GALGOTIAS UNIVERSITY

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# School of Business

**Master of Business Administration MBA Dual Specialization**
**Semester End Examination - May 2024**

**Duration : 180 Minutes**
**Max Marks : 100**

## Sem IV - MBOP6014 - Supply Chain Analytics

*General Instructions*
*Answer to the specific question asked*
*Draw neat, labelled diagrams wherever necessary*
*Approved data hand books are allowed subject to verification by the Invigilator*

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|---|---|---|---|
| **1)** | A telecommunications company is planning to lay fiber optic cables to connect several remote villages in a mountainous region. Interpret how you would use minimal spanning tree and shortest-path algorithms to design an efficient network topology. | K3 | (6) |
| **2)** | Consider a company that produces electronic gadgets. Discuss how the cycle view and process view of the supply chain can help streamline the production and distribution processes. Provide examples to illustrate your points. | K4 | (8) |
| **3)** | You are advising a courier company on optimizing its service centers. Apply the P-Median problem-solving approach to determine the most efficient locations for service centers. Discuss the trade-offs involved in the decision-making process. | K4 | (8) |
| **4)** | A shipping port serves as a trans-shipment hub for cargo arriving from multiple destinations before being forwarded to final destinations. Contrast the role of trans-shipment in optimizing the flow of goods through the transportation network and reducing overall shipping costs. | K4 | (4) |
| **5)** | You have been hired by a manufacturing firm to improve its supply chain processes. Utilize the SCOR (Supply Chain Operations Reference) model to identify and describe key processes within the supply chain. Explain how the SCOR model can facilitate performance improvement initiatives. | K3 | (9) |

6) Caselet: K5 (10)

Logistics Operations ABC Ltd. is the country's largest manufacturer of spun yarn with a well-established market. ABC Ltd. has a good reputation for quality and service. Their marketing department identified that the potential for a global market is expanding rapidly and hence the company undertook an exercise for expansion of the capacity for the export market. The company formed a team of Marketing and Materials departments to study the global logistics possibilities. After extensive study, the team came up with a report on global logistics and submitted that global logistics is essentially the same as domestic due to the following similarities:

• The conceptual logistics framework of linking supply sources, plants, warehouses and customers is the same.
• Both systems involve managing the movement and storage of products.
• Information is critical to effective provision of customer service, management of inventory, vendor product and cost control.
• The functional processes of inventory management, warehousing, order processing, carrier selection, procurement, and vendor payment are required for both.
• Economic and safety regulations exist for transportation.

The company had a very economical and reliable transportation system in existence. For exports as well they decided to evaluate the capabilities of their existing transporter and entrusted them with the job of transport to port. For customs formalities, they engaged a good CHA after proper cost evaluation and entered into a contract for freight with a shipping company agent. The response to the company's exports was very good and the company could get as many as 15 customers within the first two months and reached a level of USD 250,000 per month by the end of the first half of the year. Based on this response the export volumes were expected to grow to a level of USD 400,000 per month by the end of the year.

When the review was made at the end of the year, the company found that export volumes had come down to the level of USD 120,000 which was much lower than it had reached in the first half of the year. The managing committee had an emergency meeting to discuss this and the export manager was entrusted with the task of identifying the reasons for this decline. Mr Ganesh decided to visit the customers to get first-hand information.

When he discussed the matter with the customers, the feedback on the quality and price was good but the customers were very upset about the logistic services due to delayed shipments, frequent changes in shipping schedules, improper documentation, improper identifications, package sizes, losses due to transit damages etc. After coming back, the export manager checked the dispatch schedules and found that production and ex-works schedules were all proper.

Then he studied the logistics systems and found that the logistics cost was very high all the logistics people were de-motivated due to overwork and were complaining of a total lack of coordination and the system had become disorganised.

Questions

a. Explain the problems experienced by ABC Ltd. What is the main cause of these problems?

b. What logistics model should the company go for to ensure proper operations of the company?

