Paper – 17 - Strategic Performance Management

This paper contains 10 questions, divide in three sections; Section A, Section B and Section C. In total 7 questions are to be answered.

From Section A, Question No. 1 is compulsory and answer <u>any two questions from</u> Section A (out of three questions – questions Nos. 2 to 4). From Section B, Answer <u>any two questions</u> (i.e. out of Question nos. 5 to 7). From Section C, Answer <u>any two questions</u> (i.e. out of question nos.8 to 10).

Students are requested to read the instructions against each individual question also. All workings must form part of your answer. Assumptions, if any, must be clearly indicated.

Section –A

[Question 1 is compulsory and answers any 2 from the rest. All questions carry equal marks]

1. **Read the following case study and answer the following questions:**

   Situation: ESPN suffered from an absence of Customer Knowledge

   Several years ago, ESPN recognized that it lacked a consistent view of its customers. For example, it housed registration, product purchase, and online behavioral data in separate data repositories. Meanwhile, many business units were running their own data warehouse and decision engines to power their marketing communications. As a result, ESPN didn't just lack a consistent view of its customer; it also lacked a cohesive view of how fans were interacting with the overall business. Because it lacked a consistent view of customers, it didn't know which customers were more valuable, how the more valuable customers interacted with the company, and which customers were most likely to engage with the company in specific ways.

   Best Practice: ESPN turns customer data into intelligence

   Under the tutelage of Scott Keating, senior director of fan relationship marketing (FRM), ESPN established a simple yet powerful mission to "know our fans well enough at any point in time or place to serve them better." To deliver on this mission, Keating and his team, working with Quaero, a CSG solution, set out to:

   - Create a holistic view of fans: During the past three years, ESPN has invested significantly in how it captures and manages customer data. The company integrates fan data from product purchases and enrollments, registration, online behavior observed through Omniture, and third-party data including census and retail co-op data and Mosaic clusters. However, as Keating highlights, "It's not just about cramming the data together in a single repository. We want to understand the correlation between the different data sets to draw insights from each that we couldn't get by looking at them in isolation."

   - Understand how fans interact with the company: ESPN quickly moved beyond looking at the demographic profile of customers within specific products and dove into differences in site navigation and digital platform usage to see if it could determine interests by observing behavior. This not only allowed ESPN to promote offers based on behavior and affinities but also to understand cross-channel behavior-an increasingly important need in light of mobile visitors and new initiatives such as ESPN Networks.

   - Understand the relative value of fans: Once ESPN successfully integrated its various data sources, it began to evaluate the relative value of fans, considering both indirect revenue from online advertising and direct revenue from premium products such as ESPN Insider, ESPN Shop, and prize-eligible fantasy games. Today, fan value drives a wide range of activity including content strategies, channel strategies, network cross promotions, and even the prioritization of house ads.

Best practice: ESPN Uses customer intelligence to Drive business value
By continuing to evolve its data capture and analysis initiatives, ESPN leverages fan intelligence and its understanding of fan value to improve its marketing and business performance. Specifically, ESPN uses fan knowledge to:

- Enhance the customer experience: ESPN focuses on the fan experience in several ways – it leverages customer knowledge to improve the relevance of its messaging; it uses behavioral and product usage insight to tailor any cross-sell and up-sell efforts; and it uses deep customer knowledge to segment and target fans at a micro level. The company can also test product development and personalization with high value fans to ensure new initiatives has the most relevance for ESPN's primary digital audience. As a result, it ensures that new initiatives, and as many of its contact touches as possible, enhance the fan's experience with the company.

- Develop marketing into a profit generator: Leveraging the knowledge developed by Keating and his team, ESPN introduced ESPN Select, a premium advertising product that allows advertisers to target ESPN.com visitors based on attributes such as affluence, age ranges, and sport interests. The team can also provide advertisers with mid-campaign reports that allow the advertiser to adjust a campaign or to increase the exposure to certain segments or creative based on performance to date. As such, Keating's FRM team evolved from a cost center to a revenue driver by offering targeted inventory at premium CPM. In some cases where ads were targeted against multiple attributes, inventory commanded a significant premium.

(a) Explain Customer Intelligence.
(b) State the benefits of Customer Intelligence.
(c) Discuss the challenge face by the ESPN for non- availability of Customer Intelligence data.
(d) Explain How ESPN turns Customer Intelligence to drive Business Value.
(e) Discuss ESPN turns Customer data to Customer intelligence.   [4+2+4+5+5]

Answer of 1:
(a) Customer intelligence (CI) is information derived from customer data that an organization collects from both internal and external sources. The purpose of CI is to understand customer motivations better in order to drive future growth. The application of business analytics to customer data is sometimes called customer data mining.

So, we can say, **Customer intelligence** (CI) is the process of gathering and analyzing information regarding customers; their details and their activities, in order to build deeper and more effective customer relationships and improve strategic decision making.

(b) Benefits
Customer Intelligence provides a detailed understanding of the experience customers have in interacting with a company, and allows predictions to be made regarding reasons behind customer behaviors. This knowledge can then be applied to support more effective and strategic decision making.

(c) Several years ago, ESPN recognized that it lacked a consistent view of its customers. For example, it housed registration, product purchase, and online behavioral data in separate data repositories. Meanwhile, many business units were running their own data warehouse and decision engines to power their marketing communications. As a result, ESPN didn't just lack a consistent view of its customer; it also lacked a cohesive view of how fans were interacting with the overall business. Because it lacked a consistent view of customers, it didn't know which customers were more

valuable, how the more valuable customers interacted with the company, and which customers were most likely to engage with the company in specific ways.

