2 LITERATURE REVIEW

2.1 INTRODUCTION

In this chapter, a critical review of literature is carried out pertinent to the objectives of research. The contributions of earlier researchers focusing on issues under each supply chain element in an integrated approach are considered. The barriers for integration and expected benefits of integration have been addressed. The contributions on integrated supply chain performance measurement have been presented. The focus of literature review is on interdisciplinary nature of supply chain management with respect to the performance metrics relevant to present research objectives.

2.2 INTEGRATION OF SUPPLY CHAIN ELEMENTS

Despite their vital role in industry, supply chains have traditionally been fragmented, resulting in slow and sequential material flow downstream and similar movement of data back upstream. The disconnected flow of inventory and information has lead to build-up of excess inventory to buffer uncertainties in supply and demand. Increased inventory carrying costs, longer order lead times and
difficulty in responding proactively to real-time changes in demand have decreased profits and weakened customer goodwill. Integration of supply chain elements is considered as the major factor for improving performance by achieving coordination and cooperation among trading partners.

Over the past decade a combination of economic, technological and market forces have compelled companies to examine and reinvent their supply chain strategies. As a result, some of the strategies like earlier involvement of suppliers, CPFR, postponement, formulating strategic alliances with trading partners, etc., have been evolved. All these strategies demand the need for integration of supply chain elements in the business processes across the organizational boundaries.

Evolution of new paradigms such as lean, six-sigma and agile manufacturing as well as technological innovations such as Electronic Data Interchange (EDI), Radio Frequency Identification (RFID) and Global Data Synchronization (GDS) have laid new path towards developments in supply chain integration. The revolutions in logistics lead to the integration of Third Party Logistics (3PL) and Fourth Party Logistics (4PL) providers with distribution functions. Information Technology (IT) also played crucial role in bringing coordination and cooperation between different elements in a value chain (Kate Bailey & Mark Francis, 2008) by deploying Internet and web technology. All these technical advancements help industrial organizations
in providing better services to customers at lesser cost and ultimately lead to value addition with significant expenditure but achieve high level of customer satisfaction.

Douglas J. Thomas & Paul M. Griffin (1996) reviewed the literature addressing coordinated planning between two or more stages of the supply chain, placing particular emphasis on operational planning defining three categories of coordination: Buyer-Vendor coordination, Production-Distribution coordination and Inventory-Distribution coordination.

Michael J. Maloni & W.C. Benton (1997) suggested that the expanding importance of supply chain integration presents a challenge to operations researchers to focus more attention on supply chain modeling and there are numerous opportunities for operations researchers to provide support for the current conceptual based supply chain research. They also compared traditional supplier relationship with supply chain partnership and highlighted benefits of supply chain partnership.

Benita M. Beamon & Tonja M. Ware (1998), developed the Process Quality Model (PQM) which is an extension of Total Quality Management (TQM) to evaluate, improve and control the overall quality of the supply chain system considering qualitative performance measures such as customer satisfaction,
flexibility, information and material flow integration, supplier performance and quantitative performance measures based on cost and customer responsiveness.

Christopher C. Yang et al., (2000) developed a system by integrating constraint network model and multi-agent technology to support coordination and management of supply chains. The agents communicate through internet to support dynamic optimization.

Inter-functional integration between a firm’s marketing and logistics functions is necessary to fully capitalize on potential service improvements. The results of research by Alexander E. Ellinger (2000) on performance benefits associated with encouraging effective marketing & logistics interdepartmental relations suggest that an appropriate evaluation and reward system which recognizes team work and cooperation as a significant catalyst for the promotion of cross-functional collaboration.

Ursula Y. Alvarado & Herbert Kotzab (2001) conducted case studies in Austrian grocery industry using the principles (relationship initiation, relationship maintenance and relationship termination) of Efficient Consumer Response (ECR) by integrating logistics in marketing.
Hau L. Lee & Seungjin Whang (2001) explored how information hub acts instantly to process and forward relevant information to all parties in internet-based supply chain integration. The impact of e-business on supply chain integration & business processes of procurement, order fulfillment, product design and post-sales support were examined. The interactions between different elements in this model have been presented in figure 2.1.