**7)** Saraf Clothing is a fast-growing fashion brand that has expanded its operations pan-India. With increasing demand and complexity in its supply chain, Saraf Clothing is considering outsourcing its logistics operations to a third-party logistics service provider (LSP). The supply chain manager has identified selection criteria and 3PL company for evaluation, and provided ratings are given in the table below. Appraise the data to select the best LSP using a suitable technique. K5 (10)

Table: Criteria rating by decision experts

| Criteria | Description | Rating (1-10) |
|---|---|---|
| C1 | Cost of Service | 8 |
| C2 | On-time delivery | 7 |
| C3 | Quality of service | 4 |
| C4 | Physical resources and infrastructure | 6 |
| C5 | Flexibility | 5 |
| C6 | Geographical coverage | 5 |

Table: LSP rating by decision experts

| **LSP** | C1 | C2 | C3 | C4 | C5 | C6 |
|---|---|---|---|---|---|---|
| LSP1 | 6 | 7 | 5 | 8 | 4 | 6 |
| LSP2 | 7 | 5 | 6 | 7 | 6 | 7 |
| LSP3 | 6 | 5 | 4 | 3 | 6 | 5 |
| LSP4 | 5 | 7 | 4 | 6 | 4 | 8 |

3) Uber Technologies, Inc. K5 (15)

The 41 billion dollar firm Uber Technology, Inc., is unsettling the traditional taxi business. In over 40 countries and 240 markets around the world, Uber and similar companies are challenging the existing taxi business model. Uber and its growing list of competitors, Lyft, Sidecar, and Flywheel in America, and fledging rivals in Europe, Asia, and India, think their smartphone apps can provide a new and improved way to call a taxi. This disruptive business model uses an app to arrange rides between riders and cars, theoretically, a nearby car, which is tracked by the app.

The Uber system also provides a history of rides, routes, and fees as well as automatic billing. In addition, drivers and riders are also allowed to evaluate each other. The services are increasingly popular, worrying established taxi services in cities from New York to Berlin, and from Rio de Janeiro to Bangkok. In many markets, Uber has proven to be the best, fastest, and most reliable way to find a ride. Consumers worldwide are endorsing the system as a replacement for the usual taxi ride.

As the most established competitor in the field, Uber is putting more cars on the road, meaning faster pickup times, which should attract even more riders, which in turn attracts even more drivers, and so on. This growth cycle may speed the demise of the existing taxi businesses as well as provide substantial competition for firms with a technology-oriented model similar to Uber's.

The Uber business model initially attempts to bypass several regulations and at the same time offer better service and lower fees than traditional taxis. However, the traditional taxi industry is fighting back, and regulations are mounting. The regulations vary by country and city, but increasingly special licensing, testing, and inspections are being imposed. Part of the fee charged to riders does not go to the driver, but to Uber, as there are real overhead costs.

Uber's costs, depending on the locale, may include insurance, background checks for drivers, vetting of vehicles, software development and maintenance, and centralized billing. How these overhead costs compare to traditional taxi costs is yet to be determined. Therefore, improved efficiency may not be immediately obvious, and contract provisions are significant. In addition to growing regulations, a complicating factor in the model is finding volunteer drivers at inopportune times. A sober driver and a clean car at 1:00 a.m. New Year's Eve does cost more.

Consequently, Uber has introduced "surge" pricing. Surge pricing means a higher price, sometimes much higher, than normal. Surge pricing has proven necessary to ensure that cars and drivers are available at unusual times. These higher surge prices can be a shock to riders, making the "surge price" a contentious issue.

Discussion Questions

a. The market has decided that Uber and its immediate competitors are adding efficiency to our society. How is Uber providing that added efficiency?

b. Do you think the Uber model will work in the trucking industry?

c. In what other areas/industries might the Uber model be used

9) **Raymond: Design of Warehouse Operations** K6 (18)

"Raymond being a leader in the industry would settle for nothing but the best practices being followed. Be it either in product innovations, manufacturing supply chain, or customer satisfaction. It was in this context that we were lagging behind in our order fulfilment to our customers. Our internal study showed that our warehouse operations were not robust enough and not aligned to the best practices being followed."

Vinod Padmanabhan, Director – Works, Chhindwara plant.