(d) By continuing to evolve its data capture and analysis initiatives, ESPN leverages fan intelligence and its understanding of fan value to improve its marketing and business performance. Specifically, ESPN uses fan knowledge to:

- **Enhance the Customer Experience:** ESPN focuses on the fan experience in several ways – it leverages customer knowledge to improve the relevance of its messaging; it uses behavioral and product usage insight to tailor any cross-sell and up-sell efforts; and it uses deep customer knowledge to segment and target fans at a micro level. The company can also test product development and personalization with high value fans to ensure new initiatives has the most relevance for ESPN's primary digital audience. As a result, it ensures that new initiatives, and as many of its contact touches as possible, enhance the fan's experience with the company.

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(e) Under the tutelage of Scott Keating, senior director of fan relationship marketing (FRM), ESPN established a simple yet powerful mission to "know our fans well enough at any point in time or place to serve them better." To deliver on this mission, Keating and his team, working with Quaero, a CSG solution, set out to:
- **Create a holistic view of fans:** During the past three years, ESPN has invested significantly in how it captures and manages customer data. The company integrates fan data from product purchases and enrollments, registration, online behavior observed through Omniture, and third-party data including census and retail co-op data and Mosaic clusters. However, as Keating highlights, "It's not just about cramming the data together in a single repository. We want to understand the correlation between the different data sets to draw insights from each that we couldn't get by looking at them in isolation."
- **Understand how fans interact with the company**: ESPN quickly moved beyond looking at the demographic profile of customers within specific products and dove into differences in site navigation and digital platform usage to see if it could determine interests by observing behavior. This not only allowed ESPN to promote offers based on behavior and affinities but also to understand cross-channel behavior-an increasingly important need in light of mobile visitors and new initiatives such as ESPN Networks.
- **Understand the relative value of fans**: Once ESPN successfully integrated its various data sources; it began to evaluate the relative value of fans, considering both indirect revenue from online advertising and direct revenue from premium products such as ESPN Insider, ESPN Shop, and prize-eligible fantasy games. Today, fan value drives a wide range of activity including content strategies, channel strategies, network cross promotions, and even the prioritization of house ads.

2(a) A Finance Manager is considering drilling a well. In the past, only 70% of wells drilled were successful at 20 meters depth in that area. Moreover, on finding on water at 20 meters, some persons in that area drilled it further up to 25 meters but only 20% struck water at that level. The prevailing cost of drilling is Rs. 500 per meter. The Finance Manager estimated that in case he does not get water in his own well, he will have to pay Rs. 15,000 to buy water from outside for the same period of getting water from the well. The following decisions are
Considered:
(i) Do not drill any well;
(ii) Drill up to 20 meters, and
(iii) If no water is found at 20 meters, drill further upto 25 meters.
Draw an appropriate decision tree and determine the Finance Manager's optimal strategy.

(b) You are the manager of Raj paper Mills and have recently come across a particulars type of paper, which is being sold at a substantially lower rate (by another company Raju Ltd) than the price charged by your own mill. The Value Chain for one use of tone of such paper for Raju Ltd is: Raju Ltd. $\rightarrow$ Merchant $\rightarrow$ Printer $\rightarrow$ Customer.
Raju Value sells this particular paper to Merchant at the rate of ₹ 2,466 per Tonne. Raju Ltd pays for the Freight which amounts to ₹130 per Tonne. Average returns and Allowances amount to 4% of sales and approximately equals ₹160 Tonne.

The value chain of your Company, through which the paper reaches the ultimate customer is similar is to that of Raju Ltd. However, your Mill does sell directly to the Merchant, the latter receiving the paper from huge Distribution centre maintained by your Company at Haryana. Shipment Costs from the Mill to the Distribution centre is ₹ 111 per Tonne while the operating Costs in the distribution center are estimated at ₹ 125 per Tonne. The return on Investment required by the Distribution centre for the investments made, amount to an estimate ₹158 per Tonne.
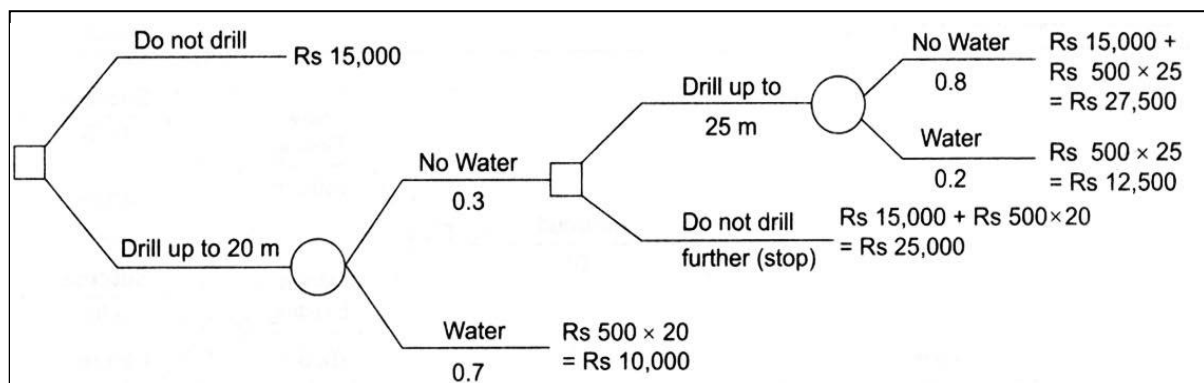Calculate the "Mill Manufacturing Target Cost" for this particular paper for RAJ Ltd. Assume that the return on the investment expected by Raj Ltd is ₹220 per tonne of paper.

(c) List the objectives of Transfer Pricing.   [9+6+5]

Answer:

(a) Based on the given information, the decision tree is shown in Figure

Decision Tree: Drilling Problem.

