BENCHMARKING OF INTERNAL SUPPLY CHAIN MANAGEMENT IN SELECT INDIAN MANUFACTURING INDUSTRIES

THESIS

Submitted in fulfillment of the requirement of the degree of

DOCTOR OF PHILOSOPHY

to

J.C. BOSE UNIVERSITY OF SCIENCE & TECHNOLOGY, YMCA, FARIDABAD

by

KAILASH
Registration No: YMCAUST/Ph47/2012

Under the Supervision of

Dr. Rajeev Kumar Saha
(Supervisor)
Assistant Professor

Dr. Sanjeev Goyal
(Co-Supervisor)
Assistant Professor

DEPARTMENT OF MECHANICAL ENGINEERING
Faculty of Engineering and Technology
J.C. Bose University of Science & Technology, YMCA
Sector-6, Mathura Road, Faridabad, Haryana, India

October, 2019

CANDIDATE'S DECLARATION

I, hereby, declare that this thesis entitled "**BENCHMARKING OF INTERNAL SUPPLY CHAIN MANAGEMENT IN SELECT INDIAN MANUFACTURING INDUSTRIES**" by **KAILASH**, being submitted in fulfilment of the requirements for the Degree of **Doctor of Philosophy** in MECHANICAL ENGINEERING under Faculty of Engineering & Technology of **J.C. Bose University of Science & Technology, YMCA, Faridabad,** (formerly YMCA University of Science & Technology, Faridabad) during the academic year 2019-2020, is a bonafide record of my original work carried out under guidance and supervision of **Dr. RAJEEV KUMAR SAHA** and **Dr. SANJEEV GOYAL, Assistant Professor, Department of Mechanical Engineering, J.C. Bose University of Science & Technology, YMCA, Faridabad** and has not been presented elsewhere.

I, further declare that the thesis does not contain any part of any work which has been submitted for the award of any degree either in this university or in any other university.

(KAILASH)

Registration No: YMCAUST/Ph47/2012

CERTIFICATE OF THE SUPERVISOR'S

This is to certify that this thesis entitled "**BENCHMARKING OF INTERNAL SUPPLY CHAIN MANAGEMENT IN SELECT INDIAN MANUFACTURING INDUSTRIES**" by **KAILASH**, submitted in fulfilment of the requirement for the Degree of Doctor of Philosophy in **MECHANICAL ENGINEERING** under Faculty of Engineering & Technology of **J.C. Bose University of Science & Technology, YMCA, Faridabad,** during the academic year 2019-2020, is a bonafide record of work carried out under our guidance and supervision.

We, further declare that to the best of our knowledge, the thesis does not contain any part of any work which has been submitted for the award of any degree either in this university or in any other university.

Dr. Rajeev Kumar Saha
Assistant Professor (Supervisor)
Department of Mechanical Engineering
Faculty of Engineering & Technology
J.C. Bose University of Science & Tech.,
YMCA, Sector 6, Faridabad -121106

Dr. Sanjeev Goyal
Assistant Professor (Co-Supervisor)
Department of Mechanical Engineering
Faculty of Engineering & Technology
J.C. Bose University of Science & Tech.,
YMCA, Sector 6, Faridabad -121106

Dated:

ACKNOWLEDGEMENT

I express my deep sense of gratitude and indebtedness to my supervisor **Dr. Rajeev Kumar Saha** and co-supervisor **Dr. Sanjeev Goyal**, Assistant Professor, Department of Mechanical Engineering, J.C. Bose University of Science & Technology, YMCA, Faridabad, for providing unreserved guidance, inspiring discussions and constant supervision throughout this research work. It would never be possible for me to take this thesis to this level without his innovative ideas and his relentless support and encouragement. Their timely help, constructive criticism and conscientious efforts made it possible to improve the quality of my research work. I will carry out their guidance throughout my life. I wish to express my deepest gratitude to both of them. I gratefully acknowledge for the prayers of all my friends for their encouraging, caring words, constructive criticism and invaluable suggestions.

I express my sincere gratitude to **my mother & father, Smt. Munni Devi & Shri Mahinder Singh, brothers (Shri Suresh Singh, Mr. Balbir Singh), sisters (Late Ms. Laxmi, Ms. Reena Rani, Ms. Pinki, Ms. Renu) and all relatives** whom constant encouragement has driven to this time where I could able to complete this work.

I should not forget to thank my wife **Dr. Roopa Rani** for her constant help, encouragement and care in completing this work.

Lastly, my deepest gratitude is due to **almighty God** whose divine light and warmth provided me the perseverance, guidance, inspiration and strength to complete this work.

(KAILASH)

Registration No.: YMCAUST/Ph47/2012

ABSTRACT

Supply chain management (SCM) come into existence in late 80's. SCM is a broad area and is studied into two parts i.e. external supply chain management (ESCM) and internal supply chain management (ISCM). ISCM is one of the most important components which affect the performance of any type of manufacturing industry. For an effective control of internal supply chain, benchmarking of ISCM should be implemented to identify different problems related to it.

Keeping above views in mind this research work consists of study carried on different types of performance indicators of benchmarking, factors and sub factors, pit falls, industrial scope and other benefits of ISCM. Through literature review, different types of benchmarking and role of benchmarking in ISCM of manufacturing industries has been studied. The comparative benchmarking practice, mathematical statistics and bar charts have been used to analyze the performance gap between variable factors. VIKOR technique has been used to assign the rank of various variable factors. The DEMATEL technique has been used to categorize different factors into two groups i.e. Cause group and effect group. Supplier selection criteria using analytical hierarchy process, weightage score card and competitiveness index (CI) has been used to develop a benchmark for analysis of select Indian manufacturing industry. Analytical benchmarking framework has been developed to analyze variable factors of ISCM. The implementation work of benchmarking framework has been used to calculate Return on investment (ROI) and its optimization ROI of select Indian manufacturing industries. The weighted interpretive structural modeling (W-ISM) technique, fuzzy analytical hierarchy process (F-AHP) and interpretive structural modeling (ISM), MICMAC analysis has been used to develop different benchmarking model of ISCM.

The major contributions made through this research are as follows:

- This present research provides history of literature review and identifies problems related to ISCM in selected Indian manufacturing industries.
- Different performance indicators of benchmarking and factors & sub factors of ISCM have been identified.

- The present trends and problems of ISCM have been reviewed through case study and plant visits.
- Competitiveness index (CI) has been found and used as a benchmark to analyze the performance of Indian manufacturing industries.
- The benchmarking framework and benchmarking model have been developed to analyze the performance of select Indian manufacturing industries.
- Based on benchmarking framework, ROI and optimize ROI of select Indian manufacturing industries has been calculated.
- Benchmarking of ISCM has been identified that it is a best practice which is used to analyze the performance of select Indian manufacturing industries.

Keywords: Internal Supply Chain Management, Comparative Benchmarking, VIKOR Methodology, DEMATEL Technique, Analytical Hierarchy Process Technique, Weightage Score Card, Competitiveness Index, Weighted Interpretive Structural Modeling Technique, Fuzzy Analytical Hierarchy Process Technique, Interpretive Structural Modeling Technique

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

S. NO.	TITLE	ABBREVIATIONS
1.	Agile Manufacturing System	AMS
2.	American Production and Inventory Control Society	APICS
3.	American Productivity and Quality Center	APQC
4.	Analytical Hierarchy Process	AHP
5.	Analytical Network Process	ANP
6.	Antecedent Set	AS
7.	Bill of Material	BOM
8.	Collaborative Planning, Forecasting and Replenishment	CPFR
9.	Competitiveness Index	CI
10.	Computer Aided Design	CAD
11.	Computer Aided Manufacturing	CAM
12.	Computer Numerical Control	CNC
13.	Critical Success Factors	CSFs
14.	Data Envelopment Analysis	DEA
15.	Decision Making Trial and Evaluation Laboratory	DEMATEL
16.	Escorts Construction Equipment Limited	ECEL
17.	Enterprise Resource Planning	ERP
18.	External supply chain management	ESCM
19.	Fast Moving Consumer Goods	FMCG
20.	Fuzzy Analytical Hierarchy Process	FAHP
21.	Fuzzy Multi Objective Genetic Algorithm	FMGA
22.	Genetic Algorithm	GA
23.	Global Supply Chain Forum	GSCF
24.	Graph Theoretic Approach	GTA
25.	Green Supply Chain	GSC
26.	Green Supply Chain Management	GSCM
27.	Gross Domestic Product	GDP

28.	Incoming Quality Control	IQC
29.	Information Technology	IT
30.	Internal Supply Chain	ISC
31.	Internal Supply Chain Management	ISCM
32.	Interpretive Structural Modeling	ISM
33.	Intersection Set	IS
34.	Just in Time	JIT
35.	Key Performance Indicators	KPIs
36.	Lean Supply Chain	LSC
37.	Man, Machine, Material, and Method	FOUR M's
38.	Management Computer System Multi criteria decision making	MCSMCDM
39.	Manufacturing Resource Planning	MRP-II
40.	Material Requirements Planning	MRP-I
41.	Matrix of Cross Impact Multiplication Applied to Classification	MICMAC
42.	Metal Inert Gas	MIG
43.	Micro and Small Enterprises	MSE
44.	Middle Scale Medium Enterprises	MSME
45.	Military Art Science	MAS
46.	Multi criteria decision making	MCDM
47.	Multinational Companies	MNCs
48.	Multi-Objective Optimization By Ratio Analysis	MOORA
49.	National Capital Region	NCR
50.	National Manufacturing Competitiveness Programme	NMCP
51.	Original Equipment Manufacturers	OEMs
52.	Outgoing Quality Control	OQC
53.	Performance Measurement Indicators	PMIs
54.	Performance Measures	PM
55.	Plan Do Check Action	PDCA
56.	Premenstrual Syndrome	PMS
57.	Process Failure Mode Effects Analysis	PFMEA

58.	Production Parts, Approval Process	PPAP
59.	Production Planning and Control	PPC
60.	Purchase order	PO
61.	Quality Management	QM
62.	Quantitative Strategic Planning Matrix	QSPM
63.	Quick Response	QR
64.	Reachability Matrix	RM
65.	Reachability Set	RS
66.	Research & Development	R & D
67.	Return on investment	ROI
68.	Simple additive weighting	SAW
69.	Situation Actor Process Learning Action Performance	SAP-LAP
70.	Small Medium Enterprises	SME
71.	Steel Re Rolling Mills	SRRMs
72.	Strength Weakness Opportunities Threats	SWOT
73.	Structural Self-Interaction Matrix	SSIM
74.	Submerged Arc Welding	SAW
75.	Supplier Development	SD
76.	Supplier Relationship Management	SRM
77.	Supply Chain	SC
78.	Supply Chain Management	SCM
79.	Supply Chain Networks	SCNs
80.	Structural Equation Modeling	SEM
81.	Supply Chain Operations Reference	SCOR
82.	Supply Chain Quality Management	SCQM
83.	Supply Chain Vulnerability	SCV
84.	Supply Driven Inoperability Input Output Model	SIIM
85.	Sustainable Business Development	SBD
86.	Sustainable Supply Chain Management	SSCM
87.	Total Interpretive Structural Modeling	TISM
88.	Total Order Preference by Similarity to Ideal Solution	TOPSIS

89.	Total Quality Management	TQM
90.	Traditional Supply Chain	TSC
91.	Ubiquitous Computing Technology	UCT
92.	Variable Factors	VF
93.	Vendor Managed Inventory	VMI
94.	Video Database Management System	VDBMS
95.	VIseKriterijumska Optimizacija I Kompromisno Resenje	VIKOR
96.	Weightage Score Card	WSC
97.	Weighted Interpretive Structural Modeling	WISM
98.	Weighted Product Method	WPM
99.	Work in process	WIP
100.	World Class Maintenance System	WCMS

CHAPTER I
INTRODUCTION

1.1 INTRODUCTION

Benchmarking of ISCM is a very sensitive area which provides the fruitful results in finding the internal supply chain performance gap. Internal benchmarking may be the first step of internal supply chain for any type of manufacturing industry. It is a primary & continuous practice tool for regular improvement of any business. The competitors regularly provide challenges within market, they also provide insight on how operating costs can be reduced and efficiency can be increased.

A study reported that, generally micro scale medium enterprises (MSME) don't use internal supply chain management (ISCM) in regular manner (Jackson et al, 1994). Therefore, to achieve optimal productivity with internal supply chains, a strong and justified need to design a hybrid system of benchmarking and ISCM is required. Based on the benchmarking practices, manufacturing industries can easily measure the performance of products or services against its competitors and also select best-in-class industries out of all. A review of benchmarking in manufacturing sector and a discussion of its future potential are carried out particularly at a time when producers have to make significant changes to their business practices for survival. Decision makers are constantly focused on those latest techniques which are helpful in quality improvement in ISCM.

The purpose of this research work is to investigate the field of benchmarking of ISCM. This is an important subject matter because the small changes in inputs may change the output of manufacturing industries by reducing idle time and optimization of available resources. The objective of this research work is to review the available literature of benchmarking in various fields and then identify the benchmarking role in improving the ISCM performance of manufacturing industries. For benchmarking in different fields, already some approaches, framework and models are available in the literature. But these techniques are too complex and having limited scope in real practice in the areas of selected Indian manufacturing industries. Therefore, the main goal of research is to identify different performance measurement indicators (PMIs) of benchmarking, factor & sub factors of ISCM through past history. After that the analysis of factors has been done by comparative benchmarking, VIseKriterijumska

Optimizacija I Kompromisno Resenje (VIKOR) methodology and decision making trial and evaluation laboratory (DEMATEL) technique. A benchmark has been developed on the basis of supplier selection criteria using analytical hierarchy process (AHP), weightage score card (WSC), and competitiveness index (CI). The value of CI has been used as a benchmark to analyze Indian manufacturing industry. Then, development of benchmarking framework of ISCM is carried out and implemented to calculate optimize ROI taking cases of Indian manufacturing industries. Further, the interrelationship between factors has been explained by different model of benchmarking using techniques like: Weighted Interpretive Structure Modelling (W-ISM), Fuzzy Analytical Hierarchy Process (F-AHP) and Interpretive Structure Modelling (ISM) techniques with Matrix of Cross Impact Multiplication Applied to Classification (MICMAC) analysis.

This chapter consist of the objective of research, benchmarking, benchmarking barriers and benchmarking misconceptions, ISCM, obstacles in ISCM implementation, benefits of ISCM implementation and their key issues & challenges. It describes the importance of benchmarking of ISCM in selected Indian manufacturing industries; identify scope of research work through recent research papers, benefits of benchmarking of ISCM and motivation of research. The aim of this research work is to focus on benchmarking of internal supply chain practice in selected Indian manufacturing industries. This study also deals with summarizing and analyzing the current challenges of ISCM in manufacturing world.

1.2 BENCHMARKING

Benchmarking is a primary practice for regular improvement of any business (Bhutta et al, 1999). The continuous benchmarking practice might be helpful to increase the productivity of manufacturing industries by reducing the idle time during the flow of raw material, finance and information. Benchmarking is a continuously comparative performance practice at internal and external levels of business. Benchmarking practice is used to identify gap and reduce them for improvement of existing process. It is the first and foremost tool for improvement through comparison with other organizations (Dattakumar et al, 2003). The selection of benchmarking partner is a very important aspect in benchmarking practice. The manufacturing industry can hire benchmarking partners either from outside agencies or from inside the industry, depending upon the capability of manufacturing industry. A group of benchmarking

partners should work continuously for eliminating the gap by reducing the idle time between internal supply chain activities within organization. For many other manufacturing industries, competition in smaller areas is necessary for making best outcomes of benchmarking. The regular practice of benchmarking supports the businessmen to distinguish the best standards of working as well as for getting the information about what their competitors are doing and how they are producing best in minimum possible time (Tutcher, 1994). Thus, benchmarking is a highly proactive management tool which is increasingly used to identify and focus on improvement activities with the goal of international competitiveness.

Benchmarking practice is a continuous regular systematic structural practice for improving the existing performance (Gift et al, 1996). It is generally carried out for the comparative analysis on the basis of standards (Gift et al, 1994). The quantitative benchmarking practice is the comparison of existing performance data of manufacturer with the best standard data (Keehley et al, 1997). Finally, it can bring adequate benefits and should be used to improve the process of manufacturing, thus taking industry to new heights in terms of production, profit and customer orientation.

1.2.1 Benchmarking Barriers

Benchmarking is not simply data comparison practice, but its purpose is to optimize the existing resources of manufacturing organization. Following are the identified barriers of benchmarking:

- Not involving the appropriate people.
- Lack of understanding the internal processes.
- Lack of action.
- Failure to see need for change.
- Inability to see opportunity to improve.

1.2.2 Benchmarking Misconceptions

Following are the common misconceptions for benchmarking.

- Benchmarking leads to explicit cause - effect relationships with best practices.
- Benchmarking leads to rating and ranking of performance.
- Benchmarking is just copying others.

1.3 INTERNAL SUPPLY CHAIN MANAGEMENT

Supply chain management (SCM) is a broad area. The main function of SCM is to manage the flow of materials, finance and information between the activities (David et al, 2006). It can be classified into two categories: external supply chain management (ESCM) and internal supply chain management (ISCM). The function of ESCM is to manage the flow of material, funds and information outside the organization. But the function of ISCM is to manage the flow of material, funds and information within the organization. ISCM consist of purchase, production and distribution units between suppliers and customers. The coordination between departments and activities is necessary for efficient working of internal supply chain of any type of manufacturing industry.

1.4 OBSTACLES IN ISCM IMPLEMENTATION

There are some obstacles that come in the way of ISCM processes implementation. These are given below:

1.4.1 Lack of Management Support

The first obstacle is the lack of willingness of management to invest something in ISCM improvement. It is a challenge faced by benchmarking team members.

1.4.2 Lack of Training

Another reason is lack of clear understanding about ISCM throughout the industry. Some area don't have well trained and well experienced specialists. Also, it can't be implemented in those manufacturing industry where knowledge of ISCM is negligible. The employees should be motivated enough in order to take this sustainability approach more seriously. The awareness is spread first in the industry so that each employee becomes aware about how this concept would create better image of the organization.

1.4.3 Lack of Integration of Information Technology System

It is one of the prime obstacles in ISCM implementation. Dashore et al, (2013) considered the integration of information technology (IT) system into the green supply chain (GSC) approach as a major necessity for this new concept to be adopted successfully. It uses computer based applications programs; IT enabled procedures

and software which may be utilized during the data and information exchange process. IT systems work as an enabler for a successful GSC. IT can facilitate the integration of sustainability into the supply chain processes by first optimizing the needed resources.

1.4.4 Lack of Knowledge

It appears to be a common hindrance for establishing a sustainable supply chain approach. Employees are not well informed concerning the importance of sustainability into ISCM. The lack of knowledge and information concerning the approach of sustainability is one of the biggest barriers (Al Zaabi et al, 2013).

1.4.5 Costs

Consumers want the availability of product to be at lowest possible prices, thus this requires the cost incurred to be low enough so as to offer low prices. Many studies have revealed that integrating sustainability into internal supply chain processes is expensive and require a big amount of money especially for small medium enterprises (SME). Hervani et al, (2005) discussed in their study that costs are considered high for SME by saying: "Incurring costs are even more significant for SME which have generally less resources available". One of studies claims that two thirds of the SME considered high costs as the major obstacle for implementing sustainable supply chain activities.

1.4.6 Past Failures

Imperfect launching of ISCM is itself a big obstacle. The lack of implementation strategy may lead to lack of faith in whole philosophy.

1.4.7 Inventory Management

Inventory management becomes a challenge due to the quantity and location of inventory including raw material, work in progress (WIP) and finished goods which affect the industrial work.

1.4.8 Poor Organizational Structures

It means defensive culture, negative thought towards change, reward system, geographical dispersion, lack of skilled shop floor staff, union activity creates 'us vs.

them' attitude, strategic misalignment, competing value streams, insufficient/ inconsistent value stream measures and poor material flow, etc. This can be emphasized from the poor top management commitment. People in such organization are considered impassioned regarding the issues of the external environment (Min et al, 2001).

1.4.9 Poor Supplier Commitment

Supplier involvement is highly important. Poor supplier commitment tells that they are not prepared to be part of the design process and technology. Supplier's commitment is crucial in order to have a successful performance. Suppliers should show some intellect concerning the GSC (Govindan et al, 2010).

1.4.10 Competition and Uncertainty

This is also a major obstacle in front of ISCM. According to Yu Lin et al, (2008) "market competition and uncertainty is high due to global competitiveness and varying customer's requirement".

1.4.11 Distribution Network Configuration

Distribution network configuration like number of supplier, production facilities, distribution centres, warehouse and customers is very common obstacles as it increases then the chances of problems may increase and hence, it stops the progress of ISCM implementation.

1.4.12 Distribution Strategy

Push and pull strategy, direct shipment and centralized verses decentralized strategy are also the challenges in front of ISCM.

1.5 BENEFITS OF ISCM IMPLEMENTATION

ISCM focus on internal activity like: waste time reduction, lowering cycle time and reduction of response time and WIP inventory inside the industry. Improvement in these may impose positive impacts on the performance of industry. During study following benefits are observed.

1.5.1 Reduced Supply Chain Costs

By implementation of ISCM, manufacturing industries can achieve the followings: reduced cycle times, increased labor productivity, elimination of bottlenecks and reduced machine downtime. The manufacturing industries can significantly increase output with reduced supply chain costs.

1.5.2 Eliminating Problems

ISCM identify the existing problems of flow inside the industry and eliminating them is one of the main functions of ISCM implementation plan. All the form of internal problems of manufacturing unit i.e. overproduction, defect, transportation, WIP inventory, over processing, waiting and motion are reduced with ISCM implementation.

1.5.3 Reduced WIP Inventory

Minimize inventory levels at all stages of production, particularly WIP between production stages. The improvement takes place in inventory reduction. Lower inventories also mean lower working capital requirements.

1.5.4 Lower Cycle Times

Reduce manufacturing lead times and production cycle times by reducing waiting times between processing stages as well as process preparation times and product/model conversion times. Using ISCM, cycle time may be improved.

1.5.5 Delivery Performance

ISCM have the ability to improve delivery performance with minimum changeover costs and changeover time.

1.5.6 Work Involvement

ISCM effectively increase the involvement of worker in various ISCM activities, creates better understanding of processes, machines, material flow among the team and improves core competencies of worker.

1.5.7 Better Utilization of Equipment & Space

Use equipment and manufacturing space more efficiently by eliminating bottlenecks and maximizing the rate of production through existing equipment.

1.5.8 Departments Coordination

It should also improve because the goal of effective ISCM can be achieved when all departments like production, sales, purchase, research & development (R&D), quality, human resource and manufacturing, etc are working together.

1.5.9 Overall Productivity

Improve labor productivity by reducing the idle time of workers and ensuring that while working they use their effort as productively as possible. Therefore, improvement occurs in overall productivity.

1.5.10 Other Benefits

- Option of bulk purchases at discount rates.
- Due to effective ISCM at these retail stores, the operating and distribution costs are kept low, reflecting in lower product prices for customers.
- Continuous stock availability.
- Good quality control.
- A single point distribution network, through which the products get distributed to all areas of the city.
- Reduction in product losses in transportation and storage.
- Increasing of sales, efficiencies and increasing the volume of trade.
- Advanced techniques, capital and knowledge among chain partners.
- Better information about the flow of products, markets and technologies.
- Tracking and tracing to the source.
- Customer satisfaction, better control of product safety and quality.
- Large investments and risks are shared among partners in the chain.

1.6 KEY ISSUES & CHALLENGES

Some of the key issues and challenges are as follow:

- Strategic network optimizations, including the number, location and size of warehousing, distribution centres and facilities.
- Strategic partnership with suppliers, distributors and customers.
- Product life cycle management.
- Information technology infrastructure to support internal supply chain operations.
- Where-to-make and what-to-make or buy decisions.
- Aligning overall organizational strategy with supply strategy.
- Sourcing contracts and other purchasing decisions.
- Production decisions including contracting, scheduling and planning process.
- Inventory decisions, including quantity, location and quality of inventory.
- Transportation strategy, including frequency, routes and contracting.
- Benchmarking of all operations against competitors and implementation of best practices throughout the enterprise.
- Focus on customer demand.
- Daily production and distribution planning.
- Production scheduling for each manufacturing facility in the internal supply chain.
- Demand planning and forecasting, coordinating the demand forecast of all customers and sharing the forecast with all suppliers.
- Sourcing planning.
- Inbound operations.
- Production operations.
- Outbound operations.
- Order promising, accounting for all constraints in the supply chain, including all suppliers, manufacturing facilities, distribution centres and other customers.

1.7 IMPORTANCE OF BENCHMARKING OF ISCM IN SELECTED INDIAN MANUFACTURING INDUSTRIES

Indian manufacturing industries persistently affect the economy of the country. So, it is necessary to take some initiatives in the areas of manufacturing. The performance of manufacturing industry would be improved through the implementation of

benchmarking of ISCM. The continuous benchmarking practice may affect the performance of ISCM through identification of performance gap. Hence, this research work has come across some review of benchmarking practice for improvements of internal supply chain of manufacturing industries. Benchmarking practice of ISCM may be fruitful to overcome supply chain challenges.

The main purpose of this research work is to implement the benchmarking practice in the field of ISCM to identify the gap between them. The manufacturing industries generally consist of different process of manufacturing like: machining, casting, forging, welding, sheet metal work, assembly and packaging goods, etc. The objective of manufacturing process is to convert raw material into final shape of the product. Four M's (men, material, machine, and method) are playing key role in the functioning of any type of manufacturing industry. The main function of management in internal supply chain is to manage the flow of raw material, funds and information among these four M's in different departments. To fix up the production targets, delivery dates production department consider the minimum production costs and time. The continuous practice of benchmarking are very helpful in improving the internal supply chain performance of multiple areas like banking sector, education sector, retail industries, defense weapons manufacturing industries, service sectors, agriculture sectors, surgical equipment's manufacturing industries, fast moving consumer goods (FMCG) sectors, etc. Therefore in almost all sectors, benchmarking continuous practice of ISCM can be implemented for improving the existing process and performance of ISCM.

1.8 LACUNA IN LITERATURE REVIEW

The available literatures on SCM, benchmarking and ISCM have been studied in different fields and consequently, some research gaps regarding benchmarking of ISCM have been identified. Following gaps for benchmarking of ISCM are identified:

- Lacuna of quantitative/quantitative models and information flow in the field of benchmarking of ISCM.
- It is also interesting to observe the evolution and advancements of benchmarking of ISCM. Although various problems related to benchmarking and ISCM have been extensively explored during the past decades but their capabilities are not fully utilized. This is due to the wide gap existing between

the theoretical research and practical expectations of Indian manufacturing industries.

- Maximum works have been done in the field of benchmarking, benchmarking of SCM, benchmarking in other sectors while work on benchmarking of ISCM has not been considered.
- Attention has not been paid regarding PMIs, factors, sub factors of ISCM which affect the performance of benchmarking and benchmarking of ISCM in Indian manufacturing industries.
- Different techniques used by researchers for developing benchmark, benchmarking frameworks and benchmarking models are too complex to be used in real industrial practice. Therefore, there is an urgent need of such types of techniques which can be easily used by manufacturing industries to overcome problems of ISCM. Keeping this in view, an attempt has been made to analyze the benchmarking practice of ISCM in some selected Indian manufacturing industries.
- The literature review addressed various issues encompassing the benchmarking of ISCM, in relation to the operational effectiveness in industry. Thus, the recent literature provides a meaningful insight regarding the state-of-art of benchmarking of ISCM activities undertaken by various types of industries. The critical issues identified were further used as a basis for development of benchmark, benchmarking framework and model of benchmarking to improve the operational effectiveness of a manufacturing industry.

1.9 IDENTIFY SCOPE OF RESEARCH WORK THROUGH OUTCOMES & LIMITATIONS OF RESEARCH PUBLICATIONS

Inadequate work, low awareness regarding benchmarking of ISCM in Indian manufacturing industries has motivated the researchers to pursue research in exploring and analyzing the benchmarking practice of ISCM in selected Indian manufacturing industries. Based on the identified gap in literature, the scope of research work has been extracted as shown in the table 1.1.

Table 1.1 Identify Scope of Research Work through Outcomes & Limitations of Research Publications

S. No.	Author	Outcomes	Limitation	Scope of Research Work
1	Partovi, (1994)	Determined what to benchmark based on analytic hierarchy approach.	Limited only to AHP technique.	Implementation of AHP technique in benchmarking of ISCM
2	Jackson et al, (1994)	The classification of literature on benchmarking based on the types of benchmarking and associated issues and comments on each article.	Classification and issues of benchmarking.	Implementation of benchmarking practice for improving ISCM performance of Indian manufacturing industries.
3	Zairi et al, (1995c, 1996)	Concentrated on a detailed review of some of the key books written by "gurus" of benchmarking with a view to help educational and training processes in companies embarking on or launching a benchmarking project.	Provides theoretical details of benchmarking by different experts.	Scope of identification of KPIs of benchmarking, which are helpful in educational and training processes in companies as well as launching a benchmarking project.
4	Ramabadr on et al, (1997)	Proposed an organizational model for review on the basis of benchmarking and project management.	A review model for organization.	Scope of development of benchmarking model for improvement of ISCM performance.
5	Dorsch et al, (1998)	Researcher have identified that the academic community is lagging in terms of providing advancing models and frameworks that integrate many facts of organizational benchmarking.	Shortage of benchmarking model and framework due to academic lagging.	Benchmarking model and framework are required for analysis of manufacturing industries.
6	Bhutta et al, (1999)	Proposed benchmarking as a best practice, an integrated approach.	Importance of benchmarking for integration of departments.	Benchmarking practice implementation for improving ISCM performance of organization.
7	Talluri, (2000)	Proposed a method more suited for internal rather than external benchmarking because of the difficulties that may arise in obtaining these types of data from competitors.	Benchmarking practice is more suitable for Internal benchmarking.	

