MEASURING SUPPLY CHAIN PERFORMANCE IN SELECTED FMCG AND MANUFACTURING INDUSTRIES

ABSTRACT

INTRODUCTION

Shortened product life cycles, increased competition and high expectations of customers have forced many leading companies to move from physical logistics management towards more advanced supply chain management (SCM). In addition to cost reduction, the supply chain management (SCM) also facilitates customer service management, inventory control, transportation systems and whole distribution networks so that organizations are able to meet or even exceed their customer's expectations. The supply chain management (SCM) is a core business concept that is deeply embedded within the functional backbone of an organization from procurement, manufacturing and distribution to customer service and sales.

Supply chain management (SCM) is the integration of key business process from goods end user through original suppliers that provides products, services and information that adds value for customers and other stakeholder. In an article in the Economic Times 500 (September, 2002) mentioned that the value of the organized market in India is estimated at $9 billion as against Brazil's fast moving consumer goods (FMCG) market in 2000-01 that was already $ 12 billion in fast moving consumer goods (FMCG). The Indian fast moving consumer goods (FMCG) sector is expected to clock over 40% growth in the next 5 years. This indicates the opportunity available and phenomenal growth potential of the fast moving consumer goods (FMCG) segment. Similarly in the manufacturing segment 20% to 30% of the value of all goods and services produced will enhance the economy of the country. A country's level of manufacturing activity is directly related to its economic health.

JUSTIFICATION FOR THE STUDY

With a gross domestic product (GDP) of over $47.43 billion, the industry spends 14% of its GDP on logistics (Raghuram & Rangaraj, 2000). Another article in the Wall Street Journal (March, 2006), mentioned that annual global logistics expenditures exceeded $3.5 billion which is nearly 20% of the world's GDP, making logistic perhaps the fast frontier for major corporations to significantly increase shareholder and customer value.

In an article in the Economic Times 500 (September, 2002), mentioned that India's 10% GDP growth is based on two areas i.e., industry and services. At a macro level the projected 7.9% GDP growth for the current fiscal year 2006-07 is indeed a remarkable achievement for the Indian economy by past standards. In an another article The Hindu Business News (April, 2002), mentioned that the govt. aims at increasing the share of manufacturing in the country's GDP from 17 to 33%, emphasizing the importance of manufacturing in India's growth. The sector contributed to about 53% of exports and received more than two third of total foreign investments. In terms of employment, it accounted for 11% of the workforce of about 45 million.

The fundamental objective of a high performing supply chain is to produce products to match customer's demand cycle, while producing the greatest value possible to the customers. The increasing competitive environment calls for speeding, cost efficient, accurate and reliable supply chain. Supply chain management (SCM) is no longer a matter of operational and functional areas of the firm. Today, it is a strategic issue demanding top-level management attention. The supply chain can have huge leverage on the creation of customer value. Supply chains will fight the new battle for market dominance; as such measurements around the supply chain are critical. If we look at competition today, it is "supply chain versus supply chain" (Ramakrishnan, 2006). This brings out a situation that competitors might focus on developing superior supply chain performance.

Thus, Indian companies need to leverage the supply chain for competitive advantage and as such, till date, there have been few initiatives to measure the performance of their existing supply chain systems.

REVIEW OF LITERATURE

Companies need to develop metrics to measure performance of supply chain. Measurement is important, as it affects behavior that impacts supply chain performance. As such, measurement provides means by which a company can assess whether its supply chain has improved or degraded. A variety of measurement approaches have been developed, including the following important approaches as reported in the AMR Research report (2000). The following approaches are considered as important:

(a) The balanced score card

(b) Supply chain council's SCOR Model

(c) The logistics score board

d) Activity based costing (ABC) and

(e) Economic value added (EVA)

Very limited literature exists on the measurements specific to the industries, more specifically, in the Indian context. The studies conducted by Performance Measurement group (1999): Korgaonkar (2000): Gunasekaran, et al., (2001): and Shah (2003), were reported in the literature review. The main research findings from these studies were comparison of metrics of delivery performance, total logistics cost, cash-to-cash cycle time, assets turns, inventory days of supply, production flexibility inventory carrying cost and cost due losses in general. In the present study efforts have been made to collect and analyze information from various segments of manufacturing and fast moving consumer goods (FMCG) with regard to supply chain performance measurements, supply chain management (SCM) initiatives and strategies in the Indian context. The review of literature ranges from the year 1980 to 2006.

RESEARCH OBJECTIVES

The overall purpose of this research was to measure the supply chain performance in selected segments in manufacturing which included auto & auto components, electronics, white goods, engineering and also FMCG sector. The objectives were:

1. To determine and measure performance metrics in the supply chain of fast moving consumer goods (FMCG) and manufacturing segments.
2. To study the significance of cycle time, cost, quality, assets and logistics cost metrics in fast moving consumer goods (FMCG) and manufacturing

industries.

3. To study the significance of cycle time, cost, quality, assets, and logistics cost metrics within manufacturing industries.
4. To study the relation ship among the supply chain performance metrics.
5. To assess the current supply chain metrics followed across various industries in India and compare the same with best practices in the respective industries.
6. To compare the Indian practices with that followed globally, wherever possible.
7. To provide inputs on improvements possible in supply chain metrics across various industry verticals.

RESEARCH METHODOLOGY

This chapter focuses on the research hypothesis, research design and the procedures followed for conducting the study. Specifically, this chapter describes the instrument development process, pilot study and pre-testing, data collection and analysis procedures. The issues of the reliability and validity of the measurement scales have also been addressed.

Hypothesis

The research hypothesis were formulated with respect to various metrics of performance measurements related to fast moving consumer goods (FMCG) and manufacturing segments relevant to selected industries in India. The null hypotheses considered for the study were:

H_{01f} : ***There are no significant differences in the mean of procurement cycle time between FMCG and manufacturing groups.*** **(H_{01f} 'f' denotes FMCG)**

H_{02f} : ***There are no significant differences in the mean of production cycle time between FMCG and manufacturing groups.***

H_{03f} : ***There are no significant differences in the mean of Delivery time between FMCG and manufacturing groups.***

H_{04f} : ***There are no significant differences in the mean of Total cycle time between FMCG and manufacturing groups.***

H_{05f} : ***There are no significant differences in the mean of cash-to-cash time between FMCG and manufacturing groups.***

H_{06f} : *There are no significant differences in the mean of supply chain flexibility (%) between FMCG and manufacturing groups.*

H_{07f} : *There are no significant differences in the mean of Total supply chain cost (% of sales) between FMCG and manufacturing groups.*

H_{08f} : *There are no significant differences in the mean of In-bound transportation cost (% TSCC) between FMCG and manufacturing groups.*

H_{09f} : *There are no significant differences in the mean of Out-bound transportation cost (% TSCC) between FMCG and manufacturing groups.*

H_{010f} : *There are no significant differences in the mean of ware-housing transportation cost (% TSCC) between FMCG and manufacturing groups.*

H_{011f} : *There are no significant differences in the mean of Inventory carrying cost (% TSCC) between FMCG and manufacturing groups.*

H_{012f} : *There are no significant differences in the mean of cost of transit losses (% TSCC) between FMCG and manufacturing groups.*

H_{013f} : *There are no significant differences in the mean of cost of damages (% TSCC) between FMCG and manufacturing groups.*

H_{014f} : *There are no significant differences in the mean of other costs (% TSCC) between FMCG and manufacturing groups.*

H_{015f} : *There are no significant differences in the mean of return Inventory costs between FMCG and manufacturing groups.*