The analysis of the tree is given in Table

Decision Node	Options	Expected Cost	Decision
1	Drill up to 25 meters	0.8 x 27,500 + 0.2 x 12,500 =₹ 24,500	

	Stop	₹ 25,500	Drill up to 25 meters
2	Do not drill	₹ 15,000	
	Drill up to 20 meters	0.3 x 24,500 + 0.7 x 10,000 = ₹14,350	Drill up to 20 meters

From the analysis table, it may be observed that decision at node 2 implies that if it is decided to drill up to 20 meters and water is not found, then drilling up to 25 meters should be done. At node 1, the decision taken is to drill up to 20 meters as it involved lower expected cost. Thus, the optimal strategy is to drill up to 20 meters and if water is not struck then drill further to 25 meters.

(b)   **In the books of Raj Ltd.**

Particulars	Amount (₹ in tonne)
Sale Price of Raju Ltd to Merchant	2,466
Less: Reduction towards – Freight paid by Raju Ltd 130 Returns and Allowances (given) <u>160</u>	190
Target sales price for Raj paper Mills	2,176
Less: target Profit margin for Raj paper Mills = Overall return on Investment Expected (given)	220
Target Cost for Raj paper Mills (Overall, i.e. Mill + Distribution)	**1,956**
Less: Value Addition at distribution centre Level(a) Shipping + Operating Cost 111 + 125=236 (b) return on Invt for distribution centre = 158	394
Target cost Mill Level i.e. Mill manufacturing target cost for Raj Paper Mills	**1,562**

(c) A transfer price is that notional value at which goods and services are transferred between divisions in a decentralized organization. Transfer prices are normally set for intermediate products which are goods and services that are supplied by the selling division to the buying division.

Objectives:

- Ensure that resources are allocated in an optimal manner.

- Promote goal congruence.

- Motivate divisional managers.

- Facilitate the assessment of management performance.

- Retain divisional autonomy.

3 (a) Describe the advantages and disadvantages of Return on investment.

  (b) A market is characterized by two sellers and many buyers (duopoly) and demand curve is p = a – bq, q = q$_1$ + q$_2$ where the cost of production is zero.
    (i) Generate the market output and show that it is two thirds of competitive output and monopoly output is three fourth of duopoly output if a, b >0
    (ii) If 3 more sellers enter the market what would be the market output?
    (iii) Show that if several sellers are now in the market i.e. a situation of competitive market, we will get competitive output.
  (c) A radio manufacturer produces 'x' sets per week at total cost of ₹ X^2+ 78x + 2500. He is a monopolist and the demand function for his product is x = $\dfrac{(600 - P)}{8}$, when the price is 'p' per set. Show that maximum net revenue is obtained when 29 sets are produced per week. What is the Monopoly Price?   **[7+8+5]**

Answer:

(a) Advantages of Return on Investment:

ROI has the following advantages

(i) It relates net income to investments made in a division giving a better measure of divisional Profitability.

(ii) It can be used as a basis for other ratios which are useful for analytical purposes.

(iii) It is easy to understand as it is based on financial accounting measurements.

(iv) It may be used for inter firm comparisons, provided that the firms whose results are being compared are comparable size and the same industry.

Disadvantages of Return on Investment:

ROI has the following limitations:

(i) Satisfactory definition of profit and investment are difficult to find. Profit has many concepts such as profit before interest and tax, profit after interest and tax, controllable profit, profit after deducting all allocated fixed costs. Similarly, the term investment may have many connotations such as gross book value, net book value, historical cost of assets, and current cost of assets, assets including or excluding intangible assets.

(ii) While comparing ROI of different companies it is necessary that the companies use similar accounting policies and methods in respect of valuation of stocks, valuation of fixed assets, apportionment of overheads, treatment of research and development expenditure etc.

(iii) ROI may influence a divisional manager to select only investments with high rates of return (i.e. rates which are in line or above his target ROI). Other investments that would reduce the division's ROI but could increase the value of the business may be rejected by the divisional manager. It is likely that another division may invest the available funds in a project that might improve its existing ROI (which may be lower than a division's ROI which has rejected the investment) but which will not contribute as much to the enterprise as a whole. These types of decisions are sub-optimal and can distort an enterprise's overall allocation of resources and can motivate a manager to make under investing in order to preserve its existing ROI.

(b)

(i) Given $TC = 0 \Rightarrow MC = 0$

$\therefore \pi_1 = TR_1 - TC = TR_1 = pq_1 = [a - b(q_1 + q_2)]q_1$

For maximum profits $\dfrac{d\pi_1}{dq_1} = 0 \Rightarrow a - 2bq_1 - bq_2 = 0 \ldots\ldots\ldots(1)$

Again, $\pi_2 = [a - b(q_1 + q_2)]q_2$

For maximum profits $\dfrac{d\pi_2}{dq_2} = 0 \Rightarrow a - bq_1 - 2bq_2 = 0 \ldots\ldots\ldots(2)$

Adding (1) & (2), $2a - 3bq_1 - 3bq_2 = 0 \Rightarrow 2a - 3b(q_1 + q_2)$

$\Rightarrow q_D = \dfrac{2a}{3b}$ which is the duopoly output.

Under perfect competition $P = MC \Rightarrow a - bq = 0 \Rightarrow q_c = \dfrac{a}{b}$

$\therefore q_D = \dfrac{2}{3} q_c$

As $q = a - bq \Rightarrow MR = a - 2bq$

For monopoly $MR = MC \Rightarrow a - 2bq = 0 \Rightarrow q_m = \dfrac{a}{2b}$

$\therefore q_m = \dfrac{3}{4} q_D$

(ii) For 2 sellers we have $q = \dfrac{2}{3} \times \dfrac{a}{b} = \left(\dfrac{2}{2+1}\right)\dfrac{a}{b}$

If 3 more sellers join the market, total sellers are 5.

$$\therefore q = \left(\frac{5}{5+1}\right) \times \frac{a}{b}$$

(iii) For n sellers in the market, $q = \left(\frac{n}{n+1}\right) \frac{a}{b}$ ....(3)

$$\Rightarrow q = \left(\frac{1}{1+1/n}\right) \frac{a}{b} \qquad\qquad ....(4)$$