8	Yasin, (2002)	Focuses on benchmarking practices in the manufacturing, service and public sector operational performance.	Importance of benchmarking practice.	
9	Dattakumar et al, (2003)	Proposed review of Literature on benchmarking.	Benchmarking: Definition, types, methodology, etc.	
10	Jainet al, (2006)	Discussion on benchmarking study of two food processing companies has been carried out to identify a number of improvement opportunities for both the companies.	Discuss benchmarking study of two food processing industries for improvement.	Benchmarking practice implementation for improving ISCM performance.
11	Baltaciogl u et al, (2007)	Designed a new framework for the service supply chain, which is built on the existing knowledge, derived with an application in the healthcare industry.	Designed a framework for service supply chain and applied in the healthcare industries.	Implementation of framework for improving the performance of ISCM of Indian manufacturing industries.
12	Gammelgaard, (2007)	Presents different view on SCM like learning to integrate: supply chains re-conceptualized, Benchmarking operations to promote learning: an internal supply chain (ISC) perspective, visualization for systems learning in supply chains, An innovative SCM program structure: broadening the SCM skill set.	Integration of benchmarking and SCM.	Implementation of benchmarking and ISCM integration to evaluate ROI of manufacturing industries.
13	Anand et al, (2008)	Its aim is to propose a universal benchmarking model, which can be applied for all types of benchmarking.	Universal benchmarking model for all types of benchmarking.	Benchmarking practice implementation for improving ISCM performance of Indian manufacturing industries.
14	Chatzigeorgiou, (2010)	Benchmarking is performed by comparing each software design to its best performing peers rather than a theoretical baseline and that efficiency is estimated by considering all input and output items enabling the comparison of projects with diverse size characteristics.	Implementation of benchmarking practice for comparing each software design.	
15	Radauer et al, (2010)	Easy identifiable/visible with well-timed delivery are the main quality aspects small and	Focus only on competence of employee for	Scope of Identification of KPIs of

		medium enterprises (SME), while the geographical proximity of the SME to the service premises is a factor of less importance.	timely delivery of items.	benchmarking is essential for improvement of overall performance of organization.
16	Jain et al, (2010)	Provides the knowledge and skills, which are necessary to work effectively at the interface between technology, management and engineering.	Explain importance of benchmarking practice for improvement of organization.	Implementation of benchmarking practice for improving ISCM performance in multiple areas.
17	Brandenburg, (2011)	Suggested that firms achieve higher levels of profitability and organizational performance through successful implementation of practices associated with quality management.	Benchmarking practice implementation associated with quality management to improve Organizational profit.	
18	Gunasekaran, et al, 2011	Developed a framework with key factors/enablers that determine the resilience and competitiveness of SME.	Developed a framework for competiveness of SME.	Implementation of comparative benchmarking practice on the basis of competitiveness of organization.
19	Giannakis et al, (2011)	Viewed the capacity of benchmarking as a key to understand the service by considering transfer of capacity for the purposes of providing value to the customer.	Importance of benchmarking in service industries.	Implementation of benchmarking of ISCM practice to optimize ROI of manufacturing industries.
20	Williams et al, (2012)	Analyzed content analysis is used to identify reasons for benchmarking reluctance and ways to overcome reluctance.	Reasons of benchmarking.	Implementation of benchmarking practice for improving ISCM performance.
21	Hong et al, (2012)	For sustainable competitive advantage, benchmarking goes beyond the operational level and moves into a wide range of value chain, strategic, operational and project levels.	Competitive benchmarking practice for sustainability in market.	
22	Moazzam et al, 2012	Presents a conceptual framework based on Supply Chain Operations Reference (SCOR) model conforming to the specific needs of agriculture-food.	Developed a framework based on SCOR model configures to needs of agriculture-food industries.	Implementation of development of a framework based on SCOR model configure to needs of Indian manufacturing industries.

23	Gunasekaran et al, (2012)	Provide an overview of the available sustainable business development (SBD) literature by classifying and then critically reviewing the material to develop a framework for SBD.	Provides overview on literature.	Implementation of benchmarking practice for improving ISCM performance of organization.
24	Kristianto et al, (2012)	Improved the level of integration in all aspects of supply chain reconfiguration, such as the inventory allocation and manufacturing process involved by incorporating manufacturing and product design into logistic design.	Integration of SCM.	Implementation of benchmarking and ISCM integration to optimize ROI of manufacturing industries.
25	Salem, (2013)	Benchmarking is the continuous process of measuring products, services and practices against competitors recognized as industry leaders.	To measure performance of product.	Implementation of benchmarking practice for improving ISCM performance.

1.10 BENEFITS OF BENCHMARKING OF ISCM

There are certain objectives to be achieved through benchmarking of ISCM. The aim of ISCM is to lower the costs and resources involved in the creation of products as well as improve efficiency and effectiveness, reducing inventory levels and respective costs, increasing profits and improving cooperation. Following are the proposed key benefits of benchmarking of ISCM.

- Increased revenues
- Cost reduction in ISCM
- Product availability on time
- Reduced order cycle time
- Economic value addition
- Proper capital utilization
- Reduce idle time
- Reduced inventory carrying costs.

1.11 MOTIVATION OF RESEARCH

The literature confers the increasing attention of benchmarking of ISCM globally. Factors like: financial problems, political issues, socio-cultural changes, highly

fragmented and rapid demand of customers, behavior of consumers, rapid development and change of products, etc has seriously modified the economic and manufacturing industrial environment. It is clear that benchmarking of ISCM has become a sensitive issue which motivates the researchers for doing work in the field of benchmarking of ISCM. Such type of research work also encourage the researchers to develop different models of benchmarking, benchmarking frameworks and benchmark for analyzing selected Indian manufacturing industries.

1.12 ORGANIZATION OF THE THESIS

The present research work has been scheduled in 11 chapters. The chapter wise organization of the research has been illustrated in figure 1.1. The precipitate of each chapter has been discussed as below:

Chapter I: This chapter consists of the objective of research, definition of benchmarking, benchmarking barriers, misconceptions, ISCM, obstacles in ISCM implementation, benefits of ISCM implementation and their key issues & challenges. It describes the importance of benchmarking of ISCM in selected Indian manufacturing industries; identify scope of research work through recent research publications, benefits of benchmarking of ISCM and motivation of research, etc.

Chapter II: In this chapter, relevant published literatures are reviewed in search of different methods of benchmarking of ISCM in different fields. Based on literature review PMIs of benchmarking and quantitative/quantitative techniques, benchmark, benchmarking framework for ISCM and different models of benchmarking have been developed to analyze the ISCM performance of some selected Indian manufacturing industries.

Chapter III: This chapter describes the methodology in terms of the research design, questionnaire design, method of data collection & analysis. The responses from selected Indian manufacturing industries were collected by a survey questionnaire, which consist of questions related to ISCM and its benchmarking. The analysis of final data is outlined through pretesting the questionnaire, its validity, reliability and techniques used for analysis.

Chapter IV: This chapter consists of multiple proposed and achieved research objectives like: Identification of PMIs of benchmarking**,** to develop a model of benchmarking for ISCM**,** to develop benchmarking framework for ISCM in manufacturing organization**,** development of a benchmark for analyzing Indian manufacturing industries**,** to optimize return on investment (ROI) taking cases of Indian manufacturing industries.

Chapter V: This chapter focuses on the identification of various PMIs of benchmarking, factors of ISCM which affects the benchmarking of ISCM based on relevant literature and after discussion with experts (industrial/academics).

Chapter VI: In this chapter, an industrial designed questionnaire survey has been utilized for data collection from selected Indian manufacturing industries. The importance of factors has decided on the basis of likert scale, mathematical expression, statistics and charts. The analysis of factors has done by following like: benchmarking practice – for performance gap identification, VIKOR methodology- for ranking of factors and DEMATEL technique - for cause and effect diagram.

Chapter VII: This chapter focuses on the development of benchmark for analyzing Indian manufacturing industries on the basis of supplier selection criteria using analytical hierarchy process, comparative benchmarking using weightage score card, and competitiveness index.

Chapter VIII: In this chapter, a framework of benchmarking has been developed for ISCM. The working of framework has been discussed by flow chart. The idle time and total length of supply chain has been calculated by implementation of comparative benchmarking framework and corrective measure action has been taken in two selected competitive industries.

Chapter IX: In this chapter, case studies of two competitive manufacturing industries have been discussed. On the basis of implementation of benchmarking framework, the optimize ROI has been calculated. The case studies of two competitive manufacturing industries are used to understand the concept of ROI and after that calculate optimize ROI by taking corrective and preventive measures about ISCM.

Chapter X: This chapter consists of various model development steps, which are helpful to develop different models like: W-ISM model for PMIs of benchmarking analytical model of benchmarking though Fuzzy-AHP and ISM model for factors of ISCM by ISM technique.

Chapter XI: This chapter consist the contributions, key findings along with significant implication, synthesis of research work, summary, limitation of research work, the scope of future work and concluding remarks.

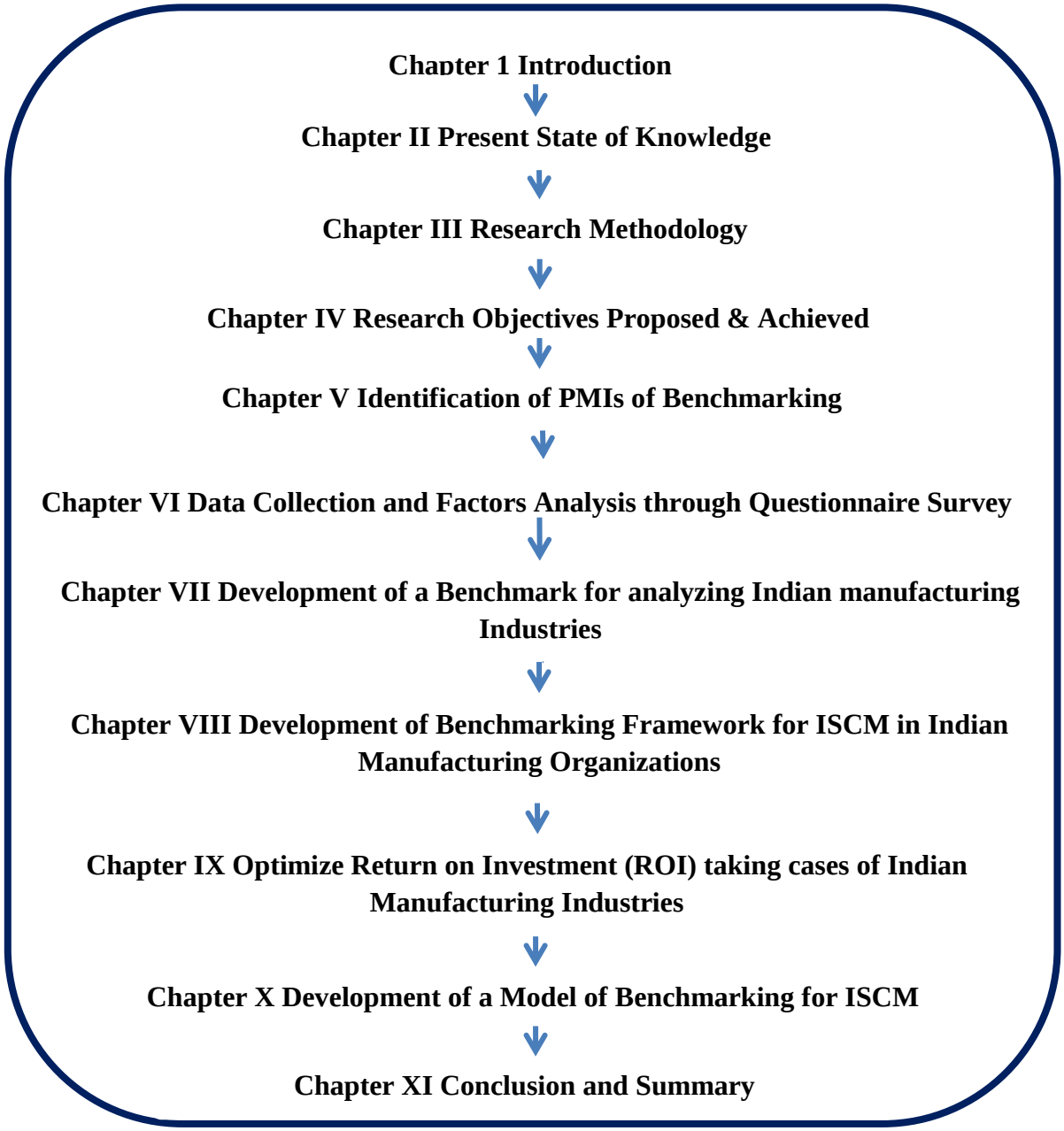

Figure 1.1 Organization of Research Work

CHAPTER II
PRESENT STATE OF KNOWLEDGE

2.1 INTRODUCTION

Benchmarking is a highly explored area of research started since last fifty years. The present work highlights the relevant literature published since 1980. Based on literature review, PMIs of benchmarking, factors of ISCM, benchmark, benchmarking framework and different models of benchmarking has been developed to perform benchmarking of ISCM in some selected Indian manufacturing industries.

2.2 JOURNEY OF BENCHMARKING

Benchmarking practices were first introduced in American markets during 1970s. This new concept was used by Xerox Corporation to identify performance gap with its competitors. The competitors of Xerox Corporation were continuously selling their product in lower prices. However, it was not easy to explore the reason and procedure followed by competitors to sell different types of machines in lower prices. In order to understand this, benchmarking was used as a tool to analyze some special measures (Kumar et al, 2001). In 1982, the Xerox Corporation followed benchmarking practice in logistics and distribution activity against its competitor (Yasin, 2002). In 1985, Metro Toronto, a reference library in Toronto, Canada used benchmarking practice in public service department (Schefczyk, 1993). Again during 1990, benchmarking was practiced in business environment for research purpose (Pfohl et al, 1999). Benchmarking practice is a very helpful tool which provides better result while comparing between competitors. The American Productivity and Quality Centre (APQC) opened its 'International benchmarking clearing house' in 1992 (APQC 1996). According to researchers "benchmarking practice is defined as a persistent comparing performance of manufacturer with its best leaders anywhere in the world and gain valuable information for improving the existing performance of manufacturer" (Anderson, 1994).

2.2.1 History of Benchmarking

Benchmarking history may be classified in five categories. The first generation was reverse engineering, which was an engineering based approach for product

comparisons that include analysis of technical product characteristics. The second generation was competitive benchmarking which include product comparisons with its competitors. The objective of third generation benchmarking was to select best process based on standards (Dattakumar et al, 2003). In fourth and fifth generations, strategic and global benchmarking was introduced in business sector. Benchmarking practice includes the concept of competitor & market analysis, quality improvement programs and performance measurement (Camp, 1993).

2.2.2 Benchmarking Process

It is the process of comparing something or someone with best practices and is collections of activities within an organization. Benchmarking interpretation is described as learning from the benchmarking partners and to introduce to improve in own organization. Benchmarking covers all activities where managers compare their practices and performance with others and make changes intended to result in improvement (Monkhouse, 1995). It is also the achievement recognized as the standard of excellence for any business process. Benchmarking is a continuous development process by identifying the gap between performance measures (Sueur et al, 1997). The objective of benchmarking is to trace the early method of examining policies and products of competitors to see how they are made and how they could be improved (Gilnduz et al, 2001).

The review of literature on benchmarking of supply chain is carried out to identify certain issues which were not suitably addressed. These issues can be regarded as inadequacies and they offer scope for further research and exploration (Balm, 1996). Firstly, the purpose of benchmarking is to identify what they need to change in order to improve their performance. Secondly, it works as a model or principle to guide the implementation of practices and also bridge the gap between goals and aspirations. It is difficult for people to learn about the benchmarking in ISCM having challenges in a complex network of individuals and industries. Davies, (2000) developed a benchmarking framework for ISCM and implemented it for performing the comparative analysis. Benchmarking is a process of measuring products, services and practices against competitors recognized as industry leaders (Salem, 2013). The classification of literature on benchmarking is based on the types of benchmarking and associated issues (Jackson et al, 1994). The research dimensions for benchmarking are discussed in terms of the strategy, operational effectiveness,

technical efficiency and micro-macro integrative benchmarking. For sustainable competitive advantage, benchmarking goes beyond the operational level and moves into a wide range of value chain, strategic, operational and project levels (Hong et al, 2012). Academic community is lagging in terms of providing models and frameworks that integrate many facts of organizational benchmarking (Dorsch et al, 1998**)**.

Zairi et al, (1995c & 1996) have concentrated on a detailed review of some of the key books written by experts of benchmarking with a view to help educational and training processes in companies embarking on or launching a benchmarking project. The philosophy of benchmarking is that one should be able to recognize short comings and acknowledge that someone is doing a better job and implementing it in own business for organizational improvements.

2.2.3 Benchmarking Steps

Benchmarking is a continuous close loop process (Ramabadron et al, 1997) which starts from planning phase and ends at action phase through do and observation phase (Brah et al, 2000). The benchmarking process cycle consists of the following steps: Plan-Do-Observe-Action as shown in figure 2.1

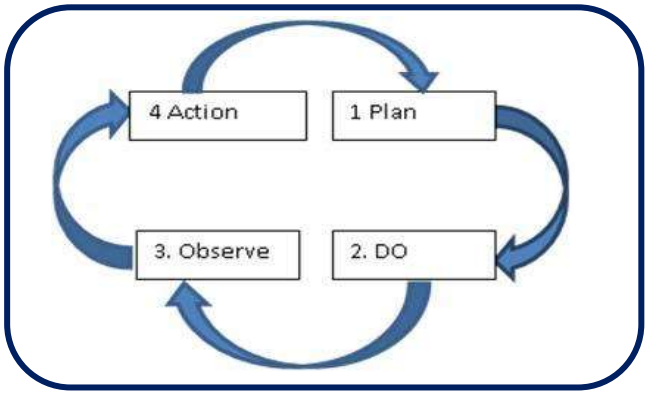

Figure 2.1 Benchmarking Cycle

1st Step- Plan

Planning includes several factors and to overcome these factors, certain steps are followed like: identifying what one wants to benchmark for example: product, process or service, etc (Carpinetti et al, 2000). The selection of benchmarking team members are also decided in planning phase (Bhutta et al, 1999).

2nd Step- Do

In this phase, one has to select the benchmarking team members from the same organization and also outside the organization.

3rdStep- Observe

The purpose of observe phase is to check the performance gap between the performance measuring parameters of benchmarking (Bowman et al, 1994).

4thStep- Action

The objective of this step is to implement the appropriate quantitative and qualitative tools and techniques to overcome the existing performance gap.

2.2.4 Types of Benchmarking

Following type of benchmarking based on performance, process, strategic, internal, competitive, functional and generic, respectively as shown in table 2.1.

Table 2.1 Types of Benchmarking

S. No.	Types	Definitions
1.	Performance benchmarking	It is the comparison of performance measures for the purpose of determining how our company is good as compared to others.
2.	Process benchmarking	Methods and processes are compared in an effort to improve the processes in our own company.
3.	Strategic benchmarking	The study relates with the change in strategic direction of the company and the comparison with one's competition in terms of strategy is made.
4.	Internal benchmarking	When comparisons are made between departments/divisions of the same company or organization. Internal benchmarking means comparison of internal operations between different divisions or similar functions in different operating units within an organization.
5.	Competitive benchmarking	The purpose of competitive benchmarking is to compare the existing performance of manufacturing industries with its best external competitor.
6.	Functional benchmarking	The objective of functional benchmarking is comparing the existing functions of organization with its competitors or best standard in the market, even if the industries themselves are dissimilar.
7.	Generic benchmarking	Comparison of processes against best process operators regardless of industry. (Zairi et al, 1999).

2.2.5 Benchmarking Models

Review of benchmarking models distinguishes the benchmarking process steps which are required to improve ISCM of Indian manufacturing industries. It was found that different models of benchmarking gave different information regarding its processing. The objective of benchmarking process models is to provide the structure which can help different users for benchmarking routes. The review of benchmarking models is

to provide the guidance for easily understandable planning and execution of benchmarking practice. Benchmarking models developed till dates are:

- The Camp model
- Meta model developed by international benchmarking clearing house
- Baxter benchmarking model
- Spendolini's 5-stage benchmarking process
- Watson model
- Benchmarking process model
- The APQC model

These models explained the benchmarking to be a continuous process with successive phases being critical to the successful execution of the process (Partovi, 1994). The models developed and utilized overcome the limitations of traditional benchmarking methods such as graphical techniques, ratio-based methods, regression analysis, etc. Actual application of this methodology requires companies to identify the critical performance measures and obtain numerical data making the method more suited for internal rather than external benchmarking because of the difficulties that may arise in obtaining these types of data from competitors (Talluri, 2000). Mishra et al, (2014) aimed to develop an integrated system model for the structural modeling and analysis of world class maintenance system (WCMS).

2.2.6 Role of Benchmarking in Different Fields

Benchmarking in Quality Management (QM) has emerged as a management paradigm for enhancing organizational effectiveness and competitiveness (Brandenburg, 2011). It is found that the competence of operating staff, easy identifiable/visible with well-timed delivery are the main quality aspects of small medium enterprises (SME) (Radauer et al, 2010). Benchmarking can be an effective means for food processing industry to help & identify improvement opportunities and implement change process to improve business effectiveness. A benchmarking study of two food-processing companies has been carried out to identify a number of improvement opportunities for both the companies (Jain et al, 2006). Aref, (2004) presented a video database research initiative that resulted in the successful development of a video database management system (VDBMS) providing comprehensive and efficient capabilities for indexing, storing, querying, searching and streaming video data. Yu et al, (2014) provides organizations with a systematic innovation management and reference for

airport renovation projects. Also, a call is given to develop innovative methodologies to guide benchmarking practices in e-commerce and SCM. Yasin, (2002) focus on review of benchmarking practices in the manufacturing, service and public sector operational performance. The researcher summarizes that despite of the increasing scope of benchmarking activities and the number of organizations utilizing benchmarking, the field of benchmarking remains to a large extent without a unifying theory to guide its advancement. After literature survey, major related outcomes and issues are: Duration of benchmarking exercise, partner selection, cost, information system and human resources in benchmarking activities.

2.3 HISTORY OF SUPPLY CHAIN INITIATIVE

The concept of supply chain has ignited research interest amongst researchers and literature available at present explains the concept of SCM from a number of perspectives. Kumar et al, (2012) analyzed various types of SCM issues in automobile industry by situation actor process learning action performance (SAP-LAP) analysis. Attempts were made to bring out various dimensions of SCM, definitions of SCM; introduce the history and evolution of SCM, its role in improving organizational efficiency by integrating SCM with business strategy and various stages of SCM implementation. The supply chain of an organization consists of a network of:

- Suppliers/vendors of the raw materials and other input components purchased from outside.
- Processing/production/manufacturing facilities used to convert them into finished products needed by customers.
- Distribution/marketing channels making product available to customers.

SCM is a set of practices and techniques to integrate the functioning of all the above three components for smooth and efficient flow of materials, information and money overcoming individual constraints. All the partners, internal and external, share the risks and prosperity through overall healthy growth while serving the customer's needs. SCM spans all movement and storage of raw materials, WIP inventory and finished goods from point of origin to point of consumption. A supply chain is a network of facilities and distribution options that performs the function of procurement of materials, their transformation into intermediate and finished products

and then distribution to customers (Ganeshan et al, 1995).The American production and inventory control society (APICS) dictionary describes the supply chain as:

- A processes from initial raw materials to the production of finished product
- Functioning inside and outside a company allowing the quality products and provide best services to their customer (Cox et al, 1995).

SCM started receiving attention as an integrated entity in the early 1980s and since then many authors have attempted to frame different definitions and concepts on SCM. Giunipero et al, (1996) noted that three typologies of SCM have been developed, ranging from a flow of goods only, to a flow of goods and information, to an integrative value-added approach. An analysis of these definitions reveals the following critical element in SCM:

- Focus on suppliers and customers, consolidated sales.
- Effective and efficient management of product and material flows, information and data flows (use of information technology).
- Intra-company co-ordination in marketing, engineering, purchasing, manufacturing, logistics, finance, human resources and information systems.
- Inter-company co-ordination related to raw material vendors, material converters and assemblers, transportation companies, services providers, warehouse and retailers.

Croom et al, (2000) presented a review of the supply chain literature in a view to contribute to a critical theory debate through the presentation and use of a framework for the categorization of literature linked to SCM. Supply chains exist in both service and manufacturing organization, although the complexity of the chain varies greatly from industry to industry. These entities may include: suppliers, carriers, manufacturing sites, distribution centers, retailers and customers. Supply chain includes all efforts made for producing and delivering a product, from the manufacturer to ultimate user (Lummus et al, 1999). The definitions described indicate that SCM is not a stand-alone process and is driven from the supply side or the logistics pipeline.

2.3.1 Evolution & Development of SCM

The major phases through which the present SCM evolved are:

A. Before 1960's: MRP- I

Management of the manufacturing units started realizing that the materials cost should be approximate 60% to 70% of the total cost of a product. Therefore, they adapted materials requirement planning (MRP-I) to procure and store input materials based on sales forecast/order position, thus controlling inventory to the minimum possible levels. Many organizations, including in India, could achieve great reduction in inventory levels, reducing problems related to liquidity and other financial matters and thus increasing the profitability.

B. 1960's to 1980's: MRP - I, II and ERP

It was observed that controlling purely material procurement and storing cost were not sufficient to reduce product cost considering the increasing competition and rising customer demands. Therefore, MRP-I graduated to manufacturing resource planning (MRP-II), which identified additionally precise requirement of materials and process stock at every stage of manufacture in direct relation to the customer orders combining purchasing and manufacturing effectively. The advancements in information technology during 1980s and the growth and development of enterprise resource planning **(**ERP) provided a dynamic online system to guide the managers for the integration of suppliers, purchasing, manufacturing and marketing across the entire organization.

C. After 1980's: Supply Chain Management

ERP was able to provide decision support system to managers integrating the activities within the organization/enterprise. The limitation of the ERP was that it could serve the internal clients only. Every organization or firm that contributes to the main enterprise is given the status of partners, who will share the risk as well as prosperity/profit/growth with the main enterprises. This concept is termed SCM which has gained immense popularity across the world. Blaser et al, (1995) examined several company practices of SCM.

Review of literature for SCM design and development issues have identified five strategic success factors, which are:

- **Building Customer-Supplier Relationship:** Good relationship of management with suppliers and customers is a crucial element of SCM. Closer

trust and long term relationships with supply chain partners are imperative in sustaining competitive advantage.

- **Implementing Information & Communication Technology:** Supply chain members must share information in order to improve the efficiency and effectiveness of SCM.
- **Re-engineering Material Flows:** Towill et al, (2000) said that control of smooth material flow lies at the heart of best SCM designed. The practices and re-engineering of material flows can improve supply chain performance. Moreover the efficient flow of material ensures that products are delivered to customers in time. This implies that inventories of raw materials, WIP and finished goods can be kept at the lowest level, which can reduce the inventory holding costs significantly (Fredendall et al, 2001).
- **Creating Corporate Cultures:** The single most important prerequisite for successful SCM is the change of corporate culture. Culture reflects the norms that characterized an organization and shape the expectations about what are appropriate behaviour's and attitudes (Schwartz et al, 1981). Change of corporate culture is necessary as the traditional culture only emphasizes organizational performance from the short-term view point (Tan et al, 1998). Culture supporting behaviour, openness, inquiry and experimentation are of great benefit to supply chain members (Spekman et al, 2002).
- **Identifying Performance Measurements:** Relevant performance measurement can encourage every firm in the supply chain and all employees to direct all of their efforts to increasing profitability in the supply chain (Fredendall et al, 2001).

2.3.2 Perception about SCM

The concept of SCM has been explained from a number of perspectives and the literature provides various definitions of SCM.

- Ellram, (1991): "SCM is network of firms interacting to deliver product or service to the end customer, linking flows from raw material to final delivery".
- Christopher, (1992): "Supply chain is a process involving all activities that produce value either in terms of products or services for consumers".

- Berry, (1994): “SCM aims at building trust, exchanging information on market needs, developing new products, and reducing the vendor base to particular original equipment manufacturers (OEMS) to release management resources for developing meaningful, long-term, relationship”.
- Monczka et al, (1996): “SCM seeks improved performance through elimination of waste and better use of internal and external vendor capability”.

2.3.3 Supply Chain Management and Its Dimensions

SCM is considered as a strategic change in organizational culture and principles by which the foreign partners set some optimal activities in their organizational agenda to reach a joint objective. Generally, performance assessment includes the effective process and activity efficiency. Effectiveness is a domain which meets the customer’s needs while efficiency measures the quality of economic usage of organization’s resources (Neely et al, 1995).

Supply performance assessment can be divided into two measures of qualitative and quantitative methods. Business incorporations and universities more often use the quantitative method. This method suffers from two major problems: first is associated with the amount of time required for data collection and the other is how to reach reliable information for data assessment (Foggin et al, 2004). Kumar et al, (2008) prepared a hierarchy for flexibility of supply chain dimensions using interpretive structure modeling to know their influence over each other in global supply chains. Stevenson et al, (2009) did inter firm empirical study on supply chain flexibilities and found inter organizational aspects, their interaction with one another within industry. ISCM is a long term orientation and inside company integration, which includes either combining or mediating collaborative relationship (Kotzab et al, 2011). The six major dimensions of SCM are:

- Partnership.
- Information technology
- Operational flexibility
- Performance measurement
- Management commitment
- Demand characterization (Lee et al, 2003).

2.3.4 Role of Supply Chain Management

Indian firms need to prepare themselves to enhance competitiveness through SCM. The SCM is a modern tool and has shown significant results in reducing the defects and improving the process speed. Up to 1990s, General Motors of USA was the top automobile manufacturer in the world with the highest sales, profits and growth for over 50 years. However, by adapting SCM practices more successfully, Toyota of Japan could overtake General Motors to become the largest automobile maker in the world now, even though Toyota started its production only 30 years back. Today Toyota is considered as the model for the best SCM practices in the world. In India, Maruti Udyog Limited has retained its top position in the country by adopting SCM practices. Many small and medium scale industrial units in India are able to become partners and supply components/services to large Indian firms and multinational companies (MNCs) like Ford, G.M, Phillips, P & G, Walmart and Merck, etc.

Information networks and technological convergence are re-defining the rules of economic and trading relationships within the country. Hence, it has become necessary for Indian manufacturing industries to look for methodologies and processes that produce maximum efficiency both within and beyond their operations (Sahay, 2000). The Indian industry spends an exceptionally high amount of 14% of its gross domestic product (GDP) on logistics. Close to 22% of the aggregate sales, amounting to over US $25 billion is tied up in inventories in the supply chain network countrywide. All the factors related to infrastructure stated above have adversely affected the supply chain network in the country- both in terms of lead-time and costs (Korgaonker, 1999). Organizations across the globe are re-organizing and streamlining their supply chains to meet the emerging challenges originating from the rising expectations of the customers (Sahay et al, 2003).

2.3.5 Linking the Supply Chain to Business Strategy

The supply chain strategy can be viewed as the decisions for sourcing, capacity planning and translation of refined product, deployment of finished product, demand management, communication and delivery. Linking supply chain strategy to the business strategy involves defining the key business processes involved in producing a company's product or service (Christopher, 1992). SCM is a strategy through which such integration can be achieved (Cooper et al, 1993). Better managing the supply

chain also involves managing the marketing link to supply chain and linking supply chain strategies to the overall company strategy (Lummus et al, 1999).

2.3.6 SCM in Different Industries

The computer components manufacturer – Hewlett & Packard, systematically linked its distribution activities with its manufacturing activities in the computer terminal business (Hammel et al, 1993). Wal-Mart began its own supply chain initiative by working directly with key manufacturers (Johnson et al, 1995). The manufacturers are responsible for managing Wal-Mart's warehouse inventory of their products, termed vendor managed inventory (VMI). In return, Wal-Mart expects near hundred percept order fulfillment rates on those products. A leader in the manufacturing and distribution of building products in North America, Georgia-Pacific began implementing SCM practices within the decentralized operations of their company (Blackwell, 1994).