On 16 July 2014 at 9 a.m., the meeting commenced at the Chhindwara (Nagpur, India) textile plant of Raymond Limited. Avnish Naik, Deputy General Manager (Warehouse), was in a discussion with warehouse management system consultants. They were contemplating how to improve warehouse operations and increase the storage capacity at the plant. In the recent past, Raymond had witnessed a series of order cancellations because of long delays in order fulfillment (the underpicking rates were more than 20%). The productivity of picking and inbound processes was declining, and the manpower requirement was at an all-time high with overtime of approximately 5,000 man days per year. Due to lack of substantial organisation of SKUs (stock-keeping units) within bins, it took up to 12 days to complete the annual stock audit procedure. The company was at a risk of losing valuable clients if the warehouse management issues were not immediately rectified. Moreover, sales were projected to grow by 40% in the next one year necessitating an expansion of storage space. However, Raymond did not have sufficient funds to acquire land and build new racks at the Chhindwara plant. Naik and his team had to find innovative ways to optimise the storage bin capacity within the existing racking structure.

Raymond Limited – India's leading textile and branded apparel company1

Incorporated in 1925, Raymond Limited was one of the leading integrated producers of suiting fabric in the world. As the flag-bearer of the multi-product, multi-divisional Raymond Group, it enjoyed an over 60% share of the Indian worsted suiting market. It produced 38 million meters of high-value pure-wool, wool blended and premium polyester viscose suiting as well as blankets and shawls, all marketed under the flagship brand 'Raymond'.

Raymond had a diverse product range of nearly 20,000 designs and colours of suiting fabric for every age, occasion and style. The company had the distinction of producing the finest suiting in the world using superfine wool from 80s to 250s count and blending the same with superfine polyester and other specialty fibers, such as cashmere, angora, alpaca, pure silk and linen. It exported its products to over 55 countries including the USA, Canada, Europe, Japan and the Middle East.

Through the years, Raymond had been consistently reckoned as the torchbearer of quality and style, as was indicated by its ever increasing customer base, and ranked amongst the first three fully integrated manufacturers of worsted suitings in the world.

Location of textile plants and warehouses

Raymond had three textile manufacturing plants in Chhindwara, Vapi and Jalgaon districts of the Indian states of Madhya Pradesh, Gujarat and Maharashtra, respectively. Most of Raymond's fabric was manufactured and distributed from Vapi and Chhindwara. The manufacturing process at these two plants involved dyeing, re-combing, spinning, weaving and mending, finishing and folding (see Exhibit 1). In contrast, manufacturing at the Jalgaon plant ended with the weaving and mending process. The Vapi and Chhindwara plants shared the finishing and folding of the fabrics woven in Jalgaon. These two plants also had a warehouse each located within their premises to store the material before the orders were dispatched to the customers.

Warehouse layout

The Chhindwara warehouse had two floors, each with an L-shaped layout. Each floor was divided into different zones based on the location of the racks. The ground floor had zones A and C, and the mezzanine floor comprised zones B and D (see Exhibits 2 and 3). All the zones at the distribution center together comprised 10,504 bins of which 537 bins in zone C on the ground floor were reserved for rolled pieces. The rolled pieces could not be stocked in any other bin. The remaining 9,967 bins were used for bolt pieces. Exhibits 4 and 5 show the rolled and bolt pieces.

The storage racks were loosely segmented into different areas based on market scenarios. The markets were classified according to product and customer mix. For instance, Raymond exclusive showrooms and multi-brand outlets were two distinct markets. Similarly, good-length pieces (9-19 meters) and odd-length pieces (less than 9 meters) constituted different markets. While the racks were separated based on markets on the floor, market scenarios were not distinguished in the software for the warehouse management system (WMS). This implied that the correct positioning of an SKU (an SKU was a bundle of multiple pieces with similar specifications, the only possible variation being in the size of individual pieces; also the number of pieces could vary across SKUs) in the storage rack of its market was entirely dependent on the competency of the workman. This was especially challenging when an SKU belonged to multiple markets. For instance, out of the 30,000 pieces of an SKU, 20,000 might belong to Market 1, 7,000 to Market 2 and the last 3,000 to Market 3. A workman who was not aware of this distribution could have put all the 30,000 pieces in the rack for Market 1. Further, SKUs belonging to multiple markets were combined and transferred from the folding unit to the warehouse on a single trolley. Once the SKU was scanned in the folding department, it was transferred to the warehousing account.