As the number of sellers increases i.e. as n tends to infinity

$Q = \frac{a}{b}$ i.e. competitive output from (4)

(c) Cost (C) = $x^2 + 78x + 2500$
Demand (D) X = (600 – P) / 8

8x = 600 – P

$\therefore$ P = 600 – 8x

Total Revenue for 'x' sets

Price x Quantity i.e., $600x - 8x^2$

Maximum revenue is obtains at MC = MR

Marginal Cost = $\frac{dc}{dx}$ = 2x + 78 – (i)

Marginal Revenue = $\frac{dr}{dx}$ = 600 – 16x – (ii)

Equity (i) & (ii)

2x +78 = 600 – 16x

or, 18x = 522

$\therefore x = \frac{522}{18} = 29$

Monopoly price 600 – 8x

600 – 8 × 29

= 600 – 232 = 368

4. (a) Discuss about the Limitations of the Value Chain Analysis.
  (b) Discuss the parameters to measure the performance of Public Undertakings.
  (c) List a few business applications of Activity Based Management.
  (d) Distinguish between Total Quality Management (TQM) and Business Process Re-
  Engineering (BPR).   **[5+5+5+5]**

  Answer:

  (a) Limitations of Value Chain Analysis
    (i) Non availability of Data
    Internal data on costs, revenues and assets used for Value Chain Analysis are derived
    from financial report of a single period. For long term strategic decision-making,
    changes in cost structures, market prices and capital investments etc. may not readily
    available.

(ii) Identification of Stages

Identifying stages in an industry's value chain is limited by the ability to locate at least one firm that participates in a specific stage. Breaking a value stage into two or more stages when an outside firm does not compete in these stages is strictly judgmental.

(iii) Ascertainment of Costs of Revenues and Assets

Finding the Costs, Revenues and Assets for each value chain activity poses/gives rise to serious difficulties. There is no specific approach and much depends upon trial and error and experiments methods.

(iv) Identification of Cost Drivers

Isolating Cost Drivers for each value creating activity, identifying Value Chain Linkages across activities and computing supplier and customer profit margins present serious challenges.

(v) Resistance from Employees

Value Chain Analysis is not easily understandable to all employees and hence may face resistance from employees as well as managers.

(b) A basic problem in the management of public undertaking is the measurement of their efficiency. Evaluation of efficiency is necessary in both public and private enterprises. However, the problem is more sensitive in public undertaking due to lack of a single criteria and due to multiplicity of objectives.

Efficiency is basically the ratio between inputs and outputs. It may be defined as the relationship between the results achieved and the means used to produce the results. In other words, efficiency is the capacity to obtain the desired results with minimum of cost, time, and effort. Efficiency is a relative term. It can be measured with reference to predetermined standards or degree of efficiency. The degree of efficiency of an enterprise depends upon the extent to which established standards or targets of performance have been achieved.

Public undertakings are supposed to exist for achieving both economic and social objectives. Therefore, the efficiency of undertaking can be measured on the basis of their achievements in economic and social fields. Economic performance of Public undertaking can be judged in terms of:-

(i) Profitability;

(ii) Capacity utilization; and

(iii) Quality of products and services.

(i) Profitability : Profitability of public undertakings can be measured in terms of rate of return on capital employed, which means net profits divided by long-term' capital investment. However, profitability is not a valid test of efficiency of public undertakings due to the following reasons:

• Many public undertakings enjoy monopoly power and they can charge high prices to keep the profits high.

• In many cases, public undertakings adopt subsidized prices. For example, electricity and fertilizers are supplied to farmers at subsidized rates. In such cases, profitability cannot measure efficiency.

• In many public undertakings, government is both the producer and the consumer. There is no market mechanism and, therefore, profitability is not the true indicator of efficiency.

• Profit is affected by several factors beyond the control of the management of public undertakings. For example, location of plant, price policy, staffing, etc is decided by the Government.

• Public undertakings have to bear huge social cost by way of longer gestation period, obligations as model employer, investment in townships, research and development, etc.

(ii) Capacity Utilization: The economic use of resources and per unit cost of production depends to a great extent on the degree of utilization of installed capacity. However, capacity utilization often depends upon factors beyond the control of an individual public undertaking. Availability of power, political interference, export

policy etc., are such factors.

(iii) Quality of Products and Services: Quality of products and services and profitability are interrelated. Therefore, maintenance of quality may be used as a criterion to measure the performance of public undertakings. However, there can be conflict between the quality and profit criteria after a certain point improvement in quality might impose upon the profit objective.

Rationalization of social objectives:

As business enterprise public undertakings should be run on commercial lines but public undertaking are established to fulfill certain objectives, which are less financial and more social. Therefore, the performance of the public undertakings cannot be judged on the basis of financial objectives alone. Financial objectives must necessarily be subordinated to social objectives like development of backward areas, generation of employment opportunities, welfare of weaker section of the society, import substitution, self-reliance etc. Therefore, profitability cannot be the sole criteria for measuring the performance of the public undertaking. To conclude public undertakings have multiple objectives and their performance cannot be judged by the criteria used by the private enterprises like net profits in a narrow commercial sense. Nevertheless, public undertakings should generate surplus for investment. Such surplus or profits can be tested to the managerial efficiency provided they are earned through better utilization of the capacity and resources higher productivity, cost reduction and labour management cooperation.

(c) Business Applications of ABM

(i) **Cost Reduction:** ABM helps the Firm to identify opportunities in order to streamline or reduce the costs or eliminate the entire activity, especially NVA activities. It is useful in identifying and quantifying process waste, leading to continuous process improvement through continuous cost reduction.

(ii) **Activity Based Budgeting:** Activity Based Budgeting analyses the resource input or cost for each activity. It provides a framework for estimating the amount of resources required in accordance with the budgeted level of activity. Actual results can be compared with budgeted results to highlight (both in financial and non-financial terms) those activities with major discrepancies for potential reduction in supply of resources. It is a planning and control system, which supports continuous improvement.