2.3.7 Literature review on ISCM

In the study, the main consideration is in the optimization of resources, capacity based on the lowest cost and fastest speed in the production of the best products, quick response (QR) to user needs in order to improve the responsiveness and efficiency of manufacturing organizations. The internal supply chain activities cover the whole process from the product maturity phase, sourcing and logistics. It also includes the transformation, movement and storage of materials. Flynn et al, (2010) define supply chain as "the degree to which a manufacturer strategically collaborates with its supply chain partners and collaboratively manages intra and inter organization processes". They state that the main goal for supply chain is to achieve the optimum level of effectiveness and efficiency in the delivery of products & services and also to achieve customer's value by delivering products and services economically and in shortest time period. In this system, the information flow, capital flow and logistics flow of transmission will be in the internal supply chain.

The core mission of ISCM is to integrate the various functional elements and to improve the efficiency of ISCM. Early definition of the supply chain limited to the operation of the enterprise, mainly referring to manufacturing enterprises from external procurement of raw materials and parts after the production, processing, sales to customers at the internal process i.e. internal supply chain (Kotzab et al, 2011).

Dynamic supply chain is composed of a group of independent entities, one of the lead entity looking for those with superior resources of partners, each partner contribute to the supply chain core competitiveness. The performance gap of internal supply chain in Indian manufacturing industries increases the scope of benchmarking in the field of ISCM (Balm, 1996).

2.3.8 Integration of ISCM: An Overview

ISCM includes suppliers, manufacturers, channel distribution and its integration. The stage of internal integration is to implement the direct control of organization. At the same time, internal integration is not only the department integration it is also the department's standardized flow integration, the formation of the standard flow and management mechanism. Power, (2005) proposed the meaning of integrating the operation of upstream and downstream supply chain between the human resources as well as the sharing of material resources. The integration of internal supply chain is providing help in improving operational efficiency and business competitiveness. The internal supply chain integration has main areas like: information integration, decision making integration, financial integration and operation integration. The financial integration will change the internal supply chain nodes to pay the relationship between the departments within industry. The stage of internal integration is to implement the direct control of industry. In the study, the main consideration is on the optimization of resources, capacity based on lowest cost, fastest speed in the production of the best products. Literature survey and analysis, proposed recommendations to the small, medium and large scale manufacturing industries regarding integrated ISCM helping in smoothening SCM operations and reduces the cost.

Benchmarking of ISCM compares and measures the internal performance of an industry with its business leaders to gain knowledge which help the industry to take action in order to improve its performance (Foster, 1992). Benchmarking practice is a technique which assists the manufacturing industries in improving the internal supply chain performance (Vig, 1995). The interlinking of benchmarking of manufacturing industries with ISCM is necessary to increase the efficiency of the industry.

2.4 OBJECTIVE OF RESEARCH WORK THROUGH LITERATURE REVIEW

Benchmarking practice is used to identify the highest standards of excellence for process, product and services in the competitive world and then take necessary action to achieve those standards. Benchmarking is needed to achieve the business and competitive objectives (Kumar et al, 1999). "The philosophy of benchmarking is that someone is doing a better job, learn how it is being done and then implement it in one's own business" (APQC, 1996). Yasin (2002) have developed innovative methodologies to guide benchmarking practices in e-commerce and SCM. Benchmarking shall be done with respect to functionalities, comparative analysis of internal and external strength of the firms, industries so as to improve the industries business processes. Comparing the activities of different divisions and components of internal supply chain like delivery rates and delays in the deliveries, the benchmarking is to be made. For examples: for fast deliveries dell computers can be considered for the comparison, for fresh deliveries of products McDonald's Pizza, for direct marketing implementation Dell computers, for JIT system in production Toyota Motors, for comparison and for accuracy in deliveries a dabba walas of Mumbai, while for a high inventory case amazon.com or also a dell computers can be considered (Kalkar et al, 2010).

Globalization and emerging technologies have massive impacts on the manufacturing industries around the world. This scenario has the prompting stiff competition in the market place the rapid changes in the environment and hence in industry has led to changes in business benchmarking and performance measures. There has been expanded research focusing on the identification of PMIs of benchmarking. It appears that much of the literature has focused on PMIs. For a project implementation team, a more intimate understanding of PMIs of the various stakeholder groups would make it possible to assess the project planning phases and determine if the concerns of these relevant groups are being addressed as effectively as possible (Mukherjee, 2002). Ultimately, this will enhance the probability of achieving higher success levels and resulting in time and cost savings and improvement in quality and efficiency in the system.

Interpretive structural model (ISM) was first proposed by Warfield, (1974) to analyze the factors of complex systems. Mandal et al, (1994) developed an ISM to demonstrate the interrelationship between diverse criteria and their levels of

significance in order to select vendor (Bolanos et al, 2005). Mishra et al, (2015) proposed a theoretical framework that can be used to study supply chain scope. Jayant et al, (2015) provided a planned categorization of literature relating to ISM. Ralston et al, (2013) proposed the effects of logistics on logistics capabilities and performance. Sandbhor et al, (2014) discussed the nature of total interpretive structural modelling (TISM) to deal with intricate matter. Singh et al, (2008) used ISM to explain the associations among the recognized information management barriers. Bigliardi et al, (2014) develop a preliminary model for supply chain (SC) performance by investigating the use of performance measurement metrics in a wider sample of companies through a survey questionnaire. Batuhan et al, (2013) used metrics and hierarchy of SCOR model, the relative importance of strategic and metrics are prioritized using AHP and also the TOPSIS method is applied to compensate for the imprecise ranking of AHP in the selection of the scenario. The objective of supply chain is to accomplish the unidirectional and continuous material, information and fund movement (Stevens, 1989). Ashrafuzzaman et al, (2016) proposed "quality function deployment approach to measure supply chain performance of any kind of manufacturing industry". The internal supply chain concept is confined to movement of material, finance, information, internal marketing, sales, planning, manufacturing, procurement and finally co-ordination between departments within industry. The implementation strategy of ISCM must be followed and might result into economic impact (Sreejith, 2012).

This section of literature review explains the meaning of SC, ISCM and necessity of theoretical benchmarking framework for ISCM. Yinan et al, (2014) proposed the supply chain planning and corporation coordination mediates the relationship between organizational flatness and mass customization capability. The fundamental principle for survival of manufacturing industry is not to maximize the profit but also to avoid harmful loss. Mostly Indian manufacturing industries are not successful to achieve their goal. But they are trying to find out the root cause of ineffective internal supply chain process. Stewart, (1997) projected a supply chain operations reference (SCOR) framework to evaluate and improve supply chain performance. Bag et al, (2014) developed a framework which analyzes the complex relationships between identified factors of sustainable supply chain using ISM.

Gunasekaran et al, (2011) have developed a framework with key factors/enablers that determine the resilience and competitiveness of small medium

enterprises (SME). This framework has been empirically studied by collecting data from SME. Moazzam et al, (2012) presented a conceptual framework based on SCOR model conforming to the specific needs. The framework integrates relevant food quality measures with the SCOR metrics. Moreover, the framework analyzes performance gaps between milk supply chain networks (SCNs) in Pakistan and New Zealand. The proposed model was pilot tested with the participants in milk SCNs of Pakistan and New Zealand, before final data collection. The method of personal interviews and postal survey was employed to measure performance and identify the best practices leading to superior performance. Baltacioglu et al, (2007) designed a new framework for the service supply chain, which is built on the existing knowledge, derived with an application in the healthcare industry. These works however provide only a conceptualized service supply chain framework and performance measurement for a specific service sector. Mishra et al, (2014) proposed a framework based on the performance metrics such as total length of the supply chain, supply chain inefficiency ratio and supply chain working capital productivity. Gunasekaran et al, (2012) provided an overview of the available sustainable business development (SBD) literature by classifying and then critically reviewing the material to develop a framework for SBD and suggest future research directions. This also includes tools, techniques, some performance measures and metrics for SBD in manufacturing and services. SCM is the systematic and strategic coordination of these flows within and across companies in the supply chain. Kurnia et al, (2014) suggested a sustainable supply chain management (SSCM) that helps industries to launch suitable scheme for growth of organization. Gunasekarana et al, (2007) used a case study of e-logistics to illustrate the role of information technology (IT) in particular on the performance of the logistics.

Kim et al, (2016) analyzed the efficiency of supply chain quality management (SCQM) by grouping buyers and suppliers and conducting an empirical analysis of aspects affecting SCQM efficiency from the supplier's perspective. Banduka et al, (2016) proposed an integrated lean approach to process failure mode effects analysis (PFMEA) for solving specific shortcomings. Dubey, et al, (2015) investigated "the relationship between leadership, supplier relationship management (SRM), total quality management (TQM) and environmental performance in green supply chain (GSC)". Simatupang et al, (2003) anticipated benchmarking method to inspect the present position of supply chain and identify performance gaps to arrange upgrading

initiatives. This can be achieved by following certain practices called the best practices benchmarking. Alexander et al, (2016) framed "a conceptual risk management framework, showing the effect of logistics outsourcing on the supply chain vulnerability (SCV) of shippers".

Gunasekaran et al, (2002) presented a framework for modelling & analysis and also provide guidelines for the selection of tools and techniques of business process re-engineering. Beamon, (1999) proposed evaluation of the performance measures used in supply chain models and also presents a framework for the selection of performance measurement system for manufacturing supply chain. Gou et al, (2013) used the fuzzy AHP method to evaluate the performance of service oriented catering supply chain model. Hausman et al, (2002) planned a model for manufacturing-marketing assimilation and then incorporation to profits. "Shabani et al, (2012) developed a linear pair model for selecting the best sales agents as a Benchmark in the presence of non-discretionary factors and imprecise data under free disposability assumption. Jun et al, (2008) used benchmarking approach to optimize the comparison result and continuous improvement. Bogan et al, (1994) proposed benchmarking, which improves the performance of internal supply chain".

Benchmarking framework for ISCM will be helpful in reducing the performance gap. The ISCM benchmarking framework might be required to meet the demand of customers as well as achieving better existence of manufacturing industry in the present scenario of competitive environment across the globe.

A benchmark is the numerical target or reference point for taking corrective measure actions against competitors. Emiliani et al, (2001) discussed the terms and conditions for the purchasing contracts and online action with advanced computerized versions of enterprise resource planning. Benchmarking practice for development of benchmark using competitiveness index is a continuous progressive way of analyzing Indian manufacturing industries. Hausman et al, (2002) identified a model involving experience to integrate the profits. Gunasekaran et al, (2011) proposed various performance measures and metrics in a supply chain environment. Tuominen et al, (2009) found the reason for inadequate efficiency in Russian food industry using SCM score card. Kalkar et al, (2010) proposed a balance score card conceptual framework for benchmarking of supply chain. Kaplan et al, (2006) used a balance score card in forecasting and replacement (CPFR) by focusing on KPIs.

2.5 CLASSIFICATION OF LITERATURE REVIEW RESEARCH PUBLICATIONS

In this research work, data collection phase of literature review includes various production, economics and benchmarking journals. The review of literature is available from year 1980 to 2014, related to benchmarking, SCM and benchmarking of ISCM. Then to arrange the publications in an orderly manner to enable easy and quick search, review the methodology adopted by the researchers in various field, outcomes of publications and finally searching gaps and providing hints for future research work.

Theoretical Model of Classification & Categorization of Publications on Benchmarking

This research work have come across the theoretical model which is designed for classification and categorization of benchmarking publications on the basis of time period and functional areas of specialization. First type of classification (on the basis of time period) is further classified in four category i.e. Category 1- having all publications of benchmarking, SCM and its related issues, from Year (1983- 1990), similarly Category 2- from Year (1991-1998), Category 3- from Year (1999-2006) and Category 4- from Year (2007-2014). Second type of classification (on the basis of functional area of specialization) are classified in ten categories (finance, sales, services, logistics & SCM, benchmarking – general papers, human resource, research & development, marketing & purchase, IT & communications, manufacturing). Logistics and SCM are further classified in two categories like ISCM and ESCM as shown in figure 2.2.

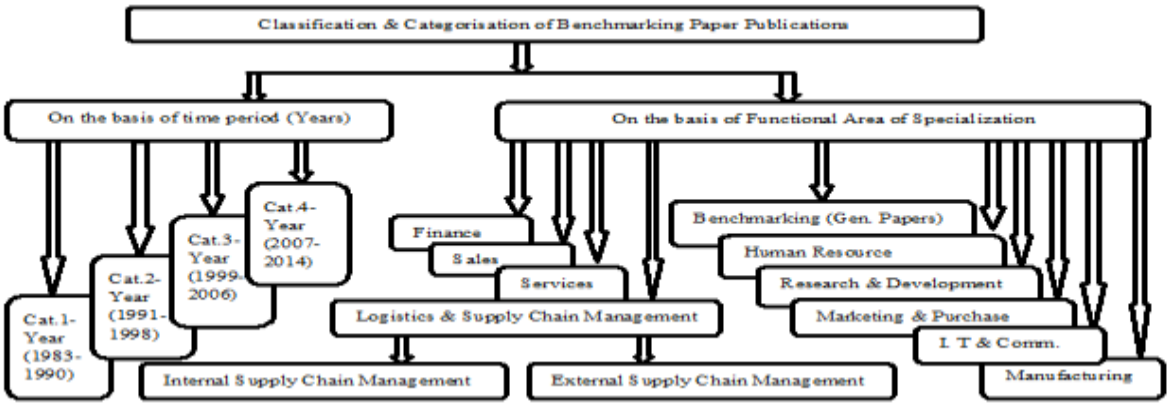

Figure 2.2 Model of Classification & Categorization of Publications on Benchmarking

The goal of this research work is to find out how much work is done in different areas, how to do the classification and categorization of publications and how to come to the main core area.

(A). Classification of Benchmarking Publications on the Basis of Time Period

It consists of benchmarking publications from Year 1983 - 2014. In this type of classification, benchmarking publications should be arranged in category 1 to 4. Each category having the benchmarking research paper publications for the time period of seven years from 1983-1990, 1991-1998, 1999-2006 and 2007-2014 is reported in this section. The proposed classification includes a simultaneous parallel categorization of literature that will provide the growth of literature available on benchmarking of ISCM as well as related issues during four categories from 1980 to 2014 as shown in table 2.2.

Table 2.2 Classification of Paper Publication on the Basis of Time Period (Years)

Classification of Paper Publication on the basis of Years			
Category No.	**Year of Publication**	**References**	**Number of Publications**
1	1983-1990	Drozdowski, (1983); Lewis et al, (1985); Cavenato, (1988)	3
2	1991-1998	Eccles, (1991); Press, (1991); QPMA report (1991); Bracken, (1992); Bean et al, (1992); Cecil et al, (1992); Owen, (1992); Johnson, (1992); Karch, (1992); Miller, (1992a); Schmidt, (1992); Sharman, (1992); Wendel, (1993); Richman, (1993); Shaughnessy, (1993) Spitzer, (1993); Verschoor, (1993); Krause et al, (1993); Lenckus, (1993); Chung, (1993); Bredin, (1993); Ford, (1993); Inger, (1993); Allan, (1993); Goff, (1993); Gable et al, (1993); Gamble,(1993); Chen, (1994); Holt,(1994); Jackson et al, (1994); Lorence,(1994); Bruder et al, (1994); Bell et al, (1994); Sweeney,(1994); Voss, (1994); Vig, (1995); Wallace, (1995); Zairi et al, (1995c & 1996); Adam et al, (1995); Morey et al, (1995); Matzko et al, (1995); Min et al, (1996); Bhat, (1995); Frederickson, (1996); Goodman et al, (1996); Hamilton et al, (1996); Prior Smith et al, (1996); Schroeder, (1996); Relihan, (1997); Voss et al, (1997); Hiltrop et al, (1997); Fuller, (1997); Nacker, (1997); Floch et al, (1997); Buscaglia, (1997); Ogava et al, (1997); Le Sueur et al, (1997); Clarke et al, (1997);	69

		Epperheimer, (1997); Davis, (1998); Dorsch et al, (1998); Beretta et al, (1998); Blinn,(1998); Badrinath et al, (1998); Mann et al, (1998); Parker, (1998); Treadwell, (1998); Whymark, (1998)	
3	1999-2006	Ahmed et al, (1999); Bhutta et al, (1999); Coe, (1999); Gilmour, (1999); Mentzer, (1999); Simpson et al, (1999); Muthu et al, (2000); Nath et al, (2000); Rodwell et al, (2000); Talluri, (2000); Per et al, (2001); Mukherjee, (2002); Yasin, (2002); McAdam et al, (2002); Dattakumar et al, (2003); Aref, (2004); Jain et al, (2006); Bai et al, (2010)	18
4	2007-2014	Gammelgaard, (2007); Baltacioglu et al,(2007); Anand et al, (2008); Jain et al, (2010); Chatzigeorgiou, (2010); Radauer et al, (2010); Batuhan et al, (2013); Brandenburg, (2011); Gunasekaran et al, (2011); Giannakis et al, (2011); Gunasekaran et al, (2012); Hong et al, (2012); Kristianto et al, (2012); Lavastre et al, (2012); Moazzam et al, (2012); William, et al, (2012); Chan et al, (2012); Musa et al, (2013); Salem, (2013); Aishah et al, (2013); Abdulrahman et al, (2014); Ahmed, (2014); Bigliardi et al, (2014); Chakraborty et al, (2014); Eldanfour et al, (2014); Chakraborty et al, (2014); Mishra et al, (2014a); Mishra, (2014); Yu et al, (2014)	29

This type of classification consists of numbers of papers of benchmarking and related issues. In the Category 1st, during 1983 to 1990, three publications were found on benchmarking. In category 2nd, from 1991 to 1998, number of publications on benchmarking increases and reaches to 69, however, 18 numbers of publications are reported during 1999 to 2006 and 29 numbers during 2007 to 2014 as given in figure 2.3. It can be seen that from Year 1983 to 2014, the most publications are under Category 2, while fewer publications are under Category 3 and after that paper publication work increases at slow rate in the field benchmarking of SCM.

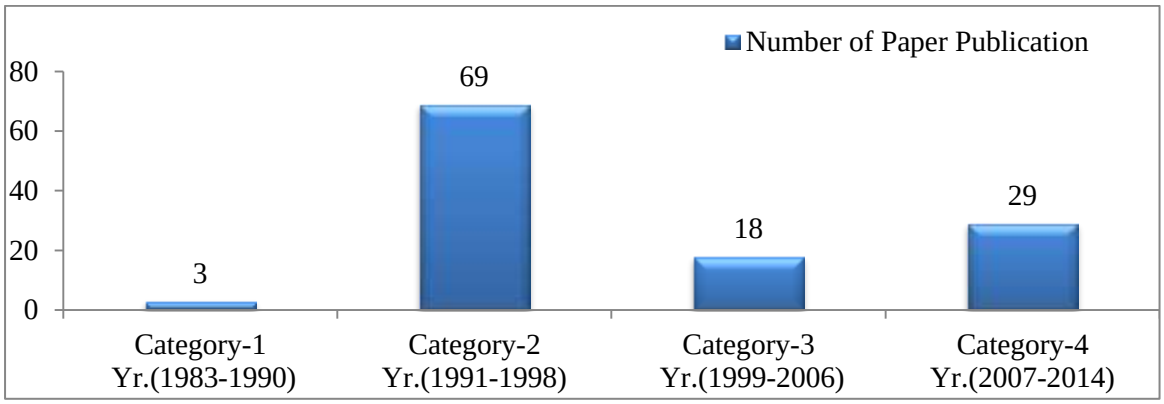

Figure 2.3 Paper Publications versus Categories of Years

(B). Classification of Benchmarking Publications on the Basis of Area of Specialization

The literature review of benchmarking publications gives the information about the different functional areas covered by various researchers in the field of benchmarking as shown in below table 2.3.

Table 2.3 Different Functional Areas Covered By Various Researchers

S. No.	Functional Areas of Benchmarking	References	Numbers of Paper				Total
			1983-1990	1991-1998	1999-2006	2007-2014	
1.	Finance						
1.1	Accounting processes	Sharman, (1992);Verschoor,(1993);Beretta et al, (1998)	0	3	0	0	3
1.2	Finance issue	Schmidt, (1992); Spitzer, (1993); Whymark,(1998); Eldanfour et al, (2014)	0	3	0	1	4
	Total		0	6	0	1	7
2.	Sales						
2.1	Sales forecasting	Mentzer,(1999)	0	0	1	0	1
2.2	Travelling salesman problem	Ahmed, (2014)	0	0	0	1	1
2.3	Sales performance	Mann et al,(1998)	0	1	0	0	1
	Total		0	1	1	1	3
3.	Services						
3.1	Banks	Wendel,(1993); Mukherjee, (2002)	0	1	1	0	2
3.2	Benchmarking-service	Chatzigeorgiou, (2010); Radauer et al, (2010); Giannakis et al, (2011); Yu et al, (2014)	0	0	0	4	4
3.3	Benchmarking - food processing	Jain et al, (2006)	0	0	1	0	1
3.4	Facility management	Johnson,(1992)	0	1	0	0	1
3.5	Hotel services	Morey et al, (1995); Min et al, (1996)	0	2	0	0	2
3.6	Law courts	Buscaglia, (1997)	0	1	0	0	1
3.7	Library	Shaughnessy, (1993); Vig, (1995)	0	2	0	0	2
3.8	Travel management	Bell et al, (1994)	0	1	0	0	1
3.9	Treasury	Wallace, (1995); Treadwell, (1998)	0	2	0	0	2
	Total		0	10	2	4	16
4.	Logistics &SCM						
4.1	Benchmarking Practice ecommerce &	Yasin, (2002)	0	0	1	0	1

	SCM						
4.2	Frame work for supply chain management	Baltacioglu et al, (2007); Moazzamet al, (2012)	0	0	0	2	2
4.3	Logistics	Cavenato, (1988); Musa, et al, (2013); Abdulrahman et al, (2014)	1	0	0	2	3
4.4	Retail distribution strategy	Matzko et al, (1995)	0	1	0	0	1
4.5	Spare parts logistics	Le Sueuret al, (1997)	0	1	0	0	1
4.6	ISCM	Aishah et al, (2013)	0	0	0	1	1
4.7	Challenges of supply chain sustainability	Chakrabortyet al,(2014)	0	0	0	1	1
4.8	Supply chain risk management	Lavastre et al, (2012)	0	0	0	1	1
4.9	Supply chain operations	Ahmed et al, (1999); Gilmour, (1999); Gammelgaard, (2007); Brandenburg, (2011); Kristianto et al, (2012); Chakrabortyet al, (2014)	0	0	2	4	6
	Total		1	2	3	11	17
5.	Benchmarking (General papers)						
5.1	Benchmarking literature	Jackson et al, (1994)	0	1	0	0	1
5.2	Benchmarking performance	Lewis, (1985); Hong et al, (2012)	1	0	0	1	2
5.3	Benchmarking review book	Zairiet al, (1995c, 1996)	0	2	0	0	2
5.4	Benchmarking model and frame work	Dorsch, et al, (1998); Anand et al, (2008)	0	1	0	1	2
5.5	Benchmarking classification	Bhutta et al, (1999); Dattakumaret al, (2003)	0	0	2	0	2
5.6	Benchmarking – reluctance	Williams et al, (2012)	0	0	0	1	1
5.7	Benchmarking operations	Cecil et al, (1992); Bredin, (1993)	0	2	0	0	2
5.8	Operational performance	Voss et al, (1997)	0	1	0	0	1
5.9	Benchmarking – VDBMS	Aref, (2004)	0	0	1	0	1
	Total		1	7	3	3	14
6.	Human Resource						
6.1	Employee attitudes	Bracken, (1992)	0	1	0	0	1
6.2	Human resource	Ford, (1993); Holt, (1994); Prior Smith et al, (1996); Hiltrop, et al, (1997); Parker, (1998);Rodwell et	0	5	1	0	6

		al, (2000)					
6.3	Health and safety management	Inger, (1993);Lorence, (1994); Fuller, (1997)	0	3	0	0	3
6.4	Performance measurement	Eccles, (1991); Miller, (1992a)	0	2	0	0	2
6.5	Physician workforce	Goodman, et al, (1996); Schroeder, (1996); Floch et al, (1997)	0	3	0	0	3
6.6	Risk management	Lenckus, (1993); Blinn (1998)	0	2	0	0	2
6.7	Safety management	Relihan, (1997)	0	1	0	0	1
6.8	Career management	Epperheimer, (1997)	0	1	0	0	1
6.9	Change management	Clarke et al, (1997)	0	1	0	0	1
6.10	Core competencies	Per et al, (2001)	0	0	1	0	1
6.11	Credit function	Gamble, (1993); Chung, (1993)	0	2	0	0	2
6.12	Environment	Karch, (1992); Bhat, (1995)	0	2	0	0	2
6.13	Public sector	Bruder et al, (1994); Frederickson, (1996); Davis, (1998); Coe, (1999)	0	3	1	0	4
	Total		0	26	3	0	29
7.	Research & Development						
7.1	Benchmarking business process re-engineering	Talluri, (2000); Jain, et al, (2010)	0	0	1	1	2
7.2	Business re-engineering	Richman, et al, (1993); Adam et al, (1995); Simpson et al, (1999)	0	2	1	0	3
7.3	Pre-project planning	Hamilton et al, (1996)	0	1	0	0	1
7.4	Product development	Ogavaet al, (1997)	0	1	0	0	1
7.5	Research and development	Press, (1991); Bean et al, (1992); Krause et al, (1993);Nathet al, (2000)	0	3	1	0	4
	Total		0	7	3	1	11
8.	Marketing &Purchase						
8.1	Marketing	Gable et al, (1993)	0	1	0	0	1
8.2	Purchasing	Drozdowski, (1983)	1	0	0	0	1
	Total		1	1	0	0	2
9.	I.T & communication						
9.1	Information technology	QPMA (1991); Allan, (1993); Goff, (1993); Chan, et al, (2012)	0	3	0	1	4
9.2	Telecommunications	Nacker, (1997)	0	1	0	0	1
	Total		0	4	0	1	5

10.	Manufacturing						
10.1	Benchmarking - SME	Badrinath et al, (1998);McAdam, et al, (2002); Gunasekaran et al, (2011)	0	1	1	1	3
10.2	Benchmarking : case study	Salem (2013); Mishra et al, (2014)	0	0	0	2	2
10.3	Preventive maintenance practices	Chen, (1994);Muthu et al, (2000)	0	1	1	0	2
10.4	Manufacturing	Sweeney, (1994); Voss, (1994);Sarkis J, (2001); Gunasekaran, et al, (2012); Bigliardi et al, (2014)	0	2	1	2	5
10.5	World class manufacturing- AHP, TOPSIS,SCOR	Owen, (1992); Batuhan, et al, (2013); Mishra, (2014)	0	1	0	2	3
	Total		0	5	3	7	15

Research papers have been categorized based on some specific functional area as shown in table 2.3. During the literature review of published research papers, in last 31 years, from year 1983 to 2014, this research work have come across total 119 numbers of review research papers available on benchmarking, SCM and benchmarking of ISCM in manufacturing, marketing, sales, service, human resource, finance, research and development, purchase and logistics, etc. The numbers of research papers considered under study from year 1983 to 1990 are three, from year 1991 to 1998 are 69, from year 1999 to 2006 are 18 and year 2007 to 2014 are 29.It consists of benchmarking research publication from year 1983 to 2014 in different functional areas i.e. 07 numbers of publications in finance, 03 in sales, 16 in services, 17 logistics & SCM, 14 in benchmarking (General papers), 29 in human resources, 11 in research & development, 02 in marketing & purchase, 05 in information technology & communication and 15 publications in manufacturing.

2.6 ANALYSIS

Above discussion on literature may conclude that less work is available on benchmarking of ISCM, thus more scope of benchmarking of ISCM exist. This type of benchmarking practice of ISCM would be helpful to analyze selected Indian manufacturing industries.

CHAPTER III
RESEARCH METHODOLOGY

3.1 INTRODUCTION

This chapter describes the methodology in terms of the research design, questionnaire design, method of data collection & its analysis. The questionnaire has been pretested for its validity, reliability and techniques used for analysis of final data. The use of some techniques for development of different model of benchmarking, benchmarking framework and benchmark, to analyze the performance of selected Indian manufacturing industries has been outlined in this chapter. The adopted methodology consists of the following steps:

3.2 FACTORS IDENTIFICATION

PMIs of benchmarking, factors and sub factors of ISCM have been identified on the basis of literature review and expert's opinion from industries and academics.

3.3 DATA COLLECTION THROUGH QUESTIONNAIRE SURVEY

Data Collection was carried out through industrial questionnaire survey. After identification of evaluation criteria, industrial questionnaires survey was designed to determine ranking/weightage of factors and their influence on each other. Data collection also consists of direct and indirect PMIs related to benchmarking and factors related to ISCM. Respondents were invited to designate the weightage of factors for managing good ISCM criterion (See appendix - 1).

3.4 DATA COMPILATION & ANALYSIS

3.4.1 Sources of Questionnaire Survey

The questionnaire survey was conducted in some selected Indian manufacturing industries from Delhi-National Capital Region **(**NCR). The sources of industrial questionnaire survey as shown in figure 3.1.

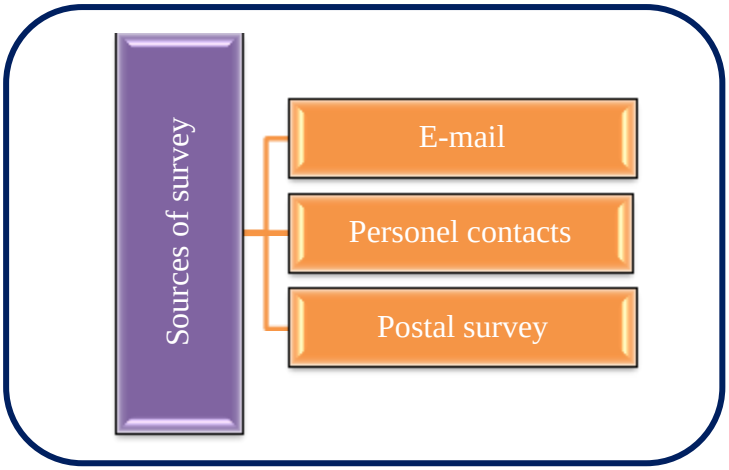

Figure 3.1 Sources of Questionnaire Survey

3.4.2 Designation of Responding Persons

Some questionnaires were e-mailed to executives of Indian manufacturing industries with a cover letter asking their details. The survey respondents were from different levels as shown in figure 3.2.

Figure 3.2 Designation of Responding Persons

3.4.3 Data Analysis

Overall 300 questionnaires were sent to different Indian manufacturing industries, out of which only 70 completely filled questionnaires were received by the researcher; however, seven were incompletely filled and thus, discarded for considering in the present study. This gives a response rate of 23.33%, which was not less (Malhotra et al, 1998). The questionnaires survey was used to carry out study related to factor analysis using comparative benchmarking, VIKOR methodology, and DEMATEL technique, development of benchmark using CI, benchmarking framework through literature and calculation of optimized ROI after implementation of benchmarking framework, development of model of benchmarking using WISM, Fuzzy AHP and ISM techniques. Different scales were used to analyze different aspects of the study. The details of questionnaire survey data is shown in table 3.1.