H_{016f} : *There are no significant differences in the mean of return processing cost between FMCG and manufacturing groups.*

H_{017f} : *There are no significant differences in the mean of % of on-time deliveries between FMCG and manufacturing groups.*

H_{018f} : *There are no significant differences in the mean of % of supply made as per the quantity ordered between FMCG and manufacturing groups.*

H_{019f} : *There are no significant differences in the mean of % of supply on desired quality between FMCG and manufacturing groups.*

H_{020f} : *There are no significant differences in the mean of Raw material inventory holding between FMCG and manufacturing groups.*

H_{021f} : *There are no significant differences in the mean of Work in progress inventory holding between FMCG and manufacturing groups.*

H_{022f} : *There are no significant differences in the mean of Finished goods inventory holding between FMCG and manufacturing groups.*

H_{023f} : *There are no significant differences in the mean of Inventory Turnover (No. of turns) between FMCG and manufacturing groups.*

H_{024f} : *There are no significant differences in the mean of logistics cost (inbound + outbound transpiration cost) between FMCG and manufacturing groups.*

Similarly, the research hypotheses were formulated with respect to various metrics of performance measurements related to manufacturing segments. The same null hypotheses were repeated for testing significant differences in the mean values of metrics between the manufacturing groups:

H_{01m} : *There are no significant differences in the mean of procurement cycle time between manufacturing groups.(* H_{01m} **'m' denotes manufacturing).**

H_{02m} : *There are no significant differences in the mean of production cycle time between manufacturing groups.*

H_{03m} : *There are no significant differences in the mean of Delivery time between manufacturing groups.*

H_{04m} : *There are no significant differences in the mean of Total cycle time between manufacturing groups.*

H_{05m} : *There are no significant differences in the mean of cash-to-cash time between manufacturing groups.*

H_{06m} : *There are no significant differences in the mean of supply chain flexibility (%) between manufacturing groups.*

H_{07m} : *There are no significant differences in the mean of Total supply chain cost (% of sales) between manufacturing groups.*

H_{08m} : *There are no significant differences in the mean of In-bound transportation cost (% TSCC) between manufacturing groups.*

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H_{014m} : *There are no significant differences in the mean of other costs (% TSCC) between manufacturing groups.*

H_{015m} : *There are no significant differences in the mean of return Inventory costs between manufacturing groups.*

H_{016m} : *There are no significant differences in the mean of return processing cost between manufacturing groups.*

H_{017m} : *There are no significant differences in the mean of % of on-time deliveries between manufacturing groups.*

H_{018m} : *There are no significant differences in the mean of % of supply made as per the quantity ordered between manufacturing groups.*

H_{019m} : *There are no significant differences in the mean of % of supply on desired quality between manufacturing groups.*

H_{020m} : *There are no significant differences in the mean of Raw material inventory holding between manufacturing groups.*

H_{021m} : *There are no significant differences in the mean of Work in progress inventory holding between manufacturing groups.*

H_{022m} : *There are no significant differences in the mean of Finished goods inventory holding between manufacturing groups.*

H_{023m} : *There are no significant differences in the mean of Inventory Turnover (No. of turns) between manufacturing groups.*

H_{024m} : *There are no significant differences in the mean of logistics cost (inbound + outbound transpiration cost) between manufacturing groups.*

RESEARCH INSTRUMENT

The research instrument (Appendix-C) consisted of a questionnaire that was specially designed for the study. The questionnaire consisted of 24 statements related to the performance measurement metrics, business profile of the company, better practices and systems that are followed in the company. The questionnaire was designed with the inputs from previous studies (Korgaonkar, 2001; Eicher Research group, 2002; IIMM, 2003; Shah, 2003; and Lapide, 2004, 2006). The research instrument was refined on the basis of the feed back received during the pilot study. After the questionnaire was pilot tested, each question / statement was examined for its clarity and relevance to the purpose of the research, which resulted in some modifications / deletions in the questions. To make the questionnaire user-friendly, definition of each metric was enclosed along with the questionnaire. Statements related to Economics value added (EVA), Supply chain mapping, Activity based costing (ABC) etc were deleted after the pilot test.

SAMPLING PROCEDURE

The population of interest was the entire database of Indian Institute of Materials Management (IIMM), which is the largest of its kind membership based industry body in India. The IIMM database consists of companies of repute spread all across the country. More than 300 companies registered with them formed the sample frame for the study. The IIMM database is itself segregated into broad industry types i.e. fast moving consumer goods (FMCG) and manufacturing. Of these, companies representing auto & components, electronics, white goods, engineering segments and fast moving consumer goods segments were selected for the study. This resulted in a sample of 100 companies.

DATA COLLECTION PROCEDURE

The researcher then collected the data in various stages as described below:

Stage 1 : Herein, the researcher sent the structured questionnaire to all 80 companies from manufacturing group and 20 companies from the FMCG group that were part of the sample. The questionnaire was sent through post & courier to production, procurement, quality, finance, material planning and marketing heads of these companies. It included a covering letter highlighting the academic nature of the study and a business return envelope. In all, 18 responses were received from the manufacturing sector and 8 from the FMCG group.

Stage 2 : A reminder letter was sent to the remaining companies and 10 responses were received. Some of the companies sought clarifications through email and surface mail. All clarifications were addressed either through email, surface mail or telephone.

Stage 3 : During this stage, the researcher contacted the companies through telephone and email. Soft copies of the questionnaire were sent to those companies, who lost / misplaced questionnaire. After the telephonic conversations continuous follow up with the companies, and personal visits to some of the companies, the researcher could get 54 more responses.

Thus, there were 88 usable responses obtained from the selected companies through census method. Statistical package for social studies (SPSS) – 13 was used for conducting statistical analysis.

METHOD OF ANALYSIS

Descriptive statistics: Descriptive statistics such as mean, media, mode, standard deviation were computed and used for analysis. Table 1 shows the descriptive statistics, and summary of performance measurements between fast moving consumer goods (FMCG) and manufacturing groups.

T-test (2 tailed): T-test was used for testing the significant differences in the mean values between the fast moving consumer goods (FMCG) and manufacturing groups. Null hypothesis were tested at 5% significance level (95% confidence level).