(iii) **Business Process Re-Engineering (BPR):** BPR is the analysis and redesign of workflows and processes in a Firm, to achieve dramatic improvement in performance, and operational excellence. A business process consists of linked set of activities, e.g. purchase of materials is a business process consisting of activities like Purchase Requisition, Identifying Suppliers, preparing Purchase Orders, mailing Purchase Orders and follow up. The process can be reengineered by sending the production schedule direct to the suppliers and entering into contractual agreement to deliver materials according to the production schedule.

(iv) **Benchmarking:** It involves comparing the Firm's products, services or activities with other best performing organizations, either internal or external to the Firm. The objective is to find out how the product, service or activity can be improved and ensure that the improvements are implemented.

(v) **Performance Measurement:** Activity performance measures consist of measures relating to costs, time quality and innovation. For achieving product quality, some illustrative performance measures are –

Area	Measures
Quality of purchased component	Zero Defects
Quality of output	Percentage yield
Customer Awareness	No. of orders, no. of complaints

(d) Differences Between Total Quality Management(TQM) and Business Process Reengineering (BPR)

Major Factor	TQM Approach	BPR
Senior-management involvement	Hands-on initially, and becoming more reinforcement- oriented	Hands-on, active involvement throughout the effort
Intensity of team-member involvement	Ongoing involvement on an as-needed, part-time basis	Ongoing involvement for a specified duration on a full-time basis
Improvement goals	Focus on incremental improvements over a period of time	Focus on dramatic improvements in a short time frame
Implementation approach	Emphasis on improving current work processes	Emphasis on creating new ways of doing things
Magnitude of organizational change	Limited disruption to existing systems and structures	Radical changes to existing systems and structures
Breadth of focus	Addresses narrowly defined work processes	Addresses processes that span entire business units
Use of benchmark data	Used after process improvement, to compare data	Used on front end, to assist with process selection
Dependence on information systems	Information systems used for data collection and interpretation	Information systems used as a central enabler with on-line access

Section – B
[Answer any 2 questions from this section]

5. (a) State the Technological and Operational factors of E-commerce.
(b) "The MI is based on the concept of the Production function. This is a function of maximum possible production, with respect to a set of inputs pertaining to capital and labour" – Discuss it. **[6+4]**

Answer of 5:
(a) Technical and Operational Factors of E-commerce

(i) **Protocol (Standards) Making Process**
A well-established telecommunications and Internet infrastructure provides many of the necessary building blocks for development of a successful and vibrant e-commerce marketplace.

(ii) **Delivery Infrastructure**
Successful e-commerce requires a reliable system to deliver goods to the business or private customer.

(iii) **Availability of Payment Mechanisms**
Secure forms of payment in e-commerce transactions include credit cards, checks, debit cards, wire transfer and cash on delivery.

(iv) **General Business Laws**
The application of general business laws to the Internet will serve to promote consumer protection by insuring the average consumer that the Internet is not a place where the consumer is a helpless victim.

(v) **Public Attitude to E-commerce**

The public attitude toward using e-commerce in daily life is a significant factor in the success of ecommerce.

(vi) **Business Attitude to E-commerce**

The willingness of companies to move away from traditional ways of doing business and develop methods and models that include e-commerce is essential.

(b) The **Malmquist Index** (MI) is a bilateral index that can be used to compare the production technology of two economies. It is named after Professor Sten Malmquist, on whose ideas it is based. It is also called the Malmquist Productivity Index.

The MI is based on the concept of the Production function. This is a function of maximum possible production, with respect to a set of inputs pertaining to capital and labour. So, if S_a is the set of labour and capital inputs to the production function of Economy **A, and Q** is the production function of Economy A, we could write **Q = f (S_a).**

While the production function would normally apply to an enterprise, it is possible to calculate it for an entire region or nation. This would be called the aggregate production function.

To calculate the Malmquist Index of economy A with respect to economy B, we must substitute the labour and capital inputs of economy A into the production function of B, and vice versa. The formula for MI is given below.

$$MI = \sqrt{(Q_1 Q_2)/(Q_3 Q_4)}$$

Where,

$Q_1 = f_a(S_a)$

$Q_2 = f_a(S_b)$

$Q_3 = f_b(S_a)$

$Q_4 = f_b(S_b)$

Note that the MI of A with respect to B is the reciprocal of the MI of B with respect to A. If the MI of A with respect to B is greater than 1, the aggregate production technology of economy A is superior to that of economy B.

6. (a) Explain the Statistical Process Control (SPC) methods.
(b) Describe about the different types of On-Line Analytical Processing.

[5+5]

Answer of 6:

(a) Statistical process control (SPC) monitors specified quality characteristics of a product or service so as:

To detect whether the process has changed in a way that will affect product quality and To measure the current quality of products or services.

- **Control** is maintained through the use of control charts. The charts have upper and lower control limits and the process is in control if sample measurements are between the limits.

- **Control Charts for Attributes**

P Charts - measures proportion defective.
C Charts - measures the number of defects/unit.

- **Control Charts for Variables**

X bar and R charts are used together - control a process by ensuring that the sample average and range remain within limits for both.

- **Basic Procedure**
  (i) An upper control limit (UCL) and a lower control limit (LCL) are set for the process.
  (ii) A random sample of the product or service is taken, and the specified quality characteristic is measured.

(iii) If the average of the sample of the quality characteristic is higher than the upper control limit or lowers than the lower control limit, the process is considered to be "out of control".

(b) Types

OLAP systems have been traditionally categorized using the following taxonomy.

