7 DISCUSSION ON RESULTS OF ANALYSIS

7.1 INTRODUCTION

In this chapter, a critical examination of the results of analysis in previous chapters has been carried out to arrive at managerial implications of supply chain performance measurement. The insights provide guidelines for managers in benchmarking expected performances from each entity for effective supply chain management with immense benefits to all the entities along the value chain.

7.2. IMPLICATIONS OF ODP MEASUREMENT

The data for analysis of delivery performance has been collected from different divisions of ARBL (Chapter 3) and consolidated elemental performances have been used in calculating ODP (Chapter 4). Detailed discussion on the facts observed and managerial implications for improved performance of different entities along the supply chain is furnished in the successive paragraphs.
The mean and variance in elemental performances (suppliers’ on-time delivery, manufacturing schedule attainment, warehouse on-time delivery and transportation providers’ on-time delivery) as well as the ODP from FY: 2004 – 05 to FY: 2009 – 10 have been calculated and presented in table: 7.1. The improvements in mean and variances in elemental performances as well as ODP in the past six years is presented in figures 7.1 and 7.2.

From figure 7.2, it is clearly indicated that the variances in performances of entities have been decreasing which means that the performances were improved in the past three years due to persistent efforts of focal firm in improving ODP. It is observed from the table 7.1 that even though, there are fluctuations in variance of element wise performance but still, the variance in ODP is continuously decreasing. This indicates that the efforts of CIP projects by SCM division of ARBL were successful in improving the ODP of the supply chain as a whole.
Table 7.1 Statistical analysis of elemental and overall delivery performance (FY: 2004 – 05 to 2009 – 10)

<table>
<thead>
<tr>
<th>Financial Year</th>
<th>Supplier on-time delivery Mean</th>
<th>Supplier on-time delivery Variance</th>
<th>Mfg schedule attainment Mean</th>
<th>Mfg schedule attainment Variance</th>
<th>Warehouse on-time delivery Mean</th>
<th>Warehouse on-time delivery Variance</th>
<th>3PL on-time delivery Mean</th>
<th>3PL on-time delivery Variance</th>
<th>Overall Delivery performance Mean</th>
<th>Overall Delivery performance Variance</th>
</tr>
</thead>
<tbody>
<tr>
<td>2004 - 05</td>
<td>0.8475</td>
<td>0.004620</td>
<td>0.9746</td>
<td>0.000162</td>
<td>0.7147</td>
<td>0.017052</td>
<td>0.6450</td>
<td>0.012554</td>
<td>0.3834</td>
<td>0.006935</td>
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<tr>
<td>2005 - 06</td>
<td>0.9250</td>
<td>0.001427</td>
<td>0.9789</td>
<td>0.000199</td>
<td>0.8825</td>
<td>0.005257</td>
<td>0.7183</td>
<td>0.011761</td>
<td>0.5756</td>
<td>0.010726</td>
</tr>
<tr>
<td>2006 - 07</td>
<td>0.8958</td>
<td>0.001354</td>
<td>0.9882</td>
<td>0.000066</td>
<td>0.8932</td>
<td>0.002949</td>
<td>0.8100</td>
<td>0.001691</td>
<td>0.6402</td>
<td>0.000728</td>
</tr>
<tr>
<td>2007 - 08</td>
<td>0.9058</td>
<td>0.000754</td>
<td>0.9909</td>
<td>0.000150</td>
<td>0.8867</td>
<td>0.002343</td>
<td>0.8416</td>
<td>0.001888</td>
<td>0.6708</td>
<td>0.003779</td>
</tr>
<tr>
<td>2008 - 09</td>
<td>0.9200</td>
<td>0.001236</td>
<td>0.9680</td>
<td>0.000321</td>
<td>0.8789</td>
<td>0.002471</td>
<td>0.8533</td>
<td>0.001424</td>
<td>0.6682</td>
<td>0.002142</td>
</tr>
<tr>
<td>2009 - 10</td>
<td>0.9358</td>
<td>0.001117</td>
<td>0.9562</td>
<td>0.000464</td>
<td>0.8404</td>
<td>0.001940</td>
<td>0.8733</td>
<td>0.003042</td>
<td>0.6564</td>
<td>0.000441</td>
</tr>
</tbody>
</table>
Figure 7.1 Track sheet of mean performance of different entities and ODP of ARBL
Figure 7.2 Track sheet of variance in performance of different entities of ARBL supply chain
To mitigate supply risks and address price volatility, ARBL formulated multi-pronged strategies:

1. Entering into annual contracts for 90% of the estimated quantity.
2. Strengthened process for junk collection and conversion.
3. Improved pay terms with suppliers and included price variation clauses.
4. Developed alternative sources for pure lead and lead alloys.
5. Explored options for synergies in procurement with trading partners.

The operational efficiency has been improved through the following efforts:

1. Adoption of lean manufacturing concepts and reduction of non-value added tasks.
2. Initiation of an in-depth analysis of the grid-casting process and modifications to improve grid production significantly.
3. Innovative modifications at the pasting unit improved operational speed and hence productivity.
4. Increasing the availability of critical components to the assembly line through a pioneering process with significant saving in production time and increasing assembly line productivity.
5. Improving the performance and life of the power stack range of batteries by modifying the design of certain internal components.
6. Reduction of waste and dross levels at various stages in the production process through Six-Sigma initiatives.

7. Planning optimal product mix in the light of capacity constraints to increase profitability.

8. Procurement of best-in-class equipment through sourcing and enduring strategic relationship with equipment vendors.

9. Reliable supplies and better pricing through constant knowledge sharing.

10. Improvement of quality management system by adopting six-sigma programs, reducing rejections to 50 ppm (approx) and aiming towards Zero Defect (ZD).

In Logistics, the company optimized costs through following initiatives:

1. Improved truck loading factor through better planning

2. Redesigned packages, facilitating increased utilization of trucks.

3. Strategic agreements with 3PL providers to improve percentage on time delivery.

All these efforts put together improved the overall delivery performance of the firm in the past three years significantly. Still there is scope for improving performance of each entity (i.e., supplier on-time delivery, manufacturing schedule attainment, warehouse on-time shipment and transportation provider on-time delivery) so as to improve the overall delivery performance.
7.3 TOTAL COST MODEL - EFFECT OF LEARNING

The total cost model developed to analyze the effect of learning has been demonstrated with an example in chapter – 4. The empirical analysis clearly indicates that the optimal performance level is shifting towards right (improvement) with significant decrease in total cost. As it is difficult to get relevant real time data on costs associated with different elements of delivery performance, trial values have been used for analysis.

The graphs plotted for total cost and performance levels (figures 4.8 to 4.23) indicate the improvement in performance with learning and significant decrease in total cost. Further, the ARBL supply chain can use the learning index for benchmarking in two ways:

(i) For a definite number of transactions, using the initial and final performance levels, the learning index can be calculated using the equation 4.15.

(ii) For a fixed time interval, using initial and expected final performance levels for different number of transactions, the learning index can be calculated using the equation 4.15.
While benchmarking, a firm and its supply chain can use learning index as a measure to improve its element wise delivery performance or a definite learning index may be targeted and actual performance may be compared with the target value to identify reasons for deviation and take corrective measures to improve the performance.

7.4 EFFECT OF REDUCING DEFERRAL PERIOD ON C2C CYCLE TIME

It has been observed (in Chapter 5) that the focal firm ARBL has not concentrated in shortening the payment deferral period to improve C2C cycle time as well as improved working capital management. The penalty values associated with different payment deferral periods for the payables and receivables in each financial year (in case of ARBL) reveals that the firms in general are not very particular about improving working capital management of whole chain in an integrated approach.