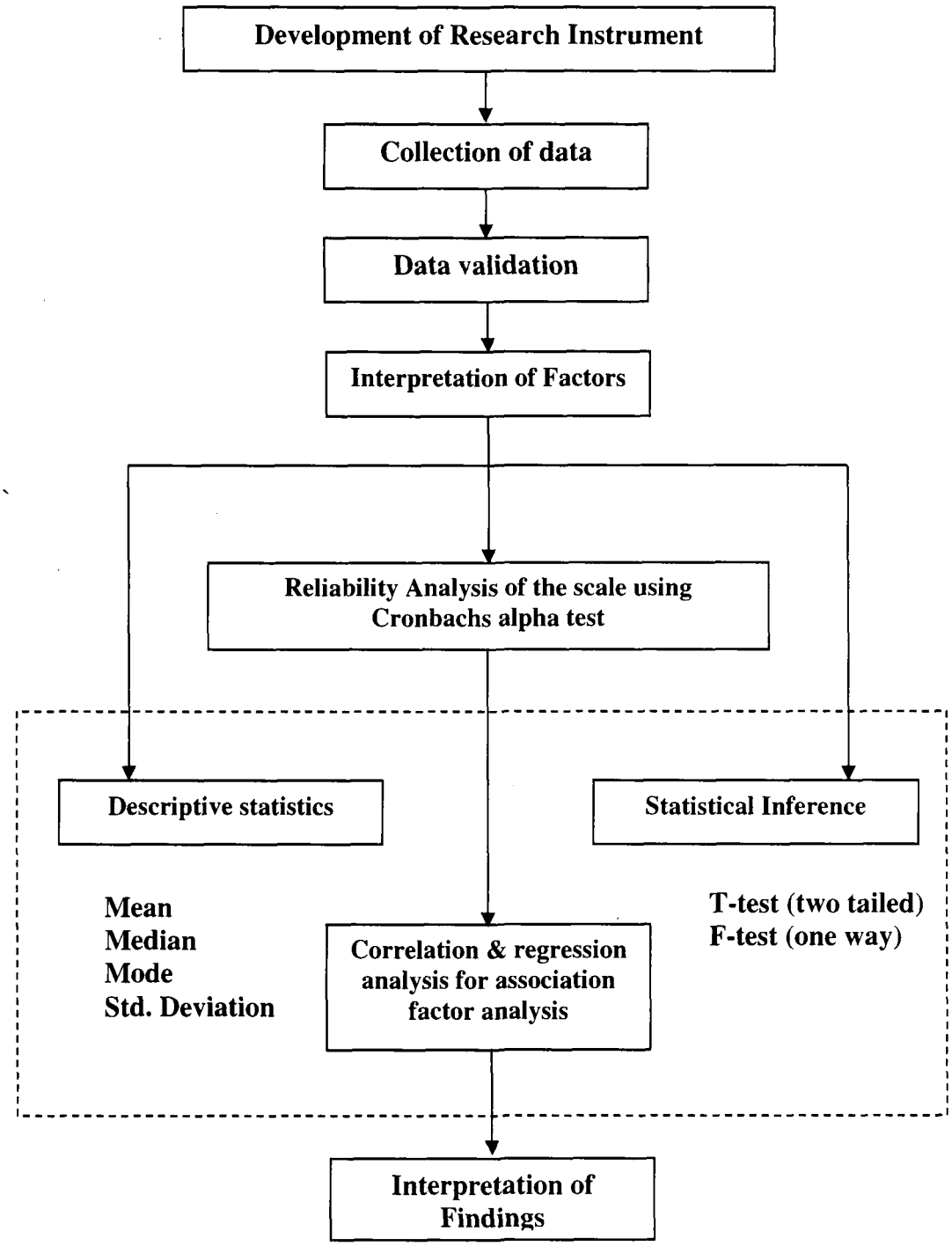
F-test (ANOVA) – one way: F-test procedure was applied for testing the significant differences in the mean values of metrics within the manufacturing groups. Null hypothesis were tested at 5% significance level.

Correlation and Regression Analysis: Correlation analysis studies the joint variation of two or more variables for determining the amount of correlation between two or more variables. In each performance metrics groups dependent variables are correlated with independent variables. The functional relationships existing between two or more variables are studied. It is used to find out the best fit.

Factor Analysis: The data was then subject to principal component analysis (PCA), a method categorized under the broad area of factor analysis. Principal components (PC) analysis all the variance in the items. PC is generally considered the best method for the pragmatic purposes of data reduction. With PCA, the 24 metrics of supply chain performance related metrics contained in part-III of the questionnaire were reduced to 7 metrics under 5 broad dimensions which were assigned names such cycle time, cost, quality, assets and logistics cost. To give a bird's eye view, the flow chart depicting the schema of analysis is presented in Figure 1.

In this research, we have used varimax rotation with Kaiser Normalization with which maximum possible simplification is reached. ie., rotation converged with iterations. With varimax rotational approach there tends to be some high loadings close to -1 or +1 thus indicating a clear positive or negative association between the variable and the factor close to zero, indicating a clear lack of association varimax rotation gives clear separation of factors.

Figure 1 : Flow chart depicting the schema of the analysis



SUMMARY OF DESCRIPTIVE STATISTICS

Table 1 : Descriptive Statistics **Sample size : 88**

Metrics	Mean	Minimum	Maximum
Procurement cycle time (No. of days)	19	3	56
Production cycle time (No. of days)	13.5	2	60
Delivery Time	7	3	16
Total cycle time	43	8	110
Cash-to-Cash cycle time	50	0	120
Total supply chain cost (% of sales)	7	2	18
In-bound transportation (% of TSCC)	21	10	44
Out-bound transportation (% of TSCC)	31	14	42
Ware-housing cost (% of TSCC)	11	4	24
Inventory carrying cost (% of TSCC)	14.5	4	26
Cost of transit losses (% of TSCC)	3	0	8
Cost of damages (% of TSCC)	4	0	8
Other costs (Insurance , freight & clearance)	6	0.50	12
% of on-time deliveries	93.6	75	100
% of supply made as per the quantity ordered	96	80	100
% of supply on desired quality	97.5	85	100
Raw Material Inventory holding (days)	19.5	2	45
Work In Progress Inventory holding	8.8	2	36
Finished Goods Inventory holding	12.5	2	40
Inventory Turnover (No. of turns)	18	5	31

ANALYSIS OF DESCRIPTIVE STATISTICS

1) Procurement cycle time: The minimum value is 3 days and the maximum value 56 days, whereas the mean value is 19 days, which means that there is a huge gap existing between the best-in-class and industry average.

2) Production cycle time: The minimum value is 2 days as against to the maximum of 60 days, whereas the mean value is 13 days. The production cycle time in the manufacturing segments was found to be high compared to FMCG segment.

3) Delivery time: The minimum value is 3 days and the maximum is 16 days as against the mean of 7 days. This can be attributed to geographical location of the companies and respective markets.

4) Total cycle time: The minimum value is 8 days as against the maximum of 110 days. This can be attributed to engineering and electronics segments in manufacturing.

5) Cash-to-cash cycle time: The minimum value is zero and the maximum is 120 days. In FMCG and white goods segments, companies take advances from their

customers and credit from their vendors for supply of items. Hence, they are able to achieve zero cash collection period.

6) Supply chain flexibility: The maximum value is 18% as against 9% in white goods segments. FMCG and auto segments are able to meet the upsurge demand above 20 %.

7) Total supply chain cost (% of sales): The minimum value is 2% as against the maximum of 18%. The mean value is 7% of sales.

8) Inbound transportation cost: The minimum value is 10% and the maximum value is 44%. Auto and Engineering segments contribute to the maximum value. The mean value is 21% of TSCC.

9) Outbound transportation cost: The minimum value is 14% and the maximum value is 42% FMCG and white goods segments contribute to the maximum value. The mean value is 31%.

10) Warehousing cost: The minimum value is 4% and maximum is 24% FMCG, Electronics and white goods segments contributes to the maximum. The mean value is 11% of TSCC.

11) Inventory carrying cost: The minimum value is 4% and the maximum is 26% engineering and auto segments contribute to the maximum value. The mean value is 14.5% of TSCC.

12, 13) Cost of transit losses and damages: The minimum value is zero and the maximum value is 8%. This maximum value due to FMCG, auto and white goods segments.

14) Other costs (Insurance, freight, clearance): The minimum value is 0.50% and the maximum is 12% for FMCG. Electronics and white goods segments contribute to the maximum. The mean value is 6% of TSCC.

15, 16) Return and processing cost: The minimum value is zero and maximum value is 6% Auto, Electronics and white segments contributes to the maximum value.

17) Logistics cost (Inbound & Outbound): The minimum value is 26% and the maximum is 80%. The mean value is 55.5% of TSCC. The manufacturing segments inbound transportation cost and FMCG outbound transportation cost are the main elements for this maximum value.