![Information Hub model](image)

Figure 2.1 Information Hub model


Craig A. Hill & Gary D. Scudder (2002) examined the use of EDI as a tool for integration with respect to inter firm coordination activities involving suppliers and customers. Also the effect of demographic conditions on use of EDI has been considered.
Markham T. Frohlick & Roy Westbrook (2002) suggested that Demand Chain Management (DCM) is most powerful and best web-based integration strategy for manufacturers to achieve integration with suppliers and customers.

M. Barut et al., (2002) developed a generic measure called Degree of Supply Chain Coupling (DSCC) a 2-tuple index which takes into account both the intensity and extent of information sharing by the firm in both directions of the supply chain. The DSCC score helps to assess improvements in supply chain integration, facilitate comparisons with competitive firms and can be applied to all members of a supply chain to identify “weak links”.

Pietro Romano (2003) developed a conceptual framework to study the interaction of the coordination and integration mechanisms in order to understand how logistics processes can be designed and managed across a supply network for successful SCM.

Jay Lee (2003) introduced e-manufacturing as a new concept for complete integration of all business elements including suppliers, customer service network and manufacturing units by leveraging the Internet, web-enabling and computational tools.
Martin Rudberg & Jan Olhager (2003) compared manufacturing network theory (intra-firm focus) and supply chain theory (inter-firm focus) under operations strategy perspective focusing on two structural decision categories: facilities and vertical integration. They suggested ways to integrate configuration and coordination of networks to analyze network hierarchies and to develop inter-firm network strategies.

Many authors seem to agree that integrative practices and a high level of integration have positive impacts on corporate and supply chain performance. The integration of electronic commerce and associated Business-to-Business (B2B) transaction capabilities lead to global inventory visibility, reduced costs and improved customer service by decreasing lead-time variability, shipping and receiving cycle times, increasing shipment and inventory accuracy (Scott J. Mason et al., 2003).

More developed SCM is indicated by systematic integration, i.e., standardized and automatic inter-organizational interfaces. In order to improve effectiveness of SCM, a synchronized operation of all partners in the supply chain is required. In the past, this has been achieved by one company owning or having control over all businesses in the chain. Now, it is more likely that this integration is carried out by using Inter Organizational Information System (IOIS) (D. Sculli et al., 2001, Elizabeth A. Williamson et al., 2004).
Mason R & Lalwani C (2004) developed a framework for decision making to integrate transportation more effectively with supply chain processes. They also highlighted the implications of structural change, operational change and inter-functional changes in reconfiguring integration of logistics with supply chain.

The adoption of Concurrent Engineering (CE) and design for manufacturability foster more trusted reliable and long-term relationships with key suppliers in internal operations of the firms particularly during new product / process design. The early involvement of supplier is one of the most effective supply chain integrative techniques which can also improve upstream production flexibility resulting in reduction of supply chain response time (Joel D. Wisner et al., 2005).

A. Chande et al., (2005) described an integrated framework for inventory management and developed an efficient algorithm for the optimization problem. A suitable architecture for the application of RFID technology to realize potential benefits has been suggested.

J. Liu et al., (2005) developed a common integrated management system called Workflow supported inner Supply Chain Management system (WSCM) for Nanjing Jin Cheng Motor Cycle Corporation Limited and most of its suppliers to manage their inner processes.
S. K. Jain & Taruna Upadhyaya (2005) presented an integrated model for agile supply chain considering elements such as inbound logistics, internal operations and out bound logistics to reduce total pipeline time in order to minimize C2C cycle time.

Ming Dong & F. Frank Chen (2005) presented an analytical framework for integrated logistic chains used to model different network topologies such as series, parallel and assembly structures. Performance measures such as fill rates, expected number of back-orders, expected number of orders waiting in queue, expected inventory level and stock out probability were analyzed using GI / G / 1 queuing model.

Günther Zäpfel & Michael Wasner (2006) developed a heuristic solution concept for an integrated reel warehouse sequencing of a steel supply chain to capture all dynamic situations of the warehousing processes.

Peter Trkman & Groznik (2006) analyzed the main aspects needed for successful renovation, integration and operation of supply chains.

Yao Weixin (2006) suggested five different atomic models of closed loop supply chains namely: MRCRM, MRCTM, MRCM, MCTM & MTM (M-
manufacturer, R- Retailer, C- Customer & T- Third party) by integrating forward and reverse supply chains. The results of analysis indicated that a manufacturer can select a certain model according to his background and business conditions or he can even combine various models to cater for quickly changing markets.