Table 3.1 Details of Questionnaire Survey

S. No.	Details of Questionnaire Survey	Response
1	Indian manufacturing industries	300 nos.
2	Filled questionnaires	70 nos.
3	Responses from email	02 nos.
4	Responses from personnel contacts	67 nos.
5	Responses from postal contacts	01 nos.
6	Incomplete/ Discarded questionnaires	07 nos.
7	Response rate	23.33%.

3.5 TECHNIQUES USED IN RESEARCH WORK

Different types of MCDM techniques were used to achieve research objectives. The purpose of techniques used is explained in table 3.2.

Table 3.2 MCDM Techniques with Purpose

S. No.	Technique	Purpose of Technique
1	VIKOR Methodology	It is a multi-attribute decision making methodology. Opricovic et al, (2004) developed VIKOR methodology**.** In this methodology, ranking of different factors and their evaluation is decided according to all established criteria (Tong et al, 2007).

2	DEMATEL Technique	Basically, DEMATEL technique was used in unarranged, incompatible and opposite phenomena to reach some integrated solutions for complex problems (Shieh et al, 2016; Fontela et al, 1976). The aim of this technique is to obtain direct and indirect cause and effect of influence across quality features by applying matrix computation to complex systems and comparing the interrelations among the quality features (Wu et al, 2011). Amiri et al, (2011), developed a DEMATEL method to prioritize distribution centers in supply chain. DEMATEL is able to convert the relationship between cause & effect into structural system model (Singh et al, 2014).
3	Interpretative Structure Modeling Technique	ISM is an extensively used technique where the decision of the selection of best factors, worst factors and interrelation between them can be find, out of multiple important variables (Singh et al, 2003).
4	Weighted Interpretative Structure Modeling (W-ISM) Technique	W-ISM technique is used to analyze performance measures and their classification using ISM technique and then evaluate it using CI. ISM is one of the intelligent administration strategies which help exploration of clusters in managing complex issues (Warfield, 1974). ISM changes hazy, inadequately explained mental models of a framework into noticeable all around characterized, hierarchal models. It is a strategy for distinguishing and compressing connections among particular elements which characterize an issue and by which request can be forced on the multifaceted nature of such elements (Mandal et al, 1994). For computing CI, the mean score of factors is calculated and rank is decided for each factors. After the rank calculation, inverse rank and weights for each element is to be calculated. For assigning weights to different factors, highest and lowest values i.e. 5 point and 1 point are termed as 100% and 0%, respectively. The methodology has been used for qualitative analysis of the important PMIs in ISCM.
5	Fuzzy Analytical Hierarchy Process Technique	It is the hybrid of fuzzy logic and AHP. In this technique, fuzzy logic is used to convert vague data into some logical form and further AHP technique for comparing the internal supply chain PMIs of manufacturing industries from year 2013-2015.
6	Weightage Score Card (WSC)	It consist of average score of industrial experts opinions about variable factors. The ranking of variables have been decided on the basis of average score of each variable. The highest average score of factor having first rank, which is more important variable factor while lowest average scores of factor having last rank, which is less important variable factor.

CHAPTER IV

RESEARCH OBJECTIVES PROPOSED & ACHIEVED

4.1 INTRODUCTION

The research work has been carried out with the aim of benchmarking of ISCM in selected Indian manufacturing industries. Today, ISCM is used in various manufacturing sector, medical sector, agriculture sector and defence sector, etc. But to extract better results from ISCM, it is very much essential to implement benchmarking practice of ISCM in manufacturing industries. Keeping the above fact in view, the present research work has been taken up.

4.2 PROPOSED RESEARCH OBJECTIVES

This research work consists of multiple research objectives which are shown in table 4.1.

Table 4.1 List of Research Objectives

S. No.	Research Objectives
1	Identification of Performance Measurement Indicators of Benchmarking
2	To develop a Model of Benchmarking for Internal Supply Chain Management
3	To develop Benchmarking Framework for Internal Supply Chain Management in Manufacturing Organization
4	To optimize Return on Investment (ROI) taking cases of Indian Manufacturing Industries
5	Development of a Benchmark for analyzing Indian Manufacturing Industries

4.3 ACHIEVEMENT OF RESEARCH OBJECTIVES THROUGH PUBLISHED RESEARCH PAPERS

In this research work, multiple proposed objectives have been achieved through evidence of published research papers as shown in table 4.2.

Table 4.2 Achievement of Research Objectives through Published Research Papers

S. No.	Research Objectives	Achievement of Research Objectives through Published Research Papers
1	Identification of PMIs of Benchmarking	**Kailash,** R.K. Saha and S. Goyal (2017), 'Performance Indicators for Benchmarking of Internal Supply Chain Management', International Journal of Social, Behavioral, Educational, Economic, Business and Industrial Engineering, Vol. 11, No. 7, pp. 1940 - 1944. **Kailash,** R.K. Saha and S. Goyal (2017), 'Benchmarking Role in Internal Supply Chain Management of Indian Manufacturing Industries', International Journal of Social, Behavioral, Educational, Economic, Business and Industrial Engineering, Vol. 11, No. 6, pp. 1646-1654. **Kailash,** R.K. Saha and S. Goyal (2016), 'Identification of Performance Measurement Indicators of Benchmarking', National Conference on Role of Science and Technology Towards 'Make in India', March 05-07, 2016, YMCAUST, Faridabad.
2	To develop a Model of Benchmarking for ISCM	**Kailash,** R.K. Saha and S. Goyal (2017), 'Enhancing Factors and Implementation Strategy Used to Develop Benchmarking Model of Internal Supply Chain Management for Analyzing Indian Manufacturing Industries', National Conference on Trends and Advances in Mechanical Engineering, March 16-17, 2017, YMCAUST, Faridabad. **Kailash,** Saha, R.K. and Goyal, S. (2019), 'Benchmarking Model to Analyze ISCM Performance of Selected Indian Manufacturing Industries using Fuzzy AHP Technique', International Journal of Industrial & System Engineering, Vol. 33, No. 1, pp. 1-16, [IF 0.36].
3	To develop Benchmarking Framework for ISCM in Manufacturing Organization	**Kailash,** R.K. Saha and S. Goyal (2018), 'Benchmarking framework for internal supply chain management: A case study for comparative analysis', International Journal of Manufacturing Technology and Management, Vol. 32, Nos. (4/5), pp. 412-429, [IF 0.54].
4	To optimize ROI taking cases of Indian Manufacturing Industries	
5	Development of a Benchmark for analyzing Indian Manufacturing Industries	**Kailash,** R.K. Saha and S. Goyal (2017), 'Scope of Internal Supply Chain Management Benchmarking in Indian Manufacturing Industries', International Journal of Social, Behavioral, Educational, Economic, Business and Industrial Engineering, Vol. 11, No. 6, pp. 1638-1641. **Kailash,** R.K. Saha and S. Goyal (2017), 'Benchmarking Practice for Identification of Internal Supply Chain Management Performance Factors Gap', Journal of Supply Chain Management System, Vol. 6, No. 4, pp. 33-38. **Kailash,** R.K. Saha and S. Goyal (2016), 'Development of a Benchmark for Analyzing Indian Manufacturing Industries', National Conference on Role of Science and Technology Towards 'Make in India', March 05-07, 2016, YMCAUST, Faridabad.

CHAPTER V
IDENTIFICATION OF PERFORMANCE MEASUREMENT INDICATORS OF BENCHMARKING

5.1 INTRODUCTION

This section focuses on the identification of various PMIs of benchmarking, factors of ISCM, through relevant literature articles. The brainstorming activity with experts from industries & academics was also helpful in factors selection process. This research work contains review of quality PMIs of benchmarking and factors of ISCM. The goal of this research study is to understand various critical PMIs of benchmarking to analyze and improve ISCM performance of manufacturing industries.

5.2 NEED OF PMIs OF BENCHMARKING

Today**,** manufacturing industries are facing various problems in competitive scenario. The identification of appropriate PMIs of benchmarking is necessary to achieve the highest standard of excellence in the world (Sharif, 2002). The PMIs of benchmarking might be helpful for entrepreneurs to overcome various types of problems related to performance of manufacturing industries. Following are the problems related issues which are generally faced by manufacturing industries.

- **Technology Issue:** This type of issue consist the problems related to technical aspects like: lack of modern and efficient processing and hand operating tools/ equipment.
- **Marketing Issue:** The marketing issue includes unawareness of international trade trend, markets due to poor marketing skills and lack of access. The stake holders were unaware about any quality control and standards. It also includes unawareness of international certifications and non- tariff barriers.
- **Human Resource Issue:** Lack of education, certified and professionally trained/skilled work force and lack of skills development centre/Institute facilities.
- **Financial Issue:** The financial issues include the inaccessibility of financial support like loan credits from informal sectors at high cost of capital.

The work shall address specific issues of manufacturing industries in the counseling as under: support the creation of providers, specialized technical, administrative and financial services. It gives rise to collective benefits with the continuous flow of raw materials supply, apparatus and equipment or the accessibility of workforce with good skills. Build a healthy environment for the growth of inter-firm collaboration as well as support among private and public institutions to support local manufacturing and combined learning. Focus on critical PMIs and their control may cut down the efforts and resources spent on non-critical PMIs and provide the scope of research in the field of benchmarking of ISCM.

5.3 METHODOLOGY USED

The critical PMIs are defined as those which give reference to any condition or element that was necessary for performance improvement. The literature review is very helpful for PMIs data collection where various methods are contemplated.

5.4 CURRENT SCENARIO OF INDIAN MANUFACTURING INDUSTRIES

Indian manufacturing industry has changed over the world due to day to day competition and customer demand. As per the concept of "Make in India", "Made in India" and "Make for India" which was started by Indian government, manufacturing industries are proving helpful in improvement of Indian economy as well as business. Every country supports a string of manufacturing products of all kinds and sizes. The important factors like changing lifestyle, economy growth and urbanization have contributed much towards the demand for different products, which in turn lead to the growth of the manufacturing industry. The Indian manufacturing industries produce and sell a wide range of products related to automobile, power plants, agriculture, office, medical sectors, house, garden, construction work, school, colleges, etc. Manufacturing groups have been found to be important in economy of any country. In India, they contribute up to 60% of India's manufactured exports. They also have a significant workforce and have a high share in the employment generation. The internal supply chain networking of manufacturing industries would lead to the following aspects:

- Faster decision making among industry members
- A cost effective team

- Higher responsiveness to industry demands
- Faster information diffusion
- Overcoming weak capital base and low scale potential
- A more flexible structure

5.5 IDENTIFICATION OF PMIs OF BENCHMARKING

The rapid changes in the business environment and finally in the industry could lead to changes in business benchmarking and performance measures. So, this research focuses only on critical reviews of available literature on PMIs of benchmarking, identification process. This will enhance the probability of achieving higher success levels and resulting in saving time and cost along with the improvement in the ISCM system. Emerging technologies has much impact on the internal supply chain of manufacturing industry around the world (Umble et al, 2003). The PMIs would be fruitful in improving the internal supply chain performance of Indian manufacturing industries.

Some of the PMIs are critical to the successful performance of any type of manufacturing industry (Bruno et al, 1984). The critical indicators exist at a variety of levels within an industry. In sense, if objectives associated with the performance indicators are not achieved, the industry will fail. Benchmarking can be practiced at industry level, process level, function level or products level. Generally there are different types of benchmarking like: performance, process, strategic, internal, competitive, functional and generic benchmarking. Benchmarking can be defined as "what is compared and what the comparison is being made against". The performance of benchmarking depends on the PMIs. In the context of benchmarking, it is essential that the manufacturing industries identify few PMIs, which should be given special attention for ensuring successful implementation of benchmarking technique. This work suggests the need for establishing linkages between PMIs affecting the benchmarking as well as manufacturing industry's performance. Through literature review some PMIs of benchmarking have been identified which are shown in figure 5.1.

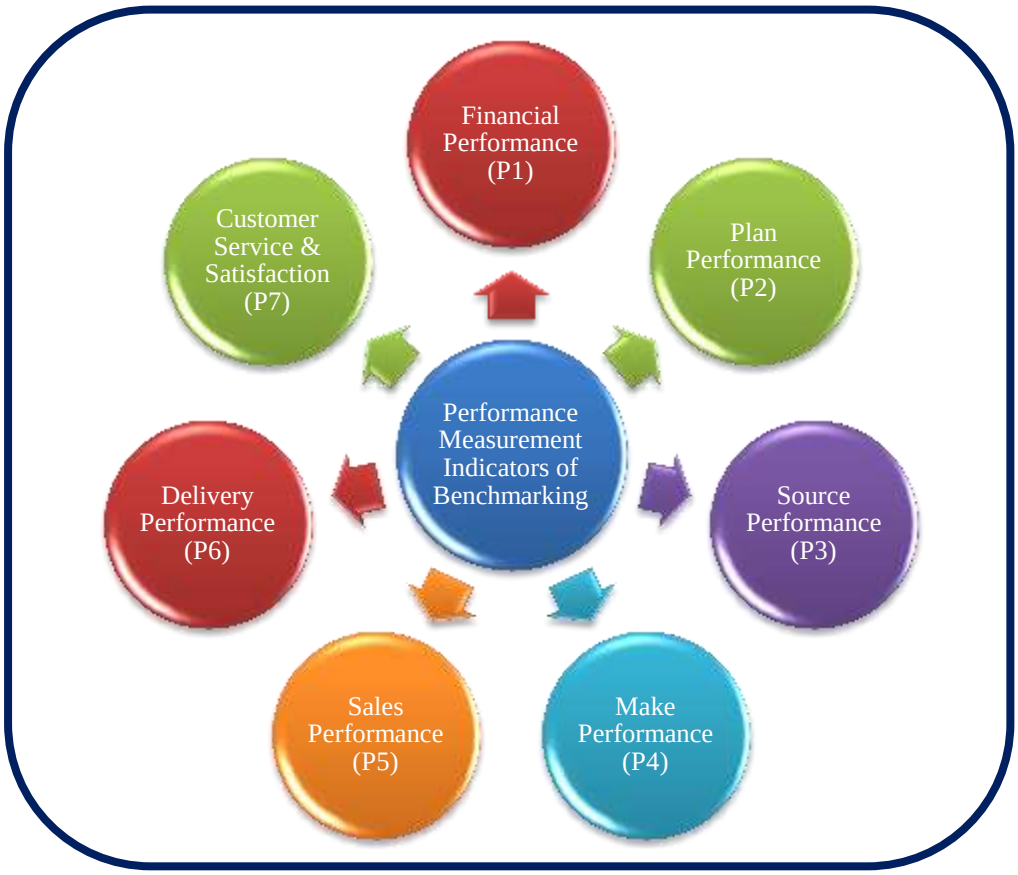

Figure 5.1 PMIs of Benchmarking to analyze Indian Manufacturing Industries

The PMIs of benchmarking depend on some identified factors and sub factors of ISCM. This study focuses on the key aspects of PMIs of benchmarking and discusses the method for identifying actual PMIs. Benchmarking is a strategic planning system that helps researchers as well as managers to understand the role of particular PMIs (Anand et al, 2008).

Table 5.1 PMIs of Benchmarking of ISCM in Selected Indian Manufacturing Industries

S. No.	PMIs	Authors References
1	Financial Performance	Bacidore et al, (1997); Ian, (2001)
2	Plan Performance	Bartlett et al, (2007); Neto et al, (2009)
3	Source Performance	Madhusudhana et al, (2011); Stefanovic et al, (2011); Giovanni, (2012)
4	Make Performance	Otchere et al, (2013); EI Sayed, (2013)
5	Delivery Performance	Mishra et al, (2014); Oliveira et al, (2014); Oliveira et al, (2014); Ibrahim et al, (2014)
6	Sales Performance	Kumar et al, (2015); Singh et al, (2015)
7	Customer Service and Satisfaction	Taghipour et al, (2015); Parmar, et al, (2016); Chandra et al,(2016)

The PMIs of benchmarking may increase and decrease according to profile, type of manufacturing product and process of manufacturing industry. This research work consists of some PMIs of benchmarking as shown in table 5.1, which are commonly used to generate and develop benchmark in manufacturing industries. These PMIs are helpful in creating benchmarking of ISCM as well as improving ISCM performance of selected manufacturing industry.

5.6 IMPORTANCE OF PMIs OF BENCHMARKING

The PMIs play an important role to analyze ISCM performance of Indian manufacturing industries. This section consists of brief introductory parts of PMIs.

- **Financial Performance**

  It is important performance indicator of any manufacturing industry because without it, management can't improve the performance of ISCM at manufacturer or customer ends.

- **Plan Performance**

  This type of performance indicator also acts as a benchmarking performance indicator because proper plan and management can optimize utilization of available resources like man, machine, material, method and money.

- **Source Performance**

  In source performance indicator of benchmarking, better quality of materials, handling equipment and inside source of material like factory stores and outside source of material like warehouses and supplier may also affect the ISCM performance of any type of manufacturing industry**.**

- **Make Performance**

  Better quality of material, efficient and accurate machines, skilled manpower and best available methods of manufacturing also act as benchmark for Entrepreneur.

- **Delivery Performance**

  The main function of delivery section is to transfer the right material from one place to another place in minimum possible of time. Delivery performance also affects the ISCM performance, therefore it act as PMIs of benchmarking in manufacturing industries.

- **Sales Performance**

  Since sale performance of any manufacturer depend upon its internal supply chain performance. The sale target of manufacturing industry may act as a benchmark for its other competitors.

- **Customer Service and Satisfaction**

  The customer service and satisfaction is a performance indicator of benchmarking because if customers are not satisfied by the performance of products & services then there is no need of ISCM.

Based on extensive survey of benchmarking literature, this study offers a set of supporting PMIs of benchmarking. While it is certainly true that other sets of PMIs of benchmarking could be developed differently in the future, this set appears to capture most of the important aspects of effective benchmarking as recommended by today's leading researchers and practitioners. Any manufacturing industry can use these performance indicators of benchmarking for comparing its own performance in different areas with other performance of best standard.

5.7 IDENTIFICATION OF FACTORS & SUB FACTORS OF ISCM

It is very important to find influencing factors of ISCM strategy and prioritize them as shown in table 5.2. These factors have been used in further study to create benchmark benchmarking framework and model of benchmarking for ISCM performance analysis of selected Indian manufacturing industries.

Table 5.2 Factors and Sub Factors of ISCM

S. No.	Factors and Sub Factors of ISCM	Authors References
1	Ideal time of inventory	Chopra, (2003); Schwarz, (2008); Mohanty et al, (2012)
2	Distance of suppliers and dealers from manufacturing industry	Mulky, (2013); Vrat, (2014); Hill, (2016)
3	Different sections productivity	Hall et al, (1999); Tangen, (2002); Leahey, (2006); Armstrong et al, (2006); Wieser, (2009); Bloom et al, (2010)
4	Performance and Comparative analysis	Singh et al, (2012); Fernald, (2014); Khaskhelly, (2015)
5	Human Resources Orientation-Education training and	Diamantopoulos et al, (1993); Stevens, (1994); Bekaertet al, (2002); Rao et al,

	development, team work, Organizational learning, provision of public goods, Export market assistance, Importance of capital and finance, Inter firm relationship	(2003); Lages et al, (2004), Lages et al, (2005); Durand et al, (2005); Schlosser et al, (2006); Vemic, (2007); Syed, (2007); Delarue et al, (2008); Salehi, (2008); Abdullah, (2009); Sheely, (2009); Chen, (2010); Rico et al, (2011); Saad et al, (2013); Fapohunda, (2013); Anuja et al, (2013); Guta, (2013); Vinesh, (2014); Husseina et al, (2014); Schmarf, (2014); Kerr et al, (2014); Mulang, (2015); Rana et al, (2015); Faroque et al, (2015); Holanda et al, (2015); Martynova, (2015); Chia et al, (2016)
6	Inbound Logistics- Information flow & analysis, Inventory level & control, Integration of group companies, Vendor development in nearby region, Underutilization of software facilities, Scientific methods for forecasting, Orientation & customer service, Market penetration, Flexibility to change, Ineffective transportation, Integrated planning, Vendor rating	David et al, (1999); Lieberman, et al (1999); Ertogral et al, (2000); Mentzer et al, (2001); Domjan, (2004); Report by ARC Advisory group, (2004); Tseng et al,(2005); Baltacioglu et al, (2006); Chandra et al, (2007); Liu et al, (2011); Maleki et al, (2011); Ray et al, (2011); Jirsak et al, (2012); Hart et al, (2013); Harriet et al, (2013); Yang (2013); Singh et al, (2013); Li, (2014); Kumar et al, (2014); Singh et al, (2014); Moore, (2015); Albarune et al, (2015); Jafari, (2015); Dornhofer et al, (2016); Tosun et al, (2016); Liu et al,(2016); Dittmann et al, (2016); Kume et al, (2016);
7	Operational Logistics – Frequent change in production schedules, Production loss due to lack of material, Frequent changes cause high WIP of sub assembly, Reduction in WIP inventory level, Manufacturing lead times, Material handling for WIP from one place to another	Cowling et al, (2002); Gram, (2013), Yuvaraj et al, (2013)
8	Outbound Logistics- Transportation lead-time, Outgoing quality control, Allocation of warehouses to different factories, Distribution strategies, Information flow about current market trends, Finished goods inventory level, Demand forecasting, Inventory level at different warehouses	Zijm et al, (1996); Fu et al,(1997); Rene et al, (2007); Cetinkaya et al,(2009); Facchin, et al, (2012); Kissani et al, (2014); Alad et al, (2014); Kwateng et al, (2014); Hanson et al, (2015); Govind et al, (2015); Mohanraj et al, (2016); Kumar et al, (2017)
9	Economies of Scale- Buffer/safety stock held by user, Cycle stock,	Graves, (1988); Thomas, (2003); Mukherjee, (2007); Sheu, (2007);

	Anticipation stock, Pipeline stock	Kristensen et al, (2008); Kampen et al, (2010); Hart et al, (2013); Yang et al, (2013); Celik, (2013); Anwar et al, (2015); World Economic Forum, (2016)
10	Flexibility- Customer service flexibility, Order flexibility, Location flexibility, Delivery time flexibility	Beach, et al, (2000); Kasarin et al, (2004); Zeytinoglu, (2005); Sanchez et al, (2005); Kasarin et al, (2006); Grigore, (2007); Wang, (2008); Hallgren et al, (2009); Chod et al, (2010); He et al, (2009); Jayant et al, (2013); Kesavan et al, (2014)
11	Logistics Strategies – Supply chain planning, Transportation system planning, Vehicle routing, Warehousing planning, Scheduling planning, New product development system, Product performance, Technology & innovation, Product development cost, Reliability of product, Warranty of product, Responsiveness of product, Flexibility of product	Schwarz et al, (1978); Desrochers et al, (1990); Scott et al, (1991); Rushton et al, (1992); Bramel et al, (1992); Bienstock et al, (1993); Bertsimas et al, (1994); Little et al, (1995); Jourquin et al, (1996); McKinnon, (2001); McKay et al, (2003); Sodhi, (2003); Rodrigue, (2006); Yamada et al, (2011); Lin et al, (2012); Ramaa, (2012); Tavasszy et al, (2012)
12	New Product Development System – Product performance, Technology & innovation, Product development cost, Reliability of product, Warranty of product, Responsiveness of product, Flexibility of product	Goulding, (1983); Agrawal et al, (1996); Murthy, (2006); Murthy, (2007); Powers et al, (2009); Adis et al, (2010); Bhuiyan, (2011)
13	Material Follow Up and Procurement- Order modification ratio, Frequency of urgent material requests from suppliers, Percentage of incoherencies between physical and system record of material, Production with missing parts, Line-stop durations and frequency, Items transported by air, express, cargo, Money spent for transportation by air, cargo charged to suppliers, Performance of early delivery, Performance of late delivery, Time spent for part missing product completions, Number of alternative material usage, Items supplied from alternative suppliers, Indirect labor hour for follow up, No. of items used	Kazerooni et al, (2004); Subramani et al, (2012); Mehta et al, (2013); Lenin, (2015); Bhargava et al, (2015); Hanson et al, (2015); Swain et al, (2015); Yadav et al, (2016)

	which are not in bill of material (BOM)	
14	Production Operation Process- Purchase order (PO) decision meeting lead time, Percent deviation PO forecasts from the realized sales, Modification frequency of PO's, Lead time of monthly production plan preparation, Realization of dealer sales target, Correctness of data transfer, Late orders quantity, Make to stock quantity, Flexibility of material handling system	Neely (1993); Ozer et al, (2004); Fekete et al, (2004); Yang et al, (2007); Pekgun et al, (2008); Tan et al, (2011); Stawowy et al, (2012); Wijaya et al, (2013); Rakicevic et al, (2015); Kumar et al, (2016)
15	Production Programming- Coherence between realized program & MRP, Frequency of postponed validation, Re-treatment quantity & frequency (based on type, period, vehicle), Urgent request fulfillment cycle time, No. of simulations to correct the mistakes, Number of items simulated, Percentage of critical items with respect to total items, Production cycle time, Quantity & frequency of scrap orders	Jiao et al, (2000); Leachman et al, (2002); Yan Yeung et al, (2007); Malak et al, (2008); Balogun et al, (2012); Al-kuhali et al, (2012); Khairnar et al, (2013); Chen, (2013); Jovanovicet al, (2014); Sarjono, (2014); Bettayeb et al, (2014)
16	Quality System- Product quality planning process, ISO/TS-16949 system related activities, Process quality control plan, Process capability Analysis, Supplier selection and approval, Production parts approval process (PPAP) Validation, Quality control (incoming/outgoing), Calibration of equipment Field failure analysis, Inspection (incoming, in process, final)	Binshan, (1991); Jabnoun, (2002); Batson et al, (2007); Colledani et al, (2011); Deshmukh et al, (2011); Mihail, (2015); Naworytaet al, (2015); Logan, (2015)
17	Products Delivery- Delivery cost per component, Number of items returned from dealer, Transport cycle time from invoicing until delivery to dealer, Factory stock (Assembly line output to assignment point), Lead time from point assignment to dealer, Ready-to-deliver stock levels more than 3,6,9,12 months,	Lonn et al, (2003); Blanquart et al, (2009); Ambe et al, (2011); Chen et al, (2012); Leung et al, (2016)

	Performance of transporters (lead time), Damaged items during transportation, Final checking time per item	
18	Foreign Trade and Service Management- Packaging mistakes of suppliers, Number of air shipments, Percentage of air shipments charged to supplier, Packaging cost percentage in total cost, Percentage of on-time deliveries, Correct programs sent to suppliers, Cycle time (waiting at warehouse), Stock level for export percentage of warehouse usage, Undeclared missing parts, Protection fault	Matear et al, (1993); Min (2009); Krajewska et al, (2009); Karim et al, (2010); Forslund et al, (2010); Goyal, (2013); Michal et al, (2015); Yu et al, (2017)
19	Transport Reception Custom decision- Vehicle routing problem description, Model review to address, transportation problems in supply chain, Supply chain integration and IT, Transport costs, Transport lead times and deviations, Extra customs clearance cost, Cycle time of the trucks in the plant, Import material customs clearance lead time, Information system incoherencies, Amount of empty area of full containers, Container/special packaging equipment returning cost	McFarland, (1984); Zayed et al, (2005); Luca et al, (2007); Costes et al, (2008); Song et al, (2009); Kim et al, (2009); Buraket al, (2009); Flynn et al (2010); Maleki et al, (2011); Naslund et al, (2012); Mogre et al, (2014); Torres et al, (2015); Saenz et al, (2015); Yuan et al, (2016); Damirzec et al, (2016); Abdul Rahman et al, (2016)

5.8 BRIEF INTRODUCTION OF FACTORS OF ISCM

The performance indicators of benchmarking directly or indirectly affect the performance of ISCM. Therefore, it is necessary to study different factors of ISCM. This research work contain brief introduction of factors.

- **Human Resources Orientation**

  Human research orientation signifies the successful implementation of ISCM (Mulang, 2015). The main objectives of human resources orientation are: employee loyalties, reduced anxiety of employee, make him understand the industries expectation (Vinesh, 2014). Human resource is an "orientation process through which an employee acquires the necessary skills, knowledge,

behaviours, training, which effectively transit into a new organization" (Abdullah, 2009). It includes recruitment and selection, maintaining good working conditions, managing employee relations and training & development (Vemic, 2007).

- **Inbound Logistics**

  It focuses on purchasing and coordinating the inbound movement of products, parts, materials and finished goods from suppliers to warehouses (Liu et al, 2011; Harrietet al, 2013). In 1985, Michael Porter explained it is to be the first stage in value chain in his book "Competitive Advantage". "Inbound logistics is an integral element of business operations for a manufacturing industry involving the processes of receiving, storing and distributing raw materials used in production" (Porter M E,1985).

- **Operational Logistics**

  It manages all logistics activities through course of material within industry (Lieberman et al, 1999; Charles et al, 2007). It is the "flow of goods, information and money throughout a manufacturing industry. It encompasses aspects of finance, marketing, accounting and gives an expanded view of industry operations" (Bertelsen et al, 1997**)**.

- **Outbound Logistics**

  This portion of logistics relies profoundly on transportation and storage of finished goods. It refers to the process for the progress and storage of products and their related information flow from production line to customer (Svensson, 2002). It control "the movement of material associated with storing, transporting, and distributing goods to its customers" (Kwateng et al, 2014; Tilokavichai et al, 2012).

- **Economies of Scale**

  Economics of scale is "the cost advantages that enterprises obtain due to size, output or scale of operation with their cost that decreases with increasing scale, as fixed costs are spread out over more units of output" (Van Kampen et al, 2010; Anwar et al, 2015**)**.

- **Flexibility**

  ISCM consist of activities related to plan, purchase and delivery via production depending on orders received, their delivery time to customer,

providing service to them and customer's location (Grigore, 2007; Raj et al, 2012). A flexible supply chain organization requires "flexibility at all levels like: strategic level, operational level and tactical levels in customer demands and supply" (Sanchez et al, 2005**)**.

- **Logistics Strategies**

  Logistics strategy is the "set of guiding principles, driving forces that help to coordinate goals, plans and policies between partners across a given supply chain" (Scott et al, 1991). Logistics strategy can be product-specific, customer-specific and location-specific. Industries may extend the logistics strategies for precise manufactured goods and specific customers (McKinnon, 2001; Sodhi, 2003).

- **New Product Development System**

  All products may not satisfy all customers; therefore, specific requirement from specific customers becomes a critical aspect that must be considered early in the product development process. Thus, it becomes prime important factor in deciding the production of goods and services and involves a number of steps i.e. conceptualization, advance product and advertising new product or services (Goulding, 1983). Therefore new product development process may affect the performance of ISCM of manufacturing unit. Product development may involve "modification of an existing product, its presentation or formulation of an entirely new product that satisfies a newly defined customer demand" (Senk et al, 2010; Murthy, 2006).

