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Investigation on Supply Chain Activities in the Manufacturing Sector of Southern and Western India

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Abstract—Supply Chain Management emerged as one of the most powerful business improvement tool available today. A number of SCM practices such as supplier, customer, ERP, subcontracting, E-procurement, EDI, E-commerce have been addressed in Indian manufacturing industries and a conceptual model was formulated based on previous literature and a questionnaire developed, survey was performed. This paper examines the effect of Supply Chain Management Strategies and its information system packages that are following in various manufacturing industries. Primary Data from manufacturing industry of various fields like Automotive, Sugar, Cement, Steel etc…were collected through interview and mail survey. The content of reply and reliability are tested. Analysis has been carried out based upon questionnaire results and suitable hypothesis developed. The survey and analysis proves that the Supply Chain Management Strategies and custom-made packages are significantly useful to the manufacturing firms.

Keywords—Supply Chain strategies, questionnaire, custom-made packages, ready-made packages, lead time, delayed orders.

I. INTRODUCTION

Defination of supply chain management**:-** A supply chain can be defined as a 'connected series of activities which is concerned with planning, coordinating and controlling materials, parts and finished goods from supplier to customer'.

Supply chain management (SCM) is concerned with the flow of products and information between supply chain members' organizations. Recent development in technologies enables the organization to avail information easily in their premises. These technologies are helpful to coordinates the activities to manage the supply chain. The cost of information is decreased due to the increasing rate of technologies. In the integrated supply chain model (Fig.1) bi-directional arrow reflect the accommodation of reverse materials and information feedback flows. Manager needs to understand that information technology is more than just computers. Except computer data recognition equipment, communication technologies, factory automation and other hardware and services are included.

1.1Stages in Supply Chain Management

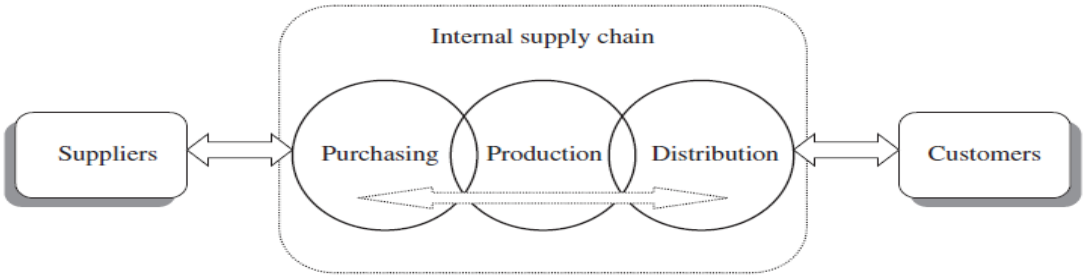

Fig 1 Stages in Supply Chain Management

In above mentioned every stages purchasing function needs, purchasing between suppliers and purchasing, purchasing between Production, Production between distributors and distributors between Customers. The information's sharing and communication between the above mentioned departments plays vital role in industry. Fig shows bi-direction information flows between every stage to keep on Supply Chain Management effectively.

1.2 Effect of Information technology on supply chain management

Information technology (IT) consists of a collection of IT resources that are shared and used by a firm. It consists of both the technical and organizational capabilities that provide the opportunities to share IT resources with and across the firm. In addition to this, the progress of web technologies for innovations in the supply chain mainly focuses on helping the decision makers develop and manage customer relationships by professionally integrating applications, and allowing for collaboration between trading partners in real-time [11].

II. OBJECTIVES

- The main objective of the study is to examine the benefits gained by the industries by implementing SCM.
- To highlight the differences between non SCM industries and SCM industries.
- To show IT and its tools are enabler of SCM.
- Importance of IT applications with respect to SCM.

III. DEVELOPMENT OF QUESTIONNAIRE

3.1 VARIOUS IT TOOLS IN SCM [4].

- BAR CODING
- DECISION SUPPORT SYSTEM
- EDI
- E-PROCUREMENT
- ELECTRONIC COMMERCE
- ERP
- INFORMATION SYSTEMS
- MRP
- WAREHOUSE MANAGEMENT SYSTEMS
- VERTICAL INTEGRATION

Based on the literature a questionnaire was designed. The questionnaire has been developed on a five point Likert scale. Various issues of Supply Chain Management have been incorporated related Indian manufacturing industries. The questionnaire contains 10 major questions, in that question no 4 contains 11 SCM strategies like partnership with suppliers and customers, E-procurement, subcontracting, use of external consultants etc… question no 5 pertaining to various information technology tools and its system of packages that the company currently following to support SCM, like MRP, MRPII, ERP, WMS, APS, JIT with its system packages like custom- made or ready-made packages. Same questions repeats in question no 6 taking into consideration of employ opinion, so what type of system they prefer for SCM. The question no 10 pertains 2 criteria with respect to IT application to SCM.