18) % of on time deliveries: The minimum value is 75% and the maximum value is 100%. The mean value is 94%. FMCG, White goods & Electronics are contributing to the maximum value.

19) % of supply made as per the quantity ordered: The maximum value is 100% and the minimum is 80%. The mean value is 96%. FMCG and Electronics segments are contributing to the maximum value.

20) % of supply on desired quality: The minimum value is 85% and the maximum is 100%. The mean value is 97.5% FMCG. Electronics and white goods are the major contributors to the maximum value.

21) Raw material inventory holding (Days): The mean value is 2 days and maximum is 45 days. The mean value is 19.5 days. Engineering, Electronics and Auto segments are contributing to the maximum value.

22) Work-in-progress Inventory holding (Days): The minimum is 2 days and maximum is 36 days. The mean value is 9 days. Engineering, auto and white goods are the contributors to the maximum value.

23) Finished goods Inventory holding (Days): The minimum value is 2 days and maximum value is 40 days. FMCG, Electronics and white goods are the contributors to the maximum value. The mean value is 12.5 days.

24) Inventory Turnover (No. of turns): The minimum value is 5 turns and the maximum is 31 turns. The mean value is 18 turns. FMCG, Auto and White goods are the contributors to the maximum value.

ANALYSIS OF T-TEST RESULTS (Independent samples)

Independent samples T-test was used to investigate the differences in means between companies belonging to fast moving consumer goods (FMCG) and manufacturing groups on each of the metrics the summary results for the same are presented in Table 2.

1. Cycle time metrics

The significance value is less than 0.05 for cash-to-cash cycle time and supply chain flexibility metrics. So we reject the null hypothesis for these cycle time metrics and conclude that there are significant differences in the means for these items. For example, as for as cash-to-cash cycle time is concerned, the manufacturing sector has a higher mean (54.42) than the FMCG sector. Similarly for supply chain flexibility, the

FMCG sector has a higher mean (14.95) than the manufacturing sector. For all other metrics under cycle time, significant differences were not observed in the mean values between manufacturing and FMCG group. (Table 2)

Table 2 : No significant differences in the mean of Cycle Time Metrics

Metric	Nature of business	N	Mean	Std. Deviation
Procurement Cycle (No. of Days)	Manufacturing	68	19.29	14.42
	FMCG	20	18.00	13.97
Production Cycle time (No. of Days)	Manufacturing	68	13.61	13.50
	FMCG	20	12.95	13.12
Delivery Time (No. of Days)	Manufacturing	68	7.22	3.23
	FMCG	20	7.05	2.76
Total cycle time (No. of Days)	Manufacturing	68	43.79	28.86
	FMCG	20	41.05	22.37
Cash-to-Cash Cycle time (No. of Days)	Manufacturing	68	**54.42***	27.41
	FMCG	20	35.10	22.51
Supply chain Flexibility %	Manufacturing	68	11.45	6.26
	FMCG	20	**14.95***	7.96

* There is a significant difference in the mean values of these metrics.

T-Test (Independent Samples)

Metric	t	df	Sig.(2-tailed)
Procurement Cycle (No. of Days)	.35	86	.72
Production Cycle time (No. of Days)	.19	86	.84
Delivery Time (No. of Days)	.21	86	.83
Total cycle time (No. of Days)	.39	86	.69
Cash-to-Cash Cycle time (No. of Days)	2.87	86	**.00 ***
Supply chain Flexibility %	-2.05	86	**.04 ***

* The significance value is less than 0.05 for cash to cash cycle time and supply chain flexibility.

2. Cost metrics

The significance value is less than 0.05 for out-bound transportation, warehousing cost, cost of damages, other costs, return inventory cost and return processing cost so we reject the null hypothesis for these cost metrics and conclude that there were significant differences in the means for these items. For example, as far as return inventory cost is concerned, the manufacturing sector has a higher mean (2.69) than the FMCG sector. Similarly for out-bound transportation cost, FMCG has a higher mean in out bond transportation cost (36.00) and warehousing cost (15.95) than the manufacturing. Cost of damages, FMCG has a higher mean (5.05) than the manufacturing group. In other costs metrics FMCG has a higher mean (8.00) than the

manufacturing and in return processing cost metrics, manufacturing has a mean of 2.50 where as FMCG sector has a mean of zero. i.e., no return processing cost involved in the FMCG sector. (Table 3)

Table 3 No significant difference in the mean of Cost metrics

Metric	Nature of business	N	Mean	Std. Deviation
Total Supply chain cost (% of sales)	Manufacturing	68	7.10	3.41
	FMCG	20	6.50	3.00
In-bound transportation cost (% TSCC)	Manufacturing	68	25.11	7.58
	FMCG	20	22.00	3.32
Out-bound transportation cost (% of TSCC)	Manufacturing	68	29.67	5.44
	FMCG	20	**36.00** *	4.25
Ware-housing Cost (% of TSCC)	Manufacturing	68	9.66	3.50
	FMCG	20	**15.95** *	4.63
Inventory carrying Cost- (% of TSCC)	Manufacturing	68	14.73	5.05
	FMCG	20	15.00	3.64
Cost of transit losses (% of TSCC)	Manufacturing	68	2.88	2.04
	FMCG	20	3.07	1.55
Cost of damages (% of TSCC)	Manufacturing	68	3.56	1.83
	FMCG	20	**5.05** *	2.32
Other Costs (Insurance, freight, clearance) (% of TSCC)	Manufacturing	68	5.52	2.62
	FMCG	20	**8.00** *	2.47
Return Inventory Cost	Manufacturing	68	**2.69** *	1.38
	FMCG	20	2.00	.97
Return Processing Cost	Manufacturing	68	**2.50** *	1.59
	FMCG	20	.00	.00

* There is a significant difference in the mean values of these metrics.

T-Test (Independent Samples)

Metric	t	df	Sig (2-tailed)
Total Supply chain cost (% of sales)	.71	86	.47
In-bound transportation cost (% TSCC)	1.78	86	.07
Out-bound transportation cost (% of TSCC)	-4.77	86	**.00** *
Ware-housing Cost (% of TSCC)	-6.53	86	**.00** *
Inventory carrying Cost- (% of TSCC)	-.21	86	.82
Cost of transit losses (% of TSCC)	-.38	86	.69
Cost of damages (% of TSCC)	-2.98	86	**.00** *
Other Costs (Insurance ,freight, and clearance) (% of TSCC)	-3.74	86	**.00** *
Return Inventory Cost	2.08	86	**.04** *
Return Processing Cost	7.01	86	**.00** *

* The significance value is less than 0.05 for Out-bound transportation cost, Warehousing Cost, Cost of damages, Other Costs (Insurance, freight, and clearance), Return Inventory Cost and Return Processing Cost.

3. Quality metrics

The significance value is less than 0.05 for % of on-time deliveries and % of supply made as per the quantity ordered so we reject the null hypothesis for these costs and conclude that there are significant differences in the means for these items. For example, as far as % of on time deliveries is concerned the FMCG sector has a higher mean (97.00) than the manufacturing sector. % of supply made as per the quantity ordered also FMCG has a higher mean (97.95) than the manufacturing sector. (Table 4)

Table 4 No significant difference in the mean of Quality metrics

	Nature of business	N	Mean	Std. Deviation
% of on-Time deliveries	Manufacturing	68	92.60	5.78
	FMCG	20	**97.00** *	3.06
% of supply made as per the quantity ordered	Manufacturing	68	95.48	4.57
	FMCG	20	**97.95** *	2.08
% of supply on desired quality	Manufacturing	68	97.48	3.36
	FMCG	20	97.95	1.82

* There is a significant difference in the mean values of these metrics.

