Kurlon Limited

Synopsis

Kurlon Limited is the largest manufacturer of mattresses in India, with sales of Rs 110 crore. Kurlon roughly had a 65% market share of the branded rubberised coir mattress market. It had witnessed rapid growth in sales and market share in the mid-nineties, but from 1996 onwards sales and market share had stagnated and profitability was on the decline. In 1998, Kurlon was worried about the increased competition, from other branded and un-branded mattresses, and the challenges of providing higher variety to the customers. In the wake of the already high number—126 configurations of mattresses and another 75 configurations that would come after Kurlon enters into a joint venture with DuPont—the managing director of the firm is concerned that the current system of operations and supply chain are inefficient to handle the load in an increasingly competitive market. He is also worried about the huge inventory lead times when compared to the far more efficient European firms, coupled with the complexity of managing increasingly large product variety due to the unorganized nature of the furniture business in the country. The case provides detailed description of production and distribution planning practices at Kurlon. Case also provides detailed data which can be used for the diagnosis of the supply chain system at Kurlon

Case Objectives

The Kurlon case is useful for an introductory purpose because it describes the totality of a supply chain context that is simple to understand at the same time case is comprehensive in nature. The case also covers a wide range of issues in supply chain management and can be used to developing skills in supply chain diagnostics. Because it can be handled at various levels of complexity, it can be used not only as an introductory case, but also as a summary case for a course or module focusing on supply chain fundamentals.

- Supply chain strategy and performance measures
  - Use of financial data to analyse SCM performance
Supply chain planning practices
  - Forecasting
  - Inventory management
  - Transportation management

IT and SCM
Supply chain integration
Supply chain restructuring

There is enough scope for the instructor to get in to several degrees of detail in each one of these issues. Apart from the above, the case also allows the instructor to discuss the unique challenges of managing SCM in the Indian context. The instructor can also use this case to hone the diagnostic skills of students.

Case Questions

1. Evaluate performance of Kurlon supply chain. What are the causes of problems faced at Kurlon?
2. Evaluate performance of Delhi Area office on supply chain dimension, For your analysis you may like to focus on SDL 72*35 *4.
3. What is your evaluation of company’s planning processes?
4. What specific actions do you recommend to Narendra Kudva to address the supply chain performance problems?

Case Analysis

Business environment

- Mattress industry is in unorganized sector. In the branded segment, Kurlon has a market share of 65%.
- Mattresses are sold through multi-brand outlets: Most of the retailers are constrained by space and credit availability. Implications for Kurlon: Kurlon has to keep stocks close to market and provide quick and reliable service to retailers.
• Complementary industry (furniture manufacturing) in India was in the unorganized sector. Cots and other furniture get manufactured in a wide variety of sizes and there were no standards operating in the furniture industry. Most mattress buyers would buy a cot first and then prospect for a mattress of matching size. Hence, Kurlon was forced to offer a wide variety of sizes in its product portfolio. Apart from large variety, it was also expected to customize its offering (challenges in offering customization).

• Increased competition from the unorganized sector

Firm performance

In 1997, inventories and receivables were Rs 390.6 million out of a total asset base of Rs 624.5 million and total income of 1.12 billion. The PAT, Rs 40.1 million in that year, could be substantially improved by reducing the current assets in inventories and receivables.

Importance of SCM

• Firm has to manage higher variety in future

• High inventory compared to European players

• High receivables (May be company is following the push strategy with its retailers leading to high receivables)

• SCM cost as % of sales (Refer to Chapter 2 section on benchmarking SC performance using financial data)

  o Supply chain related costs: SCM cost account for 10.6% of sales

    ▪ SCM cost = Inventory-carrying cost + Distribution cost

    ▪ 145.8 * 0.2 + 8.95 = 118.6 million (assuming that inventory-carrying cost is 20%). This implies that SCM cost is about 10.6% of sales compared to the net profitability of 4%
Supply chain costs benchmarking: Benchmarking with what kind of firms (scope for interesting debate)

SCM performance measures: Lost sales not measured, Customer service not tracked

Implication for Kurlon

Competition in the Indian domestic market is heating up and the success of a firm would be measured by how it was providing a high variety of products at low cost.

Analysis of SCM operations

- Analysis of material and information flow
  - Mapping material flow from RM to FG (till it reaches customer)
    - Understanding the way variety gets exploded in the supply chain
      - Kurlon has modular products and there are multiple points of differentiation
  - Mapping information flow
    - Information flow in planning processes (monthly as well as annual)
    - Current use of IT

- Analysis of current MTS and MTO strategy

- At present Kurlon is using the MTS strategy for two-thirds and MTO for one-third of its products (Refer to the section on production planning in the case).

- ABC Analysis of Exhibit 6(SKU-wise sales data at Delhi ASO) shows interesting results: (refer to Chapter 4 for a discussion on ABC classification).
• ABC analysis of Kurlon sales data:
  o Top 9 SKUs account for 80% of sales
  o Top 37 SKUs account for 99% of sales
  o 70 SKUs had zero sales in year.

• One can also do ABC analysis. Possible recommendations:
  o The company has to rationalize its product offering.
  o The company may decide to follow a different strategy for different categories of products:
    ▪ A category to be stocked at all branches.
    ▪ B Category may be stocked at zonal warehouses
    ▪ C category SKUs to be operated on an MTO basis

**Analysis of sales pattern**

To analyse the sales pattern, the Delhi sales data can be studied. One can also analyse the sales pattern for
one SKU.

Delhi Sales Data (Exhibit 7)
**Analysis for one specific SKU (72 * 35 * 4)**

The sales data shows interesting pattern:

- Week 28 represents Diwali
- Skewed sales pattern: Last week accounts for about 62% of sales.
- Unlikely that sales pattern at retailers show similar patterns (high skew at month end). Very likely that Kurlon is dumping products with retailers at month end resulting in high receivables and low sales in first week of the month.

**Analysis of supply chain planning**

Taking the example of one SKU, one can examine the quality of SCM planning and execution processes and practices at Kurlon. One would like to examine:

- Forecasting
• Inventory management
• Dispatch planning
• Transportation planning
• Production planning
• Analysis at region level

**Analysis of exhibit 8a**

One can determine weekly receipts (receipts from Bangalore CW) using the material flow balance equation:

\[
\text{Opening stock} + \text{Receipt} = \text{Sales} + \text{Closing stock}
\]

<table>
<thead>
<tr>
<th>Period</th>
<th>SDL 72<em>35</em>4</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Indent</td>
</tr>
<tr>
<td>April</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>3</td>
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<td>27</td>
</tr>
<tr>
<td></td>
<td>28</td>
</tr>
</tbody>
</table>

Using this data one can compare:

- Indent versus sales: Measure of forecasting capability at region.
  
  This analysis can be done with different units of time— week, month.

- Indent versus receipt: Measure of service from Bangalore CW.
  
  This analysis can be done with different units of time— week, month.

- Pattern of stock build up.

This analysis clearly shows that:

- Forecasting capability at region is quite poor.
Inventory management is not proper and, in general, Delhi stock points keep significantly higher stocks.

Service from CW is quite unreliable on a week-to-week basis. The service level is at a reasonable level at month level (Comparison of monthly indents versus monthly receipts).

Analysis at Plant and CW Level

Analysis of Exhibit 8a

One can determine weekly production data (FG receipts from Bangalore plant using material flow balance equation) as:

Opening stock + Production = Dispatches + Closing stock

Analysis of Exhibit 7B: Sample Data of Material and Order Flow at Bangalore Central Warehouse

<table>
<thead>
<tr>
<th>Period</th>
<th>Indent</th>
<th>Dispatch</th>
<th>Opening stock</th>
<th>Production</th>
</tr>
</thead>
<tbody>
<tr>
<td>April</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>480</td>
<td>120</td>
<td>1956</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>366</td>
<td>540</td>
<td>1836</td>
<td>0</td>
</tr>
<tr>
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<td>4</td>
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<td>120</td>
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<td>0</td>
</tr>
<tr>
<td>May</td>
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<td></td>
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<td>5</td>
<td>402</td>
<td>696</td>
<td>822</td>
<td>150</td>
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<td>12</td>
<td>288</td>
<td>686</td>
<td>1674</td>
<td>8</td>
</tr>
</tbody>
</table>
This allows students to carry out an analysis of production planning and servicing (from CW to regions). Using this data, one can compare:

- **Indent versus production**: Measure of production planning processes
  
  This analysis can be done with different units of time—week, month.

- **Indent versus dispatches**: Measure of service from Bangalore CW
  
  This analysis can be done with different units of time—week, month.

- **Pattern of stock build up**

Analysis of data would show that Kurlon needs to improve processes in the area of production planning and dispatch planning.
**Production Planning and Bottleneck Analysis**

- Though this is not the focus of the case, one can identify vulcanizing or quilting as the bottleneck processes, depending on the likely product mix (Apsara brand does not need quilting).
- One can examine the impact of skewed sales pattern on production planning.
- One can examine the role of annual planning to take care of peak sales during Diwali. One can raise several interesting questions—When to start building stocks? What skus to be build early? Who should take responsibility for Diwali planning (region versus corporate)?

**Transportation Management**

*Analysis of normal truck versus Jumbo truck for shipment to Delhi:*

One can examine the trade-off between transportation cost versus inventory-carrying cost. Let us assume that mattress cost is Rs 2000 per unit and the inventory-carrying cost is 20%. The breakeven volume would be:

\[
\text{Breakeven volume} = \frac{D}{160} \times 14000 + 80 \times 2000 \times 0.2 \\
= \frac{D}{320} \times 24000 + 160 \times 2000 \times 0.2 \\
= 5200
\]

If the volume to Delhi is less than 5200, Kurlon should use a normal truck; when the volume is more than 5200, Kurlon should use a jumbo truck. As per Exhibit 7, the annual volume is 1996 units; so Kurlon should use a normal truck while transporting goods from Bangalore CW to Delhi.

**Inventory for Latex**

Kurlon has been keeping one month’s inventory latex to protect itself against price volatility. This policy is valid when prices are going up. By buying material early, one incurs high inventory-carrying cost but ends up paying lower input cost. But price trend (data from Exhibit 4) as shown below is declining over time in the relevant period. So firm should just keep enough inventory to protect against supply uncertainty.
The classroom discussion of this case covers a lot of ground, as there are many rich topics to explore and numerous action plans to analyse. A useful method of organizing the material is suggested in this section. Specifically, the various action plans can be arrayed (on the board and as a guide to discussion) on a continuum that stretches, broadly, from those that will only contain the seat problem, albeit more efficiently, to those that actually seek to solve the problem provides such a breakdown). As the discussion unfolds, through the analysis of the plans on this continuum, students recognize that while solving the problem is the goal, because neither the problem itself nor its origin is clear, their recommendations are ineffective.
A combination of the suggestions might go a long way in improving the performance at Kurlon. Categorization of SKUs based on the frequency of sales/indent which not only helps in better management but will also lead to efficiencies in the production process and lesser micro management issues. We recommend 4 classes —A, B, C and D— of products based on the number of units sold in a year.

Postponing the Point of Differentiation

Kurlon has modular products; so it can explore the possibility of postponing fabrication operation in the region. RC pad manufacturing is manufactured at Bangalore and can be shipped to Delhi where close to market one can complete the fabrication operation. This will also result in lower damages (damages during transportation).

Summary of Analysis and Recommendations

- Improper forecasting mechanism at regions: Kurlon can explore possibility of designing better forecasting models (use time series data).
- No means to estimate “lost sales” and no monitoring to avoid excess inventory:
- Kurlon should put in place supply chain performance management system.
- Ad-hoc inventory policies (excessive stocking) followed, owing to pressures at the retailer end (competing with other brands), push strategy (sell what can be produced), improper understanding of the demand (seasonality), and various uncertainties at different stages. A substantial amount of skewness is caused internally owing to the push strategy: Inventory norms to be defined. Focus on supply chain integration with retailers.
- Excess overall inventories haven’t translated to high service levels. Stock-outs were very common. Excess inventory also contributed by despatching configurations not demanded by ASOs. SKUs to be divided in to ABC categories and appropriate policies to be designed for each category.
• Monthly indents from ASOs also contributed to building many wastes. Design less rigid systems

• Order placements are through costly means such as telephone and fax. There is lack of an integrated IT strategy. Design appropriate IT strategy.

• Purchase department orders raw materials in huge quantities owing to anticipated price fluctuation. This leads to high stock-piling. Kurlon should keep monitoring price trends and based on recent price trends use appropriate sourcing strategy.

• Too much importance given to economies of scale in transportation. Focus on total cost (transportation + inventory-carrying cost).

• Poor coordination between various functions.

**Lessons Learnt**

At the end of this case, the instructor may want to summarize the learning as follows:

• Understand supply chain by analysing past data and decisions.
  
  • System manuals or interviews do not reflect reality.

• Simple forecasting and inventory-management tools can result in substantial savings.

• Internal alignment is essential for supply chain performance enhancement.

• 20% of issues take care of 80% of the problems.

• Supply chain improvement initiatives would require lot of organizational changes in:
  
  – Structure, and

  – Performance measures.

• Top management support is essential.

• Immense potential for SCM ideas.

**Teaching Suggestions**

Although we believe that the case is ideally suited to a 90-minute class, it is possible that many classes fail to cover all the materials identified in the analysis section. This is generally true either if the instructor is teaching the case for the first time or if the instructor wants to spend more time discussing a particular
aspect of the case. The classroom discussion of this case covers a lot of ground, as there are many rich topics to explore and numerous action plans to analyse.

The instructor should decide which areas he or she would like to focus on during the case analysis. This would also depend on the sequencing of the case within the course. Modular design adopted in case analysis provides the necessary flexibility to the instructor in structuring the class discussion.
Vehicle Routing at Baroda Union

Synopsis

The Baroda Cooperative Union was set up in the late sixties with the Anand model in mind. It had a membership of 700 village-level co-operatives spread all over the district. These 700 societies were covered by 44 truck/tempo routes which collected milk twice a day, 365 days in a year. Given the perishable nature of the product, it was important that the time lag between milking and processing should not exceed seven hours.

