Paper 9 - Operations Management & Information Systems

Time allowed-3hrs   **Full Marks: 100**

Section –A (60 Marks)
(Operations Management)
Answer Question No. 1 (carrying 12 marks) which is compulsory and answer any four (carrying 12 marks each) from the rest in this Section.

Working Notes should form part of the answer.

1.

   a) **A firm operates 6 days a week on single shift of 8 hours per day basis. There are 10 machines of the same capacity in the firm. If the machines are utilized for 75 percent of the time at a system efficiency of 80 percent, what is the rated output in terms of standard hours per week?**   **[2]**

   b) **A worker works for 8 hours in each shift, but during that time he had clocked for 7 hours on the job. Calculate his utilization.**   **[2]**

   c) **Solve the game with the following pay- off matrix.**   **[2]**

$$\begin{array}{c c} & \begin{matrix} B_1 & B_2 & B_3 & B_4 \end{matrix} \\ \text{Player A} \begin{matrix} A_1 \\ A_2 \\ A_3 \end{matrix} & \begin{bmatrix} 1 & 7 & 3 & 4 \\ 5 & 6 & 4 & 5 \\ 7 & 2 & 0 & 3 \end{bmatrix} \end{array}$$

   d) **Name five general purpose machines.**   **[2]**
   e) **List the uses of Jigs and Fixtures.**   **[4]**

Answer:
   a) Maximum number of hours of work possible per week
      = (Number of machines) × (Machine hours worked per week)
      = 10 ×6 × 8 = 480 hours

      If the utilisation is 75% then number of hours worked = 480 × 0.75 = 360 hours.
      Rated output   = utilised hours × system efficiency
                            = 360 × 0.8
                            = 288 standard hours.

   b)
$$\text{Utilization} = \frac{\text{Hours worked}}{\text{Hours avilable}}$$
$$= \frac{7\,\text{hours}}{8\,\text{hours}} \times 100$$
$$= 87.5\%$$

   c) Here the row minima are (1,4,0). The maximum of these row minima is 4. So, the maximin value is 4. Again, the column maxima are (7,7,4,5). The minimum of these column maxima is 4. So, the minimax value is 4. As maximin value = minimax value = 4, the game is strictly determinable. The value of the game is 4 to player A and - 4 to player B. The optimum strategy for player A is A_2 and the optimum strategy for player B is B_3. Saddle point = (A_2, B_3)

d) Five general purpose machines are as follows:
  (i)   Lathe
  (ii) Drilling machine
  (iii) Grinding machine
  (iv) Milling machine
  (v)   Planning machine

e) Uses of jigs and fixtures are as follows:
  i)   Jigs quickly and accurately guide the tools .Difficult operations are rendered easier, speedier, and yet more accurate by using jigs.
  ii)   Jigs help in mass production by producing accurately machined interchangeable parts.
  iii) Fixtures are essential in all machine work, because work must be firmly held at the time of working of tools.
  iv)   Fixtures used along with jigs increase the speed and accuracy of work.

2.

(a) Workers come to tool store room to enquire about special tools (required by them) for accomplishing a particular project assigned to them. The average time between two arrivals is 60 seconds and the arrivals are assumed to be in Poisson distribution. The average service time (of the tool room attendant) is 40 seconds.
  Determine:
   (i) average queue length,
   (ii) average length of non-empty queues,
   (iii) average number of workers in system including the worker being attended
   (iv) mean waiting time of an arrival,
   (v) average waiting time of an arrival who waits. **[6]**

(b) Write down the eight steps of Benchmarking Process. **[4]**
(c) Write down the objectives of Scheduling. **[2]**

Answer:

a) Here, $\lambda = \dfrac{60}{60}$ per second = 1 per minute

$\mu = \dfrac{60}{40}$ per second = 1.5 per minute

(i) Average queue length:

$$L_q = \frac{\lambda}{\mu} \, x \, \frac{\lambda}{\mu - \lambda} = \frac{1}{1.5} \, x \, \frac{1}{1.5 - 1} = \frac{1}{0.75} = \frac{4}{3} \text{ workers}$$

