

# Answer to PTP\_Intermediate\_Syllabus2012\_Dec2014\_Set 2

## Paper 9 - Operations Management & Information System

Full Marks: 100

Time allowed-3hrs

This paper contains 3 questions. All questions are compulsory, subject to instruction provided against each question. All workings must form part of your answer. Assumptions, if any, must be clearly indicated.

### Question No. 1 : Answer all questions. [20 marks]

1. (a) 'Design for Manufacturing and Design for Assembly are related concepts in manufacturing'. Justify. 2
- (b) Define Time Study. 2
- (c) For a certain element of work, the basic time is established to be 20 seconds. A time study observer record rating of 125 on a 100 normal scale. What is the observed time? 2
- (d) Define Customer-Driven Quality. 2
- (e) What is Rotable Spare? 2
- (f) Define Material Planning. 2
- (g) What is Commerce Net? 2
- (h) Define programmed decision making. 2
- (i) Define Feasibility Study. 2
- (j) What is legacy data? 2

Answer :

1. (a) **Design for Manufacturing (DFM)** and **Design for Assembly (DFA)** are related concepts in manufacturing. The term design for manufacturing is used to indicate the designing of products that are compatible with an organisation's capability. Design for assembly focuses on reducing the number of parts in a product or on assembly methods and sequence that will be employed.
- (b) A technique of work-measurement used for determining as accurately as possible from a limited number of observations, the time necessary to carry out a given activity at a defined standard of performance. A stop watch is used for the purpose of recording the actual time taken by the worker under observation to perform various elements of the work or task.
- (c)  $(\text{Observed time}) \times (\text{observed rating}) = (\text{Basic or normal time}) \times (\text{standard rating})$   
 $\text{Observed Time} = [(\text{Basic or normal time}) \times (\text{standard rating})] / \text{Observed rating}$   
 $= (20 \times 100) / 125 = 16 \text{ seconds}$
- (d) **Customer-Driven Quality:** Quality is meeting or exceeding customer expectations. The term "customer" includes both the "internal customer" and the "external customer" in the "customer chain".
- (e) These are repairable and re-usable spares, such as a jet engine or an electric motor which can be reconditioned after failure and put back in operation.
- (f) **Materials planning** is the scientific way of determining the requirements of raw materials, components, spares and other items that go into meeting the production needs within economic investment policies. Materials planning is a subset of the overall production planning and control system which has a broad perspective.
- (g) **Commerce Net** is a consortium of companies which is promoting the use of internet for E-commerce. Sponsored by Silicon Valley vendors and US government agencies, it was

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launched in 1994 with the aim of creating infrastructure for business-to-business transactions on the internet.

Today, it has over 120 members and helps companies to streamline their procurement and development cycles by performing transactions online, overcome impediments to e-Commerce by making new interfaces, security mechanisms and indexing tools.

- (h) **Programmed decision making** refers to those decision making process which are based on some standard set of procedure established by the management and according to scientific principle of management. In case of programmed decision making, supporting information sets and reports are standard, well defined and well structured.
- (i) It is essential to carry out the feasibility study of the project before its implementation. Feasibility Study refers to a process of evaluating alternative systems through cost/benefit analysis so that the most feasible and desirable system can be selected for development.
- (j) Legacy data are stored manually, in excel files or in legacy system. Collection of legacy data is needed to be planned carefully to avoid the syndrome known as "garbage in and garbage out" which will undermine the confidence on the system after implementation. Cleaning of data should be done by removing duplicate and unnecessary information, before importing to ERP system.

### Operation Management

#### Answer any three questions

2. (a) (i) Explain the term Quality Function Deployment (QFD). 5  
(ii) List the important steps in problem analysis. 3  
(iii) State the causes of low productivity. 3  
(iv) 'Bain suggests that a good productivity measure should possess the following properties.' List the properties. 5

- (b) (i) Identify the five common process decisions considered by production/operations managers. 5

- (ii) Production Manager of a unit wants to know from what quantity he can use automatic machine against semi-automatic machine.