Storage requirement

The SKUs were placed in bins. The warehouse at the Chhindwara plant stored approximately 15,754 SKUs encompassing 25,92,550 meters of fabric. The storage requirement was expected to increase by 40% in the next one year (see Exhibit 6).

Bin and piece dimensions

In each storage rack within a floor, the bins were stacked vertically over each other in levels. The number of levels varied between two and four. The structure of a bin is shown in Exhibit 7. The standard bin dimensions and average piece dimensions are shown in Exhibits 8 and 9, respectively. Note that the actual dimensions of each piece were quite variable due to the difference in length and fibre quality. For instance, a coat fabric was thick and would have likely occupied more space in a bin than a cotton fabric. It was, therefore, difficult to establish the exact piece-wise bin capacity. Further, while the bin dimensions were fixed, there was no system defined upper limit for the number of pieces that could be ascribed to a bin. This allowed a workman to scan and attribute an SKU to a bin even if that bin was full to its physical capacity.

Storage policy

A put-away team member would put the material in one of the bins and scan the bin number and SKU number to facilitate traceability. More than one SKU could be put in a bin, and the put-away person decided the location of the bin for each SKU by reading the brand name on the tag and based on his experience. There was no system guided storage plan, making it difficult to induct a new person into the team. If the bin selected by the workman was crammed, he would put the material on the floor and omit the scanning procedure. Alternatively, he scanned any random bin number for the SKU without actually putting the material in that bin. This blocked the walkways and led to overutilisation of some bins even though the warehouse had sufficient capacity and several bins were lying underutilised. More importantly, such practices made it very difficult to locate the SKUs in the warehouse, affecting the picking process, and caused long delays in fulfilling the customer orders. Due to these operational inefficiencies, Raymond encountered problems such as cancelled orders, high inventory, ageing of stocks, and generation of surplus stock resulting in higher discounts offered in the markets.

Inward receipt of finished goods from the folding department

As the warehouse was situated inside the plant, all the materials were received at the warehouse from the plant's folding unit. Each consignment was delivered in 'pieces'. A piece represented the cut and folded fabric and measured between 3 to 12 meters in length and had a unique batch number. The pieces could have different shapes. For instance, rolled pieces were cylindrical whereas bolt pieces were cuboidal (see Exhibits 4 and 5, respectively). The workmen moved these pieces to the warehouse on trolleys. At the warehouse entrance, the inbound personnel scanned the materials on trolleys to confirm receipt. The materials were then moved to the bin areas for storage by the put-away team. Exhibit 10 shows the monthly fluctuation between inward receipts and orders picked in the warehouse. The handoff process between the folding and the receiving area is described below.

At the folding area:

• Scan a piece using a handheld device

• Put into 921 location in the SAP system (received from folding but not yet stored in the warehouse bin location)
• Transfer to warehouse in a mixed trolley

At the warehouse:

• Store in a bin identified by the put-away person (bin location loosely defined by the market)
• Scan the piece again using a handheld device (optional)

Picking process

Picking took place in the warehouse in two shifts, one from 7:30 a.m. to 3:30 p.m., and another from 3:30 p.m. to 11:30 p.m. On an average, approximately 2,917 pieces of 12 meters each were picked on a given day.

A pick-list was generated in the warehouse for every out bound delivery (OBD) order received from the sales team. Stock availability was not taken into consideration at the time of preparing the pick-lists. Due to the demand-supply gap, this sometimes led to picking inconsistencies. For instance, if only one piece of an SKU was available in the warehouse and five customer orders required a piece each, five pick-lists were created and each order picker requested the aforementioned SKU. There was no reservation system in place to allocate the SKU to one order picker. WMS software was updated only when the last piece of the SKU had been picked.