T-Test (Independent Samples)

	t	df	Sig. (2-tailed)
% of on-Time deliveries	-3.25	86	**.00** *
% of supply made as per the quantity ordered	-2.32	86	**.02** *
% of supply on desired quality	-.592	86	.55

* The significance value is less than 0.05 for % of on-Time deliveries and % of supply made as per the quantity ordered.

4. Assets metrics

The significance value is greater than 0.05 for all and so we accept the null hypothesis. Raw material inventory holding, Work in progress (WIP) inventory holding, Finished goods inventory holding and Inventory turnover, these is no significant difference in the mean of assets metrics. (Table 5)

Table 5 No significant difference in the mean of Assets metrics

	Nature of business	N	Mean	Std. Deviation
Raw Material inventory holding (Days)	Manufacturing	68	20.29	11.43
	FMCG	20	16.00	9.89
Work in progress inventory holding (Days)	Manufacturing	68	9.45	8.18
	FMCG	20	6.55	5.47
Finished goods inventory holding (Days)	Manufacturing	68	11.66	9.02
	FMCG	20	15.50	10.80
Inventory Turnover (Turns) No. of times	Manufacturing	68	17.77	6.58
	FMCG	20	18.95	5.89

T-Test (Independent Samples)

	t	df	Sig. (2-tailed)
Raw Material inventory holding (Days)	1.51	86	.13
Work in progress inventory holding (Days)	1.49	86	.14
Finished goods inventory holding (Days)	-1.59	86	.11
Inventory Turnover (Turns) No. of times	-0.71	86	.47

5. Logistics cost

The significance value is greater than 0.05 and so we accept the null hypothesis. i.e., no significant differences in the means of logistics cost between manufacturing and FMCG sector. (Table 6)

Table 6 No significant difference in the mean of Logistics cost

	Nature of business	N	Mean	Std. Deviation
Logistics Cost	Manufacturing	68	54.79	9.92
	FMCG	20	58.00	3.56

T-Test (Independent Samples)

	t	df	Sig. (2-tailed)
Logistics Cost	-1.41	86	.16

F-test (ANOVA) one way

1. Cycle time metrics

The F-value is 6.986 and the significance value is less than 0.05 for production cycle time so we reject the null hypothesis for these cycle time metrics and conclude

that there is a significant difference in the mean for these items. For example, as far as production cycle time is concerned, the engineering segment has a higher mean (25.11) than the other manufacturing segments. Similarly, cash-to-cash cycle time, auto and components segment has a higher mean (63.75) than the other manufacturing segments. Supply chain flexibility (%), auto & auto components have a higher mean (15) than the other segments. All other metrics under cycle time no significance difference in the mean values. (Table 7)

Table 7 Mean values of Cycle time metrics

Metrics	Segment	N	Mean	Std. Deviation	Minimum	Maximum
Procurement Cycle (No. of Days)	Auto & Auto Components	20	20.00	16.32	3.00	56.00
	Electronics	12	21.00	13.09	7.00	45.00
	White goods	19	15.00	11.70	3.00	45.00
	Engineering	17	22.05	15.80	5.00	56.00
	Total	68	19.29	14.42	3.00	56.00
Production Cycle time (No. of Days)	Auto & Auto Components	20	9.05	10.17	2.00	45.00
	Electronics	12	10.25	7.47	3.00	30.00
	White goods	19	10.26	11.59	3.00	45.00
	Engineering	17	**25.11** *	16.20	3.00	60.00
	Total	68	13.61	13.50	2.00	60.00
Delivery Time (No. of Days)	Auto & Auto Components	20	7.30	3.55	3.00	16.00
	Electronics	12	6.08	2.42	3.00	10.00
	White goods	19	7.00	3.16	3.00	14.00
	Engineering	17	8.17	3.39	3.00	14.00
	Total	68	7.22	3.23	3.00	16.00
Total cycle time (No. of Days)	Auto & Auto Components	20	40.40	25.51	8.00	104.00
	Electronics	12	54.58	34.07	10.00	110.00
	White goods	19	33.00	23.76	8.00	90.00
	Engineering	17	52.23	31.09	10.00	96.00
	Total	68	43.79	28.86	8.00	110.00
Cash-to-Cash Cycle time (No. of Days)	Auto & Auto Components	20	**63.75** *	23.45	16.00	96.00

Metrics	Segment	N	Mean	Std. Deviation	Minimum	Maximum
	Electronics	12	60.00	33.23	30.00	120.00
	White goods	19	37.00	19.84	7.00	72.00
	Engineering	17	59.00	27.87	18.00	106.00
	Total	68	54.42	27.41	7.00	120.00
Supply chain Flexibility %	Auto & Auto Components	20	**15.00** *	6.43	6.00	28.00
	Electronics	12	10.00	4.76	5.00	20.00
	White goods	19	9.00	3.44	5.00	15.00
	Engineering	17	11.05	7.85	4.00	30.00
	Total	68	11.45	6.26	4.00	30.00

* Higher mean values for these metrics within manufacturing segment.

Metrics	Segment	Sum of Squares	df	Mean Square	F-value	Sig.
Procurement Cycle (No. of Days)	Between Groups	525.17	3	175.05	.83	.47
	Within Groups	13410.94	64	209.54		
	Total	13936.11	67			
Production Cycle time (No. of Days)	Between Groups	3015.41	3	1005.13	**6.98**	**.00** *
	Within Groups	9208.64	64	143.88		
	Total	12224.05	67			
Delivery Time (No. of Days)	Between Groups	32.10	3	10.70	1.02	.38
	Within Groups	669.58	64	10.46		
	Total	701.69	67			
Total cycle time (No. of Days)	Between Groups	5052.34	3	1684.11	2.12	.10
	Within Groups	50776.77	64	793.38		
	Total	55829.11	67			
Cash-to-Cash Cycle time (No. of Days)	Between Groups	8236.88	3	2745.62	**4.17**	**.00** *
	Within Groups	42129.75	64	658.27		
	Total	50366.63	67			
Supply chain Flexibility %	Between Groups	393.92	3	131.30	**3.75**	**.01** *
	Within Groups	2236.94	64	34.95		
	Total	2630.86	67			

* The significance value is less than 0.05 for production cycle, cash to cash cycle time and supply chain flexibility metrics.