The present trend in logistics is the concept of 4PL (Fourth Party Logistics providers) which is based on drawing the disparate 3PL’s together to provide a seamless solution to the client (Paul Liston et al., 2007).

Thomas J. Kull et al., (2007) integrated extended supply chains, e-commerce and learning curve theory. The authors argued that learnability index utilizing learning rate metrics can be helpful for firms wishing to benchmark their supply chain’s customer interface effectiveness.

Piero Migliarese & Vincenzo Corvello (2007) compared virtual enterprises with vertically integrated firms and production networks. They argued that virtual enterprises are suitable for firms producing complex, modular products, with frequent changes in components but of low knowledge specificity.
Over the past decade, the main theme in the SCM literature has been the role of integration as a key factor in achieving improvements (Taco Van der Vaart & Dirk Pieter van Donk, 2008).

Harri Lorentz (2008) attempted to investigate the level of supply chain collaboration in an uncertain cross-border context in order to identify the correlation between relationships of collaboration and performance in the chosen cross-border context in international business environment of high level of supply chain uncertainty.

K. N. Subramanya & Dr. S.C. Sharma (2009) used PROMODEL and attempted to study integrated system of a two stage supply chain network of an automobile company and measured operational processes between supplier-manufacturer-distributor using qualitative data.

2.2.1. Barriers for integration of supply chain elements

A number of factors can obstruct external process integration along the supply chain causing information distortion, longer cycle times, stock-outs, bullwhip effect resulting in higher overall costs and reduced customer service capabilities.
The obstacles (barriers) are discussed as follows:

1. Silo mentality: Failing to see the big picture and acting only in regard to a single department within the firm or a single firm within the supply chain.

2. Lack of supply chain visibility: The inability to easily share or retrieve trading partner information in real time, as desired by the supply chain participants.

3. Lack of trust: Unwillingness to work together or share information because of fear that the other party will take advantage of them or use the information unethically.

4. Lack of knowledge: Lack of process and information system skills and lack of knowledge regarding the benefits of SCM among management and other employees within the firm and among partners.

5. Activities causing bullwhip effect: Frequent demand forecast updating (due to change in review periods), order batching, price fluctuations, rationing and shortage gaming causes bullwhip effect.
2.2.2. Expected benefits of supply chain integration

Integration allows companies to automatically coordinate their activities across firm boundaries and this increased coordination provides benefits at several levels that impact mission-critical activities.

1. Integration enables reduced transaction process costs, increases the speed and accuracy with which companies respond to trading partners. In addition, lowering total supply chain costs increases overall profit, which benefits all the participants in the supply chain.

2. More efficient shared work-flows: Collaboration tools structure processes, improves coordination by clarifying what activities need to be done and at what time?

3. Improved supply chain planning: Integration allows firms to share information about sales forecasts, promotions, capacity utilization, etc. CPFR efforts can both increase sales and reduce inventory by percentages in the double digits.

4. Supply chain optimization: Integration allows firms not only to operate in the same way more efficiently but also allows them to reconfigure how they operate together.
2.3 SUPPLY CHAIN PERFORMANCE MEASUREMENT

Supply chain performance refers to the extended supply chain’s activities in meeting end-customer requirements including product availability, on-time delivery, all the necessary inventory and capacity in the supply chain to achieve that performance in a responsive manner. Supply chain performance crosses company boundaries since it includes basic materials, components, subassemblies and finished products, and distribution through various channels to the end customer. Hence, businesses need to migrate from one-dimensional (process / firm specific) measures to multi-dimensional (integrated process / supply chain wide) ones’ and from single-enterprise focus to cross-enterprise focus as shown in figure 2.2.

Figure 2.2 Evolution of supply chain performance measurement
Firms need to develop an entire system of meaningful performance measures to become and then remain competitive. Many of the world’s businesses respond to increased competitive pressure by attempting to develop and maintain an effective performance measurement system linking firm’s strategy to operating decisions. Performance criteria that guide a firm’s decision making to achieve strategic objectives must be easy to implement, understand and measure. They must be flexible and consistent with the firm’s objectives and should be implemented in areas that are viewed as critical to the success of the firm and its supply chain (Sunil Chopra & Meindl P., 2001).