Raymond followed a just-in-time picking policy, that is, orders were picked as they were received. There was no pre-defined picking schedule within a shift which led to some time-intervals of very high picking rates and others with very low picking rates. An illustration of the hourly picking schedule observed in the warehouse is shown in Figure 1 . In a ten minute interval, 0-3 pieces were picked by a picker in the warehouse. The high variance in picking rates caused underutilisation of manpower during low picking intervals and mandated overtime or hiring contractual workers during high picking intervals. The overtime in the warehouse was approximately 5,000 man days in a year. There was a need to improve the workforce management for picking operations.

In addition, the picking efficiency was low at 80%. As a bin often contained different types of SKUs, an order picker had to read the tag of each piece in the bin to identify the desired SKU. There were also instances where an SKU was not in its correct position. In these cases, there was a high level of reliance on the picker’s ability and prior knowledge to find the material in the warehouse.

Packing process

Once the picking process was complete, the goods were moved to the packing table. The materials were sorted and arranged according to OBDs. An OBD order had three to 50 pieces. A packing team member entered the OBD number in the WMS software and scanned the barcode of each piece. After all the pieces had been scanned, a bale number was generated. The pieces of each bale were put inside a high density polyethylene (HDPE) bag and the bag was sealed with a

tape. Each bale was stitched by hand using hessian cloth, and manually labeled through stencil marking. The bales were then strapped with the help of a strapping machine, manually weighed, and sent to the dispatch unit for outdoor delivery. The packing process was labour intensive (requiring approximately 25 persons to pack 700 bales), time consuming and prone to errors.

Naik and his team were brainstorming alternate approaches to address the core issues. Some of the key decision questions that the management needed to answer to improve warehouse performance were the following.

Q.1: Elaborate on the selection of the optimal storage strategy between the no mix strategy (1 SKU per bin) and the mix strategy (more than 1 SKU per bin). (4)

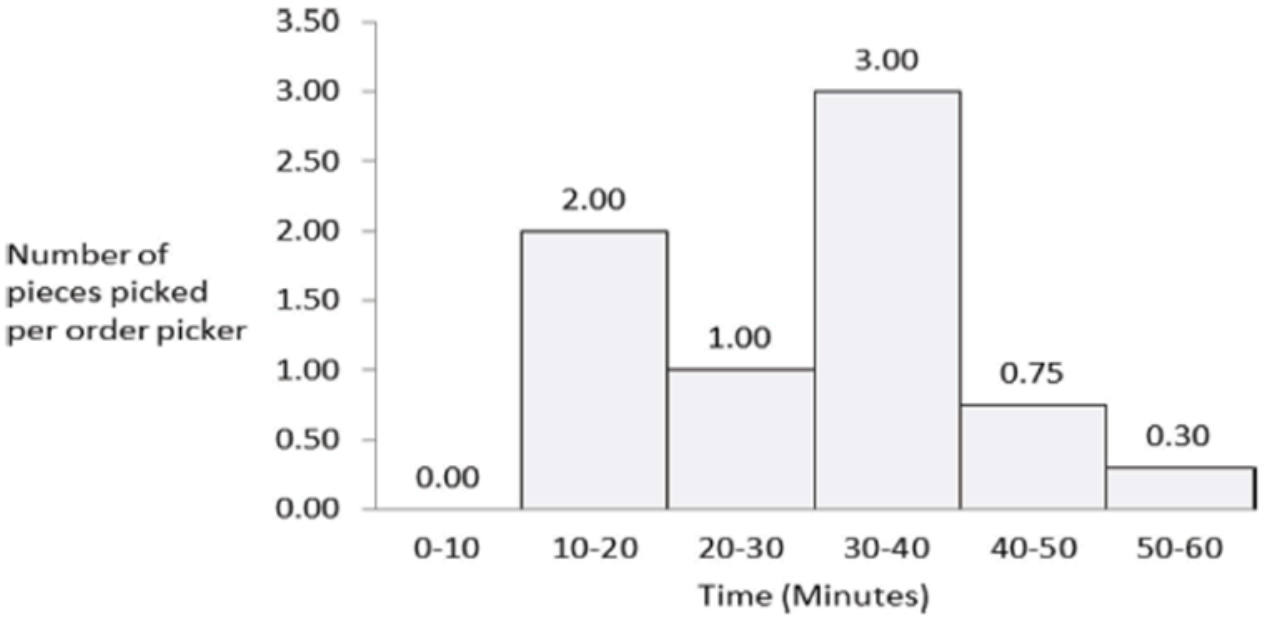
Q.2: Discuss the methodology utilized to determine the bin location for each SKU and the procedures involved in directing an SKU to its assigned bin upon inward receipt. (4)

