41	The ________ OSI model provides guidelines for development of universally compatible architecture, software and hardware.	Three layer	Five layer	Six layer	Seven layer	4
42	MAP is an application specific subject of the ISO protocol designed to meet the needs of _______	Factory automation	Marketing	Manufacturing	All of the above	1
43	_______ describe hoe the parts are to be manufactured.	Product data	Operational data	Production data	Resource data	3
44	_______ develop a subset of the OSI standards for technical and office application.	General motors	Boeing corporation	ISO	None of these	2
45	The session Presentation and and application layers are the _______	User support layer	Transport layer	Network support layer	None of these	1
46	Data base system also called as _____	Data association	Management system	Data base management	None of these	3

				system		
47	A ______ is a data containing relatively parmanent words that are generally updated periodically.	Transaction file	Master file	Data file	Data entry	2
48	A ______ can be defined as the smallest logical opeation and data base.	Scheme	Data model	Transaction	Key field	3
49	The _______ links the network support layers and the user support layer.	Transport layer	Data base	Network support layer	None of these	1
50	__________ standards are subset of the OSI standard for technical and office application.	TOP	ISO	MAP	None of these	1
51	What is SNA _____	Standard national association	System network architechture	Both a & b	None of these	2
52	________ also termed a data base is auserring already existing information in a data base.	Retreval	Updating	Both a & b	None of these	1
53	The various aspects of open system environment includes in definition can be easily remembered by _______	ISO	OSI	MUSIC	IEEE	3
54	TOP standards are subset of OSI standards for ________ application.	Technical & office	Factory automation	Marketing	Manufacturin g	1
55	Which one is data base operatore.	Union	Intersection	Both a & b	None of these	3
56	Which one is feature of DBMS among this	Data dictionary	Select	Union	Difference	1
57	Which one of these is a data model	Record based data model	Object oriented data model	Both a & b	None of these	3
58	The organisations that have published default standards to open system	IEC	ISO	Both a & b	None of these	3
59	Expansion of MAP	Manufacturing automation protocol	Management automation protocol	Main automation protocol	None of these	1
60	Network standard that have been developed based on OSI model referance.	MAP / TOP	TOP & DECENT	TCP / IP	All of the above	4

2 marks

1. Define database.
2. What are the three forms of modeling tool are desirable to characterize company operation?
3. What is meant by MAP?
4. What is manufacturing automation protocol?
5. What are the advantages and disadvantages of database management system?

14 marks

1. What is MAP? Discuss the various MAP subsets of OSI protocols.
2. What is TOP? In what way TOP differs from MAP?
3. Write short notes on various database operators.
4. What are three levels of architecture of a database system? Describe them.
5. Bring out the advantages and disadvantages of DBMS an a CIM environment
6. Compare and contrast the hierarchical, the network and the relational database models with respect to CIM environments.
7. Explain the following Technical office Protocol.
8. Explain the following Manufacturing Automation Protocol
9. Explain the features of a database management system and database models
10. Explain briefly about Network Management and installations with neat sketch.