Baroda Union had been working with same procurement routes that had evolved historically for the last couple of years. Procurement managers at Baroda Union are exploring the possibility of redesigning routes so as to reduce transportation costs. Unless they could come up with a more scientific way of designing these routes, transportation costs in milk procurement accounted for 17% of the total cost. The main objective of the union was to minimize total costs so that members (farmers) would get the highest payment per litre of milk.

This case presents the relevant data for 12 routes involving 180 societies. Apart from designing new routes, procurement managers will have to convince farmers about the desirability and benefits of these new routes.

Case Objectives

The objective of the case is to bring out the issues of strategic and operational aspects of transportation management in the cooperative sector. Specifically, it focuses on supply chain optimization involving transportation management and vehicle routing.
The case should ideally be scheduled after basic concepts in transportation management have been covered in the course. The case deals with following concepts:

Supply chain strategy and performance measures
Transportation management
Supply chain integration

It also allows the instructor to discuss the unique challenges of managing SCM in not-for-profit and co-operative organizations. The case is also useful in courses involving agriculture supply chain management or supply chain in the rural context.

Case Questions

1. Identify the key challenges faced by Baroda Union? How important is in-bound logistics for Baroda Union?
2. Suggest a suitable approach which Baroda Union can use for designing efficient routes for milk collection? What kind of conflicts are these revised routes likely to create at the Baroda dairy? How should Baroda Union handle these issues?
3. How will the problem of designing optimal vehicle schedules be affected by the nature of ownership (corporate sector vis-à-vis a co-operative dairy like Baroda Union)?
4. If you were Jagdish Patel, what would you do?

Case Analysis

Relevant Background Information

- In-bound transportation accounts for 17% of the cost (not including milk).
- Baroda Union had a membership of 700 village-level co-operatives spread all over the district. These 700 societies were covered by 44 truck/tempo routes which collected milk twice a day, 365
days in a year.

- Given the perishable nature of the product, it was important that the time lag between milking and processing should not exceed seven hours.

- Baroda Union had set up one chilling centre at Bodeli so as to take care of the problem of distance. Out of the 700 societies, about 180 societies were connected to the chilling centre through 12 procurement routes. The remaining societies were connected directly to the Baroda dairy.

**Route Design**

- Constraints on route: Vehicle capacity and route travel time
  - Due to the perishable nature of the product, route travel time (the duration time from first society to either the dairy or the chilling centre) should not exceed seven hours
    - Route travel time = Travel time + Loading time at society + Unloading time at chilling centre
    - Loading time at society involves fixed time plus variable time (Variable time is function of the quantity of milk at society)
  - Interesting issues for discussion in vehicle routing:
    - Should the route be the same throughout the year or routes should be redesigned based on milk quantity? Milk procurement in winter is twice of that in summer. If routes are designed for peak quantity, vehicles would be used at lower capacity utilization most days in year.
    - Travel time is a function of the roads (*pakka* road versus *kaccha* road): How does one maintain real-time data on quality of roads? For example, road conditions usually deteriorate after the rains.
Vehicle capacity: Cans or litres of milk

Should the focus be on cost minimization or distance minimization? The rate per km. varies significantly from route to route (Refer Exhibit 2). The rate would also depend on the nature of the vehicle (truck versus tempo). Routes which minimize distance may not lower costs.

Penalty for sour milk: Societies which come early on the route are at a disadvantage because the milk collected from these societies spends a long time on the road and there is a higher chance that the milk will either curdle or go sour.

Reducing the routing problem by aggregating societies located close to each other. (Refer to Exhibits 4 and 5) Under what circumstances would one be justified in aggregating the data?

Constraint on arrival time: If all vehicles come at same time, it would not be possible to unload the milk at the chilling centre. Therefore, the arrival of the milk at the chilling centre should be staggered

Implementation issues

Nature of ownership: Any redesigning of the route entails a change in the lifestyle of the farmers. Currently farmers have aligned the milking time with the vehicle schedule and the rest of the activities are scheduled around the milking time. Now, with change in routing, milk collection time will change; so it would mean a change in the daily routine for the farmers. Given that farmers are owners (co-operative society), farmers would not allow procurement managers to change the routes. So unless procurement managers make a strong case (reduction in cost leading to higher milk prices for farmers), it would be difficult to change the
route timing.

- Impact of ownership on supply chain decisions:
  
  o How would the nature of the problem (vehicle routing) change based on the nature of ownership? Would the problem faced by Nestlé (private sector) be similar to the problem faced by Baroda Union? A dairy that belongs to the private sector would procure milk from clusters of villages so that one can reduce the transportation cost. Co-operative societies such as Baroda Union have to collect from far-flung places. So obviously co-operative dairies incur higher transportation costs.

  o Private-sector dairies collect milk based on their requirements while co-operative dairies have to procure all the milk and can not refuse during peak periods. It is possible for private-sector dairies to pay higher prices during the lean season (summer months) and low prices during the winter months. Consequently, co-operative dairies would get very little milk during the lean season (summer months) and excess milk during the peak season (winter months). Unless co-operative dairies are really efficient, they would not be able to compete with private-sector dairies because of the inherent disadvantages under which they work.

**Teaching Suggestions**

This case is ideally suited to a 75–90 minute class. Since it is rich in data, the instructor should decide which areas they would like to focus on during the case analysis. Depending on the interest of the group, the instructor can either focus on the broader issues of vehicle routing in rural areas in the co-operative sector or focus on the application of vehicle routing algorithms such as savings algorithm. Of course, this would also depend on the sequencing of the case within the course. If students have already done basic concepts in vehicle scheduling, one can generate an interesting discussion on possible heuristics which
can be used. The instructor also should encourage students to look at supply chain problems in other not-for-profit organizations and public systems (garbage collection, post office network design, etc.) and compare and contrast problems in milk collection with SCM problems in managing other not-for-profit organizations and public systems. The instructor may also like to compare and contrast the procurement challenges in organizations such as Baroda Union with that of Nestlé or any other private-sector company operating in the dairy industry. The instructor can compare and contrast the milk-collection problem with other vehicle routing problems (students/employee pick-up by bus, milk distribution, etc.).
PC International Division

Synopsis

PC International Division (PCI) is part of a global conglomerate involved in the assembly, distribution, and sale of personal computers. PCI is reviewing the performance of its entire supply chain to identify ways of optimizing its performance. Relevant cost includes fixed cost of using facility, variable cost of manufacturing/assembly and transportation. Apart from minimizing costs, the PC division is also concerned about the lead time involved in manufacturing and transportation at various levels in the chain.

This case let has been constructed using description from global supply chain management at Digital Equipment Corporation. All the data are fictitious in nature.

Case Objectives

This case deals with network design for products with short life-cycle products. It provides detailed data for network analysis and understanding cost-versus-responsive trade-offs. It deals with following supply chain concepts:

- Network design
- Supply chain strategy and performance measures
- Agile supply chain

Case Questions

1. Design a supply chain network to minimize the total cost.

2. Design a supply chain network to minimize the weighted function of time and cost. The objective function should be a composite of cost and time. The weight factor $\alpha$ can be applied to cost terms such as variable cost of production, fixed cost of production and transportation costs. Time is measured in terms of weighted activity, days spent in production and transport and should have weight equal to $(1 - \alpha)$.
Case Analysis

a) Design a supply chain network to minimize total cost.

*Cost-optimized supply chain:*

In the first part of the problem, the supply chain design is optimized by minimizing the transportation and the production costs. The Microsoft Excel Solver can be used for optimizing the network design. Each stage in the supply chain (e.g. head disk array, media, disk, motherboard and PC box assembly) are the different nodes. There are multiple links which exist between two nodes as there are several cities in which the part at a particular node can be manufactured.

**Constraints**

1. **Demand-side constraint:** The total supply to each of the six markets has to be greater than or equal to the total demand. This makes sure that there is no unfulfilled demand.

2. **Supply-side constraint:** Another constraint used in the solver process was that the supply needs to be less than the effective capacity of each city. The effective capacity is a proxy to determine the total capacity of a node by considering the fact that a factory in a particular city is producing or not producing the product.

3. The total supply from a particular node in the supply chain cannot exceed the total number of units received from the previous node. For example, this means that the total number of disks which will get forwarded to the PC box assembly node cannot exceed the number of head disk arrays received by the disk node. A similar constraint is used for all nodes in the chain. The optimal design is as follows:

<table>
<thead>
<tr>
<th>Location</th>
<th>Production</th>
<th>Total Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>PC Box</td>
<td>Taiwan</td>
<td>24,000</td>
</tr>
</tbody>
</table>
b.) To design a supply chain network that minimizes the weighted function of time and costs (i.e. an objective function that simultaneously minimizes both cost and lead times in the supply chain).

Given the fact that the computer industry has relatively shorter life cycles, cost considerations are not the only important factor in the network. Thus, the network design for PC International needs to balance the cost and time involved in the supply chain. The cost in the chain has already been calculated as part of the first question. As mentioned in the course text as well, there are two ways of capturing the time element: (a) weighted activity time, and (b) cycle time.

$$\text{Composite Measure} = \alpha \times \text{Cost} + (1 - \alpha) \times \text{Time}$$

Thereafter, in order to make sure that the cost and time parameters are comparable, the minimum cost and minimum weighted activity time can be used to normalize the observed costs and time respectively. Thus the composite measure after normalization is:

$$\text{Composite Measure} = \frac{\alpha \times \text{Cost}}{(\text{Minimum Cost})} + \frac{(1 - \alpha) \times \text{Time}}{(\text{Minimum Time})}$$

**Solution for various values of \(\alpha\)**

<table>
<thead>
<tr>
<th>(\alpha)</th>
<th>1-(\alpha)</th>
<th>Weighted Activity Time</th>
<th>Total Costs</th>
<th>Total Time</th>
</tr>
</thead>
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Considerations in choosing between cost minimization and lead-time optimization

The risks of implementing supply chain optimization involve the trade-offs between costs of supply chain and the necessary responsiveness of the supply chain. This trade-off is between the sum of production and transportation costs versus the inventory carrying costs associated with the pipeline stock (assuming the cost of lost sales and obsolescence are minor) and chain responsiveness. The production location is based on the price of transportation for a product with low value density and will be dependent upon the inventory-carrying costs for products with high value density. Computer components, being a high value-density product, the optimized supply chain configuration will lean towards optimizing the supply chain lead times over optimizing direct costs.

With increased emphasis on the total cost (through higher weights), simulation results show longer lead time and vice-versa. Moreover, the supply chain configuration, i.e. the place of components production and their transportation is determined by the relative importance of supply chain cost or lead time. For example, as relative importance of cost in the supply chain is reduced, the production shifts from the lowest-cost manufacturers to suppliers that are geographically closest to the market and vice-versa. Although, cycle time and weighted activity time are metrics derived from lead times, they do not lead to
identical solution as the two metrics measure different things. As cycle time measures the chain responsiveness while the weighted activity time measures the pipeline inventory, they do not reach the same conclusion.

Teaching Suggestions

This case is ideally suited to 90-minute class. This case assumes that students have good background in modeling. If students do not have any previous experience in modeling, the instructor should focus on the cost modeling part of the case. Cycle time and weighted activity time can be introduced without explicit modeling. The instructor can also discuss the ways in which data can be collected for network design problems.
Supply Chain Initiative at APR Limited

Synopsis

APR Ltd. was a leading manufacturer of rayon pulp in India. APR had been doing reasonably well till the mid-nineties and found that there were a lot of growth opportunities in the pulp business. Consequently, the company decided to make substantial investment so as to double its capacity by 1997 end from 150 MT to about 300 MT per day. The company had further plans to increase the capacity so as to reach to the level of 500 MT per day by 2002.

In the beginning of the fiscal year 1997, the company came under tremendous pressure when the government slashed custom duty substantially and simultaneously international pulp prices dropped by about 40%. So the company not only had to gear up for doubling the production level, it also had to cut its costs substantially. The firm had identified wood logistics as a key area of concern because wood constituted about 33% of the cost of pulp and the company was holding about six months of wood inventory. The company also used to incur lot of costs in material handling of wood at the inbound stage. The case describes in detail the wood logistics practices at APR. APR has identified large number of ideas for improving wood logistics. APR has to decide the right mix of options which would allow the firm to increase its capacity in wood logistics and also help firm in reducing costs in the process.

Case Objectives

The APR case deals with inbound logistics operations. Ideally this case should be scheduled after all the basic concepts in supply chain management have been covered in the course. It brings out supply chain integration issues in logistics operations and provides enough data so it can be also used for developing skills in supply chain diagnostics. The case can be used for introducing the
use of simulation in supply chain analysis. The case illustrates the following supply chain concepts:

- Supply chain strategy and performance measures
- Inventory management
- Transportation management
- Supply chain integration

There is enough scope for the instructor to discuss each one of these issues in several degrees of detail.

Case Questions

1. As Saloni Yashpal, what would you do to address the wood logistics problem? Where would you focus your attention and solution efforts?

2. What options exist? What would you recommend? Why?

3. In what way simulation exercise suggested by Saloni Yashpal would help APR in attacking wood logistics problem?

Case Analysis

Bottleneck Analysis

Bottleneck analysis for wood logistics operations can be done at three levels:

- Aggregate level analysis—deterministic case(with day as a unit of analysis)
- Disaggregated analysis—deterministic case (with hour as unit of analysis)
- Disaggregated analysis—deterministic case (with hour as unit of analysis)

Data used in Analysis:

- Pulp Output per day: Current level is 150 tonnes per day but with expansion, the output level would go up to at least 250 tonnes per day.
- Wood required per day: 4.2 tonnes of wood is required per one tonne of pulp.
For rayon output level of 150 tonnes per day, wood required would be 630 tonnes per day
For rayon output level of 250 tonnes per day, wood required would be 1050 tonnes per day

- WB capacity: Weighbridge:

  Time per one truck = 10 min. (loading) + 5 min. (unloading) = 15 min.
  WB capacity: 60/15 = 4 trucks * 10 tonnes per truck
  = 40 tonnes per hour per weighbridge

**CHIPPING CAPACITY**: From Table 1 one can calculate that 380 tonnes of casuarina were chipped during 11.5 hours of operations resulting in an average capacity of 33 tonnes/working hour. In case of eucalyptus, 675 tonnes of eucalyptus was chipped during 16 hours of operations resulting in an average capacity of 41 tonnes/working hour.