(ii) Average length of non-empty queues:

$$L_n = \frac{\lambda}{\mu - \lambda} = \frac{1.5}{1.5 - 1} = 3 \text{ workers}$$

(iii) Average number of workers in the system:

$$L_s = \frac{\lambda}{\mu - \lambda} = \frac{1}{1.5 - 1} = 2 \text{ workers}$$

(iv) Mean waiting time of an arrival

$$W_q = \frac{\lambda}{\mu} \, x \, \left(\frac{\lambda}{\mu - \lambda} \right) = \frac{1}{1.5} \, x \, \left(\frac{1}{1.5 - 1} \right) = \frac{4}{3} \text{ minutes}$$

(v) Average waiting time of an arrival who waits

$$W_n = \frac{1}{\mu - \lambda} = \frac{1}{1.5 - 1} = 2 \text{ minutes}$$

b) The Benchmarking process consists of three general activities: Planning, Analysis, and Integration/action. Overall, the process follows the Plan-Do-Study-Act Cycle of all quality processes. It is recommended to use eight steps benchmarking process as mentioned below:

Planning: 1. Select Benchmarking subject and appropriate team
                    2. Identify performance indicators and Drivers
                    3. Select Benchmark partners
                    4. Determine data collection method and collect data
Analysis: 5. Analyses performance gaps.
Integration: 6. Communicate Findings and identify projects to close gaps
Action: 7. Implement plans and monitor results
                    8. Recalibrate benchmarks

c) Objectives of Scheduling

i) To prevent unbalanced use of time among departments and work centres or to evenly load all machines in the production line.

ii) To utilize machines and labour in such a way that the output is produced within the established lead time so as to (a) deliver the products/services in time and (b) complete production in the shortest cycle time possible at minimum total cost of production.

iii) To reduce idle time of labour and machines, which might be caused due to waiting for materials, waiting for movement, waiting for inspection and waiting for want of work.

iv) To fix up delivery dates for various manufacturing activities and for the finished products.

v) To increase the efficiency of production or productivity.

3.

a) A Mutual Fund has cash resources of ₹ 200 million for investment in a diversified portfolio. Table below shows the opportunities available, their estimated annual yields, risk factor and term period details.
Formulate a Linear Program Model to find the optimal portfolio that will maximize return, considering the following the following policy guidelines:

- **All the funds available may be invested**

- **Weighted average period of at least five years as planning horizon.**

- **Weighted average risk factor not to exceed 0.20.**

- **Investment in real estate and speculative stocks to be not more than 25% of the monies invested in total.**

Investment type	Annual yield (percentage)	Risk factor	Term period (years)
Bank deposit	9.5	0.02	6
Treasury notes	8.5	0.01	4

Corporate deposit	12.0	0.08	3
Blue-chip stock	15.0	0.25	5
Speculative stocks	32.5	0.45	3
Real estate	35.0	0.40	10

b) State the characteristics of just-in-time System. [6]
[4]
c) What are the difference between CPM and PERT. [2]

Answer:

a) Let x_1, x_2, x_3, x_4, x_5 and x_6 represent the six different investment alternatives, i.e., x_1 is bank deposit, x_2 is treasury note. X_3 corporate deposit, X_4 blue chip stock, X_5 speculative stock and x_6 real estate. The objective is to maximize the annual yield of the investors (in number of units) given by the linear expression.