- **Material Follow Up and Procurement**

  The process of procurement has the ability to purchase materials and conclude the continuity of operations (Hanson et al, 2015). It is to "control the manufacturing activities by grasping the progress status of issued orders and delayed orders" (Angkiriwang et al, 2014). The material follow up and procurement play a significant role to manage the performance of ISCM.

- **Production Operation Process**

  It deals with "decision related to production operation process so that the resulting goods and services are produced in accordance with the quantitative specifications and demand schedule with minimum cost" (Gogi et al, 2016). Production/operations management is the process, which combines and

transforms various resources used in the production/operations subsystem of the organization into value added product/services in a controlled manner as per the policies of the organization (Neely, 1993; Fekete et al, 2015). Thus, production operation also has an impact on ISCM.

- **Production Programming**

  The purpose of "production programming is to make the balance between demand and availability of material inside the organization (Balogun et al, 2012). Production programmer always keeps the demands of customer in his mind and then checks the availability of production capacity" (Imam et al, 2009). Production programming refers to convert the unprocessed material into functional products through optimal use of resources by following a systematic approach to achieve the aim of manufacture (Al-kuhali et al, 2012).

- **Quality System**

  It is a "collection of business processes focused consistently on customer requirements and enhancing their satisfaction. A quality system is a structure for managing the quality of the output of a manufacturer" (Matias et al, 2002). The main function of good quality system is to reduce errors and provides the customer satisfaction. A very stringent quality system is more effective for inspecting items and delivering the best products (Colledani et al, 2011). A good quality system prevents ISCM errors from occurring rather than correcting them after they have happened.

- **Products delivery**

  The main purpose of "products delivery is to supply the right material at right place in minimum possible of time" (Bhuiyan, 2011**)**. Deliver the variety of products in minimum time frame is also an important aspect. Team manager may coordinate the area of work that delivers project, products either internal or external to organization (Chen et al, 2012).

- **Foreign Trade and Service Management**

  Foreign trade refers to the exchange of goods and services across borders. International trade signifies a nation's economic, social, and political development (Goyal, 2013). International and National trade principles are almost same with reference to customer satisfaction. "The behaviour of parties involved in a trade does not change fundamentally regardless of whether trade

is across a border or not. The international trade is generally more costly than domestic trade. Industrialization, advanced transportation, globalization, multinational corporations and outsourcing have a major impact on the international trade system. Increasing international trade is crucial to the extension of globalization. International trade is necessary to enhance the economy of any country without which a nation would be limited to the goods and services produced within their own borders" (Goyal, 2012).

- **Transport Reception Custom Decision**

  A transportation management system is a "subset of SCM concerning transportation operations and may be a part of an ERP system. It is a fully customizable application with an event driven design that enables you to shop around for best pricing, consolidate orders, customize and run reports and audit freight bills" (Eksioglua et al, 2009). Transportation plays a key role in supply chain operations, affecting inbound supplies and distribution centres and delivering final products to customers (Saenz et al, 2015). A manufacturing company can never expand and grow profitably until it has excellent transportation planning and execution.

CHAPTER VI
DATA COLLECTION & FACTORS ANALYSIS THROUGH QUESTIONNAIRE SURVEY

6.1 INTRODUCTION

Data on expert's opinion has been gathered from some selected Indian manufacturing industries through different questionnaire survey consisting of questions related to ISCM and its benchmarking. The importance of factors is decided based on 5 point likert scale and mathematical calculations. The analysis of performance indicators of benchmarking and factors of ISCM has been done using following methods.

- Benchmarking practice is used to identify ISCM performance gap.
- Ranking of factors have been carried out by VIKOR methodology.
- The classification of factors into cause and effects groups through causal diagram based on DEMATEL technique.

6.2 IDENTIFICATION OF GAP BETWEEN ISCM PERFORMANCE FACTORS THROUGH BENCHMARKING PRACTICE

The managerial decision at different levels (strategic level, tactical level and operational levels) would be helpful in controlling the supply chain activities of manufacturing industries. Singh et al, (2013) identified some variables that affect the performance of a supply chain. In any type of manufacturing industry, flow of materials starts from different suppliers of industry to the customer ends through internal supply chain components (purchase, production and distribution unit) as shown in figure 6.1

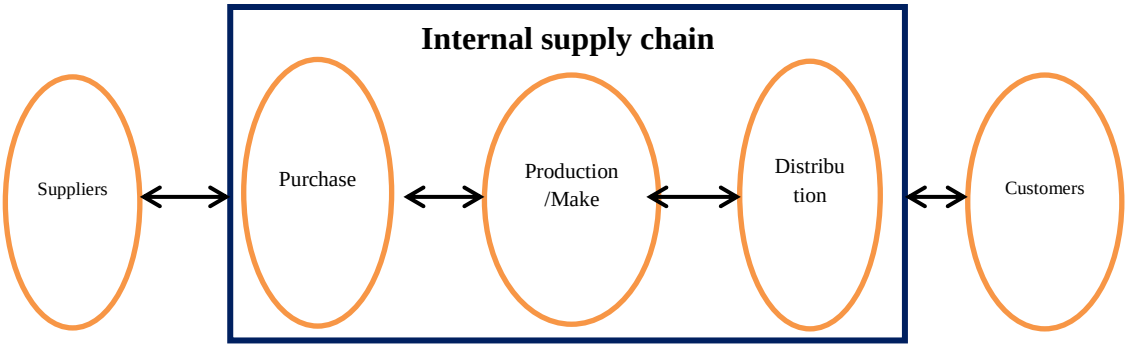

Figure 6.1 SCM Process of Manufacturing Industry

The function of ISCM is to manage the flow of funds/information/raw materials from suppliers to the customers end through various stages (Bhagwat et al, 2007). The continuous practice of comparative benchmarking provides the relevant information to the manufacturer about the competitors i.e. how competitors are manufacturing the best quality products economically and in minimum time frame (Drozdowski, 1983).

The concept of benchmarking and ISCM has been utilized simultaneously for improving the performance of internal supply chain of manufacturing industry. Pathak, (2016) identified best suppliers by benchmarking practice. Delivery of items to the customers is mainly governed through the factors of ISCM. Nurizman et al, (2017) proposed the successful investigation of barriers of SCM practices. Enlisted factors affect ISCM directly or indirectly: "quality system, human resources orientation, inbound logistics, operational logistics, outbound logistics, products delivery, economies of scale, flexibility, logistics strategies, foreign trade and service management, new product development system, material follow up and procurement, production operation process, production programming and transport reception custom decision. The implementation of performance gap between benchmarking practice and internal supply chain factors using expert's opinion and industrial questionnaire survey has been carried out. A benchmark is "measured, best-in-class achievement recognized as the standard of excellence for that business process" (Sharma et al, 2012; Le Sueur et al, 1997). The objective of benchmarking is to trace the early method of examining policies and products of competitors to see how they are made and how they could be made, whether the same or better (Gunduz et al, 2001; Vig, 1995).

The interlinking of benchmarking of manufacturing industries with ISCM is necessary to increase the efficiency of the industry (Tutcher, 1994; Balm, 1996**)**. Benchmarking of ISCM compares and measures the internal performance of an industry with its competitors in order to gain knowledge that help the industry to take action in order to improve its performance (Foster, 1992). Kumar et al, (2012) analyzed various types of SCM issues in automobile industry by situation actor process learning action performance (SAP-LAP) analysis. Bag et al, (2014) developed a framework which analyzes the complex relationships between identified factors of sustainable supply chain using ISM.

6.2.1 Industrial Questionnaire Surveys

The objective of industrial questionnaire-based survey was to find the performance gap between ISC factors within manufacturing industries. Five-point likert scale was used to collect expert's response. Lesser the points, lesser will be the effect of factor, while higher the point, higher will be the effect of factor. Three hundred questionnaires were sent to different Indian manufacturing industries and expert's opinion was collected through personal contacts, e-mail and postal survey. Out of three hundred questionnaires, seventy filled up questionnaires were received. The response rate is 23.33% which is appropriate to drive a conclusion. Practically, the questionnaire-based survey determined the ISCM factor's importance which is further categorized with their score and mean score as presented in table 6.1.

Table 6.1 Mean Score of ISCM Factors

S. No.	Factors	Score by Experts (S)	Mean Score = (S/70)
1	Human Resources Orientation	983	14.04
2	Inbound Logistics	1700	24.29
3	Operational Logistics	879	12.56
4	Outbound Logistics	850	12.14
5	Economies of Scale	618	8.83
6	Flexibility	581	8.3
7	Logistics Strategies	898	12.83
8	New Product Development System	883	8.33
9	Material Follow Up and Procurement	1565	22.36
10	Production Operation Process	990	14.14
11	Production Programming	948	13.54
12	Quality System	1738	24.83
13	Products Delivery	1493	21.33
14	Foreign Trade and Service Management	1454	20.77
15	Transport Reception Custom Decision	1351	19.3

6.2.2 Comparative Benchmarking Practices in ISCM: A Brief Introduction

Benchmarking of ISCM is the combination of two word benchmarking and ISCM which stands for a "process of comparing something or someone with best practice" (Andersen, 1994). ISCM is used to control the supply chain flow between purchase, production and distribution units within the industry. The flow of right information is one of the most critical activities of each department. The flow of supply chain takes place in forward and reverse direction. When flow is in forward direction then supply

chain is known as forward flow supply chain, otherwise it is reverse flow SCM. The purpose of benchmarking process is to compare the internal supply chain operation with similar units and standards for reducing the ISCM factor's performance gap. The implementation of comparative benchmarking practice is to compare frequently the internal supply chain performance factors and operations between different operating units and departments within industry. The main elements (purchase, production, and distribution) of ISCM are discussed below in brief:

(A) Purchase Department

The function of purchase department varies widely which are based upon different approaches. The purchasing activities may be assigned to the purchasing department or some other department also (Cavenato, 1988). Followings are some of the important functions of purchase department which are necessary:

- Assessment of demand or description of need
- Selection of sources of supply
- Receiving of quotation
- Placing order
- Making delivery at the proper time by follow-up the orders
- Verification of invoices
- Inspection of incoming materials
- Maintaining purchasing records and files
- Reporting to top management
- Developing coordination among other departments
- Meeting transport requirements of incoming and outgoing materials (Richardson, 1992).

(B) Production Department

The functions of production department are contingent upon the size of the industry. In small industry, the production manager may have to look after production planning and control along with personnel, marketing, finance and purchase functions. In medium sized industry, there may be separate managers for personnel, marketing and finance functions. But the production, planning, control as well as purchase and stores

may be under the control of production department. In large sized industry the activities of production is confined to the management of production activities only (Tan et al, 2011).

(C) Distribution Department

The importance of physical distribution can vary in nature and is typically associated with the type of product (Zairi et al, 2000**)**. The functions are interrelated because any decision have its impact on other area also, for example, a business that provide custom hand bags would consider shipping finished products via air freight versus rail or truck to expedite shipment time. The importance of this decision would offset the cost of inventory control, which could be more. Managing physical distribution from a systems approach can provide benefit in controlling costs and meeting customer service demands (Cetinkaya et al, 2009**)**.

6.2.3 Challenges for Indian Manufacturing Industries

Manufacturing industries produces a variety of products like automobiles, construction equipment, fast moving consumer goods (FMCG) products, medicines, defense weapons, surgical equipment, chemicals, etc. Indian economy changes rapidly with the variation in manufacturing sectors. The growth of manufacturing industries depends on strategies of production, planning and control to produce the goods. Competitors providing number and variety of quality products have made a challenge for customer satisfaction for any manufacturing industry.

6.2.4 Gap between Factors Using Comparative Benchmarking Practice

Benchmarking practices, either in manufacturing or service, helps to ensure that the targets are relevant as per the market needs. Comparative benchmarking practice for ISCM at national or international level is a proactive management tool which is progressively used to identify and focus improvement activities. Thus, the technique which articulates us about the strategies of competitors, like how much gap occurs between performance factors, is needed. For such competition there is scope of implementation of comparative benchmarking practice in ISCM providing help to identify gap between performance factors and then improve the internal supply chain performance of manufacturing industry by reducing the performance gap (Holloway et al, 1998). Gawankar et al, (2015) proposed the use and application of balance score

card in depth. The performance factors (1-15) of ISCM having mean score 14.04, 24.29, 12.56, 12.14, 8.83, 8.3, 12.83, 8.33, 22.36, 14.14, 13.54, 24.83, 21.33, 20.77 and 19.3, respectively are shown in figure 6.2. It consist of internal supply chain factors along abscissa while mean score values along ordinate. By regular comparative benchmarking practice, the gap between factors is easily identified and utilized as a benchmark for other factors of manufacturing industries.

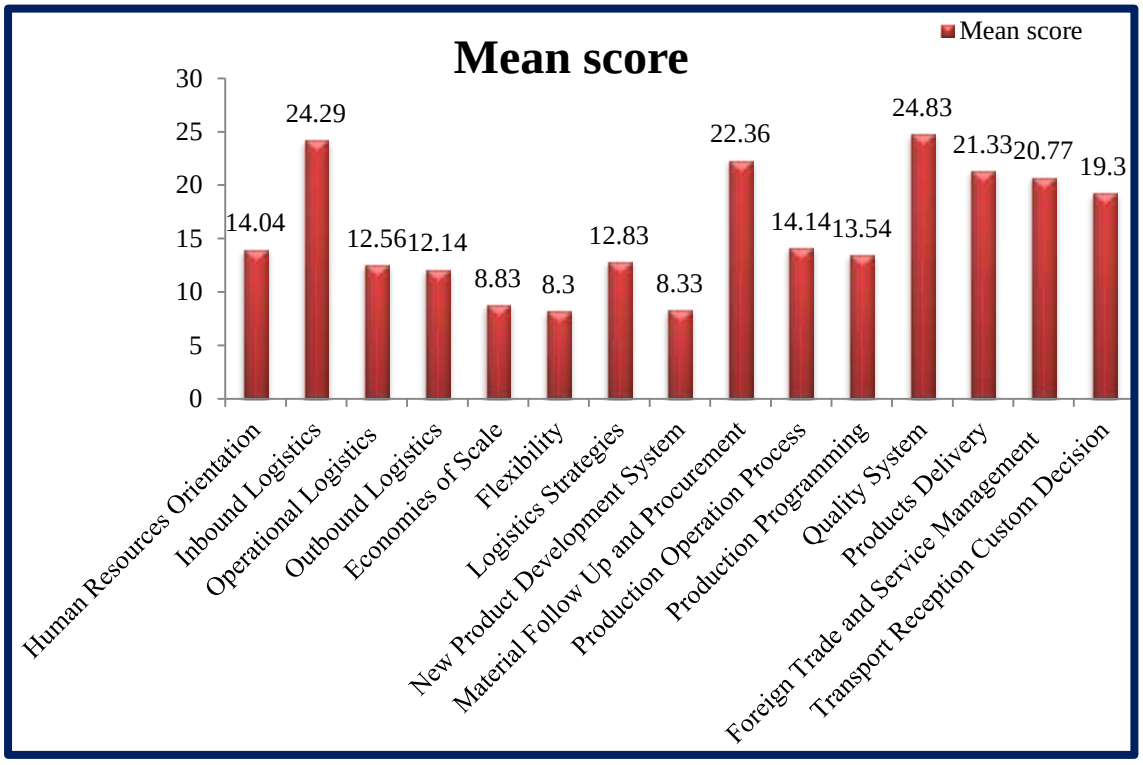

Figure 6.2 Gaps between Identified ISCM Factors

6.2.5 Factors Analysis Using Comparative Benchmarking

Fifteen ISCM performance factors are identified and the expert's opinion is gathered about their effectiveness. The individual mean score of each factor have been calculated as shown in table 6.1. The calculated maximum score of inbound logistics and quality systems is 24.29 and 24.83, respectively. Therefore, these factors act as a benchmark for remaining thirteen factors for continuous improvement of less scoring factors. The qualitative and quantitative techniques are helpful to improve the scores of factors while continuously comparative benchmarking practice can assist to find the gap between factors.

6.3 RANKING OF FACTORS USING VIKOR METHODOLOGY

SCM is defined as a type of management existing between demand of customer and supply of industries (Gunasekaran et al, 2001). SCM manages and coordinates the supply & demand activities from raw material purchase section up to distribution section through manufacturing, assembly, warehousing, inventory tracking and order entry management. ISCM is a group of management which involves all departments and also does planning of all type of material/funds/information flow (Sahay et al, 2003). The main function of internal supply chain is to transfer materials from one stage to second stage to third and further up to last stage.

The procurement task has gain importance in ISCM due to globalization and accelerated technological change (Boer et al, 2001**)**. The procurement of goods and services at the lowest possible price are most important point while considering need of the purchaser in terms of quality, quantity, time and location. Therefore, perfect internal supply chain flow is necessary for improving effectiveness of any business organization. Benchmarking is a useful performance comparative tool to determine the internal supply chain performance gap between competitors. Today, comparative benchmarking environment enforce the manufacturer towards effective internal supply chain. Competitive environments and governments policies propel manufacturer to enhance ISCM benchmarking practice, which are influenced by practices of internal supply chain design and coordination of different sections within industry. ISCM benchmarking has become a proactive approach to enhance internal supply chain performance. Thus, ISCM factors performance gap has been identified based on ranking through VIKOR methodology.

6.3.1 Classification of SCM

Supply chain is a very broad area. It can be classified into two categories like: External SCM and Internal SCM as describe below.

- **External Supply Chain Management**

  The main function of ESCM is to control all the process of supply chain outside the manufacturing industry.

- **Internal Supply Chain Management**

  The primary function of ISCM is to control all process of supply chain within manufacturing industry. The secondary function of ISCM is to control the flow and create integration between the departments. To improve the performance of manufacturing industries, collective efforts of partners of ISCM is required (Tracey et al, 2001). Selection of best possible qualitative and quantitative factors of ISCM is must for improvement of internal supply chain performance of any business (Shahadat, 2003). This research has come across some direct and indirect factors of ISCM which provides assistance for improving ISCM performance. The list of factors with their references is shown in table 6.2.

Table 6.2 ISCM Benchmarking Factors

S. No.	Factors	References
1	Human Resources Orientation	Schlosser et al, (2006); Delarue et al, (2008); Abdullah, (2009); Chen, (2010); Vinesh, (2014); Mulang, (2015)
2	Inbound Logistics	Liu et al, (2011); Dornhofer et al, (2016)
3	Operational Logistics	Ertogral et al, (2000); Cowling et al, (2002); Markus, (2013)
4	Outbound Logistics	Koster et al, (2007); Sila et al, (2009); Kwateng et al, (2014); Alad et al, (2014); Hanson et al, (2015)
5	Economies of Scale	Sheu, (2007); Kristensen et al, (2008); Celli, (2013); Anwar et al, (2015);
6	Flexibility	Roger et al, (2000); Charnsirisakskul et al, (2004); Charnsirisakskul et al, (2006); Grigore, (2007); Wang, (2008); He et al, (2009); Hallgren et al, (2009); Chod et al, (2010); Jayant et al, (2013); Kesavan et al, (2014)
7	Logistics Strategies	Sodhi, (2003); McKay et al, (2003); Ramaa, (2012)
8	New Product Development System	Agrawal et al, (1996); Murthy, (2007); Senk et al, (2010); Adis et al, (2010); Bhuiyan, (2011)
9	Material Follow Up and Procurement	Subramani et al, (2012); Mehta et al, (2013); Lenin, (2015); Bhargava et al, (2015); Agboyi et al, (2015); Swain et al, (2015); Yadav, et al, (2016)
10	Production Operation Process	Pekgun et al, (2008); Tan et al, (2011); Stawowy et al, (2012); Wijaya, (2013); Kumar et al, (2016)
11	Production Programming	Leachman et al, (2002); Al kuhali et al, (2012); Balogun et al, (2012); Chen, (2013); Bettayeb et al, (2014); Jovanovic et al, (2014)

12	Quality System	Jabnoun, (2002); Batson et al, (2007); Deshmukh et al, (2011); Colledani et al, (2011)
13	Products Delivery	Lonn et al, (2003); Blanquart et al, (2009); Ambe et al, (2011); Chen et al, (2012)
14	Foreign Trade and Service Management	Min, (2009); Krajewska et al, (2009); Forslundet al, (2010); Goyal, (2013); Michal et al, (2015); Bin et al, (2017)
15	Transport Reception Custom Decision	Song et al, (2009); Seongmoon, (2009); Maleki et al, (2011); Mogre et al, (2014); Torres et al, (2015); Yuan et al, (2016)

6.3.2 VIKOR Methodology

The main purpose of VIKOR methodology is to find rank of factors and evaluate different attributes using AHP. The objective of AHP used in this methodology is to find the weightage of factor. The detail of each step is explained consecutively in figure 6.3.

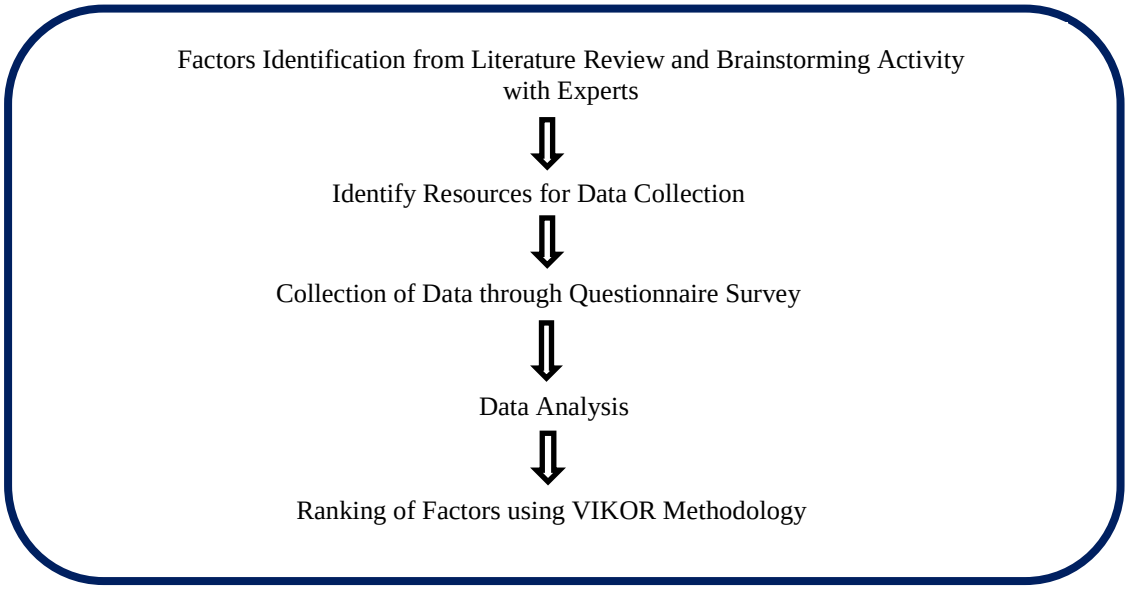

Figure 6.3 VIKOR Methodology

6.3.3 Analytical Hierarchy Process Technique

Saaty, (1986) **"**proposed the foundation of AHP and applied AHP technique to select the best decisions out of complex decisions". The objective of AHP technique is to resolve the problem into sub groups, analyze independently and then arrange all in hierarchy level (Kumar et al, 2009). Steps followed in AHP techniques are:

- Resolve the problems into sub groups and then determine the relative weights of each sub group through comparison.

- Compare each alternative with respect to each attribute.
- Evaluate sub groups on behalf of aggregate weights.

6.3.4 Steps of VIKOR Methodology

In this study, industrial expert's advices are collected in terms of factors score between rating point scale 1-5. The score of factors has been collected through questionnaire survey. Due to competitive environment, it is very typical to decide the importance of factors (Kannan et al, 2003). Thus, VIKOR methodology is used for making decision regarding ranking of factors. There are fifteen factors and fifteen experts for deciding rank of factors. (A_i represents i^{th} alternatives, i = 1, 2… 15, C_j represents the j^{th} attributes, j = 1, 2… 15). The identified factors with scores of experts are shown in table 6.3.

Table 6.3 ISCM Benchmarking Factor's Score by Experts

S. No.	Factors	E_1	E_2	E_3	E_4	E_5	E_6	E_7	E_8	E_9	E_{10}	E_{11}	E_{12}	E_{13}	E_{14}	E_{15}	Average
1	Human Resources Orientation (F_1)	1.71	2.43	2.14	2.00	2.14	2.14	1.86	2.29	1.57	2.14	2.286	2.143	2.1429	2	2.429	2.10
2	Inbound Logistics (F_2)	2.50	2.00	1.92	1.92	1.92	2.00	1.92	1.83	2.08	1.75	1.75	1.917	1.8333	2.083	1.833	1.95
3	Operational Logistics (F_3)	2.33	2.17	1.67	2.00	1.83	1.50	2.50	1.50	2.00	1.83	2	1.833	2.1667	2	2.167	1.97
4	Outbound Logistics (F_4)	1.38	1.63	1.13	1.50	1.25	1.75	1.00	1.88	1.13	1.50	1.125	1.625	1.375	1.375	1.375	1.40
5	Economies of Scale (F_5)	2.00	2.00	2.00	2.25	1.75	2.50	1.75	2.00	2.75	2.50	1.75	2.5	2	2.25	2.25	2.15
6	Flexibility (F_6)	2.75	1.50	2.50	1.50	2.25	2.00	2.25	2.25	2.25	2.50	2	2	2.25	1.75	2.25	2.13
7	Logistics Strategies (F_7)	2.00	2.40	2.20	2.20	2.00	2.40	2.20	2.20	2.60	2.20	2.8	2.6	2.2	2.4	2	2.29
8	New Product Development System (F_8)	1.00	1.57	1.00	1.14	1.43	1.29	1.14	1.00	1.14	1.14	1.143	1.143	1.2857	1	1.286	1.18
9	Material Follow Up and Procurement (F_9)	1.71	1.50	1.43	1.43	1.50	1.50	1.79	1.57	1.57	1.50	1.357	1.357	1.7857	1.643	1.643	1.55
10	Production Operation Process (F_{10})	1.44	1.67	1.56	1.56	1.44	1.56	1.89	1.33	1.56	1.44	1.333	1.556	1.5556	1.444	1.556	1.53
11	Production Programming (F_{11})	1.56	1.67	1.56	1.22	1.56	1.22	1.67	1.56	1.67	1.44	1.444	1.333	1.3333	1.556	1.333	1.47
12	Quality System (F_{12})	2.60	2.20	2.40	2.30	2.30	2.40	2.50	2.40	2.50	2.40	2.8	2.4	2.4	2.3	2.1	2.40
13	Products Delivery (F_{13})	2.78	2.22	2.44	1.89	2.22	2.00	2.89	2.11	2.67	2.44	2.333	2.333	2.5556	1.667	2.444	2.33
14	Foreign Trade and Service Management (F_{14})	1.91	1.64	2.00	1.82	1.73	2.09	1.91	1.82	1.73	1.91	1.818	1.636	1.5455	1.909	1.727	1.81
15	Transport Reception Custom Decision (F_{15})	2.64	1.73	1.91	1.55	1.82	1.64	1.82	1.82	1.73	1.64	2	1.818	1.6364	2	1.545	1.82

	SUM	30.31	28.31	27.84	26.27	27.14	27.98	29.07	27.55	28.94	28.35	27.94	28.19	28.066	27.38	27.94	
	Maximum	2.78	2.43	2.5	2.3	2.3	2.5	2.89	2.4	2.75	2.5	2.8	2.6	2.56	2.4	2.6	
	Minimum	1	1.5	1	1.14	1.25	1.22	1	1	1.13	1.14	1.13	1.14	1.29	1	1.29	
	Difference	1.78	0.93	1.5	1.16	1.05	1.28	1.89	1.4	1.62	1.36	1.67	1.46	1.27	1.4	1.31	

Let there are following attributes like: factors F_1, F_2, F_3, F_4, F_5, F_6, F_7, F_8, F_9, F_{10}, F_{11}, F_{12}, F_{13}, F_{14}, and F_{15} and there are following alternative criteria like: experts opinion E_1, E_2, E_3, E_4, E_5, E_6, E_7, E_8, E_9, E_{10}, E_{11}, E_{12}, E_{13}, E_{14}, and E_{15}. One can get the average mark of i^{th} factors and thus the decision matrix formulated by the expert team.

VIKOR methodology consists of following steps:

1. **To determine the objective like:** Best value of attributes $(m_{ij})_{maximum}$, worst value of attributes $(m_{ij})_{minimum}$ and the weights of factors are decided by a pair wise comparison influence matrix as shown in table 6.4. It is prepared from the mean of various scores given by fifteen respondents to each factor.

Table 6.4 Influence Matrix

Alternatives → Attributes ↓	**E_1**	**E_2**	**E_3**	**E_4**	**E_5**	**E_6**	**E_7**	**E_8**	**E_9**	**E_{10}**	**E_{11}**	**E_{12}**	**E_{13}**	**E_{14}**	**E_{15}**	**Geometric mean**	**Weight**
F_1	1	0.145238	0.128571	0.695238	0.054762	0.038095	0.198095	0.914286	0.542857	0.569312	0.621164021	0.304762	0.238095	0.283117	0.277056	0.280937739	0.015032984
F_2	6.885246	1	0.016667	0.55	0.2	0.183333	0.343333	0.769048	0.397619	0.424074	0.475925926	0.45	0.383333	0.137879	0.131818	0.351386801	0.018802714
F_3	7.777778	60	1	0.566667	0.183333	0.166667	0.326667	0.785714	0.414286	0.440741	0.492592593	0.433333	0.366667	0.154545	0.148485	0.614949995	0.032905986
F_4	1.438356	1.818182	1.764706	1	0.75	0.733333	0.893333	0.219048	0.152381	0.125926	0.074074074	1	0.933333	0.412121	0.418182	0.545777114	0.029204543
F_5	18.26087	5	5.454545	1.333333	1	0.016667	0.143333	0.969048	0.597619	0.624074	0.675925926	0.25	0.183333	0.337879	0.331818	0.660605427	0.035349009
F_6	26.25	5.454545	6	1.363636	60	1	0.16	0.952381	0.580952	0.607407	0.659259259	0.266667	0.2	0.321212	0.315152	1.189196903	0.063633948
F_7	5.048077	2.912621	3.061224	1.119403	6.976744	6.25	1	1.112381	0.740952	0.767407	0.819259259	0.106667	0.04	0.481212	0.475152	1.007020246	0.053885672
F_8	1.0937	1.3003	1.2727	4.5652	1.0319	1.05	0.8989	1	0.3714	0.3449	0.2931216	1.2190	1.1523	0.6311	0.6372	0.8888625	0.0475630

	5	1	27	17	41		73		29	74	93	48	81	69	29	95	54
F_9	1.842105	2.5149 7	2.413793	6.5625	1.673307	1.721311	1.349614	2.692308	1	0.026455	0.078306878	0.847619	0.780952	0.25974	0.265801	0.839668135	0.044930657
F_{10}	1.756506	2.3 58079	2.268908	7.941176	1.602374	1.646341	1.303089	2.898773	37.8	1	0.051851852	0.874074	0.807407	0.286195	0.292256	1.345799254	0.072013743
F_{11}	1.609881	2.1 01167	2.030075	13.5	1.479452	1.516854	1.220615	3.411552	12.77027	19.28571	1	0.925926	0.859259	0.338047	0.344108	1.933595252	0.103466718
F_{12}	3.238125	2.2 22222	2.307692	1	4	3.75	9.375	0.820313	1.179775	1.144068	1.08	1	0.066667	0.587879	0.581818	1.320222146	0.070645112
F_{13}	4.2	2.6 08696	2.727273	1.071429	5.454545	5	25	0.867769	1.280488	1.238532	1.163793103	15	1	0.521212	0.515152	2.204156446	0.117944452
F_{14}	3.532111	7.2 52747	6.470588	2.426471	2.959641	3.113208	2.078086	1.584362	3.85	3.494118	2.958167331	1.701031	1.918605	1	0.006061	1.842879862	0.098612536
F_{15}	3.609375	7.5 86207	6.734694	2.391304	3.013699	3.173077	2.104592	1.569293	3.762215	3.421659	2.906066536	1.701875	1.941176	165	1	3.663031295	0.196008872
SUM																18.688089 21	1

2. **Calculate the values of E_i and F_i:** The values of E_i and F_i are calculated using equation 1 and 2. All calculated values of E_i and summation of E_i for all fifteen corresponding factors are shown in table 6.5.