The LPP formulated to minimize total penalty (Chapter 5) has been solved using TORA for different objective coefficients and right hand side values of constraints. For payables and receivables in each financial year as per the financial statements, the penalty values have been estimated and in all cases, it is observed that the solution of LPP yielded minimum penalty and is decreasing with decreasing payment and collection periods as well as the payment deferral period. The summary
of sensitivity analyses carried out on results of LPP by varying payment periods as well as deferral period is furnished in tables 7.2. The results are encouraging and provide basis for benchmarking to facilitate negotiations on payment and collection periods with trading partners.

As the deferral period is decreased, automatically the cash conversion cycle time also shortens which leads to improved working capital management and good supplier and customer relationship. This in turn will lead to long run benefits to the organization and its supply chain. Once the velocity of collections and payments along the supply chain is increased, naturally all companies will get benefited. The companies along the supply chain can optimize their financial portfolio management in improving their non-operating income to increase wealth which in turn will be helpful for them to invest on renovation and effective supply chain management.
Table 7.2 Summary of sensitivity analyses on payment deferral period

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<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>Variables</td>
<td>Current</td>
<td>Min</td>
<td>Max</td>
<td>Current</td>
<td>Min</td>
<td>Max</td>
<td>Current</td>
<td>Min</td>
<td>Max</td>
</tr>
<tr>
<td>Payment Period (days)</td>
<td>82</td>
<td>14</td>
<td>35</td>
<td>84</td>
<td>14</td>
<td>35</td>
<td>80</td>
<td>14</td>
<td>35</td>
</tr>
<tr>
<td>Collection Period (days)</td>
<td>85</td>
<td>17</td>
<td>40</td>
<td>88</td>
<td>17</td>
<td>40</td>
<td>84</td>
<td>17</td>
<td>40</td>
</tr>
<tr>
<td>Payment deferral Period (days)</td>
<td>3</td>
<td>3</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>Penalty (Million Rs)</td>
<td>11.46</td>
<td>2.26</td>
<td>5.40</td>
<td>15.17</td>
<td>2.81</td>
<td>6.71</td>
<td>14.23</td>
<td>2.78</td>
<td>6.64</td>
</tr>
<tr>
<td>Variables</td>
<td>Current</td>
<td>Min</td>
<td>Max</td>
<td>Current</td>
<td>Min</td>
<td>Max</td>
<td>Current</td>
<td>Min</td>
<td>Max</td>
</tr>
<tr>
<td>Payment Period (days)</td>
<td>45</td>
<td>14</td>
<td>35</td>
<td>75</td>
<td>14</td>
<td>35</td>
<td>94</td>
<td>14</td>
<td>35</td>
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<tr>
<td>Collection Period (days)</td>
<td>86</td>
<td>17</td>
<td>40</td>
<td>88</td>
<td>17</td>
<td>40</td>
<td>70</td>
<td>17</td>
<td>40</td>
</tr>
<tr>
<td>Payment deferral Period (days)</td>
<td>41</td>
<td>3</td>
<td>5</td>
<td>13</td>
<td>3</td>
<td>5</td>
<td>-24</td>
<td>3</td>
<td>5</td>
</tr>
</tbody>
</table>
Even though, the firms strategically try to maintain shorter (or negative) deferral period, from supply chain point of view, this may induce losses to trading partner(s) up or down stream along the supply chain. In order to make benefits to all firms along the supply chain, the focal firm has to arrive at optimal payment and collection periods with its trading partners that will be acceptable to all entities for effective supply chain management. This philosophy has to be explained to all trading partners in terms of mutual benefits and long term co-operation & collaboration expected from them in carrying out business activities. The supply chain practice emphasizes on benefits to all firms along the value chain. Focal firms must workout in this direction to find optimal payment and collection periods that will be beneficial to upstream and downstream firms, to strengthen themselves financially and provide better services.