2. Cost metrics

The F-value is 14.02 and the significance value is less than 0.05 for in-bound transportation cost so we reject the null hypothesis for these cost metrics and conclude that there is a significant difference in the means for these items. For example, as far as in-bound transportation cost is concerned, the engineering segment has a higher mean (33.05) than the other manufacturing segments. Similarly, out-bound transportation cost, engineering segment has a higher mean (32.0) than the other manufacturing segments. Ware-housing cost, auto & components have a higher mean (12.65) than the other manufacturing segments. Inventory carrying cost, engineering segment has a higher mean (19.05) than the other manufacturing segments. In cost of transit losses Auto & components segment has a higher mean (5.00) than the other manufacturing segments. Cost of damages auto & components segment has a higher mean (5.00) than the other manufacturing segments. Other costs, electronics segments have a higher mean (8.08) than the other manufacturing segments. Return inventory cost, auto & components segment has a higher mean (4.0) than the other manufacturing segments. Return processing cost, auto & components segment has a higher mean (4.0) than the other manufacturing segments. It is concluded that except the total supply chain cost (% of sales) all other costs, the mean values are significantly different. (Table 8)

Table 8 Mean values of cost metrics

Metrics	Segment	N	Mean	Std. Deviation	Minimum	Maximum
Total Supply chain cost (% of sales)	Auto & Auto Components	20	6.85	3.31	3.00	14.00
	Electronics	12	6.00	2.55	2.00	10.00
	White goods	19	8.10	4.40	3.00	18.00
	Engineering	17	7.05	2.70	2.00	12.00
	Total	68	7.10	3.41	2.00	18.00
In-bound transportation cost (% TSCC)	Auto & Auto Components	20	24.15	4.74	12.00	28.00
	Electronics	12	22.00	4.51	12.00	28.00
	White goods	19	21.00	5.46	10.00	30.00
	Engineering	17	**33.05 ***	8.42	16.00	44.00
	Total	68	25.11	7.58	10.00	44.00
Out-bound transportation cost (% of TSCC)	Auto & Auto Components	20	25.35	3.61	14.00	28.00
	Electronics	12	31.50	4.60	24.00	38.00
	White goods	19	31.00	5.87	20.00	40.00
	Engineering	17	**32.00 ***	4.63	24.00	38.00
	Total	68	29.67	5.44	14.00	40.00
Ware-housing Cost (% of TSCC)	Auto & Auto Components	20	**12.65 ***	3.34	7.00	18.00

Metrics	Segment	N	Mean	Std. Deviation	Minimum	Maximum
	Electronics	12	10.08	3.47	5.00	18.00
	White goods	19	9.05	2.14	6.00	12.00
	Engineering	17	6.52	1.54	4.00	9.00
	Total	68	9.66	3.50	4.00	18.00
Inventory carrying Cost- (% of TSCC)	Auto & Auto Components	20	11.50	2.03	8.00	14.00
	Electronics	12	18.08	5.69	5.00	24.00
	White goods	19	12.15	3.83	4.00	18.00
	Engineering	17	**19.05** *	3.74	12.00	26.00
	Total	68	14.73	5.05	4.00	26.00
Cost of transit losses (% of TSCC)	Auto & Auto Components	20	**5.00** *	1.41	3.00	8.00
	Electronics	12	3.08	0.79	2.00	4.00
	White goods	19	3.00	0.81	2.00	4.00
	Engineering	17	0.11	0.33	0.00	1.00
	Total	68	2.88	2.04	0.00	8.00
Cost of damages (% of TSCC)	Auto & Auto Components	20	**5.00***	0.85	4.00	6.00
	Electronics	12	4.08	1.24	3.00	6.00
	White goods	19	4.00	1.33	2.00	6.00
	Engineering	17	1.02	.544	0.00	2.00
	Total	68	3.56	1.83	0.00	6.00
Other Costs (Insurance, freight, clearance) (% of TSCC)	Auto & Auto Components	20	5.30	.97	3.00	6.00
	Electronics	12	**8.08***	3.42	1.00	12.00
	White goods	19	5.89	2.87	0.50	10.00
	Engineering	17	3.58	1.12	1.00	5.00
	Total	68	5.52	2.62	0.50	12.00
Return Inventory Cost	Auto & Auto Components	20	**4.00** *	0.85	3.00	6.00
	Electronics	12	2.50	1.31	1.00	6.00
	White goods	19	2.00	0.81	1.00	4.00
	Engineering	17	2.05	1.43	0.00	4.00
	Total	68	2.69	1.38	0.00	6.00
Return Processing Cost	Auto & Auto Components	20	**4.00** *	1.25	2.00	6.00
	Electronics	12	2.00	1.02	.50	4.00
	White goods	19	3.05	0.52	2.00	4.00
	Engineering	17	0.50	0.30	0.00	1.00
	Total	68	2.50	1.59	0.00	6.00

* Higher mean values for these metrics within manufacturing segment.

Metrics	Segment	Sum of Squares	df	Mean Square	F	Sig.
Total Supply chain cost (% of sales)	Between Groups	34.99	3	11.66	.99	.39
	Within Groups	747.28	64	11.67		
	Total	782.27	67			
In-bound transportation cost (% TSCC)	Between Groups	1529.56	3	509.85	**14.02**	**.00 ***
	Within Groups	2327.49	64	36.36		
	Total	3857.05	67			
Out-bound transportation cost (% of TSCC)	Between Groups	539.33	3	179.77	**7.94**	**.00 ***
	Within Groups	1447.55	64	22.61		
	Total	1986.88	67			
Ware-housing Cost (% of TSCC)	Between Groups	354.57	3	118.19	**16.21**	**.00 ***
	Within Groups	466.64	64	7.29		
	Total	821.22	67			
Inventory carrying Cost- (% of TSCC)	Between Groups	787.85	3	262.61	**18.16**	**.00 ***
	Within Groups	925.38	64	14.45		
	Total	1713.23	67			
Cost of transit losses (% of TSCC)	Between Groups	220.37	3	73.45	**80.11**	**.00 ***
	Within Groups	58.68	64	.91		
	Total	279.05	67			
Cost of damages (% of TSCC)	Between Groups	157.30	3	52.43	**49.60**	**.00 ***
	Within Groups	67.65	64	1.05		
	Total	224.95	67			
Other Costs (Insurance, freight, clearance) (% of TSCC)	Between Groups	145.91	3	48.63	**9.83**	**.00 ***
	Within Groups	316.52	64	4.94		
	Total	462.44	67			
Return Inventory Cost	Between Groups	50.57	3	16.85	**13.84**	**.00 ***
	Within Groups	77.94	64	1.21		
	Total	128.51	67			
Return Processing Cost	Between Groups	121.79	3	40.60	**54.19**	**.00 ***
	Within Groups	47.94	64	.749		
	Total	169.74	67			

* Significance value is less than 0.05 for In-bound transportation cost, Out-bound transportation cost , Ware-housing Cost, Inventory carrying Cost-, Cost of transit losses, Cost of damages, Other Costs (Insurance, freight, clearance) , Return Inventory Cost and Return Processing Cost.

3. Quality metrics

The F-value is 3.24 and the significance value is less than 0.05 for % of supply made as per the quantity ordered, so we reject the null hypothesis for these quality

metrics and conclude that there are significant differences in the means for these items. For example, as far as % of supply made as per the quantity ordered is concerned the electronics segment has a higher mean (98.08) than the other manufacturing segments. Similarly, % of supply on desired quality is concerned, electronics segment has a higher mean (100.00) than the other manufacturing segments. As for as % of on-time deliveries is concerned, no significant difference in the mean within manufacturing segments. (Table 9)

Table 9 Mean values of Quality metrics

Metrics	Segment	N	Mean	Std. Deviation	Minimum	Maximum
% of on-Time deliveries	Auto & Auto Components	20	93.55	5.28	84.00	100.00
	Electronics	12	95.08	3.62	90.00	100.00
	White goods	19	92.10	6.48	75.00	100.00
	Engineering	17	90.29	6.24	80.00	100.00
	Total	68	92.60	5.78	75.00	100.00
% of supply made as per the quantity ordered	Auto & Auto Components	20	96.60	3.05	90.00	100.00
	Electronics	12	**98.08** *	2.06	95.00	100.00
	White goods	19	94.00	5.55	80.00	100.00
	Engineering	17	94.00	5.24	85.00	100.00
	Total	68	95.48	4.57	80.00	100.00
% of supply on desired quality	Auto & Auto Components	20	97.30	2.88	90.00	100.00
	Electronics	12	**100.00** *	.00	100.00	100.00
	White goods	19	96.10	3.81	90.00	100.00
	Engineering	17	97.47	3.74	85.00	100.00
	Total	68	97.48	3.36	85.00	100.00

* Higher mean values for these metrics in manufacturing segment.