$E_i = w_j[m_{ij} - m_{ij\ minimum}] / [m_{ij\ maximum} - m_{ij\ minimum}]$ (1)

j = 1

F_i= Maximum of $\{w_j[m_{ij} - m_{ijminimum}] / [m_{ij\ maximum} - m_{ijminimum}]$ (2)

j = 1,2,3,4,…….M

Table 6.5 Calculation of E_i

E_i	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Sum
E_1	0.399	1.000	0.760	0.741	0.848	0.719	0.455	0.921	0.272	0.735	0.695	0.685	0.669	0.714	0.870	10.483
E_2	0.843	0.538	0.613	0.672	0.638	0.609	0.487	0.593	0.586	0.449	0.371	0.534	0.425	0.771	0.412	8.542
E_3	0.747	0.720	0.447	0.741	0.552	0.219	0.794	0.357	0.537	0.507	0.521	0.473	0.693	0.714	0.672	8.694
E_4	0.213	0.140	0.087	0.310	0.000	0.414	0.000	0.629	0.000	0.265	0.000	0.336	0.071	0.271	0.069	2.804
E_5	0.562	0.538	0.667	0.957	0.476	1.000	0.397	0.714	1.000	1.000	0.371	0.932	0.559	0.893	0.733	10.798
E_6	0.983	0.000	1.000	0.310	0.952	0.610	0.661	0.893	0.691	1.000	0.521	0.589	0.756	0.536	0.733	10.236
E_7	0.562	0.968	0.800	0.914	0.714	0.922	0.635	0.857	0.907	0.779	1.000	1.000	0.717	1.000	1.000	12.775
E_8	0.000	0.075	0.000	0.000	0.171	0.055	0.074	0.000	0.006	0.000	0.006	0.000	0.000	0.000	0.000	0.388
E_9	0.399	0.000	0.287	0.250	0.238	0.219	0.418	0.407	0.272	0.265	0.138	0.151	0.394	0.457	0.267	4.160
E_{10}	0.247	0.183	0.373	0.362	0.181	0.266	0.471	0.236	0.265	0.221	0.120	0.288	0.213	0.314	0.206	3.945

E_{11}	0.315	0.180	0.373	0.069	0.295	0.000	0.354	0.400	0.333	0.220	0.186	0.130	0.031	0.400	0.031	3.318
E_{12}	0.899	0.753	0.933	1.000	1.000	0.920	0.794	1.000	0.846	0.926	1.000	0.863	0.874	0.929	0.618	13.355
E_{13}	1.000	0.774	0.960	0.647	0.924	0.610	1.000	0.793	0.951	0.956	0.719	0.815	1.000	0.479	0.878	12.504
E_{14}	0.511	0.151	0.667	0.586	0.457	0.680	0.481	0.586	0.370	0.566	0.413	0.342	0.205	0.650	0.336	7.001
E_{15}	0.921	0.247	0.607	0.353	0.543	0.328	0.434	0.590	0.370	0.368	0.521	0.466	0.276	0.714	0.198	6.936

$E_{imaximum}$ =12.775, $E_{iminimum}$ =0.388

F_1=1, F_2=1, F_3=1, F_4=1, F_5=1, F_6=1, F_7=1, F_8=1, F_9=1, F_{10}, F_{11}=1, F_{12}, F_{13}=1, F_{14}=1, F_{15}=1

$F_{imaximum}$=1, $F_{iminimum}$=1

3. **Calculate the Values of P_i:** The value of Pi for all factors is calculated using equation 3.

$$P_i = v * [(E_i - E_{i\ minimum}) / (E_{imaximum} - E_{i\ minimum})] + (1 - v) * [(F_i - F_{i\ minimum}) / (F_{imaximum} - F_{i\ minimum})] \quad (3)$$

P_1 =0.5[(10.48333-0.38762) / (12.77491-0.38762)] + (1-0.5) [(1-1) / (1-1)]
=0.407502606

The calculated value of P_1 is 0.407502606. Similarly, other values from P_2 to P_{15} are determined using equation 3 as shown in table 6.6.$E_{imaximum}$is the maximum value of E_i, and $E_{i\ minimum}$ is the minimum value of E_i, $F_{imaximum}$ is the maximum value of F_i and $F_{iminimum}$ is the minimum value of F_i, v is introduced as weight of strategy of the majority of attributes. Usually, the value of v is taken as 0.5. However, v can take any value from 0-1.

Table 6.6 Calculation of P_i

E_i	Sum	P_i
E_1	10.48333	0.407502606
E_2	8.54247	0.329161965
E_3	8.694497	0.335298371
E_4	2.804233	0.097544042
E_5	10.7978	0.420195889
E_6	10.23556	0.397501795
E_7	12.77491	0.5
E_8	0.38762	0
E_9	4.16026	0.152278656
E_{10}	3.945023	0.143590845
E_{11}	3.317771	0.11827245
E_{12}	13.35462	0.523399311
E_{13}	12.50398	0.489064008
E_{14}	7.001462	0.266960773
E_{15}	6.936328	0.264331707

4. Ranking of Factors: All attributes are arranged in the ascending order according to the values of P_i. Similarly arrange the attributes according to the values of E_i and F_i separately. The compromise ranking list for a given v is obtained by ranking with P_i measures. The best attributes ranked by P_i are the one with the minimum value of P_i. The ranking of factor are decided on the basis of P_i scores value of factors. For example: The P_i score value of factor F_8 (New product development system) is 0, which is minimum score so that the rank of this factor is 1. The P_i value of factor F_{12} (Quality system) is 0.52, which is maximum that why the rank of this factor is 15. Similarly, rank of other factors may be decided as shown in table 6.7.

Table 6.7 Ranking of Factors (attributes)

S. No.	Factors	P_i	Ranking of Factors
F_8	New Product Development System	0	1
F_4	Outbound Logistics	0.097544042	2
F_{11}	Production Programming	0.11827245	3
F_{10}	Production Operation Process	0.143590845	4
F_9	Material Follow Up and Procurement	0.152278656	5
F_{15}	Transport Reception Custom Decision	0.264331707	6
F_{14}	Foreign Trade and Service Management	0.266960773	7
F_2	Inbound Logistics	0.329161965	8
F_3	Operational Logistics	0.335298371	9
F_6	Flexibility	0.397501795	10
F_1	Human Resources Orientation	0.407502606	11
F_5	Economies of Scale	0.420195889	12
F_{13}	Products Delivery	0.489064008	13
F_7	Logistics Strategies	0.5	14
F_{12}	Quality System	0.523399311	15

5. Weight Criteria: For a given weight against an attribute, a compromise solution is to be prepared with alternative A_K values ranked by the measurable P, if the following conditions are satisfied:

- **Condition 1:** "Acceptable advantage" $P(A_K)-P(A_l)\leq(1/(N-1))$. A_l is the second-best alternative in the ranking by P (Opricovic et al, 2004).
- **Condition 2:** "Acceptable stability in decision-making' alternative A_K must also be the best ranked by E and/or F. This compromise solution is stable within a decision-making processes which could be; 'voting by majority rule' (when $v > 0.5$ is needed) or 'by consensus' (when $v \approx 0.5$) or 'with veto' (when $v > 0.5$). If one of the conditions is not satisfied, then a set of

compromise solution is proposed, which consists of Alternatives A_K and A_l if only condition 2 is not satisfied" (Tong et al, 2007). A_K , A_l , ……, Ap if condition 1 is not satisfied; A_P is determined by the relation $P(A_P) - P(A_l) \approx (1/(N-1))$.

6.3.5 Factors Analysis Using VIKOR Methodology

VIKOR methodology is a very appropriate method for factors ranking. By this method, the manufacturer identifies the best factor and creates ISCM benchmarking on the basis of best ranking factors. Figure 6.4 consists of different factors with its evaluated rank. The attributes P_i values are in such order according to scores: $P_{12}>P_7>P_{13}>P_5>P_1>P_6>P_3>P_2>P_{14}>P_{15}>P_9>P_{10}>P_{11}>P_4>P_8$ as shown in table 6.6. The rank of factors is decided on the basis P_i score value. Thus, it is clear that attribute (factor F_8) is the best factor and attribute (factor F_{12}) is the worst factor.

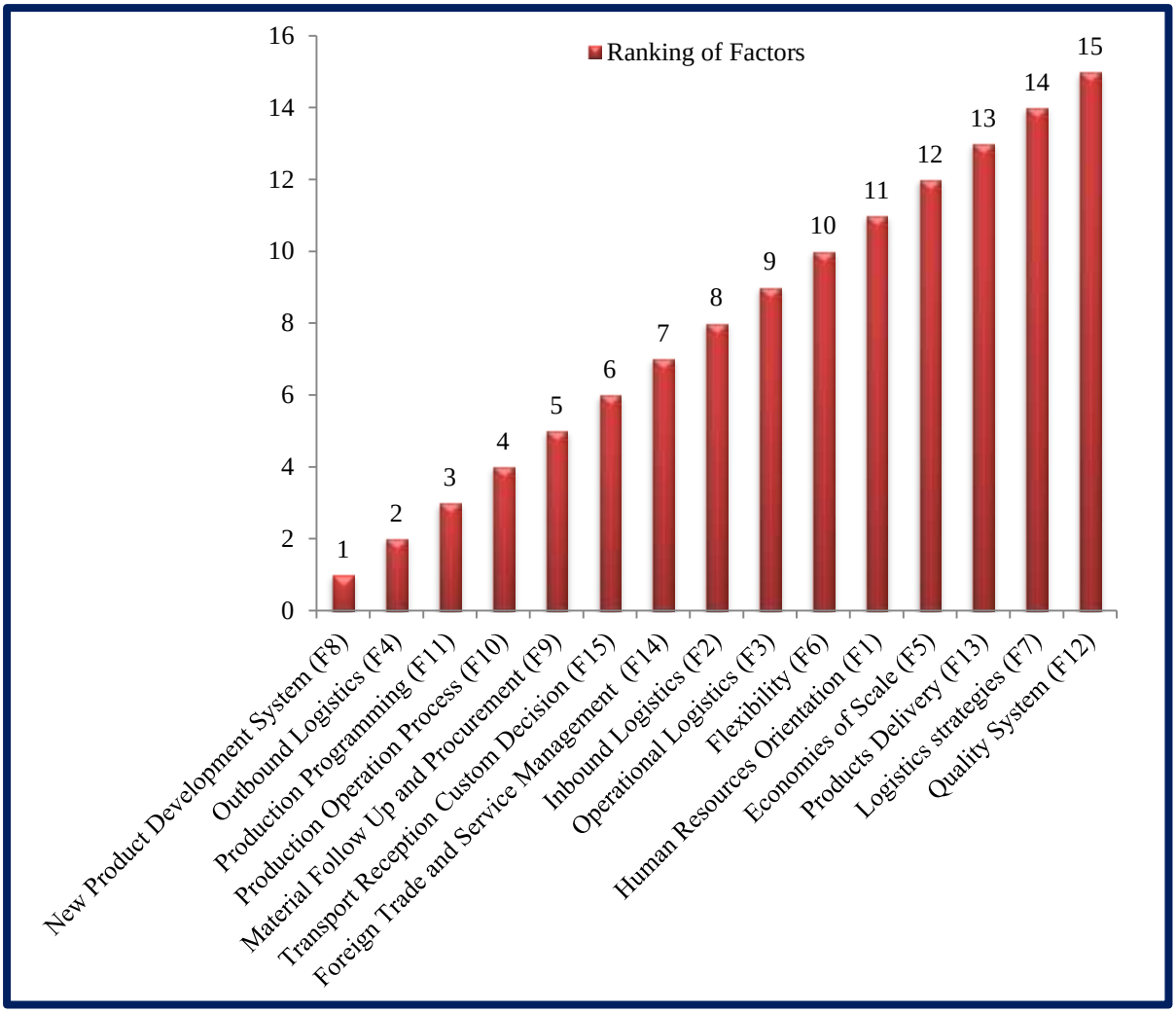

Figure 6.4 Ranking of Factors using VIKOR Methodology

6.4 CLASSIFICATION OF FACTORS USING DEMATEL TECHNIQUE

In the present century, manufacturing industries emphasizes more on sophisticated technology and quality products for customers (Dangayach, et al, 2006). ISCM allow industries to make internal changes without enhancing the operating cost. Singh, (2011) derived a framework via ISM to improve supply chain coordination. Manufacturing industries usually deals with purchase, production and distribution of goods consumed at regular basis with lowest operating cost. Several studies reveal that the flexibility of supply chain and manufacturing system was enhanced with the emergence of various new concepts and models to make better system.

International market competition has resulted in reducing the quality of existing products with increase the customer expectations (Gunasekarana et al, 2004). This concept enforced business agencies to invest more on ISCM benchmarking for its improvement. The inconsistent lifestyle and encroachment of constant communication technology brings constant renovation and motivation for improvement of ISCM. All manufacturing industries hold optimization of supply chain process requiring proper coordination among different members and departments as shown in figure 6.5.

Figure 6.5 ISCM of Manufacturing Industries

ISCM controls and coordinates all the activity of purchase, production and distribution sections which involve suppliers (S1, S2…Sn) and customers (C1, C2….Cn) **(**Kotzab, et al, 2011). Supply performance assessment can be divided into two qualitative and quantitative measurable methods. Business incorporations and universities more often use the quantitative method. This method suffers from 2 major problems: First is associated with the amount of time required for data collection and the other is how to reach reliable information for data assessment (Foggin et al, 2004).

Kumar et al, (2008) prepared a hierarchy for flexibility of supply chain dimensions using ISM to know their influence over each other in global supply chains. Stevenson et al, (2009) did inter firm empirical study on supply chain flexibilities; inter organizational aspects and their interaction with one another within industry. Sadeh et al, (2011) presented a framework to study link between TQM practices, SCM practices and performance using DEMATEL technique.

ISCM activities are based on designed, planned and organized framework where effective evaluation system provides a benchmark for it (Shaw et al, 2010**)**. Numerous interrelated criteria play important role on customer satisfaction and improving the performance of ISCM. Here, fifteen factors of ISCM benchmarking have been identified with their inter relationship and influence among each other using DEMATEL technique.

6.4.1 ISCM Benchmarking Factors

Research study has identified fifteen direct and indirect factors of benchmarking of ISCM. These factors are: "human resources orientation, inbound logistics, operational logistics, outbound logistics, economies of scale, flexibility, logistics strategies, new product development system, material follow up and procurement, production operation process, production programming, quality system, products delivery, foreign trade and service management and transport reception custom decision". The details of all factors have already been discussed in chapter 5.

6.4.2 ISCM Benchmarking

ISCM implies to complete a product following customer priorities in such a way that the concern product is produced with the highest quality at minimum price in optimum time to reach customers. It is an internal group of management within industry which interconnect the purchase and distribution department through production department. Benchmarking is required to identify best competitive factor out of all responsible factors. Further identified factors are used to improve the performance of manufacturing industries (Bhutta et al, 1999). It is a continuous practice which controls internal supply chain activity between different sections like: purchase, production and distribution by identifying ISCM performance gap of same capacity units within manufacturing industry. Such type of practice may be helpful in

improving the performance of ISCM as well as creating benchmark for others competitors**.**

6.4.3 Methodology Used

Based on influence over each other, variable factors have been classified into cause and effect diagram. Finally, cause and effect group's factors are identified and used as a benchmark to improve the performance of other manufacturing industries.

6.4.4 DEMATEL Technique

DEMATEL technique is used to obtain direct and indirect cause and the strength of influence across quality features by applying matrix computation to complex systems and comparing the interrelations among the quality features (Lee et al, 2013**)**. It has the ability not only to demonstrate direct relationship of sub systems, but also to clarify the degree of interactions between sub systems (Wu et al, 2011**)**. DEMATEL technique consists of various steps as shown in figure 6.6 (Shieh et al, 2010).

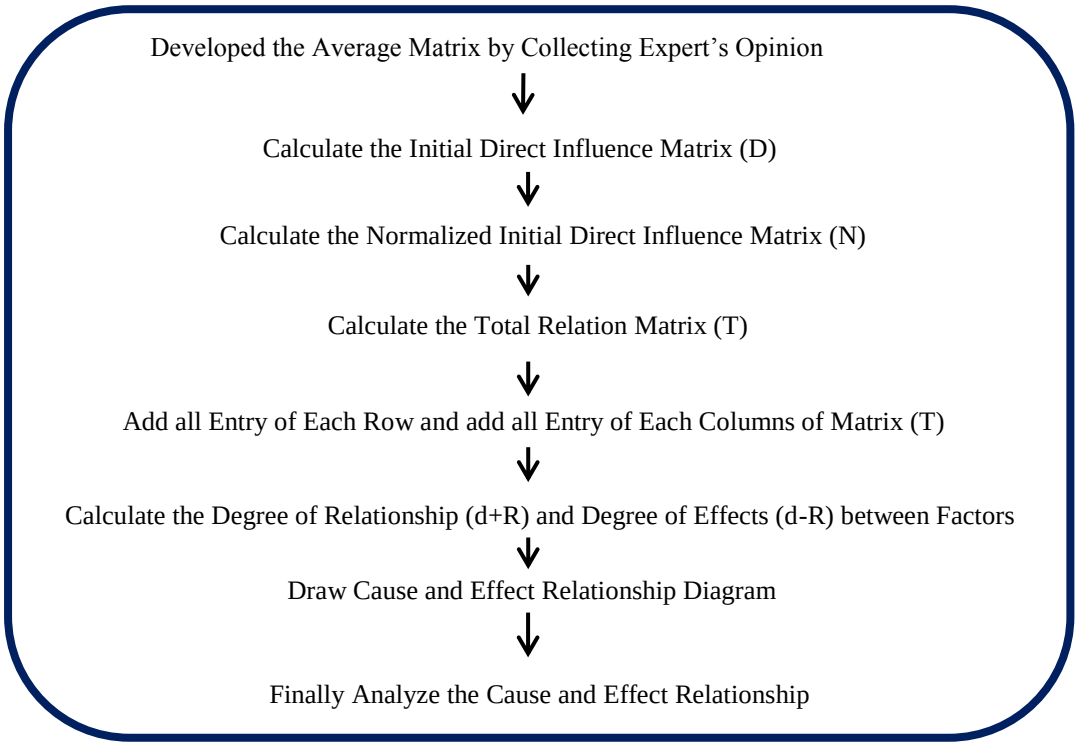

Figure 6.6 Flow Chart of DEMATEL Technique

Step 1 Calculation of the Direct Influence Matrix

The first step in DEMATEL is to calculate direct influence matrix with the help of expert views (Tzeng et al, 2007). The mutual relationship among the attributes is

being evaluated using a scale from 1 to 4 in ascending order (Sadeh et al, 2011). Each expert is asked: 'To what degree does factor i affect factor j?' The initial direct-relation matrix $D = [d_{ij}]_{n*n}$ is obtained through pair wise comparison in terms of influence and direction between criteria, in which n denotes the number of experts (Shen et al, 2012**)**. If there are n variables that impact the system, a direct influence matrix will look like:

$$D = \begin{bmatrix} 0 & \cdots & d1n \\ \vdots & \ddots & \vdots \\ dn1 & \cdots & 0 \end{bmatrix}$$

Fifteen factors were used for evaluating benchmarking of ISCM of Indian manufacturing industries. On the basis of ranking obtained from various industrial experts, direct-influence matrix has been obtained. Where the influences of one factor i on the other factor j is determined as shown in table 6.8. For example: In 2nd row and 1st column, the entry value of 1.40 indicates the influence of inbound logistics on human resource orientation. Similarly, the value of 1st row and 9th column indicates the influence of human resource orientation on material follow up and procurement. Thus, other values also indicate the influence of one factor over other.

Table 6.8 Direct Influence Matrix

ISCM Factors	Human Resources Orientation	Inbound Logistics	Operational Logistics	Outbound Logistics	Economies of Scale	Flexibility	Logistics Strategies	New Product Development System	Material Follow Up and Procurement	Production Operation Process	Production Programming	Quality System	Products Delivery	Foreign Trade and Service Management	Transport Reception Custom Decision	SUM
Human Resources Orientation	0.00	1.00	1.50	0.80	0.40	0.20	1.50	1.50	2.80	1.90	2.50	2.80	1.80	0.90	1.70	21.30
Inbound Logistics	1.40	0.00	2.80	0.30	2.20	1.40	0.70	1.20	2.60	1.60	1.00	2.40	0.60	0.20	1.50	19.90
Operational Logistics	0.90	0.20	0.00	1.50	1.80	1.30	0.30	1.60	1.40	1.70	0.90	2.40	0.70	0.00	0.60	15.30
Outbound Logistics	0.70	0.10	0.10	0.00	1.70	1.00	0.30	0.00	0.90	0.10	0.00	2.30	2.60	0.10	1.70	11.60
Economies of Scale	1.00	0.90	1.60	0.50	0.00	0.90	0.80	0.90	0.80	0.20	0.30	0.80	1.70	1.50	2.10	14.00
Flexibility	1.00	1.10	1.50	1.40	2.60	0.00	1.30	0.80	1.20	0.90	1.00	1.10	1.70	1.30	1.50	18.40

Logistics Strategies	0.70	2.10	2.30	1.80	2.30	0.40	0.00	0.20	0.50	1.60	1.00	0.70	1.60	2.00	1.90	19.10
New Product Development System	0.50	0.10	0.20	0.10	0.40	0.40	0.10	0.00	0.30	1.40	0.30	0.60	0.10	0.00	0.00	4.50
Material Follow Up and Procurement	1.20	2.70	1.40	1.20	1.50	0.60	0.80	0.20	0.00	2.70	1.70	1.90	0.50	0.70	1.20	18.30
Production Operation Process	1.30	0.40	1.30	1.00	0.90	1.20	0.20	0.00	0.70	0.00	2.10	2.50	0.90	0.00	0.00	12.50
Production Programming	0.70	0.10	0.70	0.40	0.30	0.40	0.40	0.00	0.30	2.00	0.00	2.30	0.30	0.00	0.00	7.90
Quality System	0.60	0.30	1.40	0.80	1.00	0.70	0.30	0.50	0.50	2.40	1.10	0.00	0.60	0.30	1.20	11.70
Products Delivery	0.30	0.20	0.10	1.40	1.70	0.80	1.00	0.30	0.30	1.20	0.00	2.20	0.00	1.30	0.30	11.10
Foreign Trade and Service Management	0.60	0.30	0.20	0.50	0.70	1.20	0.80	0.00	0.50	1.40	0.00	2.10	0.90	0.00	0.80	10.00
Transport Reception Custom Decision	0.40	1.30	0.30	1.70	1.70	1.40	1.20	0.00	1.00	0.20	0.20	2.00	2.70	1.40	0.00	15.50
SUM	11.30	10.80	15.40	13.40	19.20	11.90	9.70	7.20	13.80	19.30	12.10	26.10	16.70	9.70	14.50	

Step 2 Normalize the Direct Influence Matrix

Once the direct-influence matrix has been obtained, it can be normalized using equation (1) & (2) to get the initial normalized direct influence matrix 'N' as shown in table 6.9 which is developed by multiplying all entries of direct influence matrix by M. The value of M can be calculated using equation 1.

$$M = \min\left[1 \div max\sum_{i=1}^{n} dij,\ 1 \div max\sum_{j=1}^{n} dij\right] \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

$$M = \min[1 \div 26.10,\ \ 1 \div 21.30\ ]$$

$$\text{Normalized matrix } = \text{ D} * \text{M} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

Table 6.9 Normalize Direct Influence Matrix (N)

ISCM Factors	Human Resources Orientation	Inbound Logistics	Operational Logistics	Outbound Logistics	Economies of Scale	Flexibility	Logistics Strategies	New Product Development System	Material Follow Up and Procurement	Production Operation Process	Production Programming	Quality System	Products Delivery	Foreign Trade and Service Management	Transport Reception Custom Decision
Human Resources Orientation	0	0.04	0.06	0.03	0.02	0.01	0.06	0.06	0.11	0.07	0.1	0.11	0.07	0.03	0.07
Inbound Logistics	0.05	0	0.11	0.01	0.08	0.05	0.03	0.05	0.1	0.06	0.04	0.09	0.02	0.01	0.06
Operational Logistics	0.03	0.01	0	0.06	0.07	0.05	0.01	0.06	0.05	0.07	0.03	0.09	0.03	0	0.02
Outbound Logistics	0.03	0	0	0	0.07	0.04	0.01	0	0.03	0	0	0.09	0.1	0	0.07
Economies of Scale	0.04	0.03	0.06	0.02	0	0.03	0.03	0.03	0.03	0.01	0.01	0.03	0.07	0.06	0.08
Flexibility	0.04	0.04	0.06	0.05	0.1	0	0.05	0.03	0.05	0.03	0.04	0.04	0.07	0.05	0.06
Logistics Strategies	0.03	0.08	0.09	0.07	0.09	0.02	0	0.01	0.02	0.06	0.04	0.03	0.06	0.08	0.07
New Product Development System	0.02	0	0.01	0	0.02	0.02	0	0	0.01	0.05	0.01	0.02	0	0	0
Material Follow Up and Procurement	0.05	0.1	0.05	0.05	0.06	0.02	0.03	0.01	0	0.1	0.07	0.07	0.02	0.03	0.05
Production Operation Process	0.05	0.02	0.05	0.04	0.03	0.05	0.01	0	0.03	0	0.08	0.1	0.03	0	0
Production Programming	0.03	0	0.03	0.02	0.01	0.02	0.02	0	0.01	0.08	0	0.09	0.01	0	0
Quality System	0.02	0.01	0.05	0.03	0.04	0.03	0.01	0.02	0.02	0.09	0.04	0	0.02	0.01	0.05
Products Delivery	0.01	0.01	0	0.05	0.07	0.03	0.04	0.01	0.01	0.05	0	0.08	0	0.05	0.01

Foreign Trade and Service Management	0.02	0.01	0.01	0.02	0.03	0.05	0.03	0	0.02	0.05	0	0.08	0.03	0	0.03
Transport Reception Custom Decision	0.02	0.05	0.01	0.07	0.07	0.05	0.05	0	0.04	0.01	0.01	0.08	0.1	0.05	0

Step 3 Obtain Total Influence Matrix

Once the normalized direct-relation matrix (X) is obtained, the total relation matrix (T) can be acquired using equation (3) as shown in table 6.10 which depicts the total influence matrix of all factors.

Total influence matrix (T) = $N (I-N)^{-1}$…… (3)

Where I = Identity Matrix

Table 6.10 Total Influence Matrix (T)

ISCM Factors	Human Resources Orientation	Inbound Logistics	Operational Logistics	Outbound Logistics	Economies of Scale	Flexibility	Logistics Strategies	New Product Development System	Material Follow Up and Procurement	Production Operation Process	Production Programming	Quality System	Products Delivery	Foreign Trade and Service Management	Transport Reception Custom Decision	SUM
Human Resources Orientation	0.05	0.09	0.13	0.1	0.11	0.07	0.12	0.09	0.16	0.16	0.16	0.22	0.13	0.07	0.13	1.79
Inbound Logistics	0.1	0.05	0.18	0.07	0.16	0.1	0.09	0.08	0.15	0.14	0.1	0.2	0.08	0.05	0.12	1.67
Operational Logistics	0.07	0.04	0.05	0.1	0.13	0.09	0.05	0.08	0.09	0.13	0.07	0.16	0.07	0.03	0.07	1.23
Outbound Logistics	0.06	0.03	0.04	0.04	0.12	0.07	0.04	0.02	0.06	0.05	0.03	0.15	0.14	0.03	0.11	0.99
Economies of Scale	0.07	0.06	0.1	0.06	0.06	0.07	0.07	0.05	0.07	0.07	0.05	0.11	0.11	0.09	0.12	1.16
Flexibility	0.09	0.08	0.12	0.1	0.18	0.05	0.1	0.06	0.1	0.1	0.09	0.14	0.13	0.09	0.12	1.55
Logistics	0.08	0.12	0.15	0.13	0.17	0.0	0.05	0.04	0.08	0.13	0.09	0.14	0.12	0.12	0.13	1.6

Strategies						8										3
New Product Development System	0.03	0.01	0.03	0.01	0.04	0.03	0.02	0.01	0.02	0.07	0.03	0.04	0.01	0.01	0.01	0.37
Material Follow Up and Procurement	0.1	0.14	0.12	0.1	0.14	0.07	0.09	0.04	0.06	0.17	0.12	0.18	0.08	0.07	0.11	1.59
Production Operation Process	0.08	0.05	0.09	0.08	0.08	0.08	0.04	0.02	0.07	0.06	0.12	0.17	0.07	0.02	0.04	1.07
Production Programming	0.05	0.02	0.06	0.05	0.05	0.04	0.05	0.01	0.03	0.11	0.03	0.13	0.04	0.02	0.03	0.72
Quality System	0.05	0.04	0.09	0.07	0.09	0.06	0.05	0.04	0.05	0.13	0.07	0.07	0.06	0.03	0.08	0.98
Products Delivery	0.04	0.03	0.04	0.08	0.11	0.06	0.07	0.03	0.04	0.09	0.03	0.13	0.04	0.07	0.05	0.91
Foreign Trade and Service Management	0.05	0.03	0.05	0.05	0.08	0.08	0.06	0.02	0.05	0.09	0.03	0.13	0.06	0.02	0.06	0.86
Transport Reception Custom Decision	0.06	0.08	0.06	0.12	0.14	0.09	0.09	0.03	0.08	0.07	0.05	0.16	0.15	0.09	0.06	1.33
SUM	0.98	0.87	1.31	1.16	1.66	1.04	0.99	0.62	1.11	1.57	1.07	2.13	1.29	0.81	1.24	

The sum of rows and columns denoted by d and R, respectively reveals the relative importance of each factor criterion. The subtraction of d and R classifies these factors into two: cause and effect group (Wei et al, 2010). When (d-R) is positive, then factor belongs to the cause group whereas if it is negative then it belongs to the effect group. Therefore, the causal diagram can be obtained by mapping the dataset of the (d+R, d-R).

$$T = [tij]n * n, \qquad i, j = 1, 2, 3, 4, \ldots \ldots n \ldots \ldots \ldots \ldots \ldots \ldots \ldots (4)$$

$$d = \sum_{j=1}^{n} tij = [ti]\, n * 1 \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots (5)$$

$$R = \sum_{i=1}^{n} tij = [ti]\, 1 * n \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots (6)$$

Where, d and R are the sum of rows and columns respectively in total relation matrix T.