Data	Automatic	Semi-automatic
Time for the job	4 mins	10 mins
Set up time	4 hrs	3 hrs
Cost per hour	₹40	₹24

Calculate the break-even point. 7

- (iii) The demand for three months for 100 Watt bulbs is given below:

Period	January	February	March
Demand	1000	1200	1600

If the weight assigned to the period of January, February and March are 0.25, 0.35 and 0.4 respectively, forecast the demand for the month of April by using Weighted Moving Average Method. 4

- (c) (i) The breakdown probability of an equipment is given below:

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Month	Probability
1	0.05
2	0.15
3	0.30
4	0.30
5	0.20

There are 50 such equipments in the plant. The cost of individual preventive replacement is ₹15 per equipment and the cost of individual breakdown replacement is ₹30 per equipment. Which is the most suitable maintenance policy? Periodicities of replacement are considered every one, two, three and four months. 9

(ii) State the activities included in JIT manufacturing. 7

(d) (i) A retailer deals in a perishable commodity. The daily demand and supply are variables. The data for the past 500 days show the following demand and supply:

Availability (Kg.)	Supply (No. of days)	Demand (Kg.)	Demand (No. of days)
10	40	10	50
20	50	20	110
30	190	30	200
40	150	40	100
50	70	50	40

The retailer buys the commodity at ₹ 20 per kg. and sells at ₹ 30 per kg. Any commodity remains at the end of the day, has no sales value. Moreover the loss on unsatisfied demand is ₹ 8 per Kg. Given the following pair of random numbers, simulate 6 days sales, demand and profit: (31, 18) (63, 84) (15, 79) (07, 32) (43, 75) (81, 27). The first random number in the pair is that of supply and the second random number is for demand.

(ii) A project with normal duration and cost along with crash duration and cost for each activity is given below:

Activity	Normal time (Hrs.)	Normal cost (₹)	Crash time (Hrs.)	Crash cost (₹)
1-2	5	200	4	300
2-3	5	30	5	30
2-4	9	320	7	480
2-5	12	620	10	710
3-5	6	150	5	200
4-5	0	0	0	0
5-6	8	220	6	310
6-7	6	300	5	370

Overhead cost is ₹ 50 per hour.

Required:

(1) Draw network diagram and identify the critical path.

[8+8]

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**Answer:**

2. (a) (i) "QFD is a very systematic and organised approach of taking customer needs and demands into consideration when designing new product and services or when improving existing products and services." Another name for this approach is "customer-driven engineering" because the voice of the customer is diffused throughout the product (or service) development life cycle.

QFD is a planning tool that defines a process for developing products or services. The aptitude to plan is rare in the human race. Managers are evaluated on short-term results, which further inhibit this aptitude for planning. It is difficult to use Deming's PDCA (Plan, Do, Check, Act) cycle to improve the product development process if the P of PDCA Cycle is weak. QFD is applying TQM philosophy to product development by focusing on P. Using QFD counteracts the inherent weakness embedded in human nature — that of avoiding planning.

- (ii) There are six important steps in analysis of problem:

- (a) Write the result of the problem.
- (b) Write the problems under main headings.
- (c) Thinking by QC.
- (d) Discussion on results of problem suggestions.
- (e) Suggestions.
- (f) To find main reasons of the problem by Pareto principle.

- (iii) For evolving specific measures for improving productivity it will help the management to analyse on continuing basis, the causes of low productivity and, at the same time to keep abreast with the latest management and productivity techniques.

In the Indian context, the causes of low productivity have their origin in two distinct sources. The first category consists of the exogenous or external factors like shortages of essential inputs-power, raw materials, transport facilities etc. — over which the management of an enterprise has little or no control. The second basket contains the endogenous or internal factors mainly in the form of system deficiencies preventing the optimum utilisation of resources.

Since the management can do practically nothing to control the external factors and their adverse effect on productivity, it will be fruitless to discuss them here. The challenge before the Indian managers lies in overcoming the internal causes of low productivity.

- (iv) Bain suggests that a good productivity measure should possess the following properties. The more closely the measurement meets these criteria, the more useful it is for improving productivity.

1. **Validity:** it reflects accurately the changes in productivity.
2. **Completeness:** It takes into consideration all components of both the output and the input for a given productivity ratio.
3. **Comparability:** It enables the accurate measurement of a productivity change between periods.
4. **Inclusiveness:** It takes into account and measures separately the productivity of all activities.
5. **Timeliness:** It ensures that data is provided soon enough for managerial action to be taken when problems arise.

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6. **Cost effectiveness:** It obtains measurement in a manner that will cause the least interruption possible to the ongoing productive efforts of the firm.