  So chipping capacity is 74 tonnes per day of working hours (This analysis assumes that one is not required to mix eucalyptus and casuarina in the required proportion of 60:40).

Wood yard Unloading capacity: Unloading can be carried out in 6 bays. Unloading one truck takes 105 minutes.

  Capacity: 60*6/105 = 3.4 trucks * 10 tonnes per truck = 34 tonnes per hour
  Truck Unloading at chipper: 20 minutes for unloading at one chipper. So capacity = 60*2 /20 = 6 trucks per hour resulting 60 tonnes per hour during operating hours of chipper.
  Total Truck unloading capacity = 34 + 60 = 104 tonnes per hour

As weighbridge and chipper seem to be major bottlenecks, it would make sense to focus only on weighbridge and chipper in subsequent analysis.

**Aggregate-level Analysis (with day as a unit of analysis)**

For Rayon output of 150 tonnes per day:

  Required number of hours of WB operations = 630/40 = 16 hours

  Required number of hours of chipping required = 630/74 = 8.5 hours

For rayon output of 250 tonnes per day:
Required Number of hours of WB operations = 1050/40 = 26 hours

Required Number of hours of chipping required = 1050/74 = 14 hours

This clearly shows that WB is bottleneck. So either capacity of WB has to be enhanced by reducing time taken for weighing operations or number of WBs have to go up.

**Disaggregated analysis – Deterministic case (with hour as unit of analysis)**

For current level of truck arrival one can calculate likely number of trucks waiting at WB.

<table>
<thead>
<tr>
<th>Time interval</th>
<th>Arrival (Casuarina + Eucalyptus)</th>
<th>Service (WB would be able to serve 8 trucks in 2 hours)</th>
<th>Number of trucks Waiting before WB</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.00–8.00</td>
<td>13</td>
<td>8</td>
<td>5</td>
</tr>
<tr>
<td>8.00–10.00</td>
<td>21</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>10.00–12.00</td>
<td>28</td>
<td>8</td>
<td>23</td>
</tr>
<tr>
<td>12.00–14.00</td>
<td>16</td>
<td>8</td>
<td>43</td>
</tr>
<tr>
<td>14.00–16.00</td>
<td>16</td>
<td>8</td>
<td>51</td>
</tr>
<tr>
<td>16.00–18.00</td>
<td>10</td>
<td>8</td>
<td>59</td>
</tr>
<tr>
<td>18.00–20.00</td>
<td>6</td>
<td>8</td>
<td>61</td>
</tr>
<tr>
<td>20.00–22.00</td>
<td>0</td>
<td>8</td>
<td>59</td>
</tr>
<tr>
<td>22.00–24.00</td>
<td>0</td>
<td>8</td>
<td>51</td>
</tr>
<tr>
<td>0–2.00</td>
<td>0</td>
<td>8</td>
<td>43</td>
</tr>
<tr>
<td>2.00–4.00</td>
<td>0</td>
<td>8</td>
<td>35</td>
</tr>
<tr>
<td>4.00–6.00</td>
<td>0</td>
<td>8</td>
<td>27</td>
</tr>
</tbody>
</table>
For 110 trucks coming per day (Table 2), the number of trucks waiting in queue would go up to 61 truck at 20.00 hours. This shows that if truck arrival is skewed, the problem would be worse. So the firm needs to work with suppliers and logistics providers so that truck arrival is spread throughout the day. Further since there is not enough service capacity, one would have 27 un-serviced trucks waiting at the end of day. So one would have to increase WB capacity.

One can argue that increased truck waiting time does not increase cost for APR. This may be true in short run but in long run this is not sustainable. This higher waiting time would come back to APR in the form of higher charges demanded by logistics providers (trucking companies).

**Disaggregated analysis—Stochastic case**

So far we have assumed that there is no uncertainty in the system (Inter-arrival time for trucks or processing time at WB).

**ARRIVAL RATE:** Let us focus on first 10 hours of truck arrival: we have 94 trucks coming in first 10 hours of operations; that means truck arrival rate is 9.4 trucks per hour.

**SERVICE RATE:** Service rate has to be higher than arrival rate. So let us assume that APR invests in one more WB and also works on improving weigh bridge operations with a result service time per truck comes down from 15 minutes to 12 minutes. This would result in two WB with each WB having a service rate of 5 trucks per hour.

Using standard queuing models one can show that

- Avg. no. trucks in queue = 8 trucks.
- Avg. Truck waiting time = 51 minutes

This assumes that truck arrival rate is uniformly distributed throughout the first ten hours of operations. But skew in arrival would increase waiting time disproportionately even after investing in one weighbridge and improvement in WB operations.
a) Improving wood logistics operations

The performance of wood logistics can be measured on the following two performance measures:

- Time spent by truck in the system:

- Cost of involved in running the system: One major component of cost is handling cost. For example currently APR is spending 1 million as handling cost (Cost paid to contractor for material handling)

APR can reduce material handling costs if trucks are directly sent to chippers so that APR does not have to carry out non-value-added activities like unloading and loading at wood yard. But this would increase truck waiting time in system significantly. Currently, APR has decoupled truck arrival from chipping. This ensures smooth operations and lower waiting time but increased loading and unloading costs. With increased cost pressures and enhanced level of operations, the firm will have to tightly link several operations in wood logistics operations. The following ideas discussed in the case need to be analysed from this perspective:

- Invest in one more WB: This is absolutely essential as shown in bottleneck analysis

- Invest in one more chipper. This would provide more flexibility in matching chipping schedule with truck arrival pattern. This would help in ensuring that bulk of the supply required by chipper is met from incoming trucks. This would reduce material handling costs (Unloading and loading operations at wood yard).

- Invest in one more chipper and also increase silo capacity for chips. This would provide lot more flexibility in determining chipping schedule. Though this is not a bottleneck resource but having slack capacity helps in ensuring that one does not have to bother about silo capacity in scheduling rest of the system. This also allows us to decouple rest of the plant operations from wood logistics operations.

- Use better quality of knives so as to reduce downtime at chipper. Better quality of chipper knives would have longer and more reliable life and would reduce frequency of replacement.
Though this is not a bottleneck resource but having slack capacity helps in ensuring that one does not have to bother about silo capacity in scheduling rest of the system. This also allows us to decouple rest of the plant operations from wood logistics operations.

♦ Reduce the time required to replace blunt knives. This would require working with maintenance people to find ways of reducing replacement time.: this would increase capacity of chipper and would also help in aligning chipper operations with truck arrival schedule

♦ Invest in integrated information system. Better quality of information flow (Real time information about chipper schedule at weighbridge) would help in improving inbound logistics operations

b) Key operational decisions:

- After weighing loaded truck at WB, should truck be directed to wood yard or chipper
- Chipper scheduling: Currently chipper schedule is not aligned to truck arrival pattern. Blunt knives (slower chipping rate) are used during peak truck arrival times.
- Wood supply to chipper: Truck (Direct unloading) and Tractor (Material from wood yard) mix

Simulation (discussed in next section) would provide some insights in designing optimal decision rules in operations.

c) Simulation of wood logistics

As discussed in bottleneck analysis, it is difficult to understand the effect of the interaction of a large number of resources in supply chain operations under dynamic situation, involving uncertainty in arrival and service operations. Several supply chain problems involving demand and supply uncertainty can not be tracked analytically and simulation is quite useful in such situations. Simulation also gives the capability to test new ideas before implementation. Though several sophisticated simulation software packages are available, the bulk of the supply chain simulations can be carried out using Excel. Manual simulation is also powerful in explaining
coordination problems in supply chain operations. Manual simulation can be carried out as explained in Appendix 2 of the case. At the end of simulation students should be asked to submit a report (or make a presentation about their learning from simulation exercise).

d) Altering Wood mix at APR:

Currently APR is using eucalyptus and casuarina in a ratio of 60:40. As seen in Exhibit 1, relative prices of casuarina and eucalyptus keep changing over a period of time. APR should be able to reduce its cost by altering wood mix dynamically based on prices prevailing at that point in time.

**Analysis of Exhibit 1 data**

<table>
<thead>
<tr>
<th>Year</th>
<th>Casuarina</th>
<th>Eucalyptus</th>
<th>Wood price trend</th>
<th>Trend in Ratios</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Quantity</td>
<td>Value</td>
<td>Quantity</td>
<td>Value</td>
</tr>
<tr>
<td></td>
<td>(Tonnes</td>
<td>(Rs. MIL)</td>
<td>(Tonnes</td>
<td>(Rs. MIL)</td>
</tr>
<tr>
<td></td>
<td>)</td>
<td>)</td>
<td>)</td>
<td>)</td>
</tr>
<tr>
<td>93–94</td>
<td>84118</td>
<td>130.08</td>
<td>111369</td>
<td>154.6</td>
</tr>
<tr>
<td>94–95</td>
<td>68404</td>
<td>107.8</td>
<td>124777</td>
<td>179.6</td>
</tr>
<tr>
<td>95–96</td>
<td>74127</td>
<td>151.9</td>
<td>115361</td>
<td>217.2</td>
</tr>
<tr>
<td>96–97</td>
<td>73729</td>
<td>165.1</td>
<td>88463</td>
<td>174.4</td>
</tr>
</tbody>
</table>

- As can be seen from the above table that relative prices are dynamic in nature (Ratio of casuarina prices to eucalyptus prices vary from 1.08 to 1.13).
- As can be seen from above table that % of eucalyptus in wood mix has varied from 54.5 to 60%.

As discussed in the case, the percentage of eucalyptus in wood mix can be varied from 50% to 70% without affecting the quality of the pulp. So APR should keep monitoring price trends and keep varying mix of wood based so as to reduce cost of operations. Since wood account for significant part of cost operations, altering wood mix can have significant payoffs for the firm.
PRIORITIZING SUPPLY CHAIN INITIATIVES: Appendix-1 discusses three possible areas on which APR can improve supply chain performance. Since top management can not focus on all the areas simultaneously so APR may have to prioritize those initiatives for implementation purposes. APR would have to examine each initiative on the following dimensions:

- Benefit of implementation
- Degree of difficulty in implementation
- Resource availability
- Time required for implementation

Teaching Suggestions

This case should be taught over two 90-minute sessions. The first session should be used for conducting manual simulation exercise described in Appendix -2 of the case. In second session, the instructor should focus on comprehensive case analysis where results of simulation would be an important input to the discussion. Manual simulation provides interesting insights about coordination problems in supply chain operations. Students would be able to appreciate role of analytical models in analysing supply chain operations. Since case is rich in data, the instructor should decide which areas he or she would like to focus on during the case analysis. This would also depend on the sequencing of the case within the course. The modular design adopted in case analysis provides necessary flexibility to instructor in structuring the class discussion.
Managing *Tendupatta* Leaf Collection Operations

**Synopsis**

The case deals with the management of *tendupatta* leaf collection operations by the forest department. The prime objective of the government is to increase the output while using existing resources within a time window of 2–3 months. Currently, the forest department is able to collect only 32% of the potential produce. Increased collections would eventually lead to more benefit to the tribal community since they would earn more if the output were to increase. The limited time period, the threat of monsoon, the mobilization of about 10 million leaf collectors, documentation, processing of the leaf, bagging, safe transportation and warehousing poses a great challenge in terms of management. The participation in the activity by such a large number of people makes the issue politically very sensitive too. The case also provides relevant data for one zone for which students can try and improve the collection performance by better network design and vehicle scheduling approaches. It discusses the challenges of supply chain management in public systems in general, and specific challenges of *tendupatta* leaf operations in particular. The case also provides detailed data which can be used for applying the concepts of network design and vehicle scheduling.

**Case Objectives**

The objective of the case is to bring out the issues of strategic and operational aspects of the supply chain in public systems. Specifically, it focuses on supply chain optimization and draws on the facility location and vehicle routing class of problems. This case also allows substantial spreadsheet analysis and use of concepts of OR tools such as Solver embedded in spreadsheets such as Microsoft Excel. Apart from this, the user can also experiment by applying heuristic techniques within spreadsheets. Scenarios may be built and compared under different conditions as outlined in the case. The decision choices can be made based on the scenarios.

The case should be ideally scheduled after basic concepts in transportation management and network design have been covered in the course. The case deals with following concepts:
Supply chain strategy and performance measures

Supply chain planning practices
  - Network design and operations: facility location
  - Forecasting
  - Inventory management
  - Transportation management

Supply chain integration

There is enough scope for the instructor to get in to several degrees of detail in each one of these issues.

Apart from the above, the case also allows the instructor to discuss the unique challenges of managing SCM in not-for-profit organizations and public systems. The case is also useful in courses involving agriculture supply chain management or supply chain in the rural context.

Case Questions

1. Identify key challenges faced by the forest officer like Ashish in tendupatta leaf collection operations.

2. How do you measure the performance of leaf collection operations?

3. Suggest a suitable approach which Ashish can use for deciding location of collection centres?

   What kind of conflicts do the location decisions create within tribal community? How should forest officer like Ashish handle these issues?

4. How do you balance trade-offs between equity and efficiency in tendupatta leaf collection operations?

While discussing the case, you also may like to raise following specific questions:

- Which zone to be allocated to which warehouse? Is the existing allocation optimal?
- Which warehouses to requisition and how much quantity to store at each of these?
- Which candidate village sites to be chosen as a collection center?
- Which supply points to be allocated to which collection center?
What are the optimal vehicle routes among the collection centers and warehouses?

