**PAPER - 9 : OPERATIONS MANAGEMENT AND STRATEGIC MANAGEMENT**

**SUGGESTED ANSWERS**

**SECTION – A**

**1:**

(i) (A)

(ii) (D)

(iii) (A)

(iv) (C)

(v) (A)

(vi) (B)

(vii) (C)

(viii) (C)

(ix) (B)

(x) (B)

(xi) (C)

(xii) (D)

(xiii) (A)

(xiv) (D)

(xv) (D)

**SECTION – B**

**2. (a):**

**The recent Trends in production and operations management are aligned below:**

**(i) Global Market Place:**

Globalization of business has compelled many manufacturing firms to have operations in many countries where they have certain economic advantage. This has resulted in a steep increase in the level of competition among manufacturing firms throughout the world.

**(ii) Production / Operations Strategy:**

More and more firms are recognizing the importance of production / operations strategy for the overall success of their business and necessity for relating to their overall business strategy.

**(iii) Total Quality Management (TQM):**

TQM approach has been adopted by many firms to achieve customer satisfaction by a never-ending quest for improving the quality of goods and services.

**(iv) Flexibility:**

The ability to adapt quickly to change in volume of demand, in product mix demanded, and in product design or in delivery schedules, has become a major competitive strategy and a competitive advantage to the firms. This is sometimes called as agile manufacturing.

**(v) Time Reduction:**

Reduction of manufacturing cycle time and speed to market for a new product provide competitive edge to a firm over other firms. When companies can provide products at the same price and quality quicker delivery (Short lead times) provide one firm competitive edge over the other.

**(vi) Technology:**

Advances in Technology have led to a vast array of new products, new processes and new materials and components. Automation computerization, information and communication technologies have revolutionized the way companies operated.

**(vii) Worker Involvement:**

The recent trend is to assign responsibility for decision making and problem solving to the lower levels in the organization. This is known an employee involvement and empowerment. Examples of workers involvement are quality circles and use of work team or quality improvement teams.

**(viii) Re-engineering:**

This involves drastic measures or break through improvement to improve the performance of a firm. It involves the concept of clean slate approach or starting from scratch in redesigning the business process.

**(ix) Environmental Issues:**

Today's production manager are concerned more and more with pollution control and waste disposal which are key issues in protect of environment and social responsibility.

**(x) Corporate Downsizing (or Right Sizing):**

Downsizing or right sizing has been forced on firms to shed their obesity. This has become necessary due to competition, lowering productivity, need for improved profit and for higher dividend payment to shareholders.

**(xi) Supply-Chain Management:**

Management of supply chain, from suppliers to final customers reduces the cost of transportation, warehousing and distribution throughout the supply chain.

**(xii) Lean Production:**

Production systems have become lean production systems which use minimal amounts of resources to produce a high volume of high quality goods with some variety.

**2. (b):**

**Likewise, the business organizations and human beings, each product has a life that goes through various phases or Cycles which are aligned as under:**

**(i) Introduction phase:**

During this phase the product (either completely new product or a new variant of the existing product) gets introduced in the market for the first time. For the introduction of the new products in the market, at this stage, the volume stays low, sales are low and effect of learning curve is not realized. Hence the return on investment is low. This phase is featured by higher level of expenditure in the promotional campaigns.

**(ii) Growth phase:**

In this stage, the company focuses on rapid revenue generation and market growth. During this phase, the product sales intend to cover up the fixed cost and bring down the overhead costs while utilizing the learning in the previous stage. Promotional and advertising strategy is decided according to the level of the growths. The objective is to hold the existing customers and create new customers.

**(iii) Maturity phase:**

This phase is characterized by the saturation in the market place. This isa critical phase for the organizations. In the earlier stage (i.e. growth) the objective of the company is to achieve fast growth while in this stage the company want to flatten the curve to slow down the movement toward fall down. Further at this stage the organizations infuse variety and differentiation in the products most often to start a new PLC from hereon for finding out a niche market.

**(iv) Decline phase:**

After maturity, the products start losing their attractiveness in the market and sales get falling down. Profit margin becomes increasingly narrower. The organizations take a call to scrap the product and focus on cost consolidations. Sometimes, organizations come up with revival planning with product differentiation and promotional strategy to improve the sales.