- (b) (i) Five common process decisions considered by production/operations managers are:
- **Process choice** determines whether resources are organised around products or processes in order to implement the flow strategy. It depends on the volumes and degree of customisation to be provided.
  - **Vertical integration** is the degree to which a firm's own production system handles the entire supply chain starting from procurement of raw materials to distribution of finished goods.
  - **Resource flexibility** is the ease with which equipments and workers can handle a wide variety of products, levels of output, duties and functions.
  - **Customer involvement** refers to the ways in which customers become part of the production process and the extent of their participation.
  - **Capital intensity** is the mix of equipment and human skills in a production process. Capital intensity will be high if the relative cost of equipment is high when compared to the cost of human labour.

(ii) Let  $x$  be the break-even quantity between automatic and semi-automatic machines. This means, for volume of output  $x$ , the total cost of manufacture is the same on both automatic and semi-automatic machines.

For quantity =  $x$  units

Total manufacturing cost on automatic machines =  $(4.0 + 4x/60) \times 40$

Total manufacturing cost on semi-automatic machines =  $(3.0 + 10x/60) \times 24$

If ' $x$ ' is the break-even quantity, then

$$(4.0 + 4x/60) \times 40 = (3.0 + 10x/60) \times 24$$

$$160 + (4x/60) \times 40 = 72 + (10x/60) \times 24$$

$$160 + 8x/3 = 72 + 4x$$

$$4x - 8x/3 = 160 - 72$$

$$4x/3 = 88$$

$$x = 66 \text{ units.}$$

Hence for quantity upto 65, a semi-automatic machine will be cheaper. For quantity 66, both semi-automatic and automatic machines are equally costly. For quantity more than 66, automatic machine becomes cheaper than semi-automatic machine.

(iii)  $D_1 = 1000$  nos.     $W_1 = 0.25$

$D_2 = 1200$  nos.     $W_2 = 0.35$

$D_3 = 1600$  nos.     $W_3 = 0.40$

$$\begin{aligned} \text{Therefore Weighted Moving Average} &= W_1 \times D_1 + W_2 \times D_2 + W_3 \times D_3 \\ &= 0.25 \times 1000 + 0.35 \times 1200 + 0.40 \times 1600 \\ &= 250 + 420 + 640 \\ &= 1310. \end{aligned}$$

The demand for the month of April is 1310 nos. of 100 Watt bulbs.

(c) (i) Individual Breakdown Replacement Policy

The average number of individual breakdown replacements per month are:

$$\frac{\text{Number of equipments in the plant}}{\text{Average life of an equipment}}$$

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Average (Mean) life of an equipment, i.e., the mean operating time before failure  
=  $(1 \times 0.05) + (2 \times 0.15) + (3 \times 0.30) + (4 \times 0.30) + (5 \times 0.20) = 3.45$  months

The average number of individual breakdown replacements per month

$$\frac{\text{No. of equipments}}{\text{meanlife of an equipment}} = \frac{50}{3.45} = 14.49$$

Therefore, per month cost of individual breakdown maintenance =  $14.49 \times ₹30$   
= ₹434.70

Individual Preventive Replacement Policy

**Case I:** Replacement period = 1 month

The total cost per unit replacement comprises two components – (a) the possibility that the equipment may fail before its replacement age, needing a breakdown replacement and (b) the possibility that the equipment may not fail till its replacement age.

$$\begin{aligned}\text{Cost component (a)} &= (0.05) \times (\text{₹ } 30) &&= \text{₹ } 1.50 \\ \text{Cost component (b)} &= (0.95) \times (\text{₹ } 15) &&= \text{₹ } 14.25 \\ \text{Total cost of replacement per equipment} &&&= \text{₹ } 15.75\end{aligned}$$

$$\frac{\text{Total cost of replacement for all the equipments in the plant}}{\text{Expected life of an equipment}}$$

Now, Cost per month =  
The expected life of an equipment, under preventive replacement period of one month is one month only, as the first breakdown coincides with the preventive replacement.

$$\text{Thus Cost per month} = \frac{(\text{₹}15.75) \times (50)}{1} = \text{₹ } 787.50$$