Case Analysis

1. Initially, the background brings out the criticality of this system in its objective to perform a welfare function for a large number of people. It is a source of livelihood for about 10 million people and an efficient and management of the system would yield benefits to all associated with it.

2. The section on the overview of the operations elaborates on the importance of locating facilities optimally and the design of the transportation network.

3. The background and overview also cover the fact that the leaf-growing region is spread over a vast geographical area and so the supply points are not discrete units at a specific location. Therefore, it is important to capture these supply points. This kind of situation is frequently encountered wherein the supply points or the demand points are spread spatially. The newspaper production–distribution and the postal distribution problem have a similar feature where the demand is spread over an area. Likewise, while deciding the location of sugar mills or rice mills, one has to grapple with the same kind of problem. The cultivable area is in remote locations and the sugar/rice mills have to ensure a speedy collection and subsequent distribution to the markets.

4. The section titled “Need of the proximity of the collection centers to the tendupatta bearing lands” highlights the unique nature of this system and the reason as to why the facilities need to be near the supply points. The gradual decrease in the leaf extraction with the increasing distance from the supply points is given in percentage terms. Using extrapolation, one can estimate leaf output at different distances. Also, using this information the student can visualize the non-linear relationship between the distance and the leaf output. One possible way to model the relationship is as follows:

\[ f(x) = \log[10 - (2^x)] \quad \text{Where } f(x) = \text{fractional collection, } x = \text{distance in km.} \]
5. The section covering the major activities contains transportation as the subheading. Within this subsection, the transportation costs and the operating policies regarding transportation are highlighted. The operating hours for the warehouses, collection centers and the trucks are given. The transaction times associated with travel, loading/unloading, maintenance, etc. need to be considered while developing the routes. The capacity of the truck in terms of standard bags has to be simultaneously considered while developing the routes between the collection centers and the warehouses. At this stage, the student can employ the heuristic techniques to obtain a set of routes between the facilities and the required number of trucks. The data on the capacity of the trucks, cost of transportation and the distance from the figure (3) would have to be utilized for tackling this problem. It may be noted here that the distance between each facility needs to be calculated using the following scale: 1 cm. = 0.64 km. Subsequently, operating schedules for trucks can be developed within the time windows for the trucks using the information on the transaction times for different activities (under subsection: Transportation).

6. The subsection on 'Warehousing' brings out the importance of correctly estimating the quantity of leaf to be stored at each warehouse in the division. There is a penalty cost payable if the actual quantity exceeds the one that is reserved in advance. In addition, there are issues of transportation. If the warehouses are too far away from the zones then a heavy cost would be incurred in transportation. Mathematical programming approach can be utilized here to allocate the zones to the warehouses optimally and reserve optimal storage at the warehouses. The trade off is essentially between the storage cost and the transportation cost while considering the fact that if the storage quantity exceeds the reserved quantity then a penalty cost has to be paid.

7. The section covering the managerial implications brings out the ways of capturing the spatially spread supply points. A mathematical programming or a heuristic approach can be used to select optimally collection centers from the set of candidate locations. Figure (3) needs to be referred here for the purpose of getting the distances. Here the Euclidean distance needs to be considered between the supply points and the candidate village locations since the leaf collectors go on foot.
and do not follow the roads. The investment cost associated with opening the collection centers and the revenue obtainable from each standard bag needs to be considered while formulating the problem. Also important is correctly estimating the leaf extraction possible from different supply points using extrapolation. The objective is to allocate these supply points to the collection centers such that maximum extraction is attained. However, there are issues of budget constraint. There is a fixed budget allocated to the zone by the decision-maker and the objective is to maximize the leaf collection at the warehouses subject to the budget constraints. Sensitivity analysis is also recommended by changing the number of collection centers. For instance, if it is found that there is a significant increase in the leaf output by selecting an additional collection center then the decision maker can choose to open it. One can do a similar analysis by removing collection centers from the consideration set one by one.

8. After deciding the location of collection centers, the vehicle routes can be developed among the collection centers and the warehouses as discussed earlier. The transportation cost would have to be calculated using the distance along the roads as per the map given as Figure (3). The map is drawn to scale and enables distance calculation between each facility. The development of the route would have to take into account the aspects of time windows and the vehicle capacity as outlined in transportation section. A mixed integer programming formulation can be applied here to obtain the vehicle routes.

9. Subsequently, the transportation costs can be aggregated over a period of two months and an integrated model can be formulated which would capture the issues of facility location as well as the vehicle routing. The results may be compared with those obtained by solving the problems sequentially. The throughput obtainable under the same budget constraints would be higher in the latter Case because capturing strategic and operational issues does the optimization. It may be observed here that while deciding the strategic level issues one often overlook the operational considerations. This results in a solution, which is not globally optimal. The objective at this stage is to bring out this issue for consideration.
10. The problems pertain to the operations and supply chain management and the methodology follows a modeling framework. Specifically, mathematical programming approach is highlighted here as a tool for analyzing the problems. The problem is of small size owing to focus on a single zone. However, this way of concentrating on a single unit provides a way of really understanding the situation from the operational perspective. A MIP optimizer or even a spreadsheet solver can be used to obtain the solution. The reader can also experiment by changing the number of collection centers and the vehicles. The profile of the profit generated by a zone enables the student to identify a point that would be most beneficial in terms of collection under the given restrictions of budget.

Relating the case to distribution in consumer products

One encounters this kind of situation in numerous applications. A firm in the business of distributing goods to a set of customers spread over a large space has to maintain a large number of stocking points. These stocking points serve as aggregation units and maintain certain amount of inventory such that the firm can be responsive to the needs of the customer. This is achievable when the policies regarding the delivery are streamlined. For instance, the location of stocking points needs to be such that the vehicles can travel to these locations fast. The considerations would be different for urban and upcountry locations. In this case, the facilities are situated in upcountry locations and so the distance by road is calculated using the scale provided in the map. However, metropolitan distances may be used for urban locations since the facilities, in such a scenario, are situated in avenues where the roads cross frequently at right angles. The companies that face a similar situation may be in the business of selling electronic goods, fast foods, grocery, newspaper, etc. Apart from investment costs in facilities, companies also incur heavy costs in transportation, which can be as high as 15–20% of the total costs in some cases. Therefore, it is more beneficial to use a combined location-routing problem rather than solving location and routing problems sequentially. This issue is also brought out through this case.
Relating to SCM management in public systems

Typical problems in public systems have the following characteristics

- Tighter resource constraints
- Aspirations of large number of potential beneficiaries

Key concern

- Apportioning scarce resources in a fair and efficient manner
- Balancing equity and efficiency concerns

This case illustrates the role of SCM optimization-based approach in these kind of situations.

Teaching Suggestions

Although we believe that the case is ideally suited to a 90-minute class, it is possible that many classes fail to cover all the materials identified in the analysis section. Since the case is rich in data, the instructor should decide which areas he or she would like to focus on during the case analysis. Depending on the interest of the group, the instructor can either focus on broader issues of equity versus efficiency issues in the SCM context or can focus on the application of supply chain optimization ideas. Of course this would also depend on the sequencing of the case within the course. If students have already done basic concepts in network design and vehicle scheduling, one can generate an interesting discussion on possible heuristics which one can use. The modular design adopted in case analysis provides the necessary flexibility to the instructor in structuring the class discussion. The instructor also should encourage students to look at supply chain problems in other not-for-profit organizations and public systems (garbage collection, post office network design, etc.) and compare and contrast the problems in tendupatta leaf collection with SCM problems in managing other non-for-profit organizations and public systems.
Supply Chain Management at Dalmia Cements

Synopsis

Dalmia Cement Limited is a 60-year old company with the cement division contributing around 85% of its revenues. The cement manufacturing plant is located in Dalmiapuram from where it is transported to 7 regional depots, with each depot serving 1 zone. The company operates in only two states—Tamil Nadu and Kerala.

Excess capacities in the northern and western regions are likely to result in price erosion in the south as well. Given the fact that Dalmia is expected to face tremendous pressure on the profitability front in the future, any improvements in the supply chain would be of critical importance and could well define the very existence of the firm in the future.

While the unavailability of the rail link from Dalmiapuram is of short term concern, determining the optimal transport-mode mix and deciding the shifting to pack to order are long-term decisions needed to be made by Dalmia and are the focus of the case.

The case focuses on these two questions:

(a) What is the optimal transport policy that the Dalmia group should follow after the availability of the broad gauge rail link from Dalmiapuram? This decision will have to be taken by comparing the various possible transport mixes and then zeroing in on the most cost-effective one.

(b) Should Dalmia change its business model and start serving the bulk of the demand directly from Dalmiapuram (pack-to-order model), thereby eliminating the need for storage depots? This would have to be done by finding out whether it would be actually possible for Dalmia to service all stockists within 24 hours of receipt of order.
Case Objectives

The Dalmia case is a comprehensive case for integrating concepts of supply chain optimization and supply chain restructuring. The case is rich with data and provides scope for analysis at various levels. It also poses lot of challenging implementation issues, covering a wide range of issues in supply chain management and can be used to developing skills in supply chain diagnostics.

The case deals with following supply chain concepts:

- Supply chain strategy and performance measures
- Supply chain optimization
  - Inventory management
  - Transportation management
- Supply chain integration
- Supply chain restructuring

There is enough scope for instructor to get in to several degrees of detail in each one of these issues. Apart from above case also allows instructor to get in to discussion about unique challenges of managing pack-to-order (MTO) situation. The instructor can also use this case to hone the diagnostics skills of students.

Case Questions

1. What is the impact of railway gauge conversion (from meter gauge to broad gauge) on Dalmia cement’s distribution operations?
2. What should be the optimal transport mode mix for Dalmia cement?
3. Suggest ways in which Dalmia can get assured supply of trucks throughout the year.
4. Should Dalmia change its transport policy and manage a fleet of truck on its own for its distribution function?

5. Why was Dalmia cements exploring the option of moving from pack-to-stock to pack-to-order strategy? What conflicts or barriers internal to Dalmia would the pack-to-order program create? How should Dalmia cement handle these issues?

Case Analysis

Transport-mode Mix

The market for Dalmia Cement Ltd. has been divided into 7 zones (apart from Trivandrum) and 28 stockist points subsequently. The company has number of options in terms of mode of transport to cater to these markets.

Optimal Transport mix

1. **Option 1— Rail + Road:** Via Depot, the cargo is sent from factory to depot by rail and from depot to stockists by trucks.

2. **Option 2—Road + Road:** Via Depot, trucks are used for transportation from factory to depot and from depot to stockists.

3. **Option 3—Direct Road:** No depot routing; trucks are used to transport from factory to stockists.

4. **Option 4—Direct Rail + Road:** No depot routing; are used to transport from rail point to stockists.

Total costs = Transportation costs + Inventory cost + Handling cost + Loss due to damages
• **Cement has low value density so transportation cost is major component of costs**
  
  o Based on data available about road and rail freight for seven depots one can work out cost per km per tonne using regression.
  
  ```
  Cost per tonne = Fixed cost + Variable cost* Distance
  ```
  
  o Rail freight cost per tonne = 75 + 0.7 * Distance
  
  o Road Freight cost per tonne = 34 + 0.8 * Distance
  
  So for distance less than 360 km, road would be optimal; and beyond 360 km, rail would be optimal.
  
  - Optimal distance would change for mango season where road freight would be higher.

• Different mode of transport results in different number of handlings so material cost is relevant form of cost for decision making

• Extra handling would increase cost by 40 Rs. (20 bags per MT and each extra a loading and unloading would increase cost by Rs. 2 per bag). If we add handling cost (rail would involve extra handling) road would be optimal mode of transport in Dalmia case.

• **Inventory carrying costs: Relevant inventory : Cycle stock + Safety stock**
  
  o Transport by railway would involve moving material in bulk so would results in higher cycle stock. Scenario involving meter gauge movement, material would be moved in batch of 18.6*40 MT. For Scenario involving broad gauge movement, material would be moved in batch of 40*40 MT
  
  o Transportation by railway would involve longer lead time so one would need higher safety stock
Moving from Make-to-stock to Pack-to-order

- Capability analysis: Dalmia would have to check whether they can serve the stockist in 24 hours (Required delivery time)

- Dalmia would have to ensure that operations (packing, silo and transportation operations) buy in the idea

- Dalmia would have to ensure that marketing department buy in the idea

Capability Analysis

Let us try to analyse if the capacity of the packaging machines and the silos is sufficient to pack cement fast enough to enable the pack-to-order system. The total capacity of the 5 machines used for packaging is 455 tonnes/hr. (from the case exhibits). The maximum daily demand for cement (total of OPC, PPC, PSC) in May 1997 is 2291 tonnes. This may be scaled up to the highest for the year if we find the peak demand in March 1997. For this, we assume that the ratio of monthly demands for March and May 1997 is the same as the daily demand for March and May 1997.

Peak daily demand for March 1997 = Peak daily demand for May 1997*(Monthly demand for March 1997/Monthly demand for May 1997)

=2291*7197670/5901055 = 2794 tonnes

If we assume that all orders come in at the same time of the day and that silos are full of cement at any point of time, all the machines can be utilized at the same time and we can manufacture 455 tonnes /hr. This will take approximately 2794/45 = 6.14 hrs.

This, added to the transportation time, loading and unloading time would give the total time to fulfill the order. Transportation time in the worst-case scenario can be determined by using the longest route and a truck speed of 45 km/hr. Based on this we get a travel time of approximately 10 hrs. So adding the
loading and unloading time to the 16.4 hrs of packing and transporting, we may just be able to service the order by pack-to-order mechanism.

However, if the process is not run so tightly, the 24-hr threshold may be crossed and the customer may not be serviced. We must also consider the constraints introduced by the feasibility of attaching each machine only to a particular number of silos.