3.2 Target Industries for Survey

Eight sectors from the Indian manufacturing industry were selected for the administration of the questionnaire. These are: (i) Automotive (ii) Cement (iii) Electronic parts manufacturing (iv) Steel (v) Sugar (vi) Tool/machinery parts (vii) Textile (viii) Pharmaceutical.

IV. RESEARCH METHODOLOGY

4.1 Survey administration

The survey is based on data collected by framing a questionnaire. Final version of the questionnaire sent to the various manufacturing industries. The list of industries was drawn for data collection by Indian industries directory and some of them are from our college alumni passed out student list working in various industries. The methodology of data collection was through personal interview, phone calls, e-mail. Despite of repeated mailing follow up by phone calls and re-reminders the responses were collected. The truthfulness of the data was tested for reliability and for validity. The industries were southern and western part of our country. The final form of questionnaire was sent to 400 manufacturing industry after the reminders 200 filled responses have been received. A total of 20 responses were incomplete, and hence were not considered for the analysis. A total of 180 valid feedbacks were used for analysis, which gives around 45% response rate. The time duration kept to get filled response was around 4 weeks. This questionnaire was sent to only manufacturing industries in India and only those who are following Supply Chain Management.

4.2 Statistics of Respondents

The 180 responding industries were distributed in 8 major sectors as listed Cement, Sugar, Electronic parts, Steel, Tool/machinery, Automotive, Textile, and Pharmaceutical industries. The 180 respondents were more than 3 years of experience in SCM field and many of them are designated as financial officer, chief financial officer, work manager, general manager, executive director, production manager, technical head, purchase head, Quality engineer, deputy manager, operation engineer, team head and assistant engineer.

The respondent indicates that the responses from all mix sectors like, public limited industries, private limited, public sector organizations of small, medium and large manufacturing industries. The 180 feedbacks are with respective industries are as follows in table.

Cement	Electronic parts mfg	Sugar	Steel	Automotive	Textile	Tool/machinery	Pharmaceutical
22	23	22	25	23	21	22	22

Table 1 Response proportions industry wise

4.3 Survey data analysis

Method of Data Analysis

Hypothesis: Hypothesis is a "tentative assumption or preliminary statement about the relationship between two or more things that needs to be examined".
There are various statistical tools are available for the analysis of the data, but we chosen "THE TESTS OF HYPOTHESES CONCERNING PROPORTIONS" in that One tailed tests concerning single proportions chosen for the validity and reliability of the survey data obtained. In this method the assumption of null hypothesis and alternate hypothesis are very important.
Null hypothesis: It is an assumption about a population it is denoted by Ho.
Alternate hypotheses: If the null hypothesis is rejected, then the opposite of the null hypotheses must be true. The hypothesis representing the opposite of the null hypothesis is called alternate hypothesis. It is denoted by H1.
In n successive trials, let the probability of success in a trial be p and X be the number of success.
The standard normal statistic for test of survey data is

$$Z = (P-p)/\sigma$$

Where $\sigma^2 = p(1-p)/n$
Where p= proportion/ percentage of reply
n= sample size of individual industries
P=Normal distribution
$P \approx p$

If the Z value is in between -1.64 to +1.64 then Ho (null hypothesis) should be accepted or else the H1 (alternate hypothesis) should be accepted.
Ho: The performance of that particular strategy is true as per our survey response.
H1: The performance of that particular strategy is not authentic as per survey.

V. RESULTS

5.1. As per the calculations the following results were got and they are tabulated as follows.

The strategies or information technology tools were following in various industries are as follows as per our survey.

Strategy	Cement	Sugar	Electronic parts	Tool	Automotive	Steel	Textile	Pharmaceutical
Partnership with suppliers	Yes	Yes	Yes	Yes	Yes	-----	Yes	Yes
Partnership with customer	Yes	-----	Yes	Yes	Yes	Yes	Yes	------
Just-In-Time	Yes	Yes	-------	Yes	Yes	Yes	Yes	Yes
E-procurement	Yes	-----	Yes	Yes	Yes	------	Yes	Yes
Electronic data interchange	Yes	Yes	------	Yes	Yes	Yes	Yes	Yes
Sub contracting	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Vertical integration	-----	Yes	Yes	Yes	Yes	-----	Yes	Yes
Many suppliers	------	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Few suppliers	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Holding safety stock	Yes	-----	Yes	----	Yes	Yes	Yes	Yes
Use of external consultants	Yes	Yes	Yes	Yes	Yes	Yes	-------	-------

Table2 the various SCM strategy following industries

[Here (-----) line indicates the survey data out of range, so not authentic.]