**Case II:** Preventive Replacement Period = 2 months

$$\begin{aligned}\text{Cost component (a)} &= (0.05 + 0.15) \times (\text{₹ } 30) &&= \text{₹ } 6.00 \\ \text{Cost component (b)} &= (0.80) \times (\text{₹ } 15) &&= \text{₹ } 12.00 \\ \text{Total cost of replacement per equipment} &&&= \text{₹ } 18.00\end{aligned}$$

Expected life of an equipment =  $(1 \times 0.05) + (2 \times 0.95) = 1.95$  months

$$\text{Cost per month} = \frac{(\text{₹}18.00) \times (50)}{1.95} = \text{₹ } 461.54$$

**Case III:** Preventive Replacement Period = 3 months

$$\begin{aligned}\text{Cost component (a)} &= (0.05 + 0.15 + 0.30) \times (\text{₹ } 30) &&= \text{₹ } 15.00 \\ \text{Cost component (b)} &= (0.50) \times (\text{₹ } 15) &&= \text{₹ } 7.50 \\ \text{Total cost of replacement per equipment} &&&= \text{₹ } 22.50\end{aligned}$$

Expected life of an equipment =  $(1 \times 0.05) + (2 \times 0.15) + (3 \times 0.80) = 2.75$  months

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$$\text{Therefore, Cost per month} = \frac{(\text{₹}22.50) \times (50)}{2.75} = \text{₹} 409.09$$

**Case IV:** Preventive Replacement Period = 4 months

$$\begin{aligned} \text{Cost component (a)} &= (0.05 + 0.15 + 0.30 + 0.30) \times (\text{₹} 30) &&= \text{₹} 24.00 \\ \text{Cost component (b)} &= (0.20) \times (\text{₹} 15) &&= \text{₹} 3.00 \\ \text{Total cost of replacement per equipment} &&&= \text{₹} 27.00 \end{aligned}$$

Expected life of an equipment =  $(1 \times 0.05) + (2 \times 0.15) + (3 \times 0.30) + (4 \times 0.50) = 3.25$  months

$$\text{Total cost per month} = \frac{(\text{₹}27.00) \times (50)}{3.25} = \text{₹} 415.38$$

The costs (per month) of the different policies are presented in the table below:

Cost Comparisons of Different Maintenance Policies

Policy	Cost per months, ₹
Individual Breakdown Maintenance	434.70
Individual Preventive Maintenance	
I every 1 months	787.50
II every 2 months	461.54
III every 3 months	409.09
IV every 4 months	415.38

Therefore, individual preventive replacement every three months is the best option.

- (ii) JIT manufacturing includes many activities:
- (i) **Inventory reduction:** JIT is a system for reducing inventory levels at all stages of production viz. raw materials, work-in-progress and finished goods.
  - (ii) **Quality improvement:** JIT provides a procedure for improving quality both within the firm and outside the firm.
  - (iii) **Lead time reduction:** With JIT, lead time components such as set-up and move times are significantly reduced.
  - (iv) **Vendor control/Performance improvement:** JIT gives the buying organisation greater power in buyer supplier relationship. The firm moves from a situation where multiple suppliers are used to a situation where only one or two suppliers are used for supplying most parts. With fewer suppliers; the buying organisation has more power because it is making larger purchases from each vendor. Also, the buying organisation can now impose higher requirements on each supplier in terms of delivery and quality.
  - (v) **Continuous Improvement:** In the JIT system, existing problems are corrected and new problems identified in a never-ending approach to operations management.
  - (vi) **Total Preventive Maintenance:** JIT emphasises preventive maintenance to reduce the risk of equipment break-downs which may cause production hold ups and increase in manufacturing cycle time due to delays.
  - (vii) **Strategic Gain:** JIT provides the firm's management with a means of developing, implementing and maintaining a sustainable competitive advantage in the market place.