Maximize $Z = 9.5x_1 + 8.5x_2 + 12.0x_3 + 15.0x_4 + 32.5x_5 + 35.0x_6$

Subject to the Constraints:
$x_1 + x_2 + x_3 + x_4 + x_5 + x_6 \leq 1$ (Investment decision)

$0.02x_2 + 0.01x_2 + 0.08x_3 + 0.25x_4 + 0.45x_5 + 0.40x_6 \leq 0.20$ (weighted average risk of the portfolio)

$6x_1 + 4x_2 + 3x_3 + 5x_4 + 3x_5 + 10x_6 \geq 5$ (weighted average length of investment)

$x_5 + x_6 \leq 0.25$ (limit on investment in real estate and speculated stock)

$x_1, x_2, x_3, x_4, x_5, x_6 \geq 0$ (non-negativity condition)

b) JIT systems focus on reducing inefficiency and unproductive time in the production process to improve continuously the process and quality of the product or service. Employee involvement and inventory reductions are essential to JIT operations. An outline of the salient characteristics of JIT is:

(i) pull method of material flow
(ii) constantly high quality
(iii) small lot sizes
(iv) uniform workstation loads
(v) standardized components and work methods
(vi) close supplier ties
(vii) flexible workforce
(viii) line flow strategy

c) CPM originated from construction project while PERT evolved from R & D projects. Both CPM and PERT share the same approach for constructing the project network and for determining the critical path of the network.

There is some basic differences between PERT and CPM

PERT	CPM
1. Time estimate is probabilistic with uncertainty in time duration. Three time estimates.	1. Time estimate is deterministic with known time durations. Single time estimate
2. Event oriented	2. Activity oriented
3. Focused on time	3. Focused on time-cost trade off
4. More suitable for new projects	4. More suited for repetitive projects

4.

a) **Write down a short note on Mean Absolute Deviation (MAD) and Bias.**   [3+3=6]

b) **Southern Naval Command of Indian Navy has 10 ships which arrive at Cochin Naval Base for repairs and other maintenance work with a negative exponential distribution of the inter-arrival times. The mean of these times is 15 days. The time for which a ship occupies a berth for repair-and-maintenance shows a negative exponential distribution with a mean of 25 days. If the average delay in the repair/maintenance of ships is to be kept below five days, how many berths should there be at the naval base?**   [6]

Answer:

a) **Mean Absolute Deviation (MAD):** MAD is the ratio of sum of absolute deviations for all periods to the total number of periods studied. It is represented as below:

$$MAD = \frac{Sum\ of\ absolute\ values}{Total\ number\ of\ periods\ studied}$$

$$= \frac{\sum_{i=1}^{n}|Forecasted\,demand - Actual\,Demand|i}{n}$$

Where n is the number of periods studied.

Actual demand is compared with forecasted demand for each period (i) when the forecast is accurate, actual demand equals to the forecasted demand and there is no error. The extent of error is worked out and recorded period by period and then summed up. Average (mean) size of the forecasting error is then determined by dividing the sum of all absolute deviations by the number of periods studied. Mean Absolute Deviation (MAD) is an average of the number of deviations recorded without considering the sign. MAD, therefore, expresses the extent of error.

Bias: Bias is worked out by using algebraic difference between forecasted and actual demands for all the periods. The algebraic differences are summed up and divided by the total number of periods studied. Bias is represented as:

$$Bias = \frac{Sum\ of\ algebraic\ errors\ for\ all\ the\ periods}{Total\ number\ of\ periods\ studied}$$

$$= \frac{\sum_{i=1}^{n}|Forecasted\,demand - Actual\,Demand|i}{n}$$

Bias indicates the directional tendency of the forecast errors.

Forecast error functions in a similar manner as inputs to quality improvement. The process of measuring forecast accuracy resembles the process control problems. The ideal forecast should have zero MAD and zero Bias. Usually tread off is attempted between MAD and Bias i.e., one must be kept low at the cost of the other. In general, focus should be on MAD. Lowering MAD to or near zero will automatically hold Bias low.