**3. (a):**

Total Cost of Machine (₹ In thousand)

Purchase Cost = ₹ 500

Installation Cost = ₹ 50

= ₹ 550 (Thousand)

**Analysis of Annual Cost of Replacement of Cutting Machine : (₹ In Thousand )**

| Year | Maintenance Cost (₹) | Cumulative Maintenance (₹) | Total Cost (₹) | Avg. Annual Cost (₹) |
|---|---|---|---|---|
| 1. | 10 | 10 | 550 + 10 – 60 = 500 | 500 ÷ 1 = 500 |
| 2. | 15 | 25 | 550 + 25 – 60 =515 | 515 / 2 = 257.50 |
| 3. | 22 | 47 | 550 + 47 – 60 = 537 | 537 / 3 = 179.00 |
| 4. | 30 | 77 | 550 + 77 – 60 = 567 | 567/4 = 141.75 |
| 5. | 45 | 122 | 550 + 122 – 60 = 612 | 612/5 = 122.40 |
| 6. | 60 | 182 | 550 + 182 – 60 = 672 | 672/6 = 112 |
| 7. | 80 | 262 | 550 + 262 – 60 = 752 | 752/7 = 107.429 |
| 8. | 110 | 372 | 550 + 372 – 60 = 862 | 862/8 = 107.75 |
| 9. | 145 | 517 | 550 + 517 – 60 = 1007 | 1007/9 =111.889 |
| 10. | 185 | 702 | 550 + 702 – 60 = 1192 | 1192/10=119.20 |

Since the lowest average cost is in year 7 (₹ 107.429 Thousand), Steel Max Ltd. should replace the cutting Machine after 7 years on economic considerations.

**3. (b):**

**(i) Linear Regression of Y on X**

| Month | Ad. Impressions (in Crore) ( $\chi$ ) | Sales (in Crore) (Y) | $\chi^2$ | $\chi$ y |
|---|---|---|---|---|
| JAN | 1 | 18 | 1 | 18 |
| Feb | 2 | 23 | 4 | 46 |
| Mar | 4 | 32 | 16 | 128 |
| Apr | 3 | 28 | 9 | 84 |
| May | 10 | 38 | 100 | 380 |
| June | 4 | 29 | 16 | 116 |
| | $\sum\chi = 24$ | $\sum y = 168$ | $\sum\chi^2 = 146$ | $\sum\chi y = 772$ |

$\bar{\chi} = \frac{\Sigma\chi}{n} = \frac{24}{6}$, $\bar{Y} = \frac{\Sigma Y}{n} = \frac{168}{6}$

$\bar{\chi} = 4$ $\bar{y} = 28$

Regression equation of Y on $\chi$

**Y = a + b $\chi$**

To find the value of a and bwe will have to solve the following two equations.

$\sum y = na + b\sum\chi$ eqn. ……(i)

$\sum\chi y = a\sum\chi + b\sum\chi^2$ eqn. ……(ii)

By putting the value we get.

168 = 6a + 24 b eqn. ……(iii)

772 = 24a + 146 b eqn. ……(iv)

By multiplying eqn. No. (iii) by 4, get

672 = 24 a + 96 b eqn. ……(v)

By Subtracting eqn.No. (v) from eqn. No. (iv) we get,

772 = 24a + 146b …… (iv)

672 = 24a + 96b …… (v)

100 = 50 b,

So, $b = \frac{100}{50} = 2$

Putting the value of b in eqn. (iii), we get

168 = 6a + 24 b eqn. ……(iii)

$a = \frac{168 - (24 \times 2)}{6} = \frac{120}{6} = 20$

$\therefore Y = 20 + 2\chi$

**(ii) Expected monthly Sales on 5 Crore (No. Ad impression) is:**

$\therefore Y = 20 + 2X$

$Y = 20 + 2 \times 5 =$ ₹ 30 Crore

**4. (a):**

Subtract the minimum element of each row from the elements of that row to get the adjoining reduced matrix (Table – 1).

Table – 1

| JOBS / Workers | GA | BS | EM | EF |
|---|---|---|---|---|
| *R* | 0 | 2 | 6 | 7 |
| *A* | 0 | 3 | 5 | 5 |
| *N* | 0 | 2 | 3 | 4 |
| *Z* | 0 | 1 | 2 | 3 |

Subtract minimum element of each column from every element of the corresponding column to get adjoining matrix (Table – 2) and draw the minimum number of horizontal and vertical lines which cover all the zeros (in Table – 2.)