Benita M. Beamon (1999) presented an overview for evaluation of the performance measures under three headings: resource measures, output measures and flexibility measures. The author presented a framework for the selection of performance measurement system to manufacturing supply chains. Benchmarking is another important method that is used in performance measure evaluation which also helps as means of identifying improvement opportunities.

From purchasing point of view, careful and effective Supplier Relationship Management (SRM) efforts allow firms to selectively screen out poor-performing suppliers and build successful, trusting relationships with the top-performing suppliers. Thus, firms must rationalize the size of their supply bases to develop strategic alliances which would result in greater levels of supply base performance.
The Internet’s influence will continue to grow into the foreseeable future as businesses collaborate with supply chain partners to source, produce & distribute products and services globally, to leverage the inherent advantages of networked competition (Bharat Rao, 1999).

According to Richard A. Lancioni et al., (2000) General Electric has benefited by 50% reduction of purchasing staff and 40% reduction in order cycle time and the error rate in order processing by on-line purchasing.

David He et al., (2001) analyzed scheduling issues in assembly driven product differentiation strategy in agile supply chain using heuristic algorithms.

Dennis W. Krumwiede & Chwen Sheu (2002) developed a framework for reverse logistics strategic decision making model in a view to guide third party logistics providers who wish to enter into the reverse logistics market.

Felix T.S. Chan & H. J. Qi (2003) proposed a cross-organizational performance measurement method to support performance improvement in SCM. The fuzzy algorithm evaluates the holistic performances of each process and the de-fuzzified results provide easy access to benchmark the performances of whole system and identify the potential opportunities for performance improvement in SCM.
To achieve a balanced view of the supply chain, CGI (www.cgi.com, 2004) has strongly recommended that an organization should establish at least one KPI in each of the following areas: Supply Chain Reliability, Responsiveness, Flexibility, Cost and Assets. CGI has given a sample scorecard for supply chain performance measurement which provides easy analysis and understanding of baseline numbers, targets and eventually actual progress as shown in table 2.1.

Table 2.1 Sample Score Card for Supply Chain Performance Measurement

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Level 1 Metrics</th>
<th>Basis of Competition</th>
<th>Target</th>
<th>Actual</th>
<th>Value from Improvements</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Baseline</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Priority</td>
<td>Advantage</td>
<td>Superior</td>
<td></td>
</tr>
<tr>
<td>Supply Chain</td>
<td>Delivery Performance to Commit Date</td>
<td>50%</td>
<td>85%</td>
<td>90%</td>
<td>95%</td>
</tr>
<tr>
<td></td>
<td>Till Rates</td>
<td>65%</td>
<td>94%</td>
<td>96%</td>
<td>98%</td>
</tr>
<tr>
<td></td>
<td>Order Fulfillment</td>
<td>0%</td>
<td>80%</td>
<td>85%</td>
<td>90%</td>
</tr>
<tr>
<td></td>
<td>Order Fulfillment Load Time</td>
<td>35 days</td>
<td>7 days</td>
<td>5 days</td>
<td>3 days</td>
</tr>
<tr>
<td></td>
<td>Supply Chain Response Time</td>
<td>57 days</td>
<td>82 days</td>
<td>55 days</td>
<td>13 days</td>
</tr>
<tr>
<td></td>
<td>Production Flexibility</td>
<td>45 days</td>
<td>30 days</td>
<td>25 days</td>
<td>20 days</td>
</tr>
<tr>
<td></td>
<td>Total SCM Management Cost</td>
<td>19%</td>
<td>13%</td>
<td>8%</td>
<td>3%</td>
</tr>
<tr>
<td></td>
<td>Value Added Employee Productivity</td>
<td>N/A</td>
<td>$156k</td>
<td>$306k</td>
<td>$480k</td>
</tr>
<tr>
<td></td>
<td>Inventory Days of Supply</td>
<td>159 days</td>
<td>55 days</td>
<td>38 days</td>
<td>22 days</td>
</tr>
<tr>
<td></td>
<td>Cash-to-Cash Cycle Time</td>
<td>196 days</td>
<td>80 days</td>
<td>46 days</td>
<td>28 days</td>
</tr>
<tr>
<td></td>
<td>Net Asset Turns (Working Capital)</td>
<td>22 Turns</td>
<td>8 Turns</td>
<td>12 Turns</td>
<td>19 Turns</td>
</tr>
</tbody>
</table>

A cross-industry survey conducted by Deloitte (2004) found that 47 percent of companies had no formal strategy for supply chain performance measurement and therefore, had no systematic method for prioritizing supply chain improvement opportunities. Executive dashboards assist supply chain leaders by providing a view of current business conditions, tracking progress towards strategic goals and ensuring early warnings for potentially disruptive issues.