The information system packages following in various industries as per our survey.

Area of package	**All industries**
Material requirement planning	Custom-made
Manufacturing resource planning	Custom-made
Enterprise resource planning	Custom-made
Warehouse management system	Custom-made
Supplier relationship management	Custom-made
Advance planning system	Custom-made
Just-in-time	Custom-made
E-commerce	Ready -made
Decision support/ expert system	Custom-made
Radio frequency identification	Not in use
Electronic data interchange	Custom-made
Bar coding	Not in use

Table 3 the type of system packages following in industries.

5.2 Effect of SCM with respect following parameters in all industries.

I) LEAD TIME IN DAYS PER MONTH

INDUSTRY	BEFORE SCM	AFTER SCM	EFFECT
Cement	9	4	Reduced by 5 days
Sugar mfg	26	12	Reduced by 14 days
Electronic parts	15	7	Reduced by 8 days
Tool//machinery	15	5	Reduced by 10 days
Automotive	13	7	Reduced by 6 days
Steel	15	6	Reduced by 9 days
Textile	14	7	Reduced by 7 days
Pharmaceutical	14	8	Reduced by 6 days

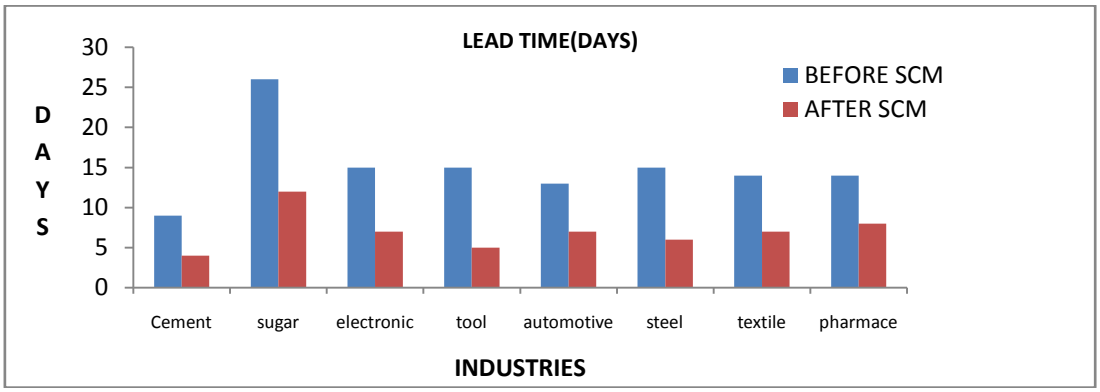

Fig 2 effect of SCM on lead time in various industries

II) AVG NO OF DELAYED ORDERS PER YEAR/1000

INDUSTRY	BEFORE SCM	AFTER SCM	EFFECT
Cement	190	110	Reduced by 80
Sugar mfg	50	30	Reduced by 20
Electronic parts	280	120	Reduced by 160
Tool//machinery	140	100	Reduced by 40
Automotive	170	100	Reduced by 70
Steel	110	40	Reduced by 70
Textile	200	80	Reduced by 120
Pharmaceutical	150	50	Reduced by 100