The essentials for effective forecasts are:
• It should be accurate enough to help the decision making process.
• It should provide timely indications of major shifts in process performance.
• It should be simple to use.
• It should be easily understandable.

b)

Average service time, T - 25 days
Average time between calls of ships, U = 15 days

$$\text{Therefore, Service Factor}, X = \frac{T}{T+U} = \frac{25}{25+15} = 0.625$$

For X = 0.625 and a population of 10, we have the following after interpolating from the Finite Queuing Tables:

M	D	F	M	D	F
9	0.016	0.999	4	0.967	0.639
8	0.098	0.991	3	0.998	0.481
7	0.298	0.963			
6	0.585	0.897			
5	0.839	0.784			

We can compute the average time a ship ("customer") waits in line, W, from the above data for different values of 'M' i.e. no. of berths.

$$W = \frac{T(1-F)}{XF}$$

M (No. of berths)	W (in days)
9	0.004
8	0.363
7	1.537
6	4.593
5	11.020
4	22.598
3	43.160

Sample Calculation:
For M = 7, we have F = 0.963
Therefore, 1 - F = 0.037
Now, T = 25 and X = 0.62

Therefore, $W = \dfrac{25 \times 0.037}{0.625 \times 0.963} = 1.537$

Thus, the Naval Base should have six berths in order that the ships do not wait for more than five days for servicing.

5. **A firm works 40 hours a week and has a capacity of overtime work to the extent of 20 hours in a week. It has received seven orders to be processed on three machines N, P,**

and C, in the order N, P, C C & to be delivered in a week's time from now. The process times (in hours) are recorded in the given table:-

Job	1	2	3	4	5	6	7
Machine N	7	8	6	6	7	8	5
Machine P	2	2	1	3	3	2	4
Machine C	6	5	4	4	2	1	5

The manager, who, in fairness, insists on performing the jobs in the sequence in which they are received, is refusing to accept an eighth order, which requires 7, 2, and 5 hours respectively on N, P and C machines, because, according to him, the eight jobs would require a total of 61 hours for processing, which exceeds the firm's capacity. Advise him.

Using the condition: If minimum processing time in column 1> max processing time of column 2.

<center>Or</center>

If minimum processing time in column 3 > maximum processing time of column 2.
 Then, new column 1 = column 1+ column 2
    new column 2 = column 2 + column 3   [12]

Answer:

The processing of 8 jobs according to the manager's plan will indeed take 61 hours. It needs to be examined, however, if this plan is optimal.

To obtain the optimal sequence, first the timings of the processing of all the eight jobs would be tabulated as follows:

<center>**Table 1**</center>

Job	Machine N	Machine P	Machine C
1	7	2	6
2	8	2	5
3	6	1	4
4	6	3	4
5	7	3	2
6	8	2	1
7	5	4	5
8	7	2	5

From the table,
Min N_i = 5, Max P_i = 4, and Min C_i = 1
Since Min A_i > Max B_i, the first of the conditions laid is satisfied. We proceed now to make the consolidation table, as shown in Table 2:

<center>**Table 2**</center>

Job	$G_i = N_i + P_i$	$H_i = P_i + C_i$
1	9	8
2	10	7
3	7	5
4	9	7
5	10	5
6	10	3
7	9	9
8	9	7

According to this, several optimal sequences are possible, of which one is as follows:

7, 1, 8, 4, 2, 5, 3, 6.

The total elapsed time T can be obtained as shown in the Table 3. It equals 57 hours. Thus, the jobs can be processed within the given capacity level.

Table 3

Job	Machine N		Machine P		Machine C	
	Start	Finish	Start	Finish	Start	Finish
7	0	5	5	9	9	14
1	5	12	12	14	14	20
8	12	19	19	21	21	26
4	19	25	25	28	28	32
2	25	33	33	35	35	40
5	33	40	40	43	43	45
3	40	46	46	47	47	51
6	46	54	54	56	56	57

Total completion time = 57 hrs.