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(d) (i) Probability Distribution (Supply)

Supply	Probability	Cum. Prob.	Range	Range for simulation
10	$40/500 = 0.08$	0.08	0 - 0.08	0 - 0.07
20	$50/500 = 0.10$	0.18	0.08 - 0.18	0.08 - 0.17
30	$190/500 = 0.38$	0.56	0.18 - 0.56	0.18 - 0.55
40	$150/500 = 0.30$	0.86	0.56 - 0.86	0.56 - 0.85
50	$70/500 = 0.14$	1.00	0.86 - 1.00	0.86 - 0.99

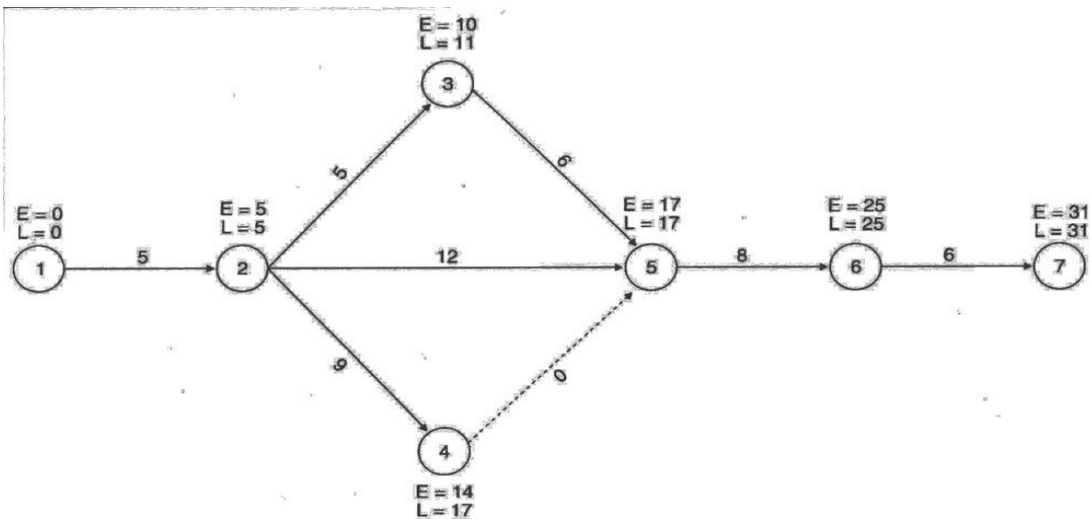
Probability distribution (Demand)

Demand	Probability	Cum. Prob.	Range	Range for simulation
10	$50/500 = 0.10$	0.10	0 - 0.10	0 - 0.09
20	$110/500 = 0.22$	0.32	0.10 - 0.32	0.10 - 0.31
30	$200/500 = 0.40$	0.72	0.32 - 0.72	0.32 - 0.71
40	$100/500 = 0.20$	0.92	0.72 - 0.92	0.72 - 0.91
50	$40/500 = 0.08$	1.00	0.92 - 1.00	0.92 - 0.99

Statement Showing Supply, Demand and Profit

Day	Supply	Demand	Sale (I)	Cost (II)	Loss on unsatisfied demand (III)	Profit/Loss I-II-III
1	30	20	600	600	-	Nil
2	40	40	1,200	800	-	400
3	20	40	600	400	160	40
4	10	30	300	200	160	-60
5	30	40	900	600	80	220
6	40	20	600	800	-	-200

(ii)



Paths →	1-2-5-6-7 (Let's denote this by A)	1-2-3-5-6-7 (Let's denote this by B)	1-2-4-5-6-7 (Let's denote this by C)
Duration	31 hours	30 hours	28 hours
The critical path is A. Its duration is 31 hours			



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### Information System

Answer any two questions.

3. (a) (i) Discuss the purpose for providing persistent storage for program objects and data structures. 5  
(ii) Describe the four types of implementation strategies. 6  
(iii) What are the strengths/Advantages of Prototyping Model. 5
- (b) (i) State the requirements of E-Procurement. 3  
(ii) List the major characteristics of Transaction Processing Systems. 5  
(iii) Describe Transaction Processing System. 4  
(iv) List the major constraints in operating MIS. 4
- (c) (i) Discuss whether web server can act as Permanent Establishment. 4  
(ii) List the steps involved to develop a sound public key infrastructure for an efficient allocation and verification of digital signatures certificates. 4  
(iii) 'The digital signature is created in two distinct steps.' Justify. 3  
(iv) State the notable features of the Information Technology Amendment Act, 2008. 5

Answer:

3. (a) (i) Databases can be used to provide **persistent storage** for program objects and data structures. This is one of the main reasons for the emergence of the **object-oriented database systems**. Programming languages typically have complex data structures, such as record types in PASCAL or class definitions in C++. The values of program variables are discarded once a program terminates, unless the programmer explicitly stores them in permanent files, which often involves converting these complex structures into a format suitable for file storage. When the need arises to read this data once more, the programmer must convert from the file format to the program variable structure. Object-oriented database systems are compatible with programming languages such as C++ and JAVA, and the DBMS software automatically performs any necessary conversions. Hence, a complex object in C++ can be stored permanently in an object-oriented DBMS, such as Object Store or O2 (now called Ardent). Such an object is said to be persistent, since it survives the termination of program execution and can later be directly retrieved by another C++ program.