Multidimensional

MOLAP is a "multi-dimensional online analytical processing".'MOLAP' is the 'classic' form of OLAP and is sometimes referred to as just OLAP. MOLAP stores this data in optimized multidimensional array storage, rather than in a relational database. Therefore it requires the pre-computation and storage of information in the cube - the operation known as processing. MOLAP tools generally utilize a pre-calculated data set referred to as a data cube. The data cube contains all the possible answers to a given range of questions. MOLAP tools have a very fast response time and the ability to quickly write back data into the data set.

Relational

ROLAP works directly with relational databases. The base data and the dimension tables are stored as relational tables and new tables are created to hold the aggregated information. Depends on a specialized schema design. This methodology relies on manipulating the data stored in the relational database to give the appearance of traditional OLAP's slicing and dicing functionality. In essence, each action of slicing and dicing is equivalent to adding a "WHERE" clause in the SQL statement. ROLAP tools do not use pre-calculated data cubes but instead pose the query to the standard relational database and its tables in order to bring back the data required to answer the question. ROLAP tools feature the ability to ask any question because the methodology does not limit to the contents of a cube. ROLAP also has the ability to drill down to the lowest level of detail in the database.

Hybrid

There is no clear agreement across the industry as to what constitutes "Hybrid OLAP", except that a database will divide data between relational and specialized storage. For example, for some vendors, a HOLAP database will use relational tables to hold the larger quantities of detailed data, and use specialized storage for at least some aspects of the smaller quantities of more-aggregate or less-detailed data. HOLAP addresses the shortcomings of MOLAP and ROLAP by combining the capabilities of both approaches. HOLAP tools can utilize both pre-calculated cubes and relational data sources.

Other types

The following acronyms are also sometimes used, although they are not as widespread as the ones above:

• **WOLAP** - Web-based OLAP
• **DOLAP** - Desktop OLAP
• **RTOLAP** - Real-Time OLAP

7. Define the following terms in the context of Supply chain Management:
(a)Capacity Strategy,(b) Lead Time/ Cycle Time, (c) Preventative Maintenance , (d) Specifications. **[2.5 x4]**

Answer of 7:
(a) Capacity Strategy:

This is one of the strategic choices that a firm must make as part of its manufacturing strategy. There are three commonly recognized capacity strategies: lead, lag, and tracking. A lead capacity strategy adds capacity in anticipation of increasing demand. A lag strategy does not add capacity until the firm is operating at or beyond full capacity. A tracking strategy adds capacity in small amounts to attempt to respond to changing demand in the marketplace.

(b) Lead Time/Cycle Time:

1) A span of time required to perform a process (or series of operations). 2) In a logistics context, the time between recognition of the need for an order and the receipt of goods. Individual components of lead time can include order preparation time, queue time, processing time, move or transportation time, and receiving and inspection time.

(c) Preventive Maintenance

The activities, including adjustments, replacements, and basic cleanliness, that forestall machine breakdowns. The purpose is to ensure that production quality is maintained and that delivery schedules are met. In addition, a machine that is well cared for will last longer and cause fewer problems.

(d) Specifications

Specifications are the most detailed method of describing requirements. Various types of design specifications are the detailed descriptions of the materials, parts, and components to be used in making a product. Hence, they are the descriptions that tell the seller exactly what the buyer wants to purchase.

<div align="center">

Section C
[Answer any 2 questions from this section]
</div>

8. (a) "**Risk Management Process refers to the process of measuring or assessing risk and then developing strategies to manage risk. In the risk management, some steps are taken up to minimize the risk**"- Discuss the steps taken to minimize the risk.

(b) "**Several techniques have been developed to help in prediction why companies fail.**" **– Describe the Altman: Z Score Model in this regard.** **[5+5]**

Answer of 8:

(a) Risk Management Process

Risk management process refers to the process of measuring or assessing risk and then developing strategies to manage risk. In the risk management, the following steps are taken up to minimize the risk:

Step 1: Risk Identification and Assessment

This step involves event identification and data collection process. The institution has to put in place a system of capturing information either through key risk drivers (KRIs) or through a rating system. Once risks are identified, combine like risks according to the following key areas impacted by the risks — people, mission, physical assets, financial assets, and customer/stakeholder trust.

Step 2: Risk Quantification and Measurement

The next step is to Quantify and Measure risks-this means Rate risks according to probability and impact. Various standard tools are used by financial institutions to measure risk and understand their impact in terms of capital or its importance to the organization through a scoring technique.

Step 3: Risk Analysis, Monitor and Reporting

The next step is risk analysis, monitoring and reporting. This will help one to get the big picture and decided on the approach to risk management.

Step 4: Capital Allocation

Risk Analysis, Monitoring & Reporting sends information to the top management of the organization to take strategic decisions. Capital allocation plays key role in management decision making.

Step 5: Risk Management and Mitigation

After the above step, the last step is to make strategic decisions to manage the risk in order to mitigate the risk.
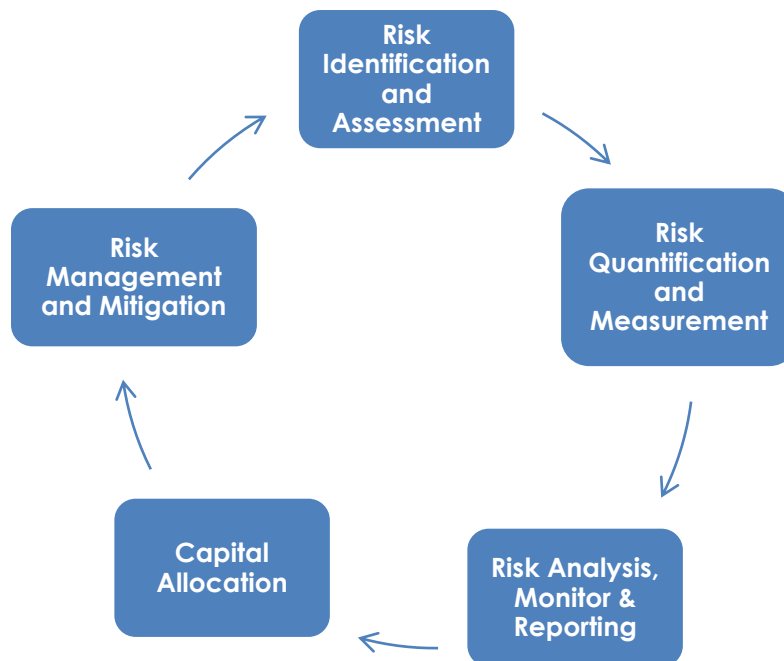
(b) The Z-Score model is a quantitative model developed by Edward Altman in 1968, to predict bankruptcy or financial distress of a business. The Z-score is a multi variate formula that measures the financial health of a company and predicts the probability of bankruptcy within 2years. This model involves the use of a specified set of financial ratios and a statistical method known as a Multiple Discriminant Analysis. (MDA). The real world application of the Altman score successfully predicted 72% of bankruptcies two years prior to their failure.