Although supply chain executives have derived hundreds of performance measures, best-in-class dashboards report only the critical few metrics. Without understanding the critical relationship between such measures as inventory turnover and Economic Value Added (EVA), companies fail to fully convert supply chain management into value chain strategy.

By reducing dashboard complexity, organizations enable upper-level management to quickly and accurately respond to changing market conditions and real-time alert messages. A sample dashboard is given in table 2.2 considering KPI’s under four perspectives: Finance, Customer Relations, Internal Process, Learning & growth.
Table 2.2  Dashboard Metric Configurations

<table>
<thead>
<tr>
<th>Supply Chain Perspectives</th>
<th>Key Performance Indicators</th>
</tr>
</thead>
</table>
| **Finance**               | • ROIC (Return on Invested Capital)  
                           | • EVA (Economic Value Added)  
                           | • Customer Profitability  
                           | • Cash-to-Cash Cycle Time  
                           | • Accounts Payable/Receivable  
                           | • NOPAT (Net Operating Profit After Tax)  
                           | • Inventory Turnover Rate  
                           | • Cost Breakdown (e.g. warehousing)  |
| **Customer Relations**    | • Retention Rate  
                           | • Satisfaction Levels  
                           | • Downstream In-Stock Ratio  
                           | • Order Fill Rate  |
| **Internal Process**      | • Record Accuracy  
                           | • Forecasting Accuracy  
                           | • Adherence to Production Schedules  
                           | • Lead Time Variability  |
| **Learning & Growth**     | • Employee Satisfaction  
                           | • Employee Productivity  
                           | • Revenue from New Products  
                           | • Utilization of New Delivery Channels  |

[Source: Supply Chain Executive Board (2004)]

James Tannock et al., (2007) introduced the concept of data driven modeling and simulation to assess the supply chain performance in aerospace industry considering the following metrics in the scorecard: Throughput capacity, cost (includes production, transportation and inventory holding costs), Fill rate by order, order fulfillment lead time, cycle time robustness.

R. Prasad (2007) conducted a case study in Diesel Locomotive Works, Varanasi (India) to show how IT has helped the firm to manage its supply chain in reducing costs, have better relationship with both its suppliers and customers, to give better product and service to its customers.
Ross E. Marshall (2007) presented a brief note on Air Force SCM processes and made a comparison between application of SCOR metrics in private sector and Air Force and opines that the SCOR metrics should be tailored as per the requirements of Air Force SCM practices.

Ana Cristina Barros (2008) explored the use of common scorecard to share performance measurements between buyer and supplier collaboration projects. The implementation and benefits of this common scorecard has been shown in a case study of a VMI operating in an environment of high demand volatility, long lead time and customized products.

Horatiu Cirtita & Liviu Ilies (2009) developed a model using Multiple Attribute Utility Theory to select best downstream network configuration with highest performance.

In the present research, the objectives have been formulated taking into account the existing practices in ARBL, limitations on data availability, the core capabilities of the firm and its supply chain partners while integrating selected performance indicators to assess the performance. Relevant to the present research objectives, the review of literature is carried out considering contributions on ODP, C2C cycle time, ITR and shareholder facing performance measures.
2.3.1 Delivery performance measurement

Hiroshi Katayama & David Bennett (1999), analyzed performance measures such as operational cycle time, procurement lead time, on-time delivery to customer, delivery lead time and speed of new product development from agility, adaptability and responsiveness perspectives using survey data collected from major Japanese companies.


Dong Li & Christopher O’Brein (1999) addressed delivery promptness as a supply chain performance measure at chain level and operations level focusing on supplier’s performance alone.

Tim A Minahan & Mark W. Vigoroso (2002) interviewed supply chain executives across multiple industries and geographies on their company’s supplier performance measurement procedures. Of more than 70% of enterprises examined,
the executives viewed measurement of supplier performance as “critical” to their companies’ overall operations.