Table - 2

| JOBS / Workers | GA | BS | EM | EF |
|---|---|---|---|---|
| *R* | 0 | 1 | 4 | 4 |
| *A* | 0 | 2 | 3 | 2 |
| *N* | 0 | 1 | 1 | 1 |
| *Z* | ~~0~~ | ~~0~~ | ~~0~~ | ~~0~~ |

Table – 3

| JOBS / Workers | GA | BS | EM | EF |
|---|---|---|---|---|
| *R* | 0 | 0 | 3 | 3 |
| *A* | 0 | 1 | 2 | 1 |
| *N* | ~~0~~ | ~~0~~ | ~~0~~ | ~~0~~ |
| *Z* | ~~1~~ | ~~0~~ | ~~0~~ | ~~0~~ |

Since the number of lines (= 2) is less than the order of the matrix. Solution is not optimal.

The least uncovered element 1 is subtracted from all the uncovered elements and added to the intersection elements to obtain the reduced matrix (Table – 3). Draw more minimum possible number of lines so as to cover the new zeros.

Now, since the number of lines (=4) is equal to the order of matrix (in table - 3) an optimum solution has been attained. To consider this optimal assignment, we consider now only the zero elements of matrix. Examine successively the rows of the matrix to find out one with exactly one zero. The second row has exactly one zero, encircle this zero and mark a cross (x) on the remaining zero of the first column. Repeat the procedure until there is exactly one encircled zero in each column and each raw.

Table – 4

| JOBS / Workers | GA | BS | EM | EF |
|---|---|---|---|---|
| ***R*** | ~~0~~ | 0 | 3 | 3 |
| ***A*** | 0 | 1 | 2 | 1 |
| ***N*** | ~~0~~ | ~~0~~ | 0 | ~~0~~ |
| ***Z*** | 1 | ~~0~~ | ~~0~~ | 0 |

**Alternative Solution:**

Now, since the number of lines (=4) is equal to the order of matrix (in table - 3), an optimum solution has been attained. To consider this optimal assignment, we consider now only the zero elements of matrix. Examine successively the rows of the matrix to find out one with exactly one zero. The second row has exactly one zero, encircle this zero and mark a cross (x) on the remaining zero of the first column. Repeat the procedure until there is exactly one encircled zero in each column and each raw.

Table – 4

| Jobs / Workers | GA | BS | EM | EF |
|---|---|---|---|---|
| R | ~~0~~ | 0 | 3 | 3 |
| A | 0 | 1 | 2 | 1 |
| N | ~~0~~ | ~~0~~ | ~~0~~ | 0 |
| Z | 1 | ~~0~~ | 0 | ~~0~~ |

The appropriate Jobs are assigned to each worker with respective hours as under:

| **Workers** | **Jobs** | **Time (Hrs.)** |
|---|---|---|
| **R** | BS | 12 |
| **A** | GA | 9 |
| **N** | EM | 15 |
| **Z** | EF | 13 |
| **Total** | | **49** |

**4. (b):**

**(i) Allocation of Random Numbers:**

| Delivery Time (Mins) | Probability | Cumulative Probability | Random Number (RNG) Range |
|---|---|---|---|
| 15 | 0.10 | 0.10 | 00 – 09 |
| 20 | 0.20 | 0.30 | 10 – 29 |
| 25 | 0.35 | 0.65 | 30 – 64 |
| 30 | 0.25 | 0.90 | 65 – 89 |
| 35 | 0.10 | 1.00 | 90 – 99 |

| RN | Mapping Explanation | Delivery Time (Min.) |
|---|---|---|
| 04 | 0 – 09 $\rightarrow$ 15 Minutes | 15 |
| 19 | 10 – 29 $\rightarrow$ 20 Minutes | 20 |
| 33 | 30 – 64 $\rightarrow$ 25 Minutes | 25 |
| 46 | 30 – 64 $\rightarrow$ 25 Minutes | 25 |
| 60 | 30 – 64 $\rightarrow$ 25 Minutes | 25 |
| 74 | 65 – 89 $\rightarrow$ 30 Minutes | 30 |
| 85 | 65 – 89 $\rightarrow$ 30 Minutes | 30 |
| 91 | 90 – 99 $\rightarrow$ 35 Minutes | 35 |
| 23 | 10 – 29 $\rightarrow$ 20 Minutes | 20 |
| 38 | 30 – 64 $\rightarrow$ 25 Minutes | 25 |