Also, we find that any demands on the system due to pack-to-order is coming from constraint in the packaging capacity (455/hr), and not from the type of silo vis-à-vis the packaging machine (what silos are connected to what machines). Hence, we do not see any tangible benefit coming from connecting all silos to all packing machines. Any improvement can come by increasing the packing capacity.

It is assumed that there is no time wasted at interstate crossing (Tamil Nadu to Kerala). If interstate crossing requires considerable time, may be Dalmia should keep one depot in Kerala at initial stage. Another assumption is the speed of truck (road condition would play important role in this assumption), time required to procure a truck would also affect above calculations.
A. Marketing buy-in

The marketing personnel have already expressed reservations as to whether zero finished-goods inventory would be a good idea at all. They don’t feel that the company can handle seasonal variations in demand without finished goods inventory.

The marketing department would be concerned about improving the current business, and expanding the business by adding more stockists/expanding the geographic presence in the future. It would be easier to get stockist buy-in during expansion when there is a geographically closer depot rather than when the servicing happens from the factory.

Thus marketing is concerned that depot elimination would lead to lost sales as well difficulty in future expansion.

Manufacturing buy-in

- Static to dynamic scheduling

Currently the packing section freezes its schedule at the beginning of the day. In the case of pack-to-order, the scheduling needs to be done dynamically as soon as the order comes from the stockist. This means the scheduling algorithm needs to be appropriately modified, and automated (if not already so) because of the complexity of dynamic scheduling.

- Implications for the loaders

Current practice: Currently the loaders in the packaging section are paid on a piece-rate basis. Each loader is assigned to a specific machine at the beginning of his shift; and does not move machines. Since the 5 machines available have different capacities, and the incentives are on a piece rate basis, a fair scheme would ensure rotation between the loaders and the machines.
For e.g., if loader A is assigned to ROTO 1 on day 1, he is shifted to Haver & Boecker on day 2, to Polysius on day 3 and so on. This ensures that over the course of 5 days each loader gets a fair chance and is not constrained by the capacity of the machine he is attached to.

**Fairness**

However, when the scheduling becomes dynamic it is not possible to ensure this fairness any more. This is because the machine utilized for packing depends on the order quantity and timing. It is possible that some loaders benefit more.

Some machines might not be used at all in a day, and this will become clear only during the course of the day. The loaders attached to these machines would lose out due to no fault of theirs.

The alternative is to make loader assignment dynamic as well, i.e., when the machine is allocated, allocate a loader to that machine also in a way that ensures maximum fairness.

**Efficiency**

However, this dynamic loader allocation causes problems in efficiency.

If loaders are assigned to machines as and when orders come, loaders might be asked to switch machines mid-way. This might cause reduced efficiency in machine handling since it would be best if one person works with the same machine throughout the day.

**Compensation scheme**

Loaders would have to be on standby, waiting for orders to come so that they can start work. If they are paid on a piece rate basis, the loaders who don’t get assigned to any work would get no pay. This however makes no sense since they incur an opportunity cost (of alternative employment) when they are on standby.
This essentially suggests that the compensation scheme needs to be changed from piece-rate-based to hours of work/presence-based. This would cause problems of its own since packing is a labour-intensive process and an hour of work scheme encourages dilly-dallying rather than efficiency.

Thus, the move from static to dynamic scheduling necessitates changes in scheduling practices and compensation structures to ensure fairness.

These changes would make the buy-in from the manufacturing section in general and the loaders in particular to be difficult to achieve.

**Summary**

Eliminating depots and servicing stockists directly from Dalmiapuram would result in considerable cost savings per year. The reduced service levels are acceptable to the stockists; hence eliminating the depots is optimal.

When moving from pack-to-stock to pack-to-order, there are considerable savings in inventory costs. However, there is an organizational cost that comes into play in terms of need for changes in the compensation structure of the packaging division employees, and broader issues of fairness. Hence, the decision must be taken after considering issues like resistance to change and organizational acceptance of the change.

Dalmia may like to start pack-to-order for the Tamil Nadu region and keep one depot for the Kerala market. Once all the systems are in place and marketing is convinced about the operations, Dalmia may like to roll out pack to order for the Kerala market.

**Annual contract for Hiring/Leasing Trucks**

- Dalmia would incur fixed cost of Rs. 25,000 per month and variable cost of Rs. 4 (Rs. 2 per forward movement and Rs. 2 for return movement) per km. per 10 MT.
- Dalmia can enter into contract for base demand and additional demand can be met by hiring trucks from the market.

- From the cost point of view, one can easily show that hiring trucks on an annual basis would result in substantial cost reduction. However, this would involve managing day-to-day truck operations and may end up taking substantial management time.

**Short-term Issues**

Train transportation facility from Dalmiapuram to Trichi was not to be available for a period of 6 months, from Dec’97. Should the company build up inventory at Trichi Depot?

The company currently uses Trichi as a depot for supplying to a large number of districts. We observe the following costs for road and rail transport.

<table>
<thead>
<tr>
<th>Mode</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rail</td>
<td>107 Rs/MT</td>
</tr>
<tr>
<td>Road</td>
<td>70 Rs/MT</td>
</tr>
</tbody>
</table>

The costs for Trichi are lower by road, than by rail. Even in the peak season, it is possible to get trucks at 50% higher costs, i.e. 105 Rs/MT, which are roughly the same as rail freight. So, we propose completely shifting from train to trucks for this route. With a view to maintaining the healthy relationship with Indian Railways, we propose Dalmia shifts to road transport for Trichi since December 1997, when the rail route becomes unavailable.

**Teaching Suggestions**

Although we believe that the case is ideally suited to a 90-minute class, it is possible that many classes fail to cover all the materials identified in the analysis section. Since the case is rich in data, the instructor should decide which areas he or she would like to focus on during the case analysis. Depending on the interest of the group, the instructor can either focus on the broader issues of implementation or on the application of supply chain optimization ideas. Of course, this would also depend on the sequencing.
of the case within the course. If students have already done basic concepts in transportation and supply chain restructuring, one can generate an interesting discussion on the implications of assumptions on the choice of strategy. Modular design adopted in case analysis provides the necessary flexibility to instructor in structuring the class discussion. The instructor also should encourage students to compare and contrast the Dell model (CTO supply chain) with the pack-to-order model adopted by Dalmia. The instructor can also raise a discussion on the impact of product characteristics (value density of product) on choice of transportation strategy.
Power Equipments (India) Ltd.

Synopsis

Power Equipments (India) Ltd., the Indian subsidiary of the French multinational, Power Equipments, is in the electrical engineering products business with a turnover of around Rs 6,000 million. Power Equipments enjoyed a market share of 22% and was a market leader in the switch gear business. The firm has plans to increase the volume of business by about 50% in the next three years. Long and unreliable order-to-delivery lead time is of major concern to Power Equipments as they have lost a number of orders in the past because of the long delivery times quoted by the company. The company has formed a task force to work on lead time reduction. The task force has come up with a very ambitious plan—to reduce the cycle time from 35 weeks to almost 18 weeks within one year. To accomplish this, it has proposed major changes in all aspects of the business. The firm is not sure whether it should initiate changes on all the fronts as suggested by the task force or take one front at a time.

This case deals with challenges of reducing order delivery lead-time in made-to-order (MTO) supply chains. This case also deals with the challenges of managing internal integration involving design, marketing and manufacturing departments.

Case Objectives

The case is a comprehensive case for integrating the concepts of supply chain integration and supply chain restructuring in an MTO business. The case is rich in qualitative and quantitative data and provides scope for analysis at various levels along with posing lot of challenging implementation issues. The case deals with following supply chain concepts:

- Supply chain strategy and performance measures
- Outsourcing: make versus buy
Case Questions

1. Identify the key challenges faced by Power Equipments.

2. How would the recommendations of the task force help Power Equipments in reducing order delivery time? What are the major challenges in implementing the recommendations of the task force?

3. The task force would like to apply the ideas of the Toyota production system at Power Equipments. Is it possible to apply the ideas of the Toyota production system for firms such as Power Equipments which are in the project business and work with made-to-order supply chains?

4. If you were Narayan Swamy, what would you do?

Case Analysis

Relevant Background Information

- Power Equipments (India) Ltd., the Indian subsidiary of the French multinational Power Equipments, is an electrical engineering products business with a turnover of around Rs 6,000 million. PEL has operations involving multiple plants and divisions.

- The power transmission and distribution (PTD) division had been identified by the parent company as a global centre of competence for medium voltage (MV) switch gears. Power Equipments enjoyed a market share of 22% and was the market leader in the switch gear business.
In 1997–98, the factory had produced 1850 medium-voltage panels with an unexecuted order book of around 600 panels. PTD had set a target for 2,400 panels for the year 2000. The company had carried out a competitive analysis in which they found that, compared to competitors, they had to improve on delivery and cost fronts to reach its target of 2,400 panels. The delivery period was of major concern as they had lost a number of orders because of long delivery times quoted—36–40 weeks as against 24–30 weeks quoted by competitors.

The switch gears are custom-built products made to individual consultant/client specifications. In most orders, the client uses a consultant involved in all stages including design, supplier selection, detailed design approval and final inspection.

**Evolution of Design and Supply Chain Processes at Power Equipments** *(Comments in italics present conceptual basis for the changes)*

- Introduction of NSG 100 with modular design: Power Equipments had indigenously designed NSG 100 panels which accounted for 85% of the total volume in the year 1997–98. The earlier design (SG 100 panel) consisted of one fabricated structure whereas in the new design (NSG 100 panel), the entire product consisted of four fabricated structures (one for each chamber), which could be bolted, in the end at the final assembly stage. The new design with the new layout (assembly of modules carried out in parallel), resulted in the reduction of the cycle time of around 4 weeks. *(Impact of product design on supply chain performance)*

- To reduce the cycle time, the company had decided to start two long lead-time activities—manufacturing of CBs (circuit breakers) and ordering of major equipments, as soon as the sales handed over the order to works. This saved about three weeks of time. *(Scheduling activity in parallel instead of sequential scheduling)*
Task Force Formation

- Interdisciplinary group consisting of marketing, engineering and manufacturing

- Targets for task force:
  - Order execution time to be reduced by 30%–40%
  - Increase capacity by 30% without increase in headcount

Analysis of Task Force Recommendations

Major Recommendations (Comments in italics present conceptual basis for the recommendations)

- Create a centralized ED group to standardize offerings (designs and drawings) for three standard modules for each of the five consultants. For the top five consultants, standard designs/drawings would be prepared for the three standard modules, ratified by the consultants. LT chamber design work would be handled by the centralized ED support group. This standardization would reduce engineering time by 60%. This would involve external integration with consultants. (Restructuring of ED would mean change in structure, performance measures and process, organization structure. Buy-in would have to be created with consultants as well as ED groups. Traditionally consultants like to maintain an arm’s-length relationship with equipment suppliers.)

- Rationalize suppliers and appoint four tier 1 suppliers for each of the four modules. Each tier 1 supplier would supply all the required components for that module in a kit form. Of course, the supplier selected for LT chamber should be able to work very closely with Power Equipments because, unlike other modules, the lead time for LT chamber would be quite small and the supplier should be in a position to respond to engineering changes that are made by customers during order execution. (This would require: implementation of the tier structure, choosing appropriate vendors. Focus of supplier selection: cost and organization capability for Tier-1 supplier of other modules &
Shorter LT and responsiveness for LT module suppliers. Supplier selection and monitoring mechanisms would be different for different suppliers.

- Order acquisition group should be able to respond to a standard enquiry in a very short period without any support from any other group. Power Equipment should prepare a standard offer format for common use by all regions. This format should be made available on the Intranet. Further, standard costing templates should be prepared to help the acquisition group in preparing quotations. (Restructuring of processes. Use of IT as Enabler)

- Manufacturing and procurement activities for three standard modules can get started as soon as the order is received from a customer. At a later point in time, once the client approval is in place, marketing can send the necessary drawings and documents for LT chamber. (Schedule activities in parallel rather than in a sequential mode. A comparison of Exhibits 4 and 8 shows the difference between the old approach and the revised approach)

- Develop software for preparing detailed wire requirements in LT wiring activity. At present, the worker in the LT chamber wiring group is expected to read the wiring diagram, estimate wire lengths and cut wires accordingly. If the same can be estimated at the design stage itself using the developed software, suppliers can be asked to supply wires in required lengths. (Deskilling of jobs, Usage of IT as enabler. Focus on internal and external supply chain integration)

- Standardize the process through which order gets transferred from acquisition to commercial. A comprehensive checklist can be prepared so as to avoid any communication gap. (Design processes to reduce waste and enable supply chain integration)

- Acquisition should transfer order documents to the execution and commercial group in a parallel fashion rather than in a sequential mode. (Schedule activities in parallel rather than in sequential mode)
Avoid duplication of activities at design and manufacturing. Link computer-aided manufacturing package for door layout to design package of door layout available with ED. (*Internal integration of supply chain activities*)

**Implementation Challenges**

Implementing changes suggested by the task force would pose serious managerial challenges. As the changes would require significant changes in supply chain processes, organizational structure, processes and technology (Information Technology), the degree of difficulty in implementation is very high. Refer to Appendix 1 discussion on managing SCM improvement programmes. Only if Power Equipment has a task force with strong execution capabilities; and is able to provide the necessary top management, it should implement all the recommendations in one phase. Else it should implement the recommendations in smaller steps.

**Teaching Suggestions**

Although we believe that the case is ideally suited to a 90-minute class, it is possible that many classes fail to cover all the materials identified in the analysis section. The classroom discussion of this case covers a lot of ground, as there are many rich topics to explore and numerous action plans to analyse. The instructor should decide which areas he or she would like to focus in the case analysis. This would also depend on the sequencing of the case within the course. Modular design adopted in case analysis provides the necessary flexibility to the instructor in structuring the class discussion.