Metrics	Segment	Sum of Squares	df	Mean Square	F	Sig.
% of on-Time deliveries	Between Groups	187.09	3	62.36	1.94	.13
	Within Groups	2057.18	64	32.14		
	Total	2244.27	67			
% of supply made as per the quantity ordered	Between Groups	185.26	3	61.75	**3.24**	**.02 ***
	Within Groups	1219.71	64	19.05		
	Total	1404.98	67			
% of supply on desired quality	Between Groups	112.76	3	37.58	**3.73**	**.01 ***
	Within Groups	644.22	64	10.06		
	Total	756.98	67			

* Significance value is less than 0.05 for % of supply made as per the quantity ordered and % of supply on desired quality.

4. Assets metrics

The F-value is 10.64 and the significance value is less than 0.05 for work in progress inventory holding so we reject the null hypothesis for these assets metrics and conclude that there is a significant difference in the mean for these items. For example, as for work in progress inventory holding is concerned the engineering segment has a higher mean (17.52) than the other manufacturing segments. Similarly, as for finished goods inventory holding is concerned, white goods segment has a higher mean (16.05) than the other manufacturing segments. All other metrics are concerned there is no significant difference in the mean values within manufacturing segments. (Table 10)

Table 10 Mean values of Assets metrics

Metrics	Segment	N	Mean	Std. Deviation	Minimum	Maximum
Raw Material inventory holding (Days)	Auto & Auto Components	20	19.05	13.49	2.00	45.00
	Electronics	12	22.08	5.712	12.00	30.00
	White goods	19	18.05	11.74	4.00	45.00
	Engineering	17	23.00	11.64	3.00	36.00
	Total	68	20.29	11.43	2.00	45.00
Work in progress inventory holding (Days)	Auto & Auto Components	20	7.15	5.29	3.00	21.00
	Electronics	12	5.75	3.27	2.00	12.00
	White goods	19	7.00	6.00	2.00	24.00

Metrics	Segment	N	Mean	Std. Deviation	Minimum	Maximum
	Engineering	17	**17.52 ***	10.29	3.00	36.00
	Total	68	9.45	8.18	2.00	36.00
Finished goods inventory holding (Days)	Auto & Auto Components	20	10.80	7.69	2.00	30.00
	Electronics	12	12.00	7.55	4.00	25.00
	White goods	19	**16.05 ***	12.58	2.00	40.00
	Engineering	17	7.52	3.39	3.00	14.00
	Total	68	11.66	9.02	2.00	40.00
Inventory Turnover (Turns) No. of times	Auto & Auto Components	20	18.20	7.91	6.00	30.00
	Electronics	12	15.00	4.04	10.00	24.00
	White goods	19	18.84	5.62	12.00	30.00
	Engineering	17	18.05	7.25	5.00	31.00
	Total	68	17.77	6.58	5.00	31.00

* Higher mean values for these metrics in manufacturing segment.

Metrics	Segment	Sum of Squares	df	Mean Square	F-value	Sig.
Raw Material inventory holding (Days)	Between Groups	289.30	3	96.43	.72	.53
	Within Groups	8470.81	64	132.35		
	Total	8760.11	67			
Work in progress inventory holding (Days)	Between Groups	1493.83	3	497.94	**10.64**	**.00 ***
	Within Groups	2995.03	64	46.79		
	Total	4488.86	67			
Finished goods inventory holding (Days)	Between Groups	672.838	3	224.27	**2.99**	**.03 ***
	Within Groups	4788.38	64	74.81		
	Total	5461.22	67			
Inventory Turnover (Turns) No. of times	Between Groups	119.02	3	39.67	.912	.440
	Within Groups	2782.66	64	43.47		
	Total	2901.69	67			

* Significance value is less than 0.05 for Work in progress inventory holding (Days) and Finished goods inventory holding (Days)

5. Logistics cost

The F-value is 13.17 and the significance value is less the 0.05 for logistics cost so we reject the null hypothesis and conclude that there is a significant difference existing in the mean of logistics cost. For example, as far as logistics cost is concerned, the engineering segment has a higher mean (65.05) than the other manufacturing segments. (Table 11)

Table 11 Mean values of Logistics Cost

Segment	N	Mean	Std. Deviation	Minimum	Maximum
Auto & Auto Components	20	49.50	7.88	26.00	56.00
Electronics	12	53.50	2.84	50.00	60.00
White goods	19	52.00	6.80	38.00	60.00
Engineering	17	**65.05 ***	11.11	40.00	80.00
Total	68	54.79	9.92	26.00	80.00

* Higher mean value for this metric in manufacturing segment.

Segment	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	2520.17	3	840.05	**13.17**	**.00 ***
Within Groups	4080.94	64	63.765		
Total	6601.11	67			

* Significance value is less than 0.05 for logistics cost

SUMMARY OF CORRELATION AND REGRESSION ANALYSIS TEST RESULTS

1. Cycle time metrics

Total cycle time (No. of days) was considered as dependent variable, the three variables such as cash-to cash cycle time, delivery time, and production cycle time explain 80.6% of the variation in the dependent variable. The remaining 19.4% of the variation is due to measurement error. Since the significance value of 0.00 is less than 0.05, we can conclude that the regression model is a good fit.

2. Cost metrics

Total Supply Chain cost is considered as dependent variable, the three variables such as inbound transportation cost, cost of transit losses and other costs explain 28.1% of the variation in the dependent variables. Since the significance value of 0.00 is less than 0.05, we can conclude that the regression model is a good fit.

3. Quality metrics

% of on-time deliveries is considered as dependent variable, % of supply made as per the quantity ordered explain 41.9% of the variation in the dependent variable. Since the significance value of 0.00 is less than 0.05, we can conclude that the regression model is a good fit.

4. Assets metrics

Inventory turnover (No. of turns) is considered as dependent variable, Raw material inventory holding (days) explain 17.0% of the variation in the dependent variable. Since the significance value of 0.00 is less than 0.05, we can conclude that the regression model is a good fit.

SUMMARY OF FACTOR ANALYSIS RESULTS

1) Cycle time metrics

Production cycle time and procurement cycle time account for around 79.17% of the variation. Varimax rotation with Kaiser Normalization was used and a rotation converged in 3 iterations. The Eigen values for these metrics were greater than one.

2) Cost metrics

Total supply chain cost, in – bound transportation cost and Out – bound transportation cost account for around 66.53% of the variation. Varimax rotation with Kaiser Normalization was used and a rotation converged in 4 iterations. The Eigen values of these metrics were greater than one.

3) Quality / Service metrics

% of on time deliveries account for around 59.87% of the variation. Varimax rotation with Kaiser Normalization was used and a rotation converged in one iteration. The Eigen value of this metric was greater than one.

4) Assets Metrics

Raw materials inventory holding account for around 58.45% of the variation. Varimax rotation with Kaiser Normalization was used and a rotation converged in one iteration. The Eigen value of this metric was greater than one.

Hence the following factors were retained for analysis, as these factors are having Eigen values more than one: (1) Total cycle time (2) Procurement cycle time (3) Total supply chain cost (4) In-bound transportation cost (5) Out-bound transportation cost (6) % of on time deliveries (7) Raw material inventory holding.