The persistent storage of program objects and data structures is an important function of database systems. Traditional database systems often suffered from the so-called **impedance mismatch problem**, since the data structures provided by the DBMS were incompatible with the programming language's data structures. Object-oriented database systems typically offer data structure compatibility with one or more object-oriented programming languages.

(ii) **Four types of implementation strategies are as follows:**

(a) **Direct Implementation/Abrupt change-over:** Conversion by direct change over means that on a specified date the old system is dropped and the new system is put into use. The users have no possibility of using the old system other than the new one. Adaptation is a necessity. The disadvantage is that as the old system is

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dropped and new system is put to use, there is no adequate way to compare new results with old ones.

- (b) Phased implementation:** If each phase is successful then the next phase is started, eventually leading to the final phase when the new system fully replaces the old one. The advantage is that. It allows users to get involved with the system gradually. The disadvantage is that It takes too long to get the new system in place.
- (c) Pilot implementation:** With this strategy, the new system replaces the old one in one operation but only on a small scale, it might be tried out in one branch of the company or in one location. When one operation is successfully completed, other conversions are done for other operations. Each module is thoroughly tested before being used. Users become familiar with each module as it becomes operational.
- (d) Parallel running implementation :** The old system remains fully operational while the new systems come online, the old and the new system are both used alongside each other .If all goes well, the old system is stopped and new system carries on. The advantage is that there is a possibility of checking new data against old data in order to catch any errors in the processing of the new system. The disadvantage is that Cost of running two systems at the same time is high. The workload of employees during conversion is almost doubled.

**(iii) Strengths/Advantages of Prototyping Model are:**

- (i) It provides quick implementation of an incomplete, but functional, application.
- (ii) Prototyping requires intensive involvement by the system users.
- (iii) A very short time period is normally required to develop and start experimenting with a prototype.
- (iv) Since system users experiment with each version of the prototype through an interactive process, errors are hopefully detected and eliminated early in the developmental process.
- (v) It reduces the cost of user training.
- (vi) It improves the fact finding process.
- (vii) It helps to identify confusing or difficult functions and missing functionality.
- (viii) Prototyping model encourages innovation and flexible designs.

**(b) (i) E-Procurement -** A typical e-procurement requirement of an organization is depicted below:

- Electronic tendering comprising of tender publication, submission, short listing, evaluation and award. Facility for evaluation of IT/Service contracts containing Complex evaluation matrix.
- Compliance of agreed quantity Vis-a-Vis called quantity, consolidation of called quantity for obtaining agreed quantity discounts.
- Facility for publication and updating of electronic catalogues by vendors.
- Analytics for spend analysis which is used for strategic decisions, supplier relation management and minimization of maverick buying.
- Facilities for reverse auctions through business to business marketplace.

For meeting the above requirement, ERP vendors carried out integration of web based front end with generation of demand (planning module), preparation of purchase order (procurement module), receiving of goods (warehouse module), payment (account payable module), dealt by back end ERP system.

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### (ii) The Major Characteristics of TPS

- Large amounts of data are processed.
- The sources of data are mostly internal, and the output is intended mainly for an internal audience.
- The TPS processes information on a regular basis: daily, weekly, monthly, etc.
- Large storage (database) capacity is required.
- High processing speed is needed due to the high volume.
- TPS basically monitors and collects past data.
- Input and output data are structured (i.e., standardized).
- Low computation complexity is usually evident in TPS.
- A high level of accuracy, data integrity, and security is needed.
- High reliability is required.
- Inquiry processing is a must.

### (iii) Transaction Processing System

Transaction processing refers to the processing of information relating to monetary transactions in the business activities like purchase, sale, payment, receipts etc. It is a computer based processing for different functional areas to generate all required reports for day-to-day use in the organization. The transaction processing system may be disintegrated or integrated. In case disintegrated transaction processing, data are collected from respective functional areas and processed and reports are generated for their use. In case of integrated transaction processing system, an application system which has capability of integrating all functional areas (say, ERP system), transaction processing are interlinked with all data from different system and the reports reflect the impact of integrated information.