6.

a) List the factors which affecting process planning. [4]

b) Find the machining cost of a M.S. Bar on a lathe from the following data :
R.P.M. of the job = 500
Feed of tool per revolution of job = 0.75 mm
Depth of cut = 2.4 mm
Diameter of raw material = 90 mm
Diameter of finished job = 60 mm
Length of job = 1500 mm
Machining cost = ₹ 4.5 per hour. [4]

c) Product A has a Mean Time Between Failures (MTBF) of 30 hours and has a Mean Time To Repairs (MTTR) of 5 hours. Product B has a MTBF of 40 hours and has a MTTR of 2 hours.
   i) Which product has the higher reliability?
   ii) Which product has greater maintainability?
   iii) Which product has greater availability?
   [1+1+2=4]

Answer:

a) The following factors are affecting the process planning
   i) Volume (quantity) of production.
   ii) Delivery dates for components or products.
   iii) Accuracy and process capability of machines.
   iv) The skill and expertise of manpower.
   v) Material specifications.
   vi) Accuracy requirements of components or parts.

b) Number of revolutions in one traverse of 1500 mm = 1,500 mm/0.75 mm = 2,000

Total depth of cut = ½(90 – 60) mm = 15 mm,

Cross – feed = 2.4 mm

The number of transverse traverse over the job from end to end

= 15/2.4 times = 6.25 times.

Thus the total number of revolutions of the job = 2,000 x 6.25 =12,500

R.P.M. of the job = 750

Machine time = (12,500/500) min. = 25 min.

Cost of machining = ₹ 3 x (25/60) = ₹ 1.25

c)

i) Product B, with higher MTBF (i.e. 40 hours) than Product A (i.e. 30 hours), is more reliable since it has lesser chance failure during servicing.

ii) By MTTR we mean the time taken to repair a machine and put it into operation. Thus Product B, with lesser MTTR (i.e., 2 hours) than Product A (i.e., 5 hours), has greater maintainability.

iii) Availability of a machine/product = $\dfrac{MTBF}{MTBF + MTTR}$

Therefore, Availability of Product A = 30/ (30+5) = 30/35 = 85.714%

Availability of Product B = 40/(40+2) = 40/42 = 95.238%

Hence, Product B has more availability.

Section B (40 Marks)
Information System
Answer Question No. 7 (carrying 8 marks) which is compulsory and answer any four (carrying 8 marks each) from the rest in this Section.

7.

a) Whether a Website is a product or a service? **[2]**
b) Write two negative effect of coding. **[2]**
c) What is the limitation of using flowcharts? **[2]**
d) What are the major attributes of judging a CPU? **[2]**

Answer:

a) There are different opinions about whether a Website is a product or a service. If a Web site is considered a product, according to law, proving negligence is unnecessary to hold the developer liable. But if a Website is considered a service, then the contract law of the state in question would apply.

b) Coding also has some negative effects:
i) Information is coarsened by forcing it all into categories – there might not be a category that matches what you want to record – e.g. hair colour
ii) The same can be true of rounding numbers – the intervals or numbers of categories is called the granularity – this needs to be chosen carefully to maintain the quality of the information.

c) Limitation of using Flow Chart are as follows:
i) Complex logic**:** Sometimes, the program logic is quite complicated. In that case, flowchart becomes complex.
ii) Alterations and Modifications**:** If alterations are required, the flowchart may require redrawing completely.
iii) Reproduction**:** As the flowchart symbols cannot be typed, reproduction of flowchart becomes a problem.

d) The major attributes of a CPU are as follows :
   i)   Memory cycle time.
   ii)   Storage Capacity
   iii) Number of data transfer channels
   iv)   Range of multi-programming capability
   v)   Real time processing capacity.