CONCLUSIONS BASED ON T-TEST (Independent samples)

The main highlights of the results presented in Table 12 are as under:

1. No significant differences in the mean values of metrics given below between manufacturing and FMCG groups.

   (i) Procurement cycle time (ii) Production cycle time (iii) Delivery time (iv) Total cycle time (v) Total supply chain cost (% of sales) (vi) In-bound transportation cost (% of TSCC) (vii) Inventory carrying cost (viii) Cost of transit losses (ix) % of supply on desired quality (x) Raw material inventory holding (xi) Work in progress inventory holding (xii) Finished goods inventory holding (xiii) Inventory turnover (xiv) logistics cost (In-bound + Out-bound).

2. However, significant differences in the mean values of the following metrics were observed (Between manufacturing and FMCG groups):

   (i) Cash-to-cash cycle time (ii) Supply chain flexibility (%) (iii) Out-bound transportation cost (iv) Ware-housing cost (v) Cost of damages (vi) Other costs (Insurance, Freight, and Clearance) (vii) Return Inventory cost (viii) Return processing cost (ix) % of on-time deliveries (x) % of supply as per the quantity ordered.

Table 12 T-Test Results (Independent samples)

Metrics	t	df	Sig. (2 tailed)	Remarks
Procurement cycle time (No. of days)	0.35	86	0.72	NS*
Production cycle time (No. of days)	0.19	86	0.84	NS
Delivery Time	0.21	86	0.83	NS
Total cycle time	0.39	86	0.69	NS
Cash-to-Cash cycle time	2.87	86	0.00	S*
Supply chain flexibility (%)	-2.05	86	0.04	S
Total supply chain cost (% of sales)	0.71	86	0.47	NS
In-bound transportation (% of TSCC)	1.78	86	0.07	NS
Out-bound transportation (% of TSCC)	-4.77	86	0.00	S
Ware-housing cost (% of TSCC)	-6.53	86	0.00	S
Inventory carrying cost (% of TSCC)	-0.21	86	0.82	NS
Cost of transit losses (% of TSCC)	-0.38	86	0.69	NS
Cost of damages (% of TSCC)	-2.98	86	0.00	S
Other costs (Insurance, freight & clearance)	-3.74	86	0.00	S
Return Inventory cost	2.08	86	0.04	S
Return processing cost	7.01	86	0.00	S

Metrics	t	df	Sig. (2 tailed)	Remarks
% of on-time deliveries	-3.25	86	0.00	S
% of supply made as per the quantity ordered	-2.32	86	0.02	S
% of supply on desired quality	-0.59	86	0.55	NS
Raw Material Inventory holding (days)	1.51	86	0.13	NS
Work In Progress Inventory holding	1.49	86	0.14	NS
Finished Goods Inventory holding	-1.59	86	0.11	NS
Inventory Turnover (No. of turns)	-0.71	86	0.47	NS
Logistics cost : (% of TSCC)	-1.41	86	0.16	NS

*NS – Non-significant
*S – Significant

CONCLUSIONS BASED ON F-TEST (ANOVA) – One way

The main highlights of the results presented in Table 13 are as under:

1. No significant differences in the mean values of metrics between manufacturing segments for the following metrics:

   (i) Procurement cycle time (ii) Delivery cycle time (iii) Total cycle time (vi) Total supply chain cost (v) % of on-time deliveries (vi) Raw material inventory holding (vii) Inventory turnover.

2. However, significant differences were observed in the mean values of the following metrics (Between manufacturing segments):

   (i) Production cycle time (ii) Cash-to-cash cycle time (iii) Supply chain flexibility (%) (vi) In-bound transportation cost (% TSCC) (v) Out-bound transportation cost (vi) Ware-housing cost (vii) Inventory carrying cost (viii) Cost of transit losses (ix) Cost of damages (x) Other costs (Insurance, Freight & Clearance) (xi) Return inventory cost (xii) Return processing cost (xiii) % of supply made as per the quantity ordered. (xiv) % of supply on desired quality (xv) Work in process inventory holding (xvi) Finished Goods. inventory holding (xvii) Logistics cost (In-bound + Out-bound)

Table 13 F-Test Results

Metrics	F-Value	df	Level of Sig.	Remarks
Procurement cycle time (No. of days)	0.83	3	0.47	NS*
Production cycle time (No. of days)	6.98	3	0.00	S*
Delivery Time	1.02	3	0.38	NS
Total cycle time	2.12	3	0.10	NS
Cash-to-Cash cycle time	4.17	3	0.00	S
Supply chain flexibility (%)	3.75	3	0.01	S
Total supply chain cost (% of sales)	0.99	3	0.39	NS
In-bound transportation (% of TSCC)	14.02	3	0.00	S
Out-bound transportation (% of TSCC)	7.94	3	0.00	S
Ware-housing cost (% of TSCC)	16.21	3	0.00	S
Inventory carrying cost (% of TSCC)	18.16	3	0.00	S
Cost of transit losses (% of TSCC)	80.11	3	0.00	S
Cost of damages (% of TSCC)	49.60	3	0.00	S
Other costs (Insurance, freight & clearance)	9.83	3	0.00	S
Return Inventory cost	13.84	3	0.00	S
Return processing cost	54.19	3	0.00	S
% of on-time deliveries	1.94	3	0.13	NS
% of supply made as per the quantity ordered	3.24	3	0.02	S
% of supply on desired quality	3.73	3	0.01	S
Raw material Inventory holding (days)	0.72	3	0.53	NS
Work in progress Inventory holding	10.64	3	0.00	S
Finished goods Inventory holding	2.99	3	0.03	S
Inventory Turnover (No. of turns)	0.91	3	0.44	NS
Logistics cost : (% of TSCC)	13.17	3	0.00	S

*NS – Non-significant
*S – Significant

DIRECTION FOR FUTURE RESEARCH

On the basis of extensive literature survey as also insights gained during the course of the present study, the following recommendations can be made regarding directions for future research:

1. There is a need for continued research in the area to keep track of the changes occurring in FMCG and manufacturing domains. This is all the more necessary as measuring supply chain performance is still in its stages of infancy in India.
2. Instead of focusing on the two broad sectors, i.e., FMCG and discrete manufacturing, future researchers need to concentrate on sub-segments within

two. Also other segments such as agro-products, leather, textile, continuous manufacturing etc may be studied.

3. To gain a deeper understanding, it is suggested that detailed researches need to be carried out focusing on other metrics such as perfect order, % of sales from new product, cycle time of design to dispatches, order fill rate, supply chain flexibility (both up stream & down stream), demand management, forecasting accuracy etc identified during the course of the present study.
4. Future researchers can perhaps improve upon the methodology adopted in the present study, for instance, they can administer questionnaires personally. It is hoped that this may lead to improvement in the quality of responses that could probably bring in more reliable and generalizable findings.
5. There is a need to carry out comparative studies focusing companies that have successfully adopted supply chain performance measurements in countries like India, China and U.S.A. The same may not only add to the extant literature on the subject but may also enable the researchers in identifying areas where improvement can be affected on the basis of experiences of supply chain performance measurement in these countries.
6. There is a need to Bench mark internally and globally to the extent possible. Researchers should establish the linkages between supply chain metrics and financial parameters.
7. The sampling frame of the present study i.e., IIMM data bank, consisting of premier companies, may have given the study bias in favor of those companies who are members. Thus, future researchers need to make an attempt to remove this bias.
8. The structured questionnaire approach used in the present study can be supplemented with case study method to gain better and deeper understanding.