**Appendix 1**

**Managing SCM Improvement Programmes**

- SCM improvement projects would affect organization on following dimensions:
- Technology
- Supply chain structure and processes
- Organization structure and processes

• Failure risk assessment: To assess likely chances of failure (success), make assessment of difficulty score (Difficulty of implementation):
  - Change required on three relevant dimensions (Technology (including IT), SCM processes, organization processes) for successful implementation of SCM improvement programme can be assessed using following scale:

No Change: 1

Minor Change: 2

Moderate Change: 3

Significant Change: 4

Difficulty score = Technology change score * Organization change score * SCM change score

The degree of difficulty in implementation is directly proportional to the difficulty score. If it is high, chances of failure are quite high. To increase chances of success, organization must back such projects with organizational resources and top management support.

Of course if one picks up project with low difficulty score, benefit of implementation are also low.

Benefit from improvement programme = Technology change score * Organization change score * SCM change score

So most supply chain projects suffer from this problem that organization wants to work on an ambitious project which obviously has a high difficulty score, but such projects are not backed by
necessary organizational resources. Consequently, most such high profile projects fail. Further, there is a tendency to focus only on the technology part and not enough attention is paid to supply chain processes and organizational processes (organization structure and performance measures).
The Global Green Company

Synopsis

The Global Green Company (GGCL) is into the business of exporting preserved vegetables to European and American markets from India. Since its inception, GGCL has been growing at a tremendous pace and is known for good quality products. The CEO of GGCL is confident of sustaining its growth in the coming years, provided the firm can improve performance on the delivery front and reduce logistics costs. Given that there has been a lot of uncertainty about yield and grade mix at the harvesting stage, GGCL was not sure how to manage its operation so as to manage the delivery schedules without increasing costs.

In 1999, the CEO of GGCL had hired a team of internal consultants from a group company to take a complete look at the supply chain (including procurement, in-bound logistics, wastage and cost) and identify critical issues in the supply chain. He wanted this team to suggest solutions to reduce delays and make the whole process more efficient. This case provides a detailed description of the supply chain practices at the firm. It also provides detailed data which the team had collected for the purpose of diagnosis.

Case Objectives

The GGCL case is useful for concluding the session because it describes the totality of the supply chain context in a simple manner. At the same time, the case is comprehensive in nature covering a wide range of issues in supply chain management which can be used to develop skills in supply chain diagnostics. The case deals with the following supply chain concepts:

- Supply chain strategy and performance measures
  - Use of financial data to analyse SCM performance
- Supply chain planning practices
  - Forecasting
  - Inventory management
Transportation management

- Supply chain integration
- Agile supply chains

There is enough scope for the instructor to get in to several degrees of detail in each one of these issues. Apart from above, the case also allows the instructor to discuss the unique challenges of managing SCM for export markets. The case is also useful in courses involving agriculture supply chain management or supply chain in the rural context. The instructor can also use this case to hone the diagnostics skills of students.

Case Questions

1. Identify the key challenges faced by Global Green.

2. Evaluate the performance of the Global Green supply chain. What are the causes of the problems faced at Global Green?

3. What is your evaluation of Global Green’s planning processes?

4. What specific actions do you recommend to Debashish to address the supply chain performance problems?

Case Analysis

Delayed shipments (Analysis of Exhibit 3)

The percentage of delayed shipment in the past has been quite significant. (Only 41% shipment in time for FAWCETT). The main reason has been the unavailability of correct grades due to a drop in procurement or mismatch in procured grades against the forecasted demand. The other reason is that there is a high lead time for the procurement of raw material such as bottle, cap, spice and preserving; and since most of them are imported, delays are caused due to shipping delays and port saturation.

As a supplier from India, it is important for GGCL to maintain delivery reliability. With low delivery reliability, GGCL would become a less preferred supplier over a period of time.
Demand Skewness (Analysis of Exhibit 4a)

Looking at the sales data, one can clearly see that there exists seasonality in demand. March sees a huge spike in demand and GGCL needs a large inventory of greens and other raw materials to be able to meet that demand. A sudden spurt in demand, such as in March, causes a huge strain on the whole supply chain since one needs to have an installed capacity to cater to this demand—be it sufficient raw material, processing capacity or the ability to ship it. Also interesting is the spike during August and October as this is the lean period for the production of gherkins; in order to meet such a demand, it is imperative for GGCL to keep high inventory, thus causing higher inventory costs.

Product Cost Structure (Analysis of Exhibit 8)

For bottled gherkins, the packaging material cost accounts for a significant part of end product cost. Gherkins are the second most important component of cost. So GGCL should focus on improving procuring and processing of packaging material and gherkins.

Procurement of Gherkins (Analysis of Exhibits 11 and 12b)

GGCL procures greens from the farmers in Bangalore by entering into contracts with them for every harvesting cycle. The biggest issue for GGCL is the high uncertainty in supply, both in terms of quantity and quality. The high uncertainty occurs because of various reasons, primary one among them being the dependence on natural factors to get the greens production. The following are the major reasons why GGCL is facing this problem:

- The production of gherkins is dependent on climatic factors, which creates the huge supply uncertainty. At the same time, it is also dependent on the soil conditions, the methods of farming, etc., which create issues not just around the amount that can be produced but also the quality of the gherkins.

There is an issue with the current way of classification of the gherkins into various grades. The farmers provide the procurement assistants with a grade of their produce and
this has been found to be very different from the forecasts i.e. the actual produce of a grade of the greens is very different from the forecast for the same grade. Also, the grades and the corresponding produce that the farmers provide to the procurement assistant are found to be different when checked at the processing facility. Thus, there is a two-fold problem with the supply—one, the processing plant finds that the forecasted supplies for each grade are either unavailable or in excess; two, based on the procurement data, the plant expects certain quantities of greens of each grade to be arriving there but when reclassified at the plant, the quantities of the grades vary from what they had been informed about earlier. This creates issues with planning and meeting customer requirements. This can also cause delays and/or higher inventory costs. The following exhibit and chart shows the variance between the actual farm data and the forecasts.

- The other problem with supply is that the gherkin production takes almost 70–75 days, i.e., seeding and harvesting while the demand lead time is almost a month for the first shipment. Thus, GGCL has to be very good with its predictions or hold a higher inventory to ensure timely and exact delivery to its customers.

- The problem of perishability also leads to higher variability in the supply of greens.

*Lower farmer Loyalty*

- Although the case claims that loyalty of farmer is high at 25%, this number is quite low. A possible reason for this could be that in spite of having a policy of prompt payments to the farmers, their account payables days are high at 123 days. With lower farmer loyalty, GGCL would not be able to build knowledge base about farmer capabilities. This in turn would result in poor forecasting.
**Procurement of Packaging Materials (Analysis of Exhibit 16)**

GGCL’s problems with procurement stretch to the other raw materials like bottles, caps, etc. as well.

- Local vendors for bottles and caps do not satisfy the stringent quality requirements of GGCL. Thus, GGCL has to face problems due to inferior quality which can lead to rejections of whole lots of procured materials and delays because they not meet the acceptance standards at GGCL.

- Local vendors also prefer to produce soft drink bottles because of the high order volumes that the soft drink industry/firms place on them versus those for GGCL. The suppliers sometimes have minimum order quantities that are extremely large for GGCL which creates problems in terms of higher inventory costs for GGCL and also because the suppliers will not be able to deliver to GGCL in time if they already have another deal/commitment due to which all their production facilities are in use.

- The lead time for procurement of bottles and caps is also very large and has a very high variance as shown by the following exhibit. Thus, GGCL may find it difficult to supply to its customers in a month’s time. (Exhibit 16)

**Inbound Transportation (Analysis of Exhibit 13)**

Since perishability is an issue, transportation plays an important role in ensuring that the quality of the product is maintained. As a result, it is not possible to collect the produce at multiple levels of aggregation which would help in reducing costs through better capacity utilization. Since each truck needs to cover individual farms, a large number of trucks are required. Moreover, since the supply from those areas might not be too high, the capacity utilization will be low.

There does not seem to be too much variability in the freight cost per kg. To further reduce the variability, it might be a good idea to get into long-term contracts with the truck
companies. What is more worrying is the over- and underutilization of trucks during certain periods of the month. Over-utilization could lead to damage to the greens which could hurt their quality and increase wastage. Underutilization leads to higher costs for the company. Thus, there needs to be better logistics planning which translates into a need for a better operations plan. Currently, the planning is done at a month level rather than a week level, whereas the yields vary according to the week of the month. Additionally, it might be a good idea to use smaller capacity trucks rather than those with a capacity of 1.5–2 tonnes.

GGCL also can explore the idea of placing orders in clusters. This would mean that procurement would take place in clusters which in turn would reduce transportation costs.

**Outbound Transportation Problems (Analysis of Exhibit 4c)**

Transportation has its own set of problems. Some liners only carry a minimum load due to which either GGCL’s options in terms of choosing the carrier are reduced or else it has to ship more through a liner to meet the minimum load criteria. GGCL also does not have very good contracts with the shippers and may find no space or may find space at a much higher cost because of last-minute bookings. At times, GGCL has had to use ports at Mumbai, Cochin and JNPT instead of Chennai which has lead to 15–30% higher costs. Looking at the monthly cost for CIF freight, it can be seen that the costs are much higher during March, July, August, October and November. One reason for this is the high demand during these months but the transportation costs here do not follow the same trend as the sales.

**Wastage (Analysis of Exhibits 5 and 10)**

Another major issue for GGCL is the wastage that occurs at different points within the supply chain. Gherkins get damaged if not processed within 24 hours of harvesting. There is wastage due to the breakage of bottles and caps, which may also add to problems with satisfying demand for a particular order. This is evident from the data on wastage where, we see high wastage during months of April, May and July as well as a lot of wastage during the other months for the
gherkins. The wastage of the bottles and caps are nearly 10% but would not be a major cost and might even be within acceptable limits, considering the stringent quality requirements. Such huge wastage in greens not only is a big cost but also creates issues of timely supply to customers. Looking at other raw materials too, we find there are similar concerns like the high rejection rate for brine in certain months.

**Forecasting (Analysis of Exhibit 11)**

Even though sales for the months of January and February are not very high, the inventory levels of the bottled greens (finished goods) in the previous months are high. Thus, GGCL is incurring high inventory-carrying costs even though the demand in the near future does not validate this. This points to the issue of planning at GGCL. At GGCL, unless there is a high variance between the actual and the forecasted data, the acreage under production of gherkins, the quantities of different grades of gherkins required and sales order booking are still based on forecasted and not actual data. A good and timely forecast is extremely important in the agri-business industry because of longer lead times and uncertainty in supply. Due to the above, both delays occur and higher levels of inventory are accumulated as bulks.

Working capital (current assets–current liability) requirements are very high in some months like March and July because of increase in receivables while the payables decrease.

**Error in Grading at Farm End (Analysis of Exhibit 12b)**

As mentioned earlier, there is an issue with the reclassification of gherkins. What is important to note is that the classification error at the farmer’s end is highest for the 160+ grade, which is a higher-priced grade, then, comes the next priced grade (60–160) and the error is lowest for the 20–60 grade. This means there is systematic bias in classification. There could be a possibility that the farmers try and actually show more of this grade within their overall produce to gain higher prices from GGCL and the procurement assistant and the farmers may be in collusion for this. This results in excess payment to framers.
**Trend in Supply Chain Cost as a Per Cent of Sales (Analysis of Exhibit 4)**

Looking at the total supply chain costs as a percentage of the total sales, it is seen that there is a huge variation with the percentage going as high as 42% in May. This means that for the same demand, the cost of supply chain was higher in May, November, September and January, which can be clearly related to the higher inventory carrying costs during these months.

This is because of skewed sales and long cycle. In such a situation, one should not measure supply cost as per cent of sales with month as a unit of time. This would be faulty measure. This should be measured over a period of 6 months or year. SCM cost as percent of sales is a good performance measure for long-term trends not for short-term variations.

**The Planning Process**

Planning involves sales planning done by the sales department and agricultural operations planning by the agri-management department.

The planning process seems to be following a nice two-step approach where the sales plan aims to capture demand patterns in the market through planning based on firm orders and forecasts based on historical data. This feeds into the agricultural operations plan along with the agri-forecasts (which indicate the supply side) to develop plans to meet the demand–supply gap for the period. This involves acreage under cultivation required, contracts with farmers, and material procurement such as seeds, bottles and logistics planning.

The only issue here seems to be that:

- The planning is limited by the accuracy of the agri-forecasts and the sales forecasts.

- While the sales plan/forecasts are shared with the agricultural operations department only once a month, the agri-forecasts are generated and updated weekly. Thus the operations planning might be limited by the slower updating of the sales forecasts.
For instance, the agri-forecasting system shows weekly effects in the production levels, i.e. it shows the production to be higher in the middle of the month (2nd or 3rd week). However, due to the once in a month sharing of information between operations and sales, the operations plan is made and updated only on a monthly basis. Thus transport planning occurs once in a month. This leads to high skews in capacity utilization of transport in the middle of the month (2nd or 3rd week).

Some of the issues faced in planning the productions include:

- Fulfilling the first month order within the promised lead time of 1 month even though the growing and harvesting of gherkins takes much more time than that. Currently this is being managed by supplying the important orders immediately and delaying the rest (who are more flexible about delivery time), to the time till the crop is harvested.

- Mismatch in grades procured and required is another issue, which can be improved by better forecasting and rethinking the assumptions in agri-forecasting about a constant GPC.

- Materials procurement also has its own share of issues such as delays in shipments (as seen in the case of bottles especially). This is solved in some special cases through airlift of material. However this is not a possible option always due to high cost. Hence it is better to reduce these uncertainties through better relations with their suppliers and contracts to enforce lead time requirements.

**Recommendations**

GGCL can take the following actions to improve its supply chain performance:

- GGCL needs better forecasting in order to reduce the variability in the supply. One way of doing this could be to do forecasts at a daily/weekly level instead of the current
monthly level, since it has daily purchase data available. Also, in agri-business, it is all the more important since it is impossible to predict the exact grade mix.