6.4.5 Causal Diagram

The interrelationships among the factors of benchmarking of ISCM are obtained using DEMATEL technique. Initially the direct influence matrix (D) and the total influence matrix (T) were obtained (Wu et al, 2010) thereafter; the degree of influence of the factors of interest are determined as shown in table 6.11.

Table 6.11 Degree of Influence of Factors of ISCM Benchmarking

ISCM Factors	d	R	d+R	d-R
Human Resources Orientation	1.79	0.98	2.77	0.81
Inbound Logistics	1.67	0.87	2.54	0.8
Operational Logistics	1.23	1.31	2.54	-0.08
Outbound Logistics	0.99	1.16	2.15	-0.17
Economies of Scale	1.16	1.66	2.82	-0.5
Flexibility	1.55	1.04	2.59	0.51
Logistics Strategies	1.63	0.99	2.62	0.64
New Product Development System	0.37	0.62	0.99	-0.25
Material Follow Up and Procurement	1.59	1.11	2.7	0.48
Production Operation Process	1.07	1.57	2.64	-0.5
Production Programming	0.72	1.07	1.79	-0.35
Quality System	0.98	2.13	3.11	-1.15
Products Delivery	0.91	1.29	2.2	-0.38
Foreign Trade and Service Management	0.86	0.81	1.67	0.05
Transport Reception Custom Decision	1.33	1.24	2.57	0.09

Based on the above analysis; a comprehensive impact relationship map has been generated as illustrated in figure 6.7. The values d, R, d+R, and d- R represent the relationships among the factors. The d value reflects the influence on other factors, while the R factor reflects the influence of other factors (Yang et al, 2008). d+R represents the degree of the relationship between factors, while d-R represents the degree of their effect. From the initial DEMATEL analysis, three factors with the highest d+R values are in decreasing mode: Quality system: 3.11, Economics of scale: 2.82 and Human resource orientation: 2.77. For a manufacturing industry, it is possible that customers from the target market have different choices of items, so it's

essential to manage the demand and quickly respond back to customer (Wu et al, 2011**)**. Quality system always plays a vital role in success of internal supply chain of manufacturing industry. Economics of scale in information system is required to cope up with this uncertain requirement, as it gives support to changing requirement of business function. The sum of rows d tells about the influence of particular factor over other internal supply chain benchmarking factor. Higher the value of sum of rows, higher shall be its influence on other factor.

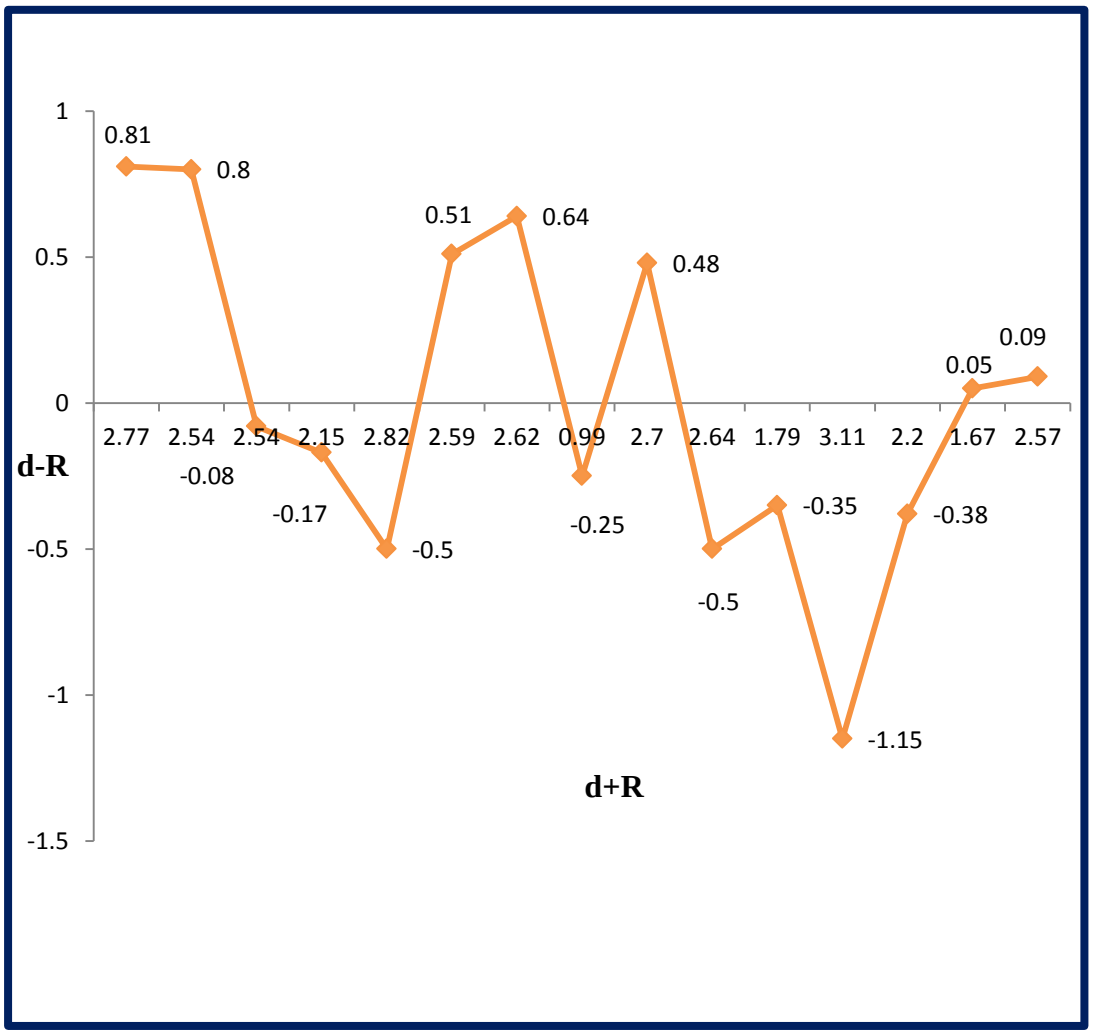

Figure 6.7 Causal Diagram

6.4.6 Factor Analysis Using DEMATEL Technique

Fifteen flexibility factors of benchmarking of ISCM were identified among which "quality system" the most important factor have highest (d + R) value of 3.11 as compare to other factors. DEMATEL technique, show the relationship amongst these

factors and the degree to which they affect to each other. The possible number of factors are classified into two group like cause group and effects group. The cause group consists of seven factors (“human resources orientation, inbound logistics, flexibility, logistics strategies, material follow up and procurement, foreign trade and service management, and transport reception custom decision”) while effects group consists eight factors (“operational logistics, outbound logistics, and economies of scale, new product development system, production operation process, production programming, quality system, and products delivery”).

CHAPTER VII

DEVELOPMENT OF A BENCHMARK FOR ANALYZING INDIAN MANUFACTURING INDUSTRIES

7.1 INTRODUCTION

This chapter focuses on development of benchmark to analyze Indian manufacturing industries on the basis of supplier selection criteria using analytical hierarchy model, comparative benchmarking using weightage score card (WSC), and competitiveness index (CI). Comparative benchmarking is done through comparison of factor between two heavy fabrication equipment manufacturing industries which is useful to develop a benchmark for analyzing selected Indian manufacturing industries.

7.2 ISCM BECNCHMARKING

Benchmarking practice is continuous process which improves the existing performance of ISCM by identifying and adapting the best practices and processes found inside and outside the manufacturing industries (Drozdowski, 1983; Bhagwat et al, 2007**)**. Manufacturing industries must be prepared to implement change in their existing system governing through benchmarking studies. The hallmark of best practice industry is a sequential approach for learning and continuous improvement in ISC of any Indian manufacturing industries (Saad et al, 2006**)**.

Benchmarking refers to a process of comparing operations and performance of agencies against recognized standards and improving those operations to enhance effectiveness. Today, industries are focused on their efforts to create best ISCM with their competitors. Boubekri, (2001) explained the importance of enterprise resource planning (ERP) of SCM. Emiliani, et al, (2001) discussed the terms and conditions for purchasing contracts and online action with advanced computerized versions of ERP. Spekman et al, (2002) discussed the complexity to establish supply chain in effective management system. The international business standards and industry leaders provide support to improve industrial performance based on benchmarking practice (Hoek, 2001). The present chapter discussed about the scope of benchmarking of ISCM in Indian manufacturing industries.

7.2.1 Methodology Used

Methodology used is as follows-

- Benchmarking and ISCM details are collected through literature review.
- The necessity of benchmarking in ISCM is identified through thorough study of selected Indian manufacturing industries.
- Develop an analytical hierarchy model through supplier selection rating.

7.2.2 Components of ISCM

The internal supply chain process consists of all activities between the sections from initial stage to final stage as shown in figure 7.1.

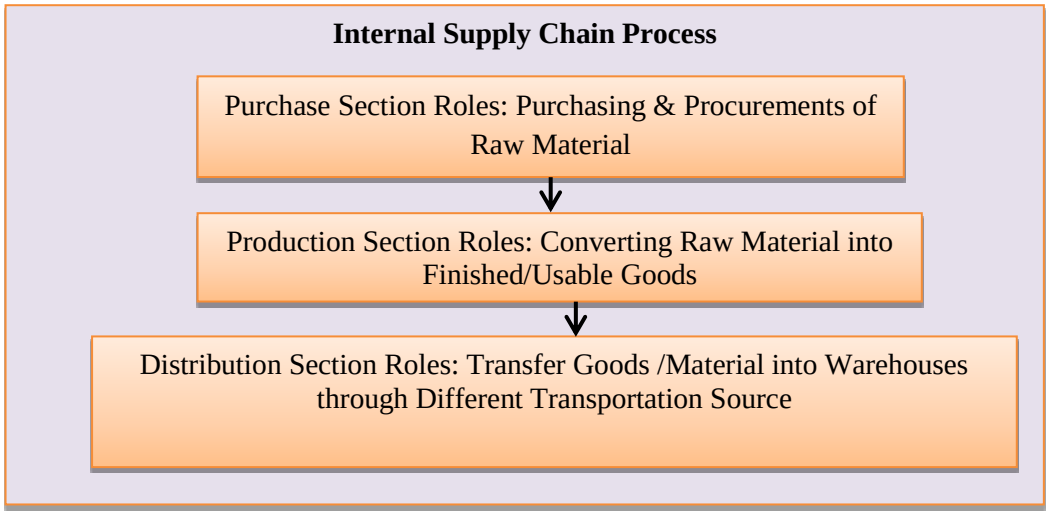

Figure 7.1 Flow Chart of ISCM Process of Indian Manufacturing Industries

An effective flow of raw material/fund/information from suppliers to customers or customers to suppliers is very important to maintain sustainability in internal supply chain of any manufacturing industry (Matzko et al, 1995). The main functions of each component of internal supply chain are discussed below:

- **Role of Purchase Section**

Purchase section controls all procedure related to materials used to develop a service or product in any manufacturing industry. Purchase management controls the activities related to purchase & procurement of raw material (Wang, 2000). Benchmarking of ISCM concept provides multiple benefits like: Shorter order cycle time, cost saving, reduced paper transaction, subsequent inventory reduction, rapid

transmission of purchase order related information, and supplier/buyer relationship through effective ISCM communication networks (Gunasekaran et al, 2004**)**. Purchase process re-engineering is related to the optimization of purchasing for maintenance and repair work (Croom et al, 2000). The development of online network is only for procurement of raw material. The difficulties of online purchasing of material have been identified by researchers (Min, 2009). Out of all, some of the major issues include size of plant, security concerns, global sourcing, contract laws and government regulations.

- **Role of Production Section**

Production manager controls all activities of production of parts/components/items between initial and final stage of production process. The production in any organization depends on the manufacturing processes and requirement of the operation process and market demand.

- **Role of Distribution Section**

This focuses on the distribution of finished materials for small units and its transformation into different warehouses through efficient, safe and effective transformation system. The efficient movement of products and their effective distribution to relevant customer is managed through proper coordination of inter firm divisions.

7.2.3 Issues of Benchmarking of ISCM

The performance gap of ISCM in Indian manufacturing industries increases the scope of benchmarking in the field of ISCM (Balm, 1996). Following are the major issues of benchmarking of ISCM:

- Duration of benchmarking exercise
- Partner selection
- Information system
- Human resources in benchmarking activities
- The decision makers are able to implement ISCM benchmarking exercise due to overall cost incurred
- Time frame must be fixed for conducting benchmarking of ISCM

7.2.4 Challenges for Indian Manufacturing Industries

With the implementation of technology and innovation in manufacturing industries, the identification of strategy followed by one's competitor is difficult for a businessman. Thus, benchmarking provides help to improve the ISCM performance of manufacturing industry against standards (Holloway et al, 1998).

7.2.5 Scope of Benchmarking of ISCM in Indian Manufacturing Industries

There exist diverse scopes of benchmarking of ISCM in Indian manufacturing industries (Le Sueur et al, 1997; Ulusoy et al, 2001; Foster, 1992; Richardson, 1992; Zairi et al, 2000). A multi-objective model for evaluation of information system for SCM has been proposed by (Cavenato, 1988; Talluri, 2000). Support of top managers and investors in obtaining latest tools and techniques is essential for successful implication of benchmarking of ISCM. In order to maintain the latest technology, information system plays the crucial role through right information and operation. Thus, there must be an alignment between operations strategy and IT strategy (Ho, 1996**)**. Therefore, benchmarking practice of ISCM would be helpful to maintain an effective ISCM system and physical distribution within industries. Most of the benchmarking and SCM work relate with different functional areas like: accounting, banking, benchmarking operations, business re-engineering, career & change management, core competencies, credit function, education, employee attitudes, environment, faculty management, finance, food and drinks industry, health and safety management, hotel services, human resources, information technology, logistics, manufacturing, marketing, operational performance, performance measurement, physician workforce, pre-project planning, preventive maintenance practices, product development, public sector, purchasing, research & development and retail distribution strategy, etc.

7.2.6 Supplier Selection Criteria

Supplier selection is a complicated process though it represents one of the most important processes for an effective inventory management. It requires evaluation of multiple criteria and various constraints associated with them. Supplier and distributor both are playing the significant role for enhancing supply chain performance. Therefore, a complete and structured methodology is proposed for analyzing critical success factors (CSFs) in SCM.

The supplier's capability and coordination play a significant role for better supply chain performance. Manufacturer expect better performance of suppliers along many directions not limited to competitive cost, minimum response time and low variability in response time, flexibility in terms of quantity as per demand in the market, superior quality and innovativeness. But when suppliers show inability to satisfy the expectation of manufacturer, then manufacturer has three possible options i.e. produce the outsourced items internally or change the supplier and go for better capable supplier or enhance the capability of existing supplier to a satisfactory level (Azadegan et al, 2010). The third possible option is known as supplier development (SD) which is only feasible and acceptable solution for manufacturer in most of the situations. As a result, many manufacturing industries put their time, effort and resource for developing the appropriate supplier to achieve right supply chain strategy. SD activities include assessing a supplier's operations, providing support and incentives to improve performance, fostering competition among the suppliers and working directly with suppliers, either through training or other activities and it requires both the supplier and local firm to commit financial, capital and personnel resources to work, share timely and sensitive information and generate an effective means for measuring performance (Kannan, et al, 2010). Many original equipment manufacturers (OEMs) such as Sony, Nissan, Toyota, IBM, Motorola, Visteon Corporation, John Deere, and HP have adopted SD approach in order to enhance the capability of the supplier and improve the supply chain performance. Most of the manufacturing firms organize the networks of manufacturing and distribution facilities that procure raw materials and transform them into intermediate and finished products and distribute the finished products to the customers (Bai et al, 2010). The simplest network consists of facilities which perform procurement, manufacturing and distribution. These networks are called value added chains or supply chains.

7.2.7 Customer Expectations

SCM is a cross-functional concept to manage the flow of goods toward the end-consumer in order to satisfy customer demand. The purpose of SCM is also to improve trust and collaboration among suppliers and customers, via improving inventory visibility. "SCM is the management of a network of interconnected companies involved in the ultimate provision of production, supply and distribution of products required by end customers". Following are the expectations of customers:

- Timely availability of product.
- Fewer prices.
- Good quality of product.
- More credit sales.
- Timings of retail outlets should be extended.
- Convenience/nearness of retail outlets.
- Good design, service, packing facility and response by retailers.

7.2.8 Integration of ISCM

ISCM emphasizes the integration of supply chain flow coordination in order to achieve business efficiency, cost reduction and supply chain systems integration to lay a good foundation. Generally, connectivity and willingness both are used by managers and academics to provide prescriptive direction where research and development (R & D) should be channeled to facilitate information integration success. This section provides the information of obstacles as well as benefits of successful implementation of integrated ISCM. The internal supply chain integration is defined as the integration from suppliers of raw materials to finished goods to end users as shown in figure 7.2.

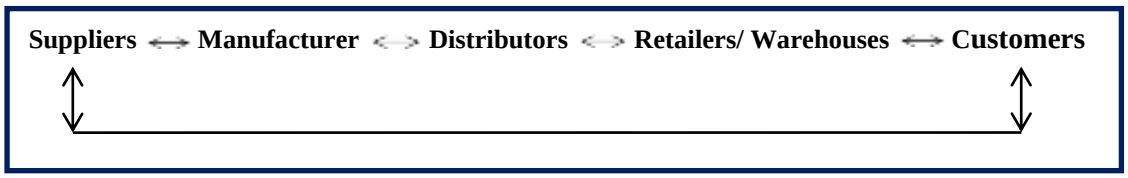

Figure 7.2 Integration of ISCM

The integrated ISCM includes outsourcing, manufacturing, distribution, inventory management, transportation, warehousing, customer service, unified coordination and restructuring, etc. Generally ISCM integration includes the followings:

- Integrated flow from raw material supply to product manufacturing and then product distribution.
- Integration of suppliers, manufacturers, distributors, retailers.
- Process integration of information flow, logistics, capital flow and management.
- Comprehensive integration of ISCM, manufacturing organization, management approach and technology.

7.2.9 Distribution Process

Distribution implies to the delivery of goods to the users in the most rational way. It occurs between every pair of stage in supply chain. Raw materials and components are moved from supplier to manufacturer, whereas finished products are moved from the manufacturer to end customer. Distribution in SCM refers to the transfer of a product from one industry to other sites (Anderson et al, 1984).

7.2.10 Role of Distributors

Optimization of manufacturing components distribution is done with the help of establishing a distribution firm, which directly buy the materials from the wholesaler, OEMs firms supply it up to the end customer. The business of distribution is to provide product to the consumer at the desired time, with appropriate quantities and good quality at reasonable prices. The nature of distribution is described for manufacturer in terms of producer, middleman and consumer.

7.2.11 Classification of Distribution

Distribution could be classified in different ways like: centralized distribution, decentralized distribution which is explained below:

(A) Centralized Distribution

Centralized distribution is specialized in distribution business and delivers goods to numbers of users as shown in figure 7.3.

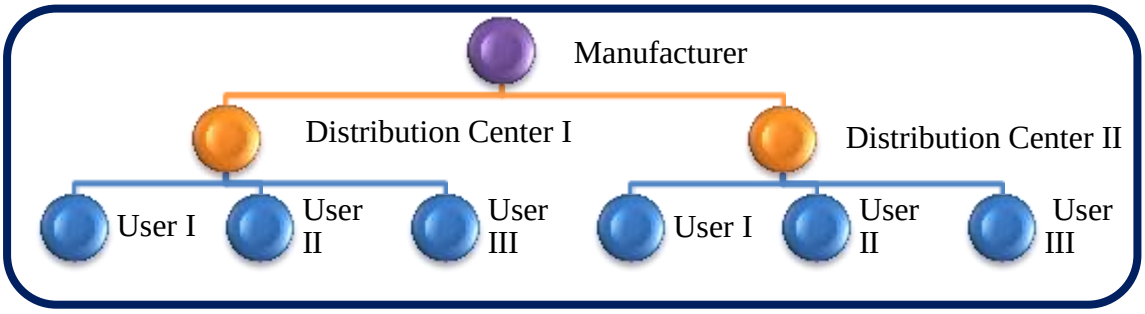

Figure 7.3 Centralized Distributions

Centralized distribution is economically beneficial because of large number of varieties and large quantities having following advantages:

- It reduces the organizational total inventory since it decreases the use of stock funds. The stock funds are quite high especially in the home appliance

retailers since the single items are of high value, off period is short and they can be used for a long time.

- Secondly, since the organization have no stock, except in the distribution centre, there is more area for sales and the operating costs can be reduced.
- Thirdly, it can lower the transportation cost. Centralized distribution could reduce the transportation from the warehouse to the stores.

(B) Decentralized Distribution

It is a kind of goods delivery business, especially for the small or sporadic amount of goods or temporary needs by commercial retail sales networks. Decentralized distribution center which is suitable for delivering goods with a wide variety and a small quantity for a short distance is shown in figure 7.4. The numbers of distribution centers will be set according to the geographical distribution of users. Decentralized distribution is characterized by low outbound and high inbound transportation cost. It is also characterized by high management cost, dispersed inventory, relatively short lead-time for users.

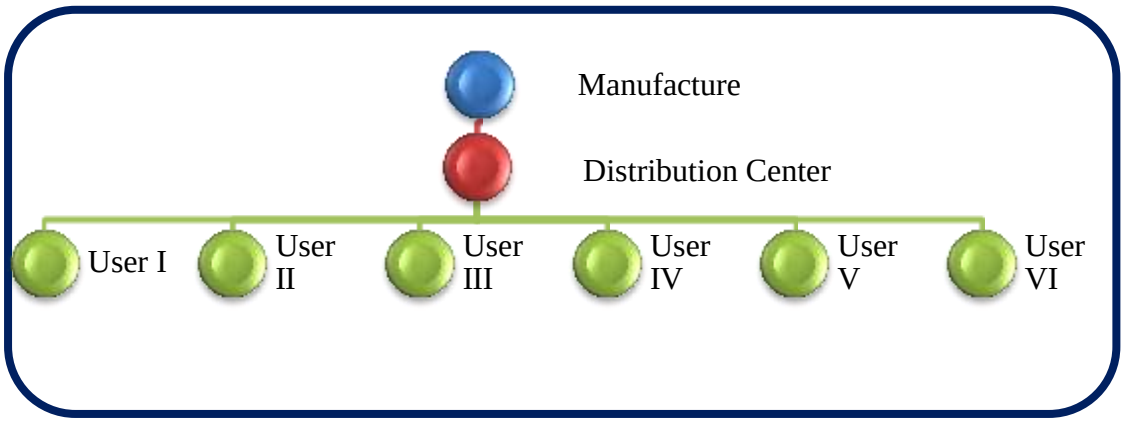

Figure 7.4 Decentralized Distributions

7.2.12 Duties of Delivery Persons

- Report for duty at the local distribution centre by 6:00 am
- Ensure that the location of customer address is known
- Deliver the coupons to the customers and collect the correct amount of money from the customer as specified in the customer bill
- Collect the daily salary from the designated representative and sign a daily duty register

7.2.13 Responsibilities of Customer

- They can place orders with “delivery at home” option and the desired date of delivery can be known
- The customer is expected to be aware that the order placed with delivery to home is correct and make the correct description of the order, to eliminate possibility of errors in order taking and end of delivery
- Customers will have to buy coupons to cover the customer bill

7.2.14 Structure of Hierarchical Model

The selection of supplier for manufacturing industry is acknowledged in first level. The second level defines the location, quality, quantity and trust. Third level contains different suppliers. The structure of analytical hierarchy model is as shown in figure 7.5.

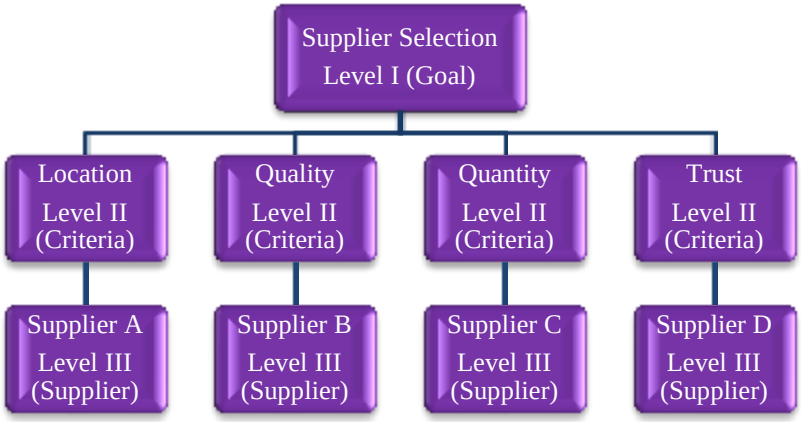

Figure 7.5 Analytical Hierarchy Model

7.2.15 Definite Criteria for Supplier Selection

The problem of supplier selection has been treated with questionnaire based study. A structured questionnaire was framed and all the criteria are rated by the professional of various fields (Bello, 2003). The supplier selection process consists of different criteria as shown in figure 7.6.

Figure 7.6 Supplier Selection Process

7.2.16 Supplier Rating

Eight criterion point were selected through literature in order to have supplier selection (Anbanandam et al, 2011) based on which the responses were collected and rating was done through 9 point scale i.e. from 1 to 9 as shown in table 7.1.

Table 7.1 Average Score of Criteria based on Experts

Criterion	Rating R(1)	Rating R(2)	Rating R(3)	Average
Location	9	7	9	8.33
Quality	7	9	8	8
Quantity	8	8	8	8
Trust	8	8	7	7.66
Price of Product	8	7	5	6.66
Goodwill of vendor	7	8	5	6.66
Environment Preference	8	6	3	5.66
Experience of Vendor	7	4	7	6

On the basis of experts, the average scores of criteria: location, quality, quantity, trust price of product, good will of vendor, environment preference and experience of supplier are 8.33, 8, 8, 7.66, 6.66, 6.66, 5.66, and 6 respectively. The selection of

supplier is based on those factors which has the highest score. Therefore, while selecting best supplier, factors like location of supplier, quality of product, quantity of product, trust are very important factors as compare to other factors.

7.3 WEIGHTED SCORE CARD FOR COMPARATIVE BENCHMARKING OF ISCM

Manufacturing industries are desperate to find different ways to improve flexibility and responsiveness (Gunasekaran et al, 2004; Stevens, 1989). Agha, (2008) used AHP approach for benchmarking and evaluation of training programs. The partner's selection is also an important step in benchmarking practice. Razmi et al, (2000) applied graphical technique for evaluation of benchmarking partners. The weight score card (WSC) of ISCM provides meaningful results for comparative benchmarking of all types of manufacturing organisations (Monkhouse, 1995). This section has following main objectives:

- Identification of PMIs through literature review. The different PMIs for comparative benchmarking of ISCM of manufacturing organizations are: financial performances, plan performance, source performance, make performance, delivery performance, sales performance and customer services & satisfaction (Singh et al, 2015).
- Develop weight score card for ISCM.
- Analyzing each PMIs using comparative bar charts.
- Validate PMIs by implementing comparative benchmarking for ISCM.

Shabani et al, (2012) "develop a linear pair model for selecting the best sales agents as a ''Benchmark'' in the presence of non-flexible factors and imprecise data under free disposability assumption". Bigliardi et al, (2014) proposed the metrics for supply chain performance indicators to develop a preliminary model and extended the pilot study by investigating the use of performance measurement metrics in a wider sample of companies through a questionnaire survey. Bindu et al, (2010) proposed fuzzy cross boundary performance evaluation approach for benchmarking of supply chain. Beamon, (1999) proposed "evaluation of the performance measures used in supply chain models and also presents a framework for the selection of performance measurement systems for manufacturing supply chains". Such types of factors may

affect ISCM performance of any manufacturing industry. The improvement of ISCM performance can be achieved by pursuing certain comparative benchmarking of ISCM (Sharif, 2002; Sharma et al, 2012).

7.3.1 Methodology Used

The weightage score card and comparison bar charts were used for comparative benchmarking of ISCM. The weightage of factors and sub factors was collected through questionnaire survey.

7.3.2 Analysis of Highly Competitive Heavy Fabrication Works Manufacturing Organizations

Sreejith, (2012) proposed hierarchical framework of barriers to green supply chain management (GSCM)in the construction sector. Wong et al, (2008) proposed work on benchmarking of supply chain performance measures. Jeffcoate et al, (2002) implemented benchmarking practice in the field of E-commerce in different small medium enterprise. Kumaret al, (2001) enhanced the effective benchmarking in manufacturing industries. Jajimoggala et al, (2011) proposed a hybrid model for ranking of competing suppliers overall performances using fuzzy ANP.

The comparative benchmarking analysis of organizations A and B was completed by weight score card. The evaluation of performance indicators of ISCM was done with the help of organization's performance assigned score points and its individual weightage. The weightage score card consists of individual score, weightage and weight score of each PMIs as shown in table 7.2.