7.5 ITR – EFFECT ON IMPROVING C2C CYCLE TIME

Inventory management is vital in supply chain performance of a firm. Inventory turnover is a measure of management's ability to use resources effectively and efficiently. Precise control and safeguarding of inventory is an essential task for a successful and well organized company. Business requires timely and accurate information on inventory location, movement and valuation. ERP systems provide data pertaining to receipt of goods, movement within and between locations, the sale, removal or disposition of goods, lot and serial tracking, precise valuation and status of
goods remaining in inventory at any point of time. As a part of continuous improvement program (CIP), firms can focus on inventory turn ratio as a means of improving their supply chain performance.

Researches reveal that IT, internal operations, customer-supplier relationship and information sharing significantly influence inventory turnover performance. To achieve high inventory turnover companies need to improve their internal efficiency through elimination of non value added activities and excessive inventories. This can be achieved by effectively implementing IT in all operational activities. In addition, companies also need to go beyond their internal operations to work closely with their external counterparts both upstream and downstream the supply chain. Close coordination amongst members of a supply chain is facilitated by high level of information sharing. Through EDI, firms can integrate their activities and work hand in hand with collaborative forecasting and replenishment to maintain minimum level of inventory throughout the supply chain for the competitive advantage of all companies along the chain.

The improved ITR (chapter 5) tends to decrease in inventory days of supply which in turn leads to shortened C2C cycle time. At ARBL, the improvement in ITR helped it in decreasing inventory days as well as cash-to-cash cycle time in the year 2008 – 09. In the past nine years, the correlation between inventory days and cash-to-cash cycle time is 0.8 and $R^2 = 0.64$. It means 64 % of the variance in C2C cycle time
is attributed to variations in inventory days and the rest 36% may be due to other factors (such as payment and collection periods).

In any financial year, when there were longer inventory days (Smaller ITR), there was higher penalty to one or the other company of that particular supply chain. Hence, it is strongly recommended that the firms must look at ITR as a means of improving performance not only from inventory management point of view but also from working capital management point of view. Higher the ITR, shorter will be the inventory days and shorter C2C cycle time.

7.6 IMPLICATIONS OF SHAREHOLDER FACING PERFORMANCE MEASUREMENT

It seems clear from the literature that the information available from a traditional costing system is not sufficient for CIPs that are essential to competitiveness in rapidly changing market environments.

Shareholders are also equally interested as others in assessing the performance of a firm in terms of its financial efficacy. The metrics provide some basis for management to continuously improve its supply chain performance. By continually
monitoring some of these measures, management can take better decisions regarding financial commitments. Shareholder facing metrics also provide basis for improved inventory control, asset utilization, financial leverage, productivity and so on. These metrics not only provides insight from the financial perspective but also reflects the internal operational performance.

By tracking the performance of the firm in terms of financial metrics such as OI, NOI, ROA, etc., a firm can achieve improvements in different functional areas: inventory management, cost control in internal operations, labor productivity and asset utilization. If there is continuous tracking of these financial metrics, focal firm can alarm its supply chain trading partners for effective achievement of common goals.

In any supply chain, focal firm is the driving force which can provide required information to all its trading partners. Through efficient communication channels among the trading partners, the cross-border functions may be carried out in a most economic and effective manner so that all the firms along the supply chain get benefited.
7.7 SUMMARY

Throughout the research, the focus is towards an integrated approach to find the means for performance improvement that will reap benefits to all the firms along a supply chain. The tool for continuous improvement is benchmarking performance levels expected from each entity along the supply chain. This research has provided a methodology to assess ODP and improve C2C cycle time with minimum penalty to all entities and analyzed effect of ITR on C2C cycle time. Also a frame work to assess the performance from shareholder’s perspective to find the overall supply chain efficacy. The mathematical models have provided most promising results and guides firms in benchmarking their performances towards improvement. The results of analysis are encouraging and ensure improvement in core areas. In practice, the firms can use the models for dynamic optimization in each performance measure for overall development.