- It is important for GGCL to measure the grade at the farmer level to eliminate the variability arising from a mismatch of grade at the farmer level and the factory level, which happens currently. This is going to be difficult as quality control at such a decentralised level is hard to implement and can be a costly affair but it will help immensely as the factory will get accurate data on the different grades.

- The improvement in forecasts and measuring of quality at farmer level should be accompanied with sharing of information with sales department as well as factory in real time. This is important as factory and sales would know of the grades coming in from the farmers, the farmers and factory would know of the expected sales and thus, accordingly plan the supply of greens and raw materials as well as the processing reducing the mismatch between supply and demand.

- GGCL definitely needs to lessen wastage that happens in the processing of greens as well as during transportation and due to perishability.

- In order to ensure enough supply of bottles and caps, GGCL needs to maintain large inventory and at the same time it should develop relations with local manufacturers so that they get regular and quality supply of raw materials going forward.

- If the demand pattern is similar year after year, then GGCL can plan better for it. It can get into contracts with the shippers especially for these peaks and do space bookings earlier to get lower costs.

- GGCL can work on its credit policy to minimize its working capital requirements.

- GGCL should also think about charging differently for delivering at different ports within a country instead of having the same price across all ports in a country.
• GGCL should improve farmer-retention rate. This would help GGCL in building a knowledge data base which in turn would help GGCL in improve forecasting.

• GGCL also can explore the idea of placing orders in clusters. This would mean that procurement would take place in clusters which in turn would reduce transportation costs.

• GGCL should improve its planning processes.

Teaching Suggestions

Although we believe that the case is ideally suited to a 90-minute class, it is possible that many classes fail to cover all the materials identified in the analysis section. The classroom discussion of this case covers a lot of ground, as there are many rich topics to explore and numerous action plans to analyse. The instructor should decide which areas he or she would like to focus in the case analysis. This would also depend on the sequencing of the case within the course. Modular design adopted in case analysis provides the necessary flexibility to the instructor in structuring the class discussion.
Marico Industries : mySAP™ Supply Chain Management

Synopsis

Marico Industries, Ltd. is a leading India-based consumer goods company. By the late nineties, Marico had successfully introduced a number of products, but the resulting growth strained its highly regarded distribution network and exposed the shortcomings in its forecasting, planning and supply chain processes. This case describes the supply chain evolution at Marico Industries. Over the last four years, Marico has taken several steps to change what had become a “vicious cycle” of escalating supply chain network problems. Marico took a “big bet, big bang” approach in 2000–2001, putting together all the resources and management commitment needed to redesign processes and implement a fully integrated system comprising: ERP, Supply chain software, and data warehousing software. These initiatives laid the groundwork for other major developments, including technology-supported partnerships with major distributors. With vendor-managed inventory (VMI) and the online exchange of distributor sales and other information, Marico has managed to improve forecasting accuracy and reduce inventory levels at both Marico and the distributors. This case illustrates the successful use of IT for improving supply chain performance. It also presents the best practices in execution of supply chain improvement programme.

Case Objectives

The Marico case is useful for an introductory session on IT for supply chain management. It is also useful for illustrating the strategic management framework for IT adaptation in supply chain management (refer Fig. 8.8 in the text). Unlike most other IT implementation cases, the Marico case always keeps the focus on the business perspective and does not get lost in the technical details. The focus is always on how IT was used as an effective tool for solving a business problem. It also discusses the challenges in implementation, dealing with performance measures and organization structure. The Marico case can also be used towards the end of course where the instructor may want to focus on execution challenges in a supply chain improvement programme. The case deals with following concepts:
Case Questions

1. Diagnose the underlying causes of the difficulties that the SAP implementation project was created to solve.

2. How did Marico manage to break the vicious cycle poor supply chain performance?

3. What conflicts or barriers internal to Marico did the VMI program create? What causes these conflicts? How did Marico handle these issues?

4. Why do you think some of the dealers were reluctant to join VMI programme? How did Marico handle their concerns?

5. Do you believe that other FMCG companies would be able to copy the VMI programme as implemented by Marico? What difficulties they are likely to face and what they need to do to handle those difficulties?

Case Analysis

Business Environment and Firm performance

- Marico Industries, Ltd. is a leading India-based consumer goods company with sales of Rs 6.96 billion (approximately US $142 million) for the fiscal year ending March 2002. The company has six factories and about 1000 employees, and it has maintained steady revenue and profitability growth over the past 10 years. Marico offers a range of products that cater to the
consumption habits in the local and export markets (primarily South Asia and the Middle East) that it serves, including refined edible oils, niche fabric care products, hair oils, and food products such as jams and sauces.

- Since its inception, a key strength of the company has been its ability to build brands. Marico’s approach has enabled the company to create unique value for consumers and thereby to build significant market share in many product categories. Of Marico’s nine brands, three are market leaders. Marico faces competition from large, well-capitalized international rivals such as ConAgra Foods and Unilever, domestic brands, and non-branded products.

- A key attribute of Marico’s brands is the widespread availability of the company’s goods throughout India. Marico’s products reach about 100 million people each month, and the company’s distribution network is its key to achieving access by households throughout the subcontinent. Marico produces 125 SKUs at its own factories and through 15 sub-contract manufacturers, stores products at 32 warehouses and sells to 3500 distributors. These distributors in turn provide products to 1.6 million domestic retail outlets.

- Though Marico experienced robust expansion throughout the 1990s, the company realized that it would face challenges to continued profitable growth. There was greater rivalry in its core markets and a requirement to increase marketing expenditures to address associated competitive issues.

**Supply Chain Challenges** (Vicious cycle—poor supply chain performance)

- Even though Marico had core strength in distribution, the performance of its supply chain network was not keeping pace with the growing scale of its operations. The company had a planning cycle of 30 days, an inability to respond to changes in demand within the planning period, and bucketed time horizons for manufacturing and distribution which were not synchronized. Distribution levels were uneven during the course of each month, with a weighting of 15%, 32% and 53% for the first, second, and final one-third of each month. This sub-optimal
skewing of distribution activity over time, coupled with low levels of forecast accuracy, led to a mismatch of supply and demand, inventory build-ups at Marico and at its distributors, expired products, and stock-outs that adversely influenced end-customer perceptions. Total delivered costs were increased due to storage capacity constraints and the requirement to initiate corrective actions such as inter-warehouse stock transfers, temporary renting of additional storage space, and truck demurrage. Planning process problems were compounded by spreadsheet-based planning methods and multiple, non-integrated transaction systems which inhibited widespread visibility into essential data.

• Thus, key goals for Marico were to improve forecast accuracy, achieve more uniform distribution levels throughout each month, and implement planning processes that more effectively matched supply and demand. Through these actions, costs would be more in line with the best-in-class operations in the consumer industry. Inventory-carrying costs and total supply chain costs would be reduced, freeing cash flow to reinvest in growth-generating activities. Marico targeted improvements in stock-out reductions and on-time delivery that would be a consequence of better planning processes, and these actions would support the company’s branding initiatives as well as help to ensure profitable operation and continued viability of its distributor network.

• In order to achieve sustained profitable growth, given market factors and the need to maintain its distribution effectiveness, Marico determined that it must improve its supply chain capabilities.

• The company also faced an inability to sustain the performance of its supply chain as the scale of its operations grew. These supply chain performance issues were reducing Marico’s cash flow and not supportive of the brand image the company had taken care to develop.

_Supply Chain Diagnostics and Design and Implementation o Supply Chain Initiative_ (Breaking the vicious cycle—poor supply chain performance)

• In 1999, Marico initiated a detailed evaluation of its supply chain operations to determine how best to reduce costs, satisfy customer needs, support its brands’ images, and position the company
for long-term growth. The company’s analysis of its operations concluded that sourcing and manufacturing were straightforward, while its distribution operations were the key source of complexity as well as opportunity. Marico procured only a few commodity raw materials (e.g., vegetable oils, safflower seeds), had no major manufacturing capacity constraints, had no sales seasonality associated with its products, and minimized artificially induced demand surges by avoiding the use of promotions. However, the distribution network was complex, with SKU/distribution point combinations numbering in the millions.

- Marico focused on business processes that addressed internal collaborative forecasting between its manufacturing sites and warehouses. The company defined clear responsibilities to ensure that distribution from its warehouses to distributors would meet service level and inventory objectives. Also, the company implemented policies to distinguish the relative priority of SKUs and of distributors.

- After a careful evaluation, Marico selected mySAP™ SCM to enable the associated planning and execution processes. These processes included calculation of monthly shipment requirements from its plants to its warehouses to support make-to-stock operations, electronic transfer of stock levels at the distributors to Marico, and push distribution of products from Marico to distributors based on forecasted retail-level demand and distributor inventory levels.

- Implementation of SAP R/3 capabilities in finance, cost accounting, materials management, production planning, quality management and sales and distribution was started in June 2000 and went live quickly in April 2001. Implementation of demand planning and supply network planning capabilities of the Advanced Planner and Optimizer of mySAP™ SCM—along with the SAP Business Warehouse—began in August 2001 and went live in a big bang implementation in May 2001. Marico assigned 26 staff members to this rapid implementation using ASAP methodologies, and there were 20 consultants supporting this program. The scope included all company factories, warehouses and business offices; distributors; and contract manufacturers, and...
the implementation achieved systems integration that efficiently supported the new planning and execution processes.

**Best practices in IT for SCM implementation**

- **Clear identification of strategic goals for IT and SCM initiative**
  - Enhance long-term value of company brands by achieving excellence in distribution performance
  - Scale supply chain operations to sustain customer service as the business grows
  - Reduce total delivered cost

- **Project managed by business people and not by IT specialist**
  - Vinod Kamat, senior manager, was made project manager
  - Marico formed an 18-member team that represented all relevant functions, including sales, manufacturing, finance, and logistics. This team was to work full time on the project, predominantly on the very extensive SAP R/3 implementation. To ensure that everyone could work uninterrupted and at high energy, Marico decided to locate the team at a different site.
  - Marico was aware that implementation of ERP and SCM software would involve substantial restructuring of processes and buy-in from all the functional managers who would be affected. To achieve this objective, Marico appointed these managers as process owners, making them fully responsible for the revisions of their respective processes. They had to sign off on the revisions at the blueprint stage. Furthermore, to ensure that each manager provided the necessary support to the project, top managers made their work on these initiatives a key measure in their performance appraisals.

- **Assessment of key implementation risk:** To ensure that the project was completed on time and successfully, the team performed a risk analysis. This included a survey of employees about potential obstacles to the success of the new systems. They were asked to rate the risk—
credibility risk, organization risk and individual risk—associated with the project. This survey was carried out twice—during the pre-implementation phase and during the post-implementation phase. Mid-term corrections were made to minimize the risks.

- Adequate training was given to users
- Identification of key strategy driven metrics at the project execution stage
  - Business intelligence system was configured to generate data on performance metrics in real time
- Top management support
- Marico focused on few key supply chain processes
- Specifically, the company focused concurrently on customer-facing business processes as well as on its internal operations.

**Implementation results (The virtuous cycle)**

The implementation produced quick results. By early 2002, forecast accuracy improved by 14%, and the levels of shipment activity through each one-third of a month had become more even (25%, 32%, 43%). The planning cycle time was reduced from 30 days to 15–20 days, and enhanced reporting facilitated management decision-making. These outcomes led to reduced internal and distributor inventory, fewer stock-outs, lower lost sales levels, and reduced supply chain exception-handling costs.

**Results (achieved over the period 3Q01 to 1Q02):**

- **Decreased stock-outs** associated with distributor sales to retailers from by 33%
- **Reduced lost sales** due to stock-outs by 28%
- **Lowered excess distributor inventory** by 33%
- **Reduced late deliveries** to distributors by 37.5%
- **Reduced costs associated with supply chain exceptions by 25%** (e.g., intra-company stock transfers, truck detention costs)
VMI Implementation Challenges

Distributor’s concerns

- Fear of major disintermediation in log run
- Loss of control by distributors
- Additional work because of MIDAS operations

Concerns of sales team

- Loss of control (sales force has minimal role to play in primary sales)
- Change in performance measures (From primary to secondary)
- Loss of flexibility (No dumping, uniform schemes throughout the year)

Handling of VMI/sales team related concerns by Marico

- Lot of time was spent on educating each person (internal and external) likely to be affected.
- Use of power in influencing dealers: parted relationship with dealers who don’t want to work with the VMI approach.
- Involvement of the top management
- Ensured that ROI for dealer increased by significant amount.

Would other FMCG companies be able to copy the VMI programme as implemented by Marico?

Implementing VMI looks easy but requires strong execution capabilities and top management support and lot of patience. Refer to the appendix for a discussion on managing SCM improvement programmes.

Teaching Suggestions

The Marico case is ideally suited to a 90-minute class. Since it is rich in material, the instructor should decide which areas he or she would like to focus on during the case analysis. This would also depend on the sequencing of the case within the course. Some instructor may want to focus on IT for SCM while others may want to focus on supply chain improvement programme implementation. Instructors who
want to focus on IT dimension should like this case with the strategic framework for IT adoption in SCM (Fig. 8.8 in Chapter 8). Instructors who want to focus on execution issues may want to use the framework discussed in the appendix. This case has several interesting quotes from senior managers of Marico. Instructors should explore idea of using theses quotations at appropriate places in case discussions. This (use of such quotations in discussions) is almost like bring in the practitioner in the classroom. One can generate a lot of interesting discussion on the comments.

**Appendix: Managing SCM Improvement Programmes**

- SCM improvement projects would affect organization on following dimensions:
  - Technology
  - Supply chain structure and processes
  - Organization structure and processes
- Failure risk assessment: To assess likely chances of failure (success), make assessment of difficulty score (difficulty of implementation) as outlined here:
  - Change required on three relevant dimensions—technology (including IT), SCM processes and organization processes—for successful implementation of SCM improvement programme which can be assessed using following scale:
    - No Change: 1
    - Minor Change: 2
    - Moderate Change: 3
    - Significant Change: 4
  
  Difficulty score = Technology change score * Organization change score * SCM change score
- Degree of difficulty in implementation is directly proportional to difficulty score. If difficulty score is high, chances of failure are quite high. To increase chances of success organization must back such projects with organizational resources and top management
support. Of course if one picks up project with low difficulty score, benefit of implementation are also low.