Transaction processing may also be in batch mode or may follow on-line or distributed data processing system. Example of transaction processing in an organization:

- Payroll
- Accounts Receivable
- Bank Reconciliation
- Purchase Order Processing
- Sales Order Processing
- Inventory Control
- Job Costing etc.

### (iv) Major constraints which come in the way of operating an information system are:

- Non-availability of experts, who can provide a desired direction for installing and operating the system aligning with the objectives of the organization. This problem may be overcome by grooming internal staff. The grooming of staff should be done by proper selection and training.
- Approach adopted by experts for designing and implementing MIS is a non-standardized one. Standardization may be arrived for the organizations in the same industry.
- Non-availability of cooperation from staff is a critical problem. The problem may be solved by educating the staff about the utility of MIS. The task should be carried out by organizing lectures, and explaining the utility of the system. Some persons from staff should also be involved in the development and implementation of the system.
- There is high turnover of experts in MIS. This problem can be handled by creating the better working conditions and paying at least at par with similar organizations.

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- There is a difficulty in quantifying the benefits of MIS, the constraints can be resolved by educating the top managers and telling them about the advantages of MIS.

**(c) (i)** Earlier it was a controversial issue that whether in cyber space the web server act as permanent Establishment. However, this controversy was solved in 2001 when the working party of OECD had agreed upon considering the server as Permanent Establishment for taxing e-transactions. According to OECD the server on which website is stored and through which it is accessible is a piece of, equipment having a physical location which constitute a fixed place of business of the entity that operates that server. However, for the server or other computer equipment to constitute a Permanent Establishment following conditions must be fulfilled:

1. It must be owned or leased by that entity.
2. It must be in a fixed location.
3. Business must be wholly or partly carried on in the jurisdiction where that server or other equipment is located and the activities carried on through the server must be core and not merely preparatory or auxiliary.

Therefore, now it is settled law that existence of a web server in a country is enough to act as Permanent Establishment.

**(ii)** Public Key Infrastructure (PKI) is about the management and regulation of key pairs by allocating duties between contracting parties (Controller/CA/Subscribers), laying down the licensing and business norms for CAs and establishing business processes/applications to construct contractual relationships in a digitized world. The idea is to develop a sound public key infrastructure for an efficient allocation and verification of digital signatures certificates.

**Step 1-** Subscriber applies to Certifying Authority (CA) for Digital Signature Certificate.

**Step 2 -** CA verifies identity of Subscriber and issues Digital Signature Certificate.

**Step 3 -** CA forwards Digital Signature Certificate to Repository maintained by the Controller.

**Step 4 -** Subscriber digitally signs electronic message with Private Key to ensure Sender Authenticity, Message Integrity and Non-Repudiation and sends to Relying Party.

**Step 5 -** Relying Party receives message, verifies Digital Signature with Subscriber's Public Key, and goes to Repository to check status and validity of Subscriber's Certificate.

**Step 6 -** Repository does the status check on Subscriber's Certificate and informs back to the Relying Party.

**(iii)** The digital signature is created in two distinct steps. First the electronic record is converted into a message digest by using a mathematical function known as "hash function" which digitally freezes the electronic record thus ensuring the integrity of the content of the intended communication contained in the electronic record. Any tampering of the contents of the electronic record will immediately invalidate the digital signature. Secondly, the identification of the person affixing the digital signature is authenticated through the use of the private key which attaches itself to the message digest and which can be verified by anybody who has the public key corresponding to such private key. This will enable anybody to verify whether the electronic record is retained intact or has been tampered with since it was so fixed

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with the digital signature. It will also enable a person who has a public key to identify the originator of the message.

**(iv)** The notable features of the Information Technology Amendment Act, 2008 are as follows:

- Focusing on data privacy
- Focusing on Information Security
- Defining cyber café
- Making digital signature technology neutral
- Defining reasonable security practices to be followed by corporate
- Redefining the role of intermediaries
- Recognizing the role of Indian Computer Emergency Response Team
- Inclusion of some additional cyber crimes like child pornography and cyber terrorism
- Authorizing an Inspector to investigate cyber offences (as against the DSP earlier)