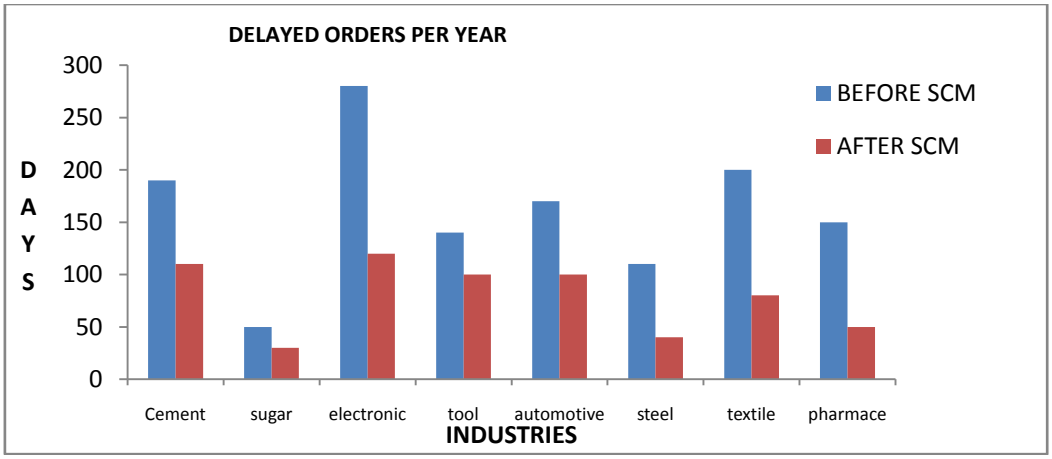

Fig 3 effect of SCM on delayed orders in various industries

III) AVG NUMBER OF CASES OF SHORTAGE OF MATERIAL/1000

INDUSTRY	BEFORE SCM	AFTER SCM	EFFECT
Cement	170	80	90 Cases Reduced
Sugar mfg	180	130	50 Cases Reduced
Electronic parts	220	80	140 Cases Reduced
Tool//machinery	120	60	60 Cases Reduced
Automotive	180	110	70 Cases Reduced
Steel	75	25	50 Cases Reduced
Textile	200	120	80 Cases Reduced
Pharmaceutical	170	110	60 Cases Reduced

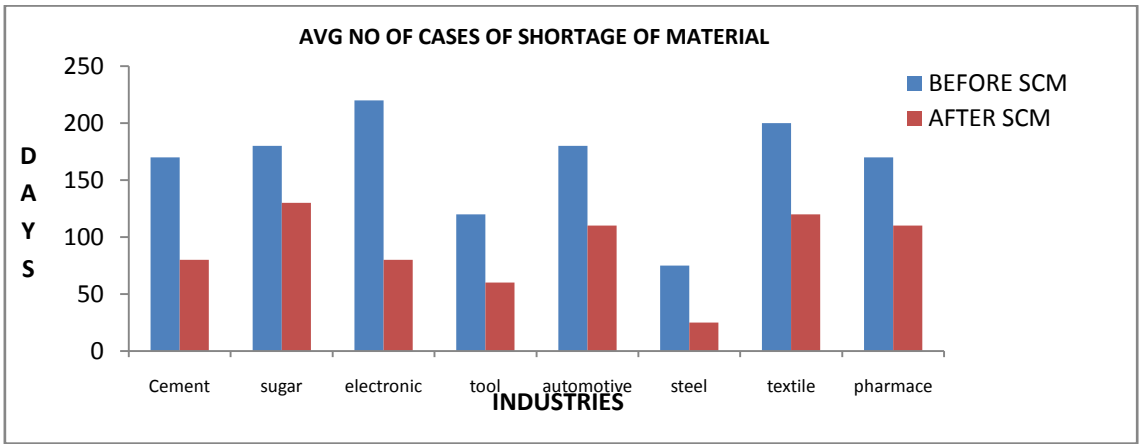

Fig 4.Effect of SCM on number of cases of shortage of material

IV) AVG NO OF DELAYED ORDERS TO CUSTOMER AFTER DUE DATES/1000

INDUSTRY	BEFORE SCM	AFTER SCM	EFFECT
Cement	75	35	40 Cases Reduced
Sugar mfg	50	10	40 Cases Reduced
Electronic parts	200	100	100 Cases Reduced
Tool//machinery	100	40	60 Cases Reduced
Automotive	100	50	50 Cases Reduced
Steel	140	60	80 Cases Reduced
Textile	150	80	70 Cases Reduced
Pharmaceutical	80	30	50 Cases Reduced