Q.3: Propose strategies for enhancing picking efficiency and evaluate the necessity of automating the packing process. (4)

Q.4: Discuss the suitability of implementing either a single warehouse location or a warehouse-within-warehouse setup. (3)

Q.5: Propose a set of recommended Key Performance Indicators (KPIs) for assessing warehouse performance. (3)

***Figure 1: Number of pieces picked by an order picker in an hour***




Source: Company records.

**10)** Case: Timbuk2 K6 (12)

"Timbuk2 is more than a bag. It's more than a brand. Timbuk2 is a bond. To its owner, a Timbuk2 bag is a dependable, everyday companion. We see fierce, emotional attachments form between Timbuk2 customers and their bags all the time. A well-worn Timbuk2 bag has a certain patina—the stains and scars of everyday urban adventures. Many Timbuk2 bags are worn daily for a decade or more, accompanying the owner through all sorts of defining life events. True to our legend of 'indestructibility, it's not uncommon for a Timbuk2 bag to outlive jobs, personal relationships, and even pets. This is the Tao of Timbuk2."

What makes Timbuk2 so unique? Visit its website and see for yourself. Bags can be custom designed by the customer on its website. After the customer selects the basic bag configuration and size, colours for each of the various panels are presented; various lines, logos, pockets, and straps can be selected so that the bag is tailored to the exact specifications of the customer. A click of the mouse and the bag is delivered directly to the customer in less than three weeks. How does it do this?

This San Francisco-based company is known for producing high-quality custom and classic messenger bags according to the customer's personally customized order, using a team of approximately 25 hardworking cutters and sewers. Over the years, it has fine-tuned its plant's production line to make it as efficient as possible, while producing the highest-quality messenger bags available. Early on, the focus was on making the bags fast and delivering within two days, but over time they found that speed of delivery was not important to customers wanting custom bags.

The local manufacturing is focused on the custom messenger bag. For these bags, orders are taken over the Internet. The customers are given many configurations, sizes, colours, pockets, and strap options. The bag is tailored to the exact specifications of the customer on the Timbuk2 assembly line in San Francisco and sent via overnight delivery directly to the customer.

Timbuk2 makes some of its new products in China, which is a concern to some of its long-standing customers. The company argues that it has designed its new products to provide the best possible features, quality, and value at reasonable prices and stresses that these new products are still designed in San Francisco. Timbuk2 argues that the new bags are much more complex to build and require substantially more labour and a variety of very expensive machines to produce. It argues that the San Francisco factory labour cost alone would make the retail price absurdly high. After researching a dozen factories in China, Timbuk2 found one that is up to the task of producing these new bags. Much as in San Francisco, the China factory employs a team of hardworking craftspeople who earn good wages. Timbuk2 visits the China factory every four to eight weeks to ensure superior quality standards and working conditions are met.

On the Timbuk2 website, the company argues it has the same

hardworking group of bag fanatics designing and making great bags and supporting the local community and the increasingly competitive global market. The company reports that demand is still strong for the custom messenger bags made in San Francisco and that the new laptop bags sourced from China are receiving rave reviews. The additional business is allowing it to hire more people in all departments at the San Francisco headquarters, creating even more jobs locally. The company has grown significantly over the years and it now runs stores in a few major cities including Los Angeles, Chicago, New York, Toronto, Melbourne, Tokyo, and Singapore.

Questions

1. Choose the two categories of products that Timbuk2 makes and sells for the custom messenger bag, Elaborate the key competitive dimensions that are driving sales? (6)
2. Discuss the assembly line in China to that in San Francisco along the following dimensions: (i) volume or rate of production, (ii) required skill of the workers, (iii) amount of raw materials and finished goods inventory. (6)