**Simulation Worksheet**

| Parcel No. | Random Number | Delivery Time (min.) |
|---|---|---|
| 1. | 04 | 15 |
| 2. | 19 | 20 |
| 3. | 33 | 25 |
| 4. | 46 | 25 |
| 5. | 60 | 25 |
| 6. | 74 | 30 |
| 7. | 85 | 30 |
| 8. | 91 | 35 |
| 9. | 23 | 20 |
| 10. | 38 | 25 |

**(ii) Assessment of Total and Average Delivery Time:**

- Total Delivery Time = 15 + 20 + 25 + 25 + 25 + 30 + 30 + 35 + 20 + 25 = 250 Minutes.
- Average Delivery Time = 250 / 10 = 25 Minutes

**5. (a):**

Let $\chi_1$ be the no. of units of Product Regular

$\chi_2$ be the no. of units of Product Supper.

The appropriate mathematical formulation of the given problem as L. P. Model is as follows :

Maximize $Z = 50\chi_1 + 75\chi_2$

**Subject to Constraints:**

$12\chi_1 + 16\chi_2 \leq 16000$ (Constraint on available assembly time)

$8\chi_1 + 9\chi_2 \leq 7000$ (Constraint on hours of Paint time)

$2\chi_1 + 2\chi_2 \leq 3000$ (Constraint on hours of Inspection time)

$\chi_1 \geq 500$ (Constraint relating to Product Regular)

$\chi_2 \geq 200$ (Constraint relating to Product Supper)

and $\chi_1 , \chi_2 \geq 0$ (Non-negative Constraint)

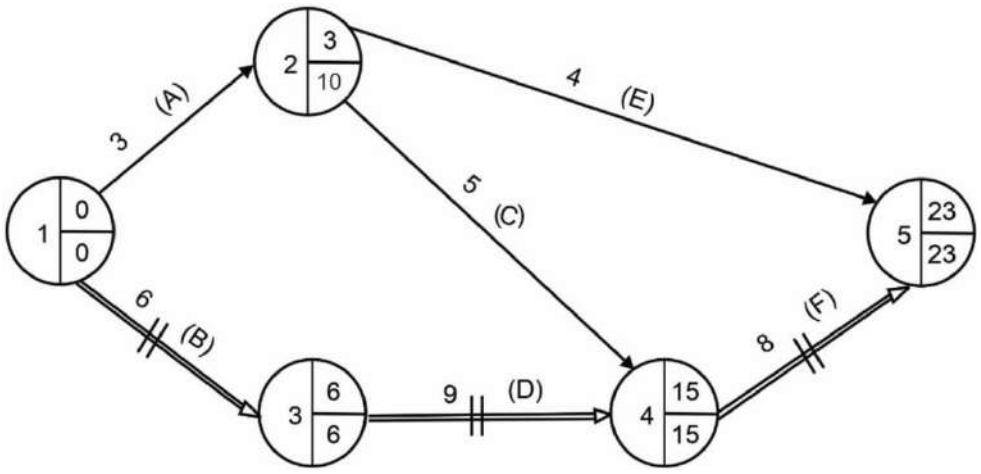
**5. (b):**

**(i)**

**(Time in Weeks)**

| **Activity and Identification** | | **Optimistic Time estimate ($T_0$)** | **Pessimistic Time estimate ($T_p$)** | **Most likely Time estimate ($T_m$)** | **Expected duration ($T_e$)** $T_e = \frac{o + 4m + p}{6}$ | **Total Float (LST – EST)** |
|---|---|---|---|---|---|---|
| A | 1 – 2 | 1 | 5 | 3 | (1 + 4 x 3 + 5) / 6 = 3 | 16 – 0 = 16 |
| B | 1 – 3 | 3 | 9 | 6 | (3 + 4 x 6 + 9) / 6 = 6 | 0 – 0 = 0 |
| C | 2 – 4 | 2 | 8 | 5 | (2 + 4 x 5 + 8) / 6 = 5 | 10 – 3 = 7 |
| D | 3 – 4 | 5 | 13 | 9 | (5 + 9 x 4 + 13) / 6 = 9 | 6 – 6 = 0 |
| E | 2 – 5 | 3 | 5 | 4 | (3 + 4 x 4 + 5) / 6 = 4 | 19 – 3 = 16 |
| F | 4 – 5 | 5 | 11 | 8 | (5 + 8 x 4 + 11) / 6 = 8 | 15 – 15 = 0 |

**(ii)**




**(iii)** Critical path is 1 – 3 – 4 – 5 (B $\rightarrow$D $\rightarrow$F)
Whose duration is '23 weeks' the longest path.