8.
   a) Write down the major areas of computer-Based applications. **[5]**
   b) What steps should be taken for successful installation of an equipment? **[3]**
   Answer:
   a) Major areas of computer-based applications are finance and accounting, marketing and sales, manufacturing, inventory/stock management, human resource management etc.
   i)   **Finance and Accounting:** It helps forecasting revenues. It determines the procurement of funds and its optimum utilization and also managing other financial resources. The areas in Finance and accounting are:-General Ledger, cash management, accounts receivable/payable, fund management etc.

   ii)   **Marketing and Sales:** The marketing system facilitates the chances of order procurement by marketing the products of the company, creating new customers and advertising the products. The objective of this system is to maximize sale and ensure customer satisfaction.

   iii) **Production or Manufacturing:** The system generates production schedules and schedules of material requirements. It monitors the product quality, control the waste and try to utilize its full capacity for producing goods and services.

   iv)   **Inventory/Stores Management:** The system is used to regulate the maximum and minimum level of stocks, identification of important items in terms of stock value (ABC analysis), most moving items and also non moving items.

   v)   **Human Resource Management:** Less disputes, right utilization of manpower and quiet environment in this functional area ensure smooth conducting of business. HRM maintain the database of employee qualifications, experience and helps the management in allocating the people at right place.

   b)   Following steps should be taken for successful installation of an equipment:
   i)   **Site preparation:** An appropriate location must he found to provide an operating environment for the equipment that will meet the vendor's temperature, humidity and dust control specifications. The electric lines should be checked to ensure that they are free of static or power fluctuation. The site layout should allow sufficient space for moving the equipment in and setting it for normal operation.
   ii)   **Equipment installation:** The equipment must be physically installed by the manufacturer, connected to the power source and wired to communication lines, if required.
   iii) **Equipment check out:** The equipment must be turned on for testing under normal operating conditions, the implementation team should devise and run extensive tests of its own to ensure that equipments are in proper working condition.

9.
   a) State the benefit of Business Intelligence (BI). **[4]**
   b) What is communication protocol? What are its functions? **[4]**

   Answer:

a) **The benefits of business Intelligence (BI) are as follows**
    i)   Time savings
    ii)   Single version of truth
    iii) Improved strategies and plans
    iv) Improved tactical decisions
    v)   More efficient processes
    vi) Cost savings
    vii) Faster, more accurate reporting
    viii) Improved decision making
    ix) Improved customer service
    x)   Increased revenue

b) When two data communications equipments are connected together, they follow certain rules and conventions while transferring massages between them. Protocols are the procedure and rules for inter computer communication. Protocols are software that performs a variety of actions necessary for data transmission between the computers.

Some of the functions of communication protocol:
1. Control on information transfer
2. Specification on structure and format of data
3. Recovery steps in case of error
4. Re-transmission

10.

a) **What are the features of Inventory Management in SAP?**   **[5]**
b) **What is meant by "backup" of computer files? Why is it necessary to keep back up of computer file?**   **[3]**

Answer:
a) **Features of Inventory Management in SAP:**
    i)   Entry of goods movements (receipt, issue, transfer posting etc.) are on real time basis. Goods movements include both "external" movements (e.g. goods receipts from external procurement, goods issues for sales orders) and "internal" movements (e.g. goods receipts from production, withdrawals of material for internal purposes, stock transfers, and transfer postings)
    ii)   Creation of a document for every goods movement
    iii) Automatic updating of quantity & value for inventory management and creation of accounting documents (Cost Accounting and Financial Accounting).
    iv) Division of the stocks into different categories (such as Unrestricted-use stock, stock in quality inspection or blocked stock)
    v)   Batch management
    vi) Management of special stocks (e.g. Vendor consignments, material provided to vendor etc.)
    vii) Physical Inventory (Stock verification)
    viii) Various analyses (such as the stock overview, Age Analysis etc.)

b) The storage devices used, especially the disks, in a computer system are not very reliable being susceptible to becoming bad, which may be caused by "bad sectors", the storage location becoming partially bad. Also, the possibility of total disk failure, called "erasing" cannot be ruled out. All these would cause loss of the data/program stored. To avoid such a loss, a duplicate copy of the data and program files are kept in a separate storage device, which is called back ups. For example, the files from hard disks are backed up in floppies, tapes, or tape cartridges. A separate utility is used for creating backups, where the files which are being copied, are combined to make better utilization of the storage space.