The model of Altman is based on a linear analysis in which five measures are objectively weighted and summed to arrive at an overall score that then becomes the basis for classification of companies into one of the two a priori groupings that is bankrupt or non-bankrupt. These five indicators were then used to derive a Z-Score. These ratios can be obtained from corporations' financial statements.

The five Z-score constituent ratios are:

(i) Working Capital/Total Assets (WC/TA):- a firm with negative working capital is likely to experience problems meeting its short-term obligations.

(ii) Retained Earnings/Total Assets: - Companies with this ratio high probably have a history of profitability and the ability to stand up to a bad year of losses.

(iii) Earnings Before Interest & Tax/ Total Assets: - An effective way of assessing a firm's ability to profit from its assets before things like interest and tax are deducted.

(iv) Market Value of Equity/ Total Liabilities: - A ratio that shows, if a firm were to become insolvent, how much the company's market value would decline before liabilities exceed assets.

(v) Sales/Total Assets: - A measure of how management handles competition and how efficiently the firm uses assets to generate sales.

Based on the Multiple Discriminant Analysis, the general model can be described in the following form:

$$Z = 1.2 WC/TA + 1.4 RE/TE + 3.3 EBIT/TA + 0.6 MVE/TL + 1.0 SL/TA$$

Probability of failure according to the Z-Score result:

Z-Score	Probability of Failure
Less than 1.8	very High
Greater that 1.81 but less than 2.99	Not Sure
Greater than 3.0	Unlikely

Calculation of the Z-Score for a fictitious company where the different values are given to calculate the Z-Score.

Sales	25,678
Total Assets	49,579
Total liabilities	5,044
Retained earnings	177
Working Capital	-1,777
Earnings before interest and tax	2,605
Market value of Equity	10,098
Book value of Total Liabilities	5,044

The calculations of the ratios are as follows:

1. Working Capital/Total Assets (-1,777/ 49579) = -0.036
2. Retained Earnings/Total Assets (177/ 49579) =0.004
3. Earnings Before Interest & Tax/ Total Assets (2605/ 49579)= 0.053
4. Market Value of Equity/ Total Liabilities (10098/ 5044)= 2.00
5. Sales/Total Assets (25978/ 49579)=0.52

   Thus according to the formula the answer should be:

   Z=1.2(-0.036) + 1.4 (0.004) + 3.3 (0.053) + 0.6 (2.0) + 1.0(0.52)

   Z= -0.04+ 0.01+0.17+1.20+0.52

   Z=1.86

According to Altman, this company may or may not fail as it is greater than 1.81 but less than 2.99, which situates it neither on the safe side nor on the failure side.

9.(a) Describe about the Partial Adjustment Process under the Corporate Bankruptcy Prediction Models.

(b) Discuss the benefits of Risk Mapping.   **[6+4]**

Answer of 9:

(a) Partial Adjustment Process

Partial adjustment models are a theoretic rationale of famous Koyck approach to estimate distributed-lag models. Application of partial adjustment model in bankruptcy prediction can best be explained by using cash management behaviour of the firms as an example. According to Laitinen and Laitinen (1998), cash management refers to the management of cash from the time it starts its transit to the firm until it leaves the firm in payments. Failure of the cash management can be defined as an imbalance between cash inflows and outflows. This leads to failure usually defined as the inability of the firm to pay its financial obligations as they mature.

Traditionally, cash management behaviour of a firm is described by different models of demand for money, e.g., the quantity theory of demand for money, which assumes that the demand for money does not differ from the demand for any funds in the firm. The most popular and simple approach to the demand for money in this framework is that followed by the inventory cash management approach, where demand for money by a firm is assumed to depend on the volume of transactions. The idea may be summarized as follows.

The actual cash balance of a firm in period t is a multiplicative function of S and i as follows:

$\ln M(t) = \ln D + e_s \ln S(t) + e_i \ln i(t) + u(t)$………………………………… [1]

Where;

ln: natural logarithm

M(t): actual cash balance in period t

D: a scale constant

S(t): the volume of transactions

i(t): the opportunity cost

e_s : the elasticity of cash balance with respect to S

e_i : the elasticity of cash balance with respect to i

u(t): a random error variable with standard autoregressive property

Equation [1] is static in nature whose dynamic version presented in partial adjustment form is as below:

$\ln M(t) = y\{\ln D + e_s \ln S(t) + e_i \ln i(t) + u(t)\} + (1-y)M(t-1) + yu(t)$………………….. [2]

Where y and (1-y) are the weights representing adjustment rate.

The overall classification and prediction process, in this particular example of partial adjustment model, follows the following criterion:

• For a failing firm, absolute values of the elasticity's of cash balance with respect to the motive factors (volume of transactions and the opportunity cost here) will be smaller than for a similar healthy firm;

• For a failing firm, the rate of adjustment y may be even greater than unity and will certainly exceed the rate for healthy firm;

• Validity of the results can be tested by any appropriate technique like Lachenbruch procedure.