**(iv)**

| Activity and Identification | | Standard Deviation $\sigma = \frac{p - o}{6}$ | $\sigma^2$ Variance |
|---|---|---|---|
| A | 1 – 2 | 0.66 | 0.444 |
| B | 1 – 3 | 1.00 | 1.000 |
| C | 2 – 4 | 1.00 | 1.000 |

| | | | |
|---|---|---|---|
| D | 3 – 4 | 1.333 | 1.778 |
| E | 2 – 5 | 0.333 | 0.111 |
| F | 4 – 5 | 1.00 | 1.000 |

**6. (a):**

**The details regarding the SMART Goal framework to create organization objective are appended below:**

(i) **Specific:**

Specific goal provides the employee with the exact result needed for their performance to be successful. A clear objective can optimize productivity and effectiveness.

(ii) **Measurable:**

Successful goals can usually be measured using metrics that determine an employee‘s success or progress. A quota, for example, is one way to measure an employee‘s success.

(iii) **Attainable:**

Effective goals are often those which are ambitious an also possible to achieve. Consider if and how an employee can attain their objectives with the tools and resources available to them within a specified time frame.

(iv) **Relevant:**

A relevant objective contributes to the larger goals of a company. Consider the upward impact of employees achieving certain goals, like how they tie to bigger company strategies like growth.

(v) **Time Based**:

Set realistic timelines for employees to complete their tasks. If a task is ongoing, you might consider your next review as a deadline for achieving objectives.

SMART Goals help clarify responsibilities and ensure both manager and employee knows what to expect. They can help develop employees skills and move goals forward toward larger, higher level goals.

**6. (b):**

**The important components of a block chain are aligned as under:**

**i. Distributed ledger Technology:**

All network participants have access to the distributed ledger and its immutable record of transactions. With this shared ledger, transactions are recorded only once, eliminating the duplication of effort that’s typical of traditional business networks.

**ii. Immutable records:**

No participant can change or tamper with a transaction after it’s been recorded to the shared ledger. If a transaction record includes an error, a new transaction must be added to reverse the error, and both transactions are then visible.

**iii. Smart contracts:**

A smart contract is stored on the blockchain and executed automatically. A smart contract can define conditions for corporate bond transfers; include terms for travel insurance to be paid and much more. A smart contract acts a set of rules and allows fastest transactions.

**The benefits of blockchain network**

**i. Increased trust:**

As block chain is used by only the members who are within a defined network. This assures the members that the data being received by them is accurate and timely data. Moreover, the confidential blockchain records will be shared only with network members to whom one has specifically granted access.

**ii. Greater security:**

The increase security in blockchain network arises from the fact that consensus on data accuracy is required from all network members, and all validated transactions are immutable because they are recorded permanently. No one, not even a system administrator, can delete a transaction.

**iii. Increased efficiencies:**

With a distributed ledger that is shared among members of a network, timewasting record reconciliations are eliminated.

**7. (a):**

**The PESTEL framework categories environmental influences into six main types: Political, Economic, Social, Technological, Environmental and Legal which are summarized as under:**

**(i)** Political processes shape a society's laws, which constrain the operations of organizations and managers and thus create both opportunities and threats. Political instability creates adverse conditions for the businesses to function.

**(ii)** Macroeconomic forces affect the general health and well-being of a nation or the regional economy of an organization which in turn affect companies' and industries' ability to earn an adequate rate of return. The four most important macroeconomic forces are the growth rate of the economy, interest rates, currency exchange rates, and inflation (or deflation) rates.

- Economic growth tends to ease competitive pressures within an industry as it leads to an expansion in customer expenditures.
- Interest rates can determine the demand for a company's products. Interest rates are important whenever customers routinely borrow money to finance their purchase of these products.
- Currency exchange rates define the comparative value of different national currencies. Movement in currency exchange rates has a direct impact on the competitiveness of a company's product.
- Price inflation can destabilize the economy, producing slower economic growth, higher interest rates, and volatile currency movements.

**(iii)** Social influences include changing cultures and demographics. Demographic forces are outcomes of changes in the characteristics of a population, such as age, gender, ethnic origin, race, sexual orientation, and social class.

**(iv)** Technological influences refer to innovations such as artificial intelligence, internet, nano-technology, or the rise of new composite materials.