11.

    a) What is Program Debugging? Mention the steps involved therein.   **[4]**

    b) Discuss the characteristics of a good coding system.   **[4]**

Answer:

a) Program Debugging: Debugging is the form of testing activity which refers to correcting programming language syntax and diagnostic errors so that the program compiles cleanly and thus in this process, errors are found and then they are corrected.

Debugging consisting of following four steps:

i) Inputting the source program to the compiler.

ii) Letting the compiler find errors in the program.

iii) Correcting lines of code that are erroneous.

iv) Resubmitting the corrected source program as input to the compiler.

b) A good coding system should have the following characteristics:

i) **Individuality:** The code should be universally used over the entire organization.

ii) **Convenience:** The code number should be short and simple and consists of digits or alphabets.

iii) **Reliability:** Poor setting of parameters and hard coding may subsequently could result in the failure of a program.

iv) **Robustness:** It refers to the process of taking into account all possible inputs and outputs of a program.

v) **Efficiency:** It refers to the performance which should not be affected with the increase in input values.

vi) **Usability:** It refers to a user-friendly interface and easy-to-understand.

vii) **Readability:** The maintenance of program must be easier.

12.

    a) Write a short note on DBMS [Data Base Management System].   **[2]**

    b) What is Business process Re- engineering (BPR).   **[2]**

    c) How does EDI work? Write about the uses of EDI.   **[4]**

Answer:

a) A **Database Management System (DBMS)** is a collection of programs that enables users to create and maintain a database. The DBMS is hence a general-purpose software system that facilitates the processes of defining, constructing, and manipulating databases for various applications. Defining a database involves specifying the data types, structures, and constraints for the data to be stored in the database. Constructing the database is the process, of storing the data itself on some storage medium that is controlled by the DBMS. Manipulating a database includes such functions as querying the database to retrieve specific data, updating the database to reflect changes in the mini world, and generating reports from the data.

It is not necessary to use general-purpose DBMS software to implement a computerized database. We could write our own set of programs to create and maintain the database, in effect creating our own special-purpose DBMS software. In either case— whether we use a general-purpose DBMS or not—we usually have to employ a considerable amount of software to manipulate the database. We will call the database and DBMS software together a database system.

b) BPR means not only change but radical change within a short period. This change is achieved by complete revamp of organizational structure, business process workflow, job description, performance measurement and adoption of information technology.

Some of Basic characteristics of BPR are:

- o View business as a set of customer (both internal and external) oriented processes rather than a set of departmental functions.
- o Processes must have clear cut ownership.
- o Non value adding activities within a process should be eliminated.
- o Gather information only once at the point of origin.

A successful BPR implementation brings significant improvement to productivity, customer service and bottom-line. There are pain and difficulties during implementation and instances where BPR efforts did not achieve desired result. Notwithstanding, the risk is worth taking. Otherwise, there will be greater risk of being overtaken by competitors who develop and progress rapidly through BPR.

c) Before EDI following steps were involved in commerce:
Step I: Creation of purchase order (PO) by the customer.
Step II: PO is sent by the customer (sender of the message) using post office, fax, telex and so on.
Step III: PO is received by the supplier (receiver of the message).
Step IV: PO is interpreted by the supplier (receiver).

After EDI following steps were involved in commerce:

Step I: Customer's computer system creates and sends the electronic PO.

Step II: PO is received by the supplier (receiver of the message) and places the order directly into his system and he acts accordingly.

Uses of EDI

EDI is used in following ways:

1. EDI is used to electronically transfer documents such as purchase order, invoices, shipping notices, receiving advises and other standard business correspondence between the trading partners.
2. EDI can also be used to transmit financial information and payment in electronic form. However, where EDI is used for effecting payment it is commonly known as financial EDI or electronic funds transfer.