Scott J. Mason et al (2003) highlighted the indirect benefit in terms of improved delivery lead time performance as a result of improvements in inbound and outbound logistics.

Dinesh Garg, et al (2003) concentrated on delivery sharpness and delivery probability using process capability studies in a Make-to-Order (MTO) supply chain without any focus on supplier and logistic providers performances.

J. Schmitz & K. W. Platts (2004) investigated the use of supplier performance measurement primarily in the logistics context and only from the Original Equipment Manufacturers’ (OEMs) perspective.

Thomas M. Rupp & Mihailo Ristic (2004) proposed a system that supports cooperation in complex production networks by enabling companies to determine and exchange supply information with their customers. The system helps to gain competitive advantages and efficiency improvements such as reduced inventory and higher delivery reliability.
Garg D et al., (2004) argued that achieving superior delivery performance is the primary objective of any industry supply chain. Destruction of synchronization as a result of increase in number of resources, operations and organizations in a supply chain leads to poor delivery performance. The authors introduced a new notion, called Six Sigma supply chains to describe and quantify supply chains with sharp and timely deliveries and developed an innovative approach for designing such networks.

Kee-Hung Lai et al., (2004) carried out a study to empirically evaluate the supply chain performance in logistics industry by assessing the perceptions of service providers in the three sectors: air & sea transport, freight forwarding and third party logistics services. The results of study provide managerial insights for the firms to understand their supply chain performance and to benchmark areas to improve the performance.


C. Morgan & A. Dewhurst (2008) investigated the usability of control charts to examine supplier’s delivery performance into the retailer’s distribution centers and to monitor the supplier-retailer interface. The results could potentially be used to monitor and manage the buyer-supplier relationship effectively.

Soroush Avakh Darestani et al., (2010) carried out process capability studies in an automotive industry to assess supplier performance in terms of on-time delivery using control charts.

2.3.2 Inventory management

The most prominent area for improvement in SCM is inventory control. There are several sub-measures in inventory management such as order quantity, inventory accuracy, inventory tracking, inventory carrying cost, safety stock planning, inventory capability, etc. As the present research deals with study on the impact of Inventory days and ITR in improving C2C cycle time, a few contributions in inventory management are presented.

Prashant C. Palvia & D. Lim (2001) developed a customer service support system model with EDI and tested hypothesis concerning customer service under six
sub-hypotheses, i.e., impact on inventory capability, order cycle time, distribution system flexibility, quality of distribution system information, distribution system malfunction and post-sale product support.

Stefan Minner (2001) carried out analysis combining the problem of safety stock planning in a general supply chain with the integration of external and internal product return and reuse.

The implementation of WSCM system (J. Liu et al., 2005) resulted in rapid response to ever changing market, stability and operability of the manufacturing plan, very low inventory levels, 15% reduction in average life cycle of products in warehouse, quick flow of information along supply chain and improved working capital management.

K. Michael & L. McCathie (2005) discussed about the pros and cons of the application of RFID in SCM. They addressed some advantages such as asset tracking, improved inventory management, etc., and some of the disadvantages such as cost of software, equipment upgrades for integration of RFID with existing practices, barriers in achieving supplier and retailer cooperation, privacy concerns, etc.
Fu-ren Lin et al., (2006) proposed a simulation model of supply chain performance measurement. The model includes average fulfillment rate, average out of stock cost and average cycle time.

Today, many supply chain inefficiencies originate from inaccurate data about the location of products in the supply chain. RFID promises to enable new efficiencies in the supply chains by tracking goods (Ravi Mathur, 2006) from the Point of Manufacture (POM) through the retail Point of Sale (POS).

Chandandeep S. Grewal et al., (2010) Compared reorder point and kanban replenishment strategies on the basis of robustness in a capacitated supply chain network. Robustness was measured on the basis of area under performance trade-off curves based on total inventory and customer service levels.

Arumugam Mahamani & Dr. K. Prahlada Rao (2010) developed a spreadsheet model for VMI system in a single echelon supply chain to measure total inventory cost and attempted to find its impact on buyer-supplier relationship.
2.3.3 C2C cycle time assessment

In cash management area, the problem is to find out with which partner the benefits are pooled. The idea of reallocation of benefits among the supply chain partners is a real challenge. However, there must be a mechanism to identify opportunities to strengthen all the channel members through strategic agreements. In this section, a few contributions on C2C cycle time assessment are presented.