(b) Benefits of risk mapping

- Promotes awareness of significant risks through priority ranking, facilitating the efficient planning of resources.
- Enables the delivery of solutions and services across the entire risk management value chain.
- Serves as a powerful aid to strategic business planning.
- Aids the development of an action plan for the effective management of significant risks.
- Assigns clear responsibilities to individuals for the management of particular risk areas.
- Provides an opportunity to leverage risk management as a competitive advantage.
- Facilitates the development of a strategic approach to insurance programme design.
- Supports the design of the client's risk financing and insurance programmes, through the development of effective/optimal retention levels and scope of coverage etc.

10 (a) Describe the Asset Liability Management Model in the perspective of Corporate Risk Management

(b) Explain the Neural Network (NN) under the Corporate Bankruptcy Prediction Models.

[6+4]

Answer of 10:

(a) Risks encountered in portfolio management need to be addressed more emphatically. In passive portfolio management, normally the mean variance and mean absolute deviation are employed to arrive at an optimal fixed mix strategy. However, this method does not recognize the high volatility in financial markets and as such the volatility risk is not addressed. However, active portfolio management is more aggressive, and involves reviewing the initial investment strategy every time rebalancing of the portfolio is required. Carino and Turner (1998) present the superiority of dynamic asset allocation framework using stochastic programming applications. Any financial planning strategy should be such that the mix of asset classes in a portfolio is able to grow and satisfy future goals with the best possible returns. This is the crux of asset liability management.

Asset liability management applications with the aid of stochastic programming conceptualize the problem of creating a portfolio by allocating a set of assets. The investor needs to decide the three factors, namely:

- Amount of assets to buy
- Amount of assets to sell
- Amount of assets to hold

The indices are defined and the problem parameters and decision variables are set out so that the stochastic programming model can develop a solution.

In this deterministic model, uncertainty is introduced to take care of risk. A refinement to the deterministic model is to apply a more sophisticated technique for estimation of asset prices that takes into consideration any unusual occurrence in the market as well as volatility. Sub-models based on randomness are introduced into the programming to take care of the risk as well. The randomness introduced is able to generate a set of scenarios which can be incorporated into the optimization model.

This model can be further improved using a two-stage stochastic program because an investor tries to use this model for making a contingent decision involving future risk. The first stage involves fixing a time period for stage two observation followed by finally taking a decision. The observation part of it can be likened to a 'wait and see' period of observation.

Asset liability management model can also be conceptualized as a method to compute the matching of assets and liabilities to generate a cautious investment portfolio. The purpose of this model is to optimize risk-adjusted returns to the shareholders over a long run. Two approaches for matching assets and liabilities are as follows:

Duration: This is defined as a measure of price sensitivity in relation to interest rates. It refers to the weighted average maturity where the weights are applied in terms of present value. This can be represented by the following formula:

Modified duration =Duration / [1+ (Yield to maturity/Number of coupon payments per year)]

Convexity: This is defined as the change in duration corresponding to changes in yield as follows:

Convexity = $(P_+ + P_- - 2P_0)/ 2P_o ((\Delta i)^2)$

where

Δi = Change in yield (in decimals)

P_o = Initial price

P_+ = Price if yields increase by Δi

P_- =Price if yields decline by Δi

Combining convexity and duration is a good approach to examining the influence on change in yield on the market values of assets and liabilities.

The asset management model can also be employed to manage liquidity risk. Assets and liabilities can be arranged according to their maturity pattern in a time frame. Applying gap analysis, the differential between maturing assets and maturing liabilities are computed. If the gap is positive, then assets exceed liabilities; if it is negative, infusion of

funds would be necessary either through sale of assets or creating new liabilities or a rollover of existing liabilities.

This model can also be applied to exchange rate risk management. Financial institutions match their assets and liabilities at a particular exchange rate. Fluctuations in the exchange rate obviously disturb the balance. This risk is corrected by matching the assets and liabilities in the same currency. The risk of foreign exchange borrowings can also be passed on to the lenders through foreign currency loans. The uncovered borrowings can be hedged through forward covers for the entire amount.

(b) Although capable of outperforming human brain in basic arithmetic calculations, computers are certainly inferior when it comes to tasks involving symbolic recognition like signs of bankruptcy in a firm. Neural networks are enthused by biological works related to brain and its nervous system to triumph over this lack of computational efficiency in computers. Neural networks perform the classification task, in response to impending signals of financial health of a firm, in the way a brain would do for example in deciding whether the food is salty or sweet by its taste signal.

Human brain is made up of certain types of neurons (nerve cells), which is the base of neuroscience. Neurons, in neural networks, are called 'processing elements' or 'nodes'. Like real neurons, these nodes are connected to each other through 'weighted interconnections' (synapses in neuroscience terms). Nodes are organized in layers. Each node takes delivery of, joins, and converts input signals into a single output signal via weighted interconnections. This output signal is accepted as the classifying decision if it satisfies the researcher; otherwise it is transmitted again as an input signal to many other nodes (possibly including itself). Process keeps going until satisfaction is gained from researchers' point of view.

Perhaps the major task of any neural network is to determine appropriate weights to interconnections of different nodes. Neural networks perform this task by a training process in which knowledge about the relationship between input and output signals is learned following certain principle. This knowledge produces a distinct structure of nodes (in one of the network layers called 'hidden layer') and connection weights, which correctly classifies the objects into their respective known groups. Technically, this process of mapping is termed as 'convergence'. Following a mathematical theorem, the network is always able to converge.

While predicting corporate bankruptcy, NN would take information on explanatory variables at input nodes via input layer. The hidden layer nodes, connected to input nodes through weighted interconnections, collect and process this information to suggest a probability of a firm getting failed or succeeded.