Benefit from improvement programme = \text{Technology change score} \times \text{Organization change score} \times \text{SCM change score}

- So most supply chain projects suffer from this problem that organization wants to work on ambitious project which obviously has high “difficulty score”, but such projects are not backed by the necessary organizational resources. Consequently, most such high profile projects fail.

Further there is tendency to focus only on the technology part and not enough attention is paid to supply chain processes and organizational processes (organization structure and performance measures).
Subhiksha: Managing Store Operations

Synopsis

Founded in 1997, Subhiksha grew from one store in 1997 to over a 1000 in 2008. It sells FMCG, grocery, pharmacy, mobile products, and fruits and vegetables (F & V). It is one of the largest supermarket and mobile retail chains in India with a presence in 90 cities. In 2008, organized retail accounted for about 4% of the industry share. Though organized retail was identified as a high growth area, by the middle of 2008, players who had entered Indian retail realized that organized retail in India is going to be tough business. Various players (Reliance, Bharti, Birla and Future Group) were experimenting with different formats and different models. Subhiksha had decided to come with its own model which, in their view, was suitable to the Indian context. Subhiksha targeted the middle and lower class instead of the high-end customer. To do so, it operates with an everyday-low-pricing model and locates several smaller stores to move closer to the customer. At an operational level, it constantly plans to increase supply chain process efficiency to deliver goods at low prices. The Subhiksha business model is explained through a detailed description of operations of one store (Indiranagar) located in Bangalore. It also describes the operations of the distribution centre which servers the Indiranagar store apart from serving 58 other stores. The case discusses the challenges of organized retail in general and specific challenges of inventory and cost management for discount retailers. The case also provides detailed data which can be used for the diagnosis of the supply chain system at Subhiksha.

Case Objectives

The Subhiksha case is a comprehensive case dealing with retail operations and supply chain issues in the retail context. Ideally, this case should be scheduled after all the basic concepts in supply chain management have been covered in the course. It is also a useful case for discussing the complexity of introducing a unique business model in the Indian organized retail context. The case also covers a wide
range of issues in supply chain management and can be used to developing skills in supply chain diagnostics. Because it can be handled at various levels of complexity, it can be used as a summary case for a course or module focusing on supply chain fundamentals. The concepts covered by the case include:

- Retail supply chain management
- Supply chain strategy and performance measures
- Supply chain planning practices
- Forecasting
- Inventory management
- Transportation management
- Warehouse management
- Assortment planning
- IT and SCM
- Supply chain integration

There is enough scope for the instructor to discuss in detail each one of these issues. Apart from the above, the case also allows the instructor to discuss the unique challenges of managing discount retailing in the Indian context. The instructor can also use this case to hone the diagnostic skills of students.

**Case Questions**

1. Examine the various decisions made by Subhiksha and how do they match (fit or align) with the business model of Subhiksha.
2. Identify the key challenges faced by Subhiksha. How important is assortment planning and inventory management for Subhiksha?

3. Evaluate the performance of the Indiranagar store on forecasting and inventory management? For your analysis you may like to focus on three items listed in Exhibit 8.

4. Examine the supply chain practices followed by Subhiksha for different categories.

5. How does Subhiksha mange variation in demand within a month and within a day?

6. In what ways is a Subhiksha store likely to be different from a regular Kirana store or grocery store in Big Bazaar?

7. Subhiksha is facing “serious problems” these days. What might be the reasons for this?

Case Analysis

1. The Subhiksha Business Model can be described as follows:

Low cost, moderate assortment, everyday low pricing (EDLP) and deep discount with closeness to customers. Subhiksha has made the following long-term decisions to support its business model:

- Network decisions: Large number of stores per city
  - Common DC and advertisement (At launch)
  - Frequent delivery and DC

- Location decisions: Low rentals, Target market

- Investment in Furniture & fixtures: bare Minimum

- Assortment planning: Serve 90% of basket requirement

- Addition of F&V, Pharmacy & telecom
• Inventory management: target inventory. turns 0f 20-24 at store level
  – Inventory tightly controlled

• Managing Checkout time during peak without increasing Labor cost

• Location: Catchment area should be sufficient (Number of low and middle class in 1-km. neighbourhood), Not main street but close to main street: Low rental does not need too much parking space

• Assortment: (90% of basket, SKUs will go up: inventory would go up number of: Space required would be higher – rental cost, inventory)

Alignment issues

• Offering and managing the complexities associated with Quantity discount (Promotional schemes) at the beginning of month along with EDLP.

• Location choices: Indiranagar is a posh locality

• Service Promise (Exhibit 7): should discount store offer these services

• Home delivery for small basket: shouldn’t they insist on minimum amount?

• Price comparison for grocery items (Exhibit 5)

• Fruits & vegetables: managing supply chain

• Managing variability with full time employees: Motivation level is likely to be higher, better training but difficult to manage with

• can we mix different categories in one store: Telecom visavis FMCH & F&V

2. Key challenges
Key challenges would involve understanding of retail economics. Subhiksha has to ensure that each store is viable and generates enough surplus which can support DC operations and overall organization overheads. For this analysis we would exclude Pharmacy & Mobile category:

- **Subhiksha Retail economics:**
  - Bulk of costs are fixed in nature
  - Impact of sales & product mix (Gross margin):
    - Offering discounts mean one needs higher sales per square feet and higher sales per employee

- Large number of stores in one city: warehouse and advertisement costs can be leveraged

- What is the minimum demand needed to support the fixed costs of store.

One can try and do some analysis with given numbers in the case for Indirarnagr store.

**Gross Profit of the Indiranagar store**

<table>
<thead>
<tr>
<th>Category of item</th>
<th>Supermarket</th>
<th>Fruits and Vegetables</th>
<th>Gross Profit In Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monthly sales</td>
<td>900,000</td>
<td>300,000</td>
<td>135,000</td>
</tr>
<tr>
<td>% Gross margin</td>
<td>15</td>
<td>30</td>
<td>90,000</td>
</tr>
</tbody>
</table>

**Monthly store costs**

<table>
<thead>
<tr>
<th>Category</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rental</td>
<td>40,000</td>
</tr>
<tr>
<td>Wages</td>
<td>60,000</td>
</tr>
<tr>
<td>Electricity</td>
<td>10,000</td>
</tr>
<tr>
<td>Security</td>
<td>10,000</td>
</tr>
</tbody>
</table>
*(Assumption: 10% of sales value as wastages) *(2 million per month WH cost allocated to 59 stores)*

This generates surplus of Rs 39,000 per month per store, which is just 3.25% of sales. This still does not take care of managerial manpower and corporate overheads. So it is very likely that Indiranagar is making losses. Further, the store would have investments of about 1.0 million in furniture and fixtures (about 6% of annual sales value) & about 0.8 million in inventory (assuming 18 inventory turns). Since bulk of the expansion is funded by debt if we take 10% as financing cost, one would end up with monthly financing cost of Rs 15,000.

So Indiranagar store has to generate high sales for same level of costs or should have items with high gross margin in its assortment. Higher sales can be done by getting more customers visit the stores (footfall) or increasing average purchase value per customer. If Subhiksha tries to pull in more customers by higher discounts, gross margin may get affected. Further more customers on weekends during first week of month means waiting time at counter would go up which in turn would result in customer dissatisfaction. Further Subhiksha has to ensure product availability on shelf (Look at Exhibit 8 data: Maggi noodle was not on shelf on 6 out of 29 days in month) and ensure that store has right assortment for every locality. For stocking items with high gross margin, Subhiksha has to focus on private labels where margins or on higher side. Currently private label accounts for very small percentage of Subhiksha sales. One can make some comparisons with Aldi, a successful chain in Europe, which is similar to Subhiksha in concept (small format and limited number of SKUs). Private labels account for significant part of sales at Aldi.

This analysis shows that cost management and generating demand (more footfalls) is going to be central challenge for organized retail in India. Most of the organized retail players ended up paying high rentals
and high wages (to attract employees from competitions) and high investments in inventory (Pantaloons has inventory turns of 4) and furniture and fixtures. This has resulted in losses or very low profitability and strained financial position for most of the retailers.

3. Evaluation of forecasting and inventory management.

- Understand challenge of inventory management through data
  
  o Understand MBQ with data and identify challenges in working with tight inventory levels, implications of stock-out for different categories (A B C D)

- Understand that different categories are different in nature and require different responses/supply chains

- Understand A B C D categorisation and review mechanisms

- Inventory management: Very low inventory levels, Focus on A and B category but review more often and
  
  o Require high forecast accuracy (day of week)
  
  o Require high responsiveness (Currently it takes 36 hours), poor service level

The inventory review process requires that employees actually count and report the available units. Time and cost is incurred in this exercise. ABCD classification allows Subhiksha to allocate the time and effort to different SKUs in a better way. A-class SKU bring higher sales to Subhiksha compared to a D-class SKU. Also, customer gains more in terms of discounts on A-class SKU compared to a D-class SKU. Hence, stock-out of an A-class item is much costlier than a D-class item as it not only affects sales but also customers satisfaction. With a result, review period is shorter for an A-class item compared to a D-class item. Also, this review period structure helps Subhiksha in reducing the pipeline inventories in the supply chain.
One can carry out above analysis by analysing material flow (receipt and sales) and information flow (indent). One can use the following material balancing equation to calculate receipt numbers:

Opening stock + receipt = Sales + Closing stock

<table>
<thead>
<tr>
<th>Date</th>
<th>Maggi Sales</th>
<th>MBQ=30 OS</th>
<th>Pepsodent Sales</th>
<th>MBQ=15 OS</th>
<th>Sunflower oil Sales</th>
<th>MBQ=70 OS</th>
<th>Receipt</th>
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Though Subhiksha has developed a reasonably good forecasting and inventory management system in concept, though the inventories are checked at outlets as per the norms, it seems that there are some problems with the actual implementation. For example, in the case of sunflower oil, receipt in the second
week (=401) was not consistent and much higher than the MBQ. Such a decision will increase the inventory. Also, despite of the fact that the sunflower oil is an A-class item, the store hardly received deliveries on a daily basis and the receipts hardly matched with the requisitions placed to warehouses (requisition quantities can be easily calculated using MBQ, OS, and lead time = 3 day). In some situations, there is out of stock situation. For example, both Pepsodent and Maggi noodles were out of stock on many occasions. It seems that the tighter inventory norms do not consider the supplier’s delivery reliability performances (around 70%). In addition, the practice of not following the inventory management system during allocating the available units to different stores results in excess inventory and stockout situations across the supply chain.

4.

**a) Different category: Different characteristics**

<table>
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<tr>
<th>Type of Supply chain</th>
<th>Number of skus</th>
<th>Margin</th>
<th>Value density</th>
<th>Supply Characteristics</th>
<th>Demand Uncertainty</th>
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<td>MTS</td>
<td>Large</td>
<td>Low-moderate</td>
<td>moderate</td>
<td>Service level low, short LT</td>
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<td>MTS</td>
<td>Few</td>
<td>High</td>
<td>Low</td>
<td>Service level high, Bulk purchase</td>
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<td>High</td>
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<td>Moderate service level</td>
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<td>Medicine</td>
<td>MTO</td>
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<td>MTS</td>
<td>Few</td>
<td>Very Low</td>
<td>Very High</td>
<td>High service level</td>
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</table>

- Why medicine service. In the pharmacy business, Subhiksha caters only to customers who are on continuous therapy. So they work with MTO model.

- Why telecom: Nokia sales higher than HUL. Almost like FMCG

- Why F &V: Increase Footfall and high margin
5. One can analyse Exhibit 3 (variation within a month) and Exhibit 2 (Variation within a day) to understand demand pattern within a day and across the days in month.

- More customers visit store during first 10 days
- More customers visit store during week ends
- Sales/bill is higher during initial days of month.
- Within a day relatively more customers visit store during evenings.

Ideally firm should vary crew size based on demand pattern. Unfortunately Subhiksha has no flexibility as it works with full time employees.

To some extent Subhiksha is sensitive to this demand pattern and ensures that all activities like stock taking and receipt of goods and stocking of shelves are not scheduled in the evening times.

Employees are not given holidays during first 10 days of the month. Given that wages account for significant part of store costs Subhiksha should look at possibility of employing part time crew.

6. In what ways Subhiksha store is likely to be different from regular Kirana store or grocery store in Big Bazaar?

- Number of SKUs
- Inventory/sales
- Sales/employee

7. Possible reasons for severe problems faced by Subhiksha nowadays:

- Rapid growth
- Insufficient cash, managerial bandwidth
• Challenges of managing new city

• Assortment planning (what constitutes 90% of basket), Needs higher inventory as demand forecasting difficulty,

**Vicious Cycle**

New locations so assortment planning difficult & new set of people who do not understand Subhiksha model Further, tight inventory norms and poor service from suppliers as suppliers are not paid in time (Tight case as funding needed to support growth (investment in fixtures, sustain losses at initial time period). Fast growth leads to vicious cycle which lowers demand which means higher losses and forecasting problems

**Teaching Suggestions**

Although we believe that the case is ideally suited to a 90-minute class, it is possible that many classes fail to cover all the materials identified in the analysis section. Since case is rich in data Instructor should decide which areas he or she would like to focus in the case analysis. This would also depend on the sequencing of the case within the course. If students have already dome course on retail management one can generate interesting discussion on retail economics. Modular design adopted in case analysis provides necessary flexibility to instructor in structuring the class discussion. Instructor can also try and bring in data from Pantaloon (from financial statements) so as make discussion richer. Instructor also should encourage students to visit one of the store in neighbourhood and compare and contrast operations at Subhiksha with store in the neighbourhood.