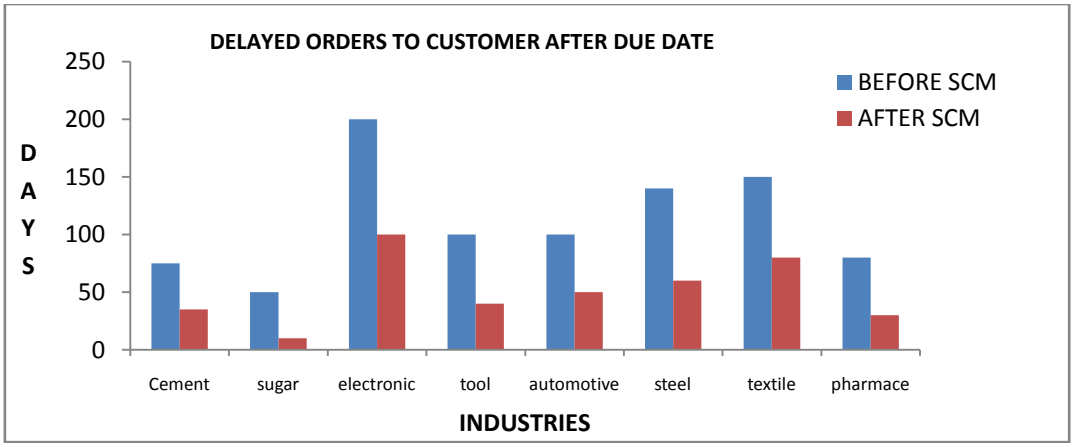

Fig 5 Effect of SCM on delayed orders to customer

V) PERCENTAGE OF ACTIVITIES NOT CARRIED AS PER THE SCHEDULE

INDUSTRY	BEFORE SCM	AFTER SCM	EFFECT
Cement	8	4	4% Improved
Sugar mfg	25	15	10% Improved
Electronic parts	30	10	20% Improved
Tool//machinery	13	4	9% Improved
Automotive	9	4	5% Improved
Steel	7	3	4% Improved
Textile	17	10	7% Improved
Pharmaceutical	25	10	15% Improved

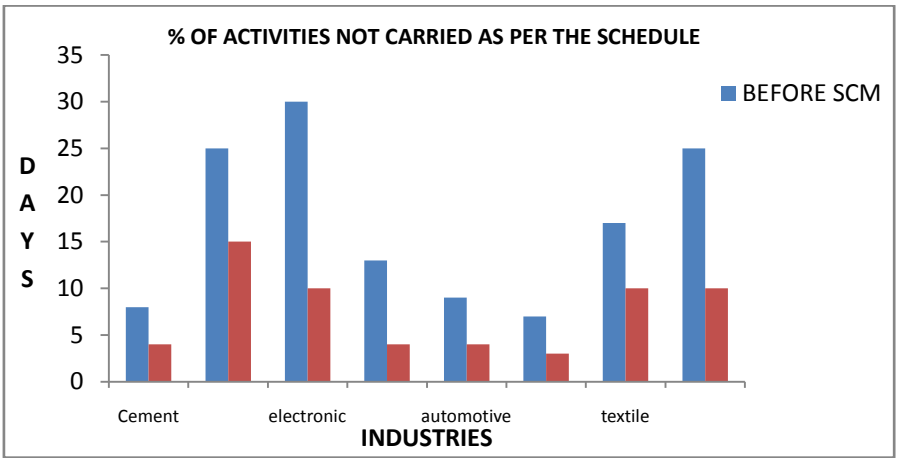

Fig 6 effect of SCM on scheduling activities of various industries

VI. FINDINGS

Based on the results got by the questionnaire survey and detailed calculation over reliability and validity of the data the following findings are made.

1: Many Indian manufacturing industries are following supply chain strategies to become competitive.
2: The supply chain management strategies and system packages are contributing to achieve good lead time, better manufacturing activities and reducing delayed order to customer.
3: The custom-made information system packages are more adopted than the ready-made packages.

VII. CONCLUSION

The previous works have considered only individual supply chain strategy and its effect. Here we focused on various supply chain strategies and information system packages, their effect on manufacturing lead time, delayed orders per year, shortage of material, delayed orders to customer after due dates and % of manufacturing activities carried as per the schedule in various industries. In our study an attempt is made to study supply chain strategies in Indian manufacturing industries.

The interviews and mail survey confirms that the supply chain strategies and information system packages are contributing very much in making industries more competitive and with more capabilities then before at a faster rate. The survey method shows that how SCM strategies especially e-business application improves industry processes and consequently improve the performance of manufacturing industries.

The 8 manufacturing industries which we are selected for our survey follows almost all strategies to improve business processes. The radio frequency identification and bar coding technology are the strategies which are less proffered. With proper implication of SCM strategies and information system packages industry can achieve good lead time, less shortage of material, less chances of supplying products to customer after due date and more chances of carrying manufacturing activities as per the schedule. These are the some vital information gathered by our investigation.

By our study many Indian manufacturing industries are following supply chain strategies to become competitive. They are now on course of aligning their processes and management focus on areas of customer service, profit maximization and operational excellence. Among various information system packages the ready-made packages are adopted by all 8 major manufacturing sector to get better benefit.

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