**(v)** Environmental stands specifically for 'green' issues, such as pollution and waste. The environmental factors have now become extremely important for organizations as countries across the globe are increasingly concerned with the environmental changes and are striving towards clean, green and renewable sources of energy .

**(vi)** Finally legal embraces legislative constraints or changes, such as health and safety legislation or restrictions on company mergers and acquisitions.

**7. (b):**

**The five main steps of Strategic planning process are aligned as under:**

**(i) Select the corporate mission and major corporate goals:**

The first component of the strategic planning process is crafting the organization's mission statement, which provides the framework or context within which strategies are formulated. A mission statement has four main components: a statement of its reason for existence which is normally referred to as the mission; a statement of some desired future state, usually referred to as the vision; a statement of the key values that the organization is committed to; and a statement of major goals.

**(ii) Analyze the organization's external competitive environment to identify opportunities and threats:**

The second component of the strategic planning process is an analysis of the organization's external operating environment. The essential purpose of the external analysis is to identify strategic opportunities and threats within the organization's operating environment that will affect how it pursues its mission.

**(iii) Analyze the organization's internal operating environment to identify the organization's strengths and weaknesses:**

Internal analysis, the third component of the strategic planning process, focuses on reviewing the resources, capabilities, and competencies of a company. The goal is to Identify the strengths and weaknesses of the company.

**(iv) Select strategies:**

Managers select strategies that build on the organization's strengths and correct its weaknesses in order to take advantage of external opportunities and counter external threats. In order to select the right strategies managers compare and contrast the various alternative possible strategies against each other and then identify the set of strategies that will create and sustain a competitive advantage

**(v) Implement the strategies:**

In order to achieve a competitive advantage and increase profitability managers must put those strategies selected into action. Strategy implementation involves taking actions at the functional, business, and corporate levels to execute a strategic plan.

**Implementation can include, for example,**

- putting quality improvement programs into place
- changing the way a product is designed
- positioning the product differently in the marketplace
- segmenting the marketing and offering different versions of the product to different consumer groups.

**8. (a):**

- **Project-based structures**

  A project - based structure is one where teams are created, undertake the work and are then dissolved. This can be particularly appropriate for organizations that deliver large and expensive goods or services (civil engineering information systems, films) or those delivering time-limited events (conferences, sporting events or consulting engagements). The organization structure is a constantly changing collection of project teams created, steered and glued together loosely by a small corporate group. Many organizations use such teams in a more adhoc way to complement the "main" structure.

**For example:**

taskforces are set up to make progress on new element of strategy or to provide momentum where the regular structure of the organization is not effective

**Advantages of Project-based structures are aligned below:**

- The project -bsed structure can be highly flexible, with projects being set up and dissolved as required.
- Accountability and control are good because project teams should have clear tasks to achieve within a defined life.
- Projects can be effective at knowledge exchange as project team members will typically be drawn from different departments within the firm.
- Project can also draw members internationally and, because project life spans are typically short, project teams may be more willing to work temporarily around the world.

**Disadvantages of Project based structure are aligned below:**

- Without strong program management providing overarching strategic control, organizations are prone to proliferate projects in an ill-coordinated fashion.
- The constant breaking up of project teams can also hinder the accumulation of knowledge over time or within specification.

**8. (b):**

**Three important reasons that lead an organization to undertake Business Process Re-engineering are as follows:**

**(i)** An organization needs dramatic improvements to sustain itself and is already in deep trouble. High failure rates of products and repetitive customer complaints can be a one of the reasons that can cause huge disruption in the functioning of the organization.

**(ii)** The need for re-engineering can be felt by the management keeping in mind the imminent problems that the organization is expected to face in the future due to some dramatic changes in the environment, both internal and external.

**(iii)** There can be situations when reengineering can help organizations to be in better position than they are currently in.

**Four concerns while implementing the Business Process Re-engineering program are as follows:**

**(i)** One of the major realizations to emerge from BPR is that most business processes are complex. To redesign a process one must first understand it.

**(ii)** Process mapping exercises reveal that even seemingly simple business processes, such as the procurement of office supplies, involve complex and sophisticated systems of interactions among a number of organizational members.

**(iii)** Many organizational routines operate without any single person fully understanding the mechanism.

**(iv)** Hammer and Champy's (1993) recommendation to 'obliterate existing processes and start with a 'clean sheet of paper runs the risk of destroying organizational capabilities that have been nurtured over a long period of time.