Dong Li & Christopher O’Brien (1999) developed an integrated decision model for assessing potential partners in a supply chain. The model enables decision makers to be proactive in decision process in balancing the profits of the whole supply chain among its supply chain partners.

In reality, most challenging situation occurs when the benefits pool with some members at the detriment of the others. This new challenge requires that managers find a way to measure and report costs and other data that span company boundaries; share information about the level of the benefits and with which members it reside; and reallocate the benefits among those channel members in a worse position as a result of their cooperation (Ronald H. Ballou et al., 2000).
Pedro Ortín-Ángel & Diego Prior (2004) analyzed the reliability of accounting ratios when entry flow and exit flow versions are used in computing receivables conversion period, inventory conversion period and payment deferral period. They also considered grouping the data of successive periods in calculating the averages in order to gain precision.

According to AMR Research reports (2004), companies with better demand forecast accuracy have 15% less inventory, 17% better perfect order ratings and 35% shorter C2C cycle times than their peers. An effective performance measurement system should consist of the traditional financial information for external reporting purpose along with tactical level performance criteria used to assess the firm’s competitive capabilities while directing its efforts to attain other desired capabilities (Joel D. Wisner et al., 2005).

Ruth Banomyong (2005) measured C2C cycle time of each supply chain member of an International Supply Chain (dealing with Shrimp exports from Thailand to United States) to identify which of the trading partners is benefited in the chain.

W. Meszek & M. Polewski (2006) analyzed the variations in working capital requirements and C2C cycle time of selected companies operating in construction field.
The computations of standardized financial variables for multiple-company data serve as an excellent benchmark to guide improvements within an individual company and across the supply chain (Paul D. Hutchison, et al, 2007).

Ali Uyar (2009) attempted to set industry benchmarks for cash conversion cycle of merchandising and manufacturing companies in Turkey and to examine the relationship between the length of Cash Conversion Cycle, size of the firms and profitability.

2.3.4 Shareholder facing performance measurement

Conventionally, the performance of any firm is assessed in terms of production quantities, sales volume and profit after tax, book value of share and earnings per share etc. The annual reports of the firms provide the information regarding above measures in the form of comparative statement showing performance in past few years.

According to A. Gunasekaran et al., (2004), the information available from a traditional costing system is not sufficient for the continuous improvement programs that are essential to competitiveness in rapidly changing market environments.
Generally, the balance sheet, profit & loss account of any firm will provide raw information showing net profit / loss after all deductions.

A. Gunasekaran et al, (2005) addressed Activity Based Costing (ABC) system to express the performance indicators in financial terms so that the performance can be assessed and necessary steps could be taken to improve the supply chain performance.

So far in the literature, no work has been done towards developing shareholder facing performance metrics to assess the effect of integration and renovation in supply chain management.

2.4 SUMMARY

After critical review of relevant literature, it has been identified that the models developed in the past in measuring delivery performance were not focused on all elements involved in the delivery process right from supplier end to the customer end in an integrated approach. Very limited work has been done to measure ODP considering all responsible entities. Also, the scope and methodology for benchmarking the expected performances of different entities in achieving desired
ODP to develop coordination and cooperation among supply chain partners has not been dealt with by earlier researches.

The earlier researches were limited to find C2C cycle time or identifying the trading partners with whom the benefits were pooled. In an integrated approach, so far no work has been done to develop a mechanism to find optimal payment and collection periods among trading partners that would be acceptable and profitable to both the parties. In the present research work, a term called “penalty” has been introduced which is the loss of interest on money of a firm blocked with its trading partner in the form of goods or services.

In Indian Context, some reputed companies like Hindustan Lever Limited has paid great attention to its vendors in order to improve its supply base. ITC’s e-Choupal, Ralli’s Kisan Kendra, PepsiCo’s Contract farming, Mahindra & Mahindra’s Subh-Labh services, Marico’s Midas-MI-Net, Amul’s Cooperative dairy in Gujarat, ARBL’s lean six-sigma practices have proven the improved performances through adoption of SCM in this decade. Particularly, from integration point of view there are several practical problems in achieving high level of coordination and cooperation from trading partners due to lack of trust and privacy problems. There is a need for firms to understand the benefits of shared vision, collaborative businesses and joint approach in problem solving in order to make benefits to all trading partners along the supply chain.