Table 7.2 Weightage Score Card for Comparative Benchmarking of ISCM

S. No.	Performance Measurement Indicators	Strategy Objective	Performance Measures	Weightage	A	B	A	B	A	B
					Year 2013		Year 2014		Year 2015	
1.	Financial Performance (P1)	Profitable Growth	Turnover: Sales through Channels	0.6	1.2	1.8	1.2	1.8	1.2	1.8
			Funds Allocations	0.4	0.8	1.2	0.8	1.6	1.2	1.2
			Total score		2.0	3.0	2.0	3.4	2.4	3.0
			Weight score		1.04	1.56	1.04	1.72	1.2	1.56
2.	Plan	Reduce	Product	0.12	0.24	0.24	0.12	0.36	0.24	0.48

	Performance (P2)	delay	developed cycle time							
			Order entry methods	0.05	0.05	0.1	0.1	0.15	0.15	0.15
			Total cycle time	0.1	0.1	0.2	0.2	0.3	0.2	0.4
			Accuracy of forecasting techniques	0.13	0.13	0.39	0.26	0.52	0.39	0.52
			Range of product and service	0.07	0.14	0.21	0.21	0.28	0.28	0.28
			Total cash flow time	0.11	0.33	0.33	0.22	0.33	0.33	0.33
			Net profit verses productivity ratio	0.12	0.12	0.24	0.24	0.36	0.24	0.36
			Order lead time	0.08	0.16	0.24	0.24	0.24	0.24	0.32
			Information carrying cost	0.02	0.02	0.04	0.04	0.06	0.06	0.08
			Rate of return on investment	0.2	0.4	0.6	0.6	0.6	0.8	0.8
			Total score		1.7	2.6	2.2	3.2	2.9	3.7
			Weight score		0.2119	0.3243	0.2809	0.3878	0.3721	0.459
3.	Source Performance (P3)	Existence	Supplier interest in developing Partnerships	0.04	0	0	0	0	0	0
			Supplier cost saving initiatives	0.08	0.08	0.16	0.16	0.24	0.24	0.32
			Supplier delivery performances	0.18	0.36	0.54	0.36	0.54	0.54	0.54
			Supplier lead time against industry norms	0.12	0.12	0.24	0.24	0.36	0.48	0.48
			Supplier delivery pricing against market	0.14	0.28	0.42	0.28	0.42	0.42	0.56
			Supplier booking procedures	0.04	0.04	0.08	0.04	0.08	0.04	0.08
			Achievements of defects free delivery	0.15	0.30	0.30	0.30	0.60	0.45	0.60
			Mutual assistance in solving problems	0.09	0.18	0.27	0.36	0.36	0.36	0.36
			Mutual ability	0.05	0.05	0.05	0.05	0.1	0.1	0.1

			to respond quality problems							
			Purchase order cycle time	0.11	0.22	0.22	0.33	0.33	0.33	0.44
			Total score		1.6	2.3	2.1	3.0	3.0	3.5
			Weight score		0.2143	0.2968	0.2634	0.3853	0.3756	0.4378
4.	Make Performance (P4)	Facilities	Production Capacity	0.02	0.04	0.04	0.06	0.08	0.08	0.08
			% of Utilization - Under/ Over	0.01	0.01	0.02	0.02	0.03	0.03	0.03
			Theoretical and Actual flow/cycle time of Production	0.01	0.01	0.02	0.02	0.03	0.02	0.03
			% of Product Variety	0.02	0.04	0.06	0.06	0.06	0.06	0.06
			Idle time	0.02	0.04	0.04	0.06	0.06	0.06	0.08
			Average Production Batch Size	0.02	0.02	0.02	0.04	0.04	0.04	0.04
			Manufacturing cost	0.01	0.01	0.02	0.02	0.03	0.03	0.04
			Economic order quantity	0.03	0.03	0.06	0.03	0.06	0.03	0.06
			Effectiveness of master production schedule	0.02	0.02	0.04	0.02	0.04	0.02	0.04
			Capacity utilization	0.02	0.02	0.04	0.04	0.04	0.06	0.08
			Production/process cycle time	0.02	0.04	0.06	0.04	0.08	0.06	0.08
		Inventory Management	No. of Stock-keeping unit	0.02	0.02	0.04	0.04	0.04	0.04	0.06
			% of Inbounds and out bounds	0.02	0.02	0.04	0.02	0.04	0.04	0.04
			% level of service / Order fill rate	0.01	0.01	0.02	0.02	0.03	0.03	0.03
			% of Quality rejections	0.01	0.01	0.01	0.02	0.03	0.02	0.04
			% Average Safety Inventory	0.02	0.02	0.04	0.02	0.06	0.04	0.06
			% fraction of time out of stocks	0.02	0.02	0.02	0.02	0.02	0.04	0.02

			% of Seasonal Inventory	0.02	0.02	0.02	0.02	0.02	0.02	0.02
			Inventory level as scrap	0.01	0.02	0.01	0.02	0.01	0.02	0.02
			Inventory level as waste	0.02	0.08	0.06	0.06	0.04	0.04	0.02
			Inventory level as WIP	0.02	0.02	0.04	0.04	0.06	0.04	0.06
			Inventory level as finish goods	0.02	0.04	0.04	0.04	0.06	0.04	0.06
			Inventory level as incoming stock	0.02	0.04	0.06	0.06	0.06	0.08	0.08
			Inventory level as inventory in transit	0.02	0.02	0.02	0.02	0.02	0.02	0.04
		Transportation	No. of Vehicles operated	0.03	0.03	0.03	0.03	0.06	0.06	0.06
			% of Outbound Shipments	0.02	0	0	0	0	0	0
			Average Outbound Shipment Size	0.02	0	0	0	0	0	0
			% of Inbound Shipments	0.02	0	0	0	0	0	0
			% Average Inbound Shipment Size	0.02	0	0	0	0	0	0
			Fraction of Transportation Mode	0.02	0.02	0.04	0.02	0.04	0.02	0.04
			% on Timely Delivery	0.03	0.06	0.06	0.06	0.09	0.09	0.12
			% of Accidents	0.02	0.04	0.02	0.04	0.02	0.04	0.02
			Average km vehicles running full load and empty per day	0.03	0.06	0.03	0.03	0.03	0.03	0.03
		Warehouses	Number of Warehouses	0.03	0	0	0	0	0	0
			Average cost of warehousing per SKU	0.02	0	0	0	0	0	0
			Average carpet area covered	0.03	0	0	0	0	0	0
			Average time required to access per	0.03	0	0	0	0	0	0

			SKU							
			% of SKUs placed in automated shelves	0.03	0	0	0	0	0	0
			Average variable cost of material handling equipment	0.02	0	0	0	0	0	0
		Data Synchronization	No. of servers	0.02	0.02	0.04	0.02	0.04	0.02	0.04
			% of break downs of servers	0.03	0	0.03	0	0.03	0	0
			% of data damages	0.03	0	0	0	0	0	0
			% of data not accessed or least accessed	0.03	0	0	0	0	0	0
			% of internal & external complaints or data unavailability	0.03	0.06	0.12	0.03	0.09	0.06	0.06
			% of software inaccuracy	0.03	0	0.03	0	0.03	0	0
			% of inaccuracies in Invoices	0.03	0.06	0.12	0.03	0.09	0.06	0.06
			Total score		0.95	1.36	1.07	1.56	1.34	1.60
			Weight score		0.0217	0.0500008	0.0803116	0.0300008	0.0286	0.0325
5.	Delivery Performance (P5)	Customer Satisfaction	Deliver lead time	0.12	0.12	0.24	0.24	0.36	0.24	0.36
			Number of faultless delivery	0.11	0.22	0.33	0.33	0.33	0.33	0.44
			Effectiveness of deliveries invoice methods	0.12	0.24	0.36	0.24	0.36	0.36	0.48
			Information richness in carrying out delivery	0.11	0.11	0.33	0.22	0.33	0.22	0.33
			Response to number of urgent deliveries	0.11	0.11	0.22	0.22	0.33	0.33	0.44
			Total distribution	0.11	0.11	0.22	0.33	0.44	0.33	0.44

			cost							
			% of suppliers involvement in Aligning Co's SCM	0.11	0.22	0.44	0.33	0.22	0.22	0.44
			% of Supplier's contribution in R&D	0.11	0.11	0.22	0.11	0.33	0.22	0.33
			% of Suppliers involved in VMI	0.1	0.1	0.1	0.1	0.22	0.1	0.2
			Total score		1.25	2.46	2.12	2.92	2.35	3.46
			Weight score		0.15	0.2756	0.237	0.3262	0.2635	0.387
6.	Sales Performance (P6)	Company Growth	Sales forecasting	0.6	0.6	0.6	1.2	1.8	1.8	2.4
			Demand planning	0.4	0.4	0.8	0.4	1.3	0.4	1.6
			Total score		1.0	1.4	1.6	3.1	2.2	4.0
			Weight score		0.52	0.68	0.88	1.6	1.24	2.08
7.	Customer Service and Satisfaction (P7)	Market Share	Channels Market Share of Customer's purchase	0.2	0.2	0.6	0.6	0.6	0.6	0.8
		Customer Satisfaction	Flexibility to meet particular customer needs	0.2	0.4	0.6	0.8	0.8	0.8	0.8
			Customer satisfaction Index-(Survey)	0.2	0.2	0.4	0.4	0.6	0.5	0.8
			Number of Complaints	0.2	0.2	0.4	0.4	0.6	0.4	0.6
			Customer query time	0.1	0.1	0.2	0.4	0.4	0.3	0.4
			Percentage of Orders with complaints	0.1	0.1	0.2	0.2	0.3	0.2	0.2
			Total score		1.2	2.4	2.8	3.3	2.8	3.6
			Weight score		0.22	0.44	0.5	0.59	0.51	0.66

7.3.3 Comparative Benchmarking of ISCM

Kaplan et al, (2006) proposed a balance score card using which the weightage score card has been designed and develop for comparative benchmarking of ISCM and validated through expert's opinion as shown in table 7.3.

Table 7.3 Comparative Benchmarking of ISCM

S. No.	Performance Indicators	Strategy Objective	Weightage Score					
			Year 2013		Year 2014		Year 2015	
			A	B	A	B	A	B
1.	Financial Performance (P1)	Profitable Growth	1.04	1.56	1.04	1.72	1.2	1.56
2.	Plan Performance (P2)	Reduce delay	0.2119	0.3243	0.2809	0.3878	0.3721	0.459
3.	Source Performance (P3)	Existence	0.2143	0.2968	0.2634	0.3853	0.3756	0.4378
4.	Make Performance (P4)	Facilities	0.0217	0.050008	0.080316	0.030008	0.0286	0.0325
5.	Delivery Performance (P5)	Customer Satisfaction	0.15	0.2756	0.237	0.3262	0.2635	0.387
6.	Sales Performance (P6)	Company Growth	0.52	0.68	0.88	1.6	1.24	2.08
7.	Customer Service and Satisfaction (P7)	Market Share, Customer Satisfaction	0.22	0.44	0.5	0.59	0.51	0.66

7.3.4 Comparative Benchmarking Analysis using bar Charts

The comparison study of A and B organization is carried out by preparing bar charts to identify & compare the ISCM performance gap. This was helpful to find out the root cause for performance gap in A organization. The height of bar indicate the difference between PMIs of both competitors from year 2013 to 2015 as shown in figure 7.7. The weight scores of each PMIs of both manufacturing organisation A and B have shown in comparison bar charts. The performance of B is better than A for year 2013 and 2015 except production performance (P4) in 2014. This concludes that organisation B implemented best benchmarking practices and has better weight score of benchmarking for ISCM as compared to organisation A. While organization A act as a benchmark only in case of production performance (P4) in 2014. Therefore, organization A can identify the areas for improvement of ISCM with respect to organization B. Organization A need to improve in areas of financial performance, plan performance, source performance, delivery performance, sales performances, customer service and satisfaction.

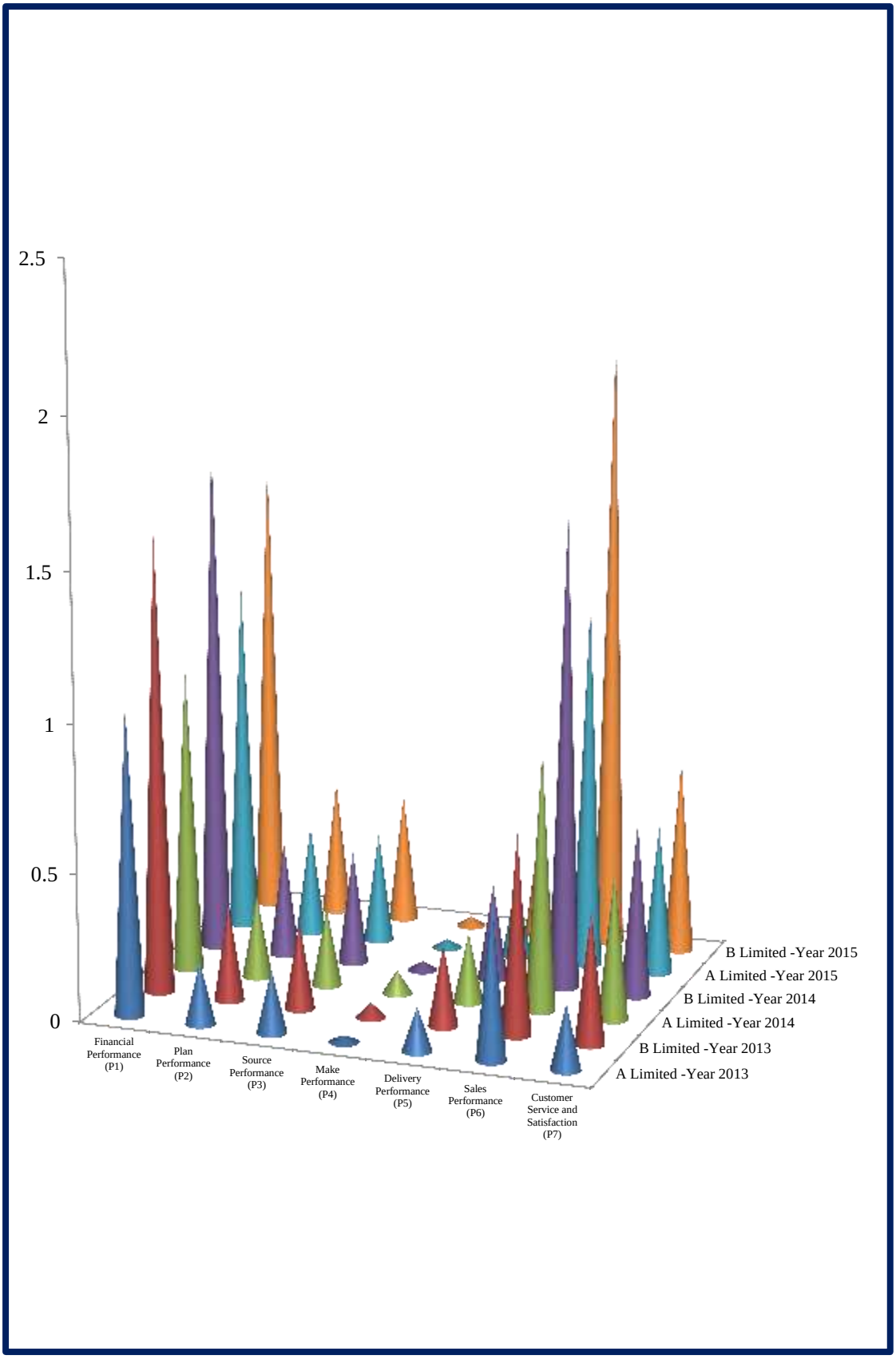

Figure 7.7 Comparative Analysis of A and B Organizations

7.4 DEVELOPMENT OF A BENCHMARK TO ANALYZE INDIAN MANUFACTURING INDUSTRIES BASED ON COMPETITIVENESS INDEX

The development of benchmark practice using competitiveness index (CI) is a continuous progressive way of analyzing Indian manufacturing industries. Various performance measures have been reviewed for manufacturing industries from P1 to P7. These performance parameters continuously affect the benchmark using CI of Indian manufacturing industries. Therefore, the development of a benchmark using CI to analyze Indian manufacturing industries has been carried out through a questionnaire based study to collect expert's opinion.

7.4.1 Scenario of Manufacturing Industries

Rapid industrialization and urbanization has changed the demands of customer for best quality, faster delivery at lower cost in both manufacturing and service sector. This lead to adoption of new tools and techniques used to analyze the performance of manufacturing industries. Benchmarking is key business technique employed by industries to analyze their performance (Eccles, 1991). However, there is significant information available on implementing benchmarking in manufacturing industries. The effective implementation of benchmarking technique will lead to greater opportunities for manufacturing industries to analyze their performance as well as achieve economic sustainability (Ahmed et al, 1999).

As per the latest estimates, MSE sector accounts for about 39 % of the manufacturing output and 33% of the national exports of the country. With a focus to review the competitiveness as well as its contribution to GDP; the national manufacturing competitiveness programme (NMCP) a nodal programme of the Government of India was initiated in 2007-2008 to develop global competitiveness among Indian manufacturing industries (Gunasekaran et al, 2011). There are ten components under the NMCP targeted at enhancing the entire value chain of the MSME sector. Even after implementing the schemes of NMCP, MSME could not attain competitiveness on stand-alone base (Matzko et al, 1995).

7.4.2 Need of Benchmark

In this study, performance measures of benchmarking were used in the evaluation of CI as shown in figure 7.8. The values of CI act as a benchmark for analysis of any manufacturing industries (Lewis et al, 1985**)**. The major advantage of benchmark is

that it helps in identification of weakest area of performance measures in ISCM of any manufacturing industries.

Figure 7.8 Performance Measures of Benchmark to Analyze Indian Manufacturing Industries

7.4.3 Manufacturing Industry Profile

ABC limited is a heavy fabrication manufacturing industry located in district Faridabad, Haryana. The turnover of ABC limited manufacturing industry is 30 crores. It manufactures wide range of construction equipment's like cranes, vibrating compactors or road rollers and heavy fabricating structures for cement plant, etc. In this industry, different grades of mild steel sheets as a raw material are used for heavy fabricated structures and construction equipment manufacturing industries.

7.4.4 Development of a Benchmark Using Competitiveness Index to Analyze Indian Manufacturing Industries

Cleveland et al, (1989) developed a framework for calculating the competitiveness index (CI = Sum [Wi Log Ki]) of manufacturing industries. CI was used to develop a benchmark and to analyze the performance of Indian manufacturing industries. Mean score of each performance measures with their rank has been calculated on the basis

of questionnaire survey. After this rank, inverse rank and weight for each performance measures is determined. To identify the opinion of industrial experts, research study used five point likert scales, i.e. for each of the issues of CI a weightage is assigned. The criteria for weight (W_i) are as under:

W_i = +1 (strength) when percentages score > 60% (mean value> 3)

= 0 (neutral) when percentage score is between 40% - 60% (2<mean value <3)

= -1 (weakness) when percentage score < 40% (mean value < 2)

To assign rank, the mean score of each performance measures is determined and assign rank 1 for maximum mean score value 16.16 and last rank 7 for minimum mean score value 8.65. Now calculate inverse rank (K_i) and then sum of entries of last column (W_i Log K_i) will give CI i.e., 2.02 as shown in table 7.4.

Table 7.4 Evaluation of benchmark based on CI to Analyze ABC Limited

S. No.	Performance perspectives and its measures	Total Mean	Rank	Inverse rank (K_i)	Log K_i	Weight (W_i)	W_i*logK_i
1	Financial Performance (P1)	16	2	6	0.78	+1	+.0.78
2	Plan Performance (P2)	15.9	3	5	0.70	+1	+0.70
3	Source Performance (P3)	13.7	5	3	0.48	0	0.00
4	Make Performance (P4)	8.65	7	1	0.00	-1	0.00
5	Delivery Performance (P5)	14.5	4	4	0.60	0	0
6	Sales Performance (P6)	13	6	2	0.30	-1	-0.30
7	Customer Service & Satisfaction (P7)	16.16	1	7	0.84	+1	+0.84
Benchmark based on CI of performance measures to analyze ABC limited = 2.02							

7.4.5 Analysis

The calculated value of benchmark, based on CI to analyze ABC limited, is 2.02. While theoretically, CI value may range between –3.70 to +3.70. The value of CI is very less as compare to theoretical value of CI. In other words, the calculated value of CI lies between the theoretical ranges. So chances are more to improve those weak performance measures whose scores are less. Thus, CI value of ABC limited can act as a benchmark for its competitors. However, any type of manufacturing industries can use this benchmark based on CI to identify the weak performance measure of supply chain and also analyze performance of manufacturing industries.

CHAPTER VIII
DEVELOPMENT OF BENCHMARKING FRAMEWORK FOR INTERNAL SUPPLY CHAIN MANAGEMENT IN MANUFACTURING ORGANIZATIONS

8.1 INTRODUCTION

In order to implement SCM internally and externally the main focus is on assessing the relationships between team members, flow of materials, information and funds. The interrelationship between the functional elements of ISCM and ESCM from suppliers (S1, S2, S3, etc) to customers (C1, C2, C3, etc) through production, sales, distribution, warehouses and retailor (Walden, 2009) as shown in figure 8.1.

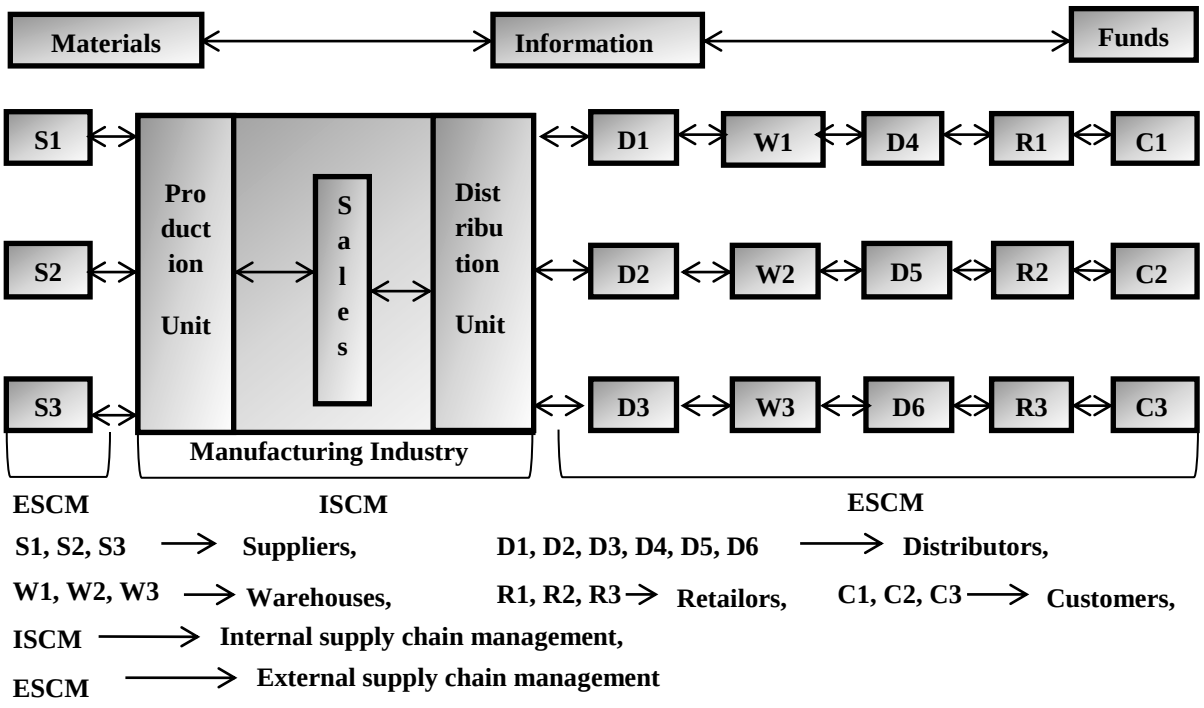

Figure 8.1 Supply Chain of Manufacturing Industries

8.2 HISTORY RELATED TO BENCHMARKING FRAMEWORK

Banduka et al, (2016) proposed an integrated lean approach to process failure mode effects analysis (PFMEA) for solving explicit shortcomings. Dubey et al, (2015) has investigated "the relationship between leadership, supplier relationship management

(SRM), total quality management (TQM) and environmental performance in green supply chain (GSC)". Gunasekarana et al, (2005) proposed framework to formulate strategies to build order SCM. Ocampo, (2015) presents a preliminary framework for computing a sustainable manufacturing index using AHP technique. Konig et al, (2016) proposed "a conceptual risk management framework, showing the effect of logistics outsourcing on the supply chain vulnerability (SCV) of shippers".

Gunasekaran et al, (2008) proposed an integrated framework for responsive supply chain to customization of product/service based on analyzing agile manufacturing and SCM. Omega et al, (2016) proposes a supply driven inoperability input-output model (SIIM) in analyzing risks of manufacturing systems. Stewart, (1997) used the score reference model that allows industry to compare their processes to other competitors, benchmark themselves and compare their own practices to demonstrate best practices. Gunasekarana et al, (2004) developed a framework to promote a better understanding of importance of SCM performance measurement and metrics. Matook et al, (2009) emphasized on supplier progress using benchmarking approach and dealer risk management framework. The best practice of constructive conceptual framing would be helpful for improving the performance of internal supply chain within industry. Yet, no benchmarking framework for ISCM came across during research work. However, benchmarking framework for ISCM will be helpful in gaining an insight into the performance gap of manufacturing organization. This framework might be required to meet the demand of customers as well as achieving better existence of manufacturing organization in the present scenario of competitive environment.

8.3 METHODOLOGY USED

Based on above findings a conceptual benchmarking framework for ISCM has been developed through literature review and brainstorming with industrial and academic experts. The validation work has been done by experts, advisors, supervisors of selected Indian manufacturing industries.

8.4 THEORETICAL BENCHMARKING FRAMEWORK FOR ISCM IN MANUFACTURING ORGANIZATION

Marchesini et al, (2016) "proposed a set of logistics activities for each key supply chain business process of the global supply chain forum (GSCF) model and a

conceptual framework to guide their implementation". Tan, (2001) discussed an integrated framework of purchasing and logistics functions of various SCM strategies to achieve a common goal of manufacturing industry by reducing waste while emphasizing on management processes like source, make, plan, sale, deliver, customer service and return. ISCM of manufacturing industries is changeable depending on manufacturing process of product, management policies, etc. Gunasekaran et al, (2003) proposed a framework for the organisation to develop its logistics operations.

Kalkar et al, (2010) proposed strategic conclusion concerning with ISCM i.e. production facilities, distribution centers, number and location of suppliers, warehouses and customers, etc. The developed benchmarking framework is used to analyze performance parameters of ISCM within manufacturing industry. The benchmarking framework for ISCM has performance parameters i.e. financial performance, plan performance, source performance, make performance, delivery performance, sales performance, customer service & satisfaction etc. Kim et al, (2012) "determine the distinguishing characteristics of factors that affect the successful adoption of ubiquitous computing technology (UCT) in SCM in different settings". Similarly this research work have come across various tools and techniques of ISCM like: reducing inventory level, reducing internal processing cost, reducing idle time between activities, reduces the breakdown of machines, by well-defined information flow, delivery flow without delay, effective distribution network with less transportation cost and safe delivery of product, etc. The most critical issues of ISCM are idle time of activities, length of inventory level and existing internal processing cost of manufacturing products.

The performance of internal supply perspectives from source-make-deliver-sale department of manufacturing industry is shown in figure 8.2. If clientele are not pleased by sales and services of the organization providing product, then benchmarking framework is supports for identifying and analyzing the weakest link of ISCM within organization. It is utilized by functional benchmarking team of manufacturing industries to discover the performance gap and performing comparative analysis between performance parameters. This benchmarking framework acts as a benchmarking platform for Indian manufacturing industry.

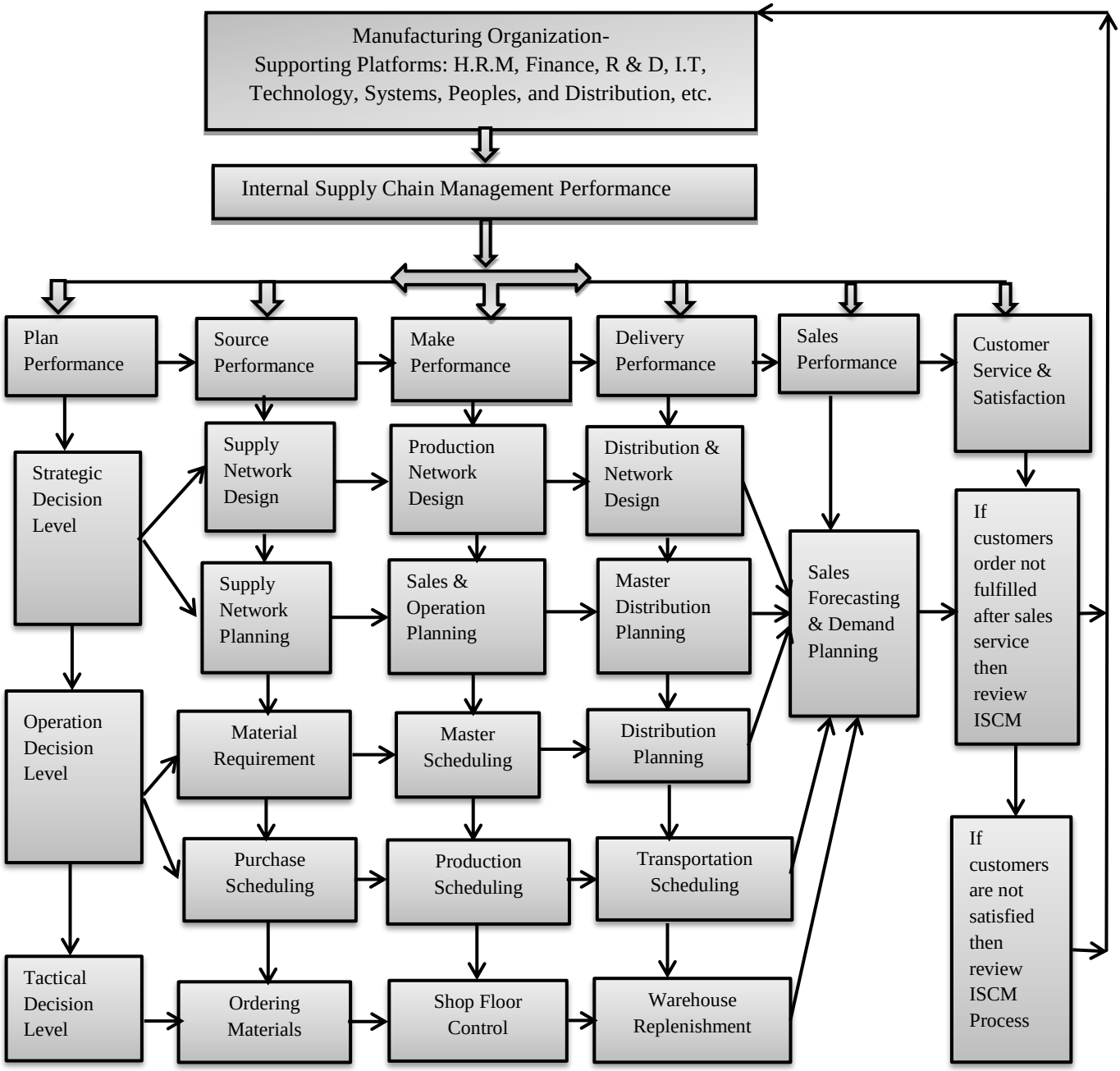

Figure 8.2 Theoretical Benchmarking framework for ISCM in Manufacturing Organization

8.5 FUNCTIONAL ACTIVITY OF THEORETICAL BENCHMARKING FRAMEWORK FOR ISCM

Thomas et al, (2013) proposed a partition based framework to support multiple tasks related to building regression models for quantifying relationships. Benchmarking framework may be used to analyze the performance parameters of internal supply chain in manufacturing industry (Paul et al, 2013). The flow chart depicting functional activity is used to understand the working steps of benchmarking framework as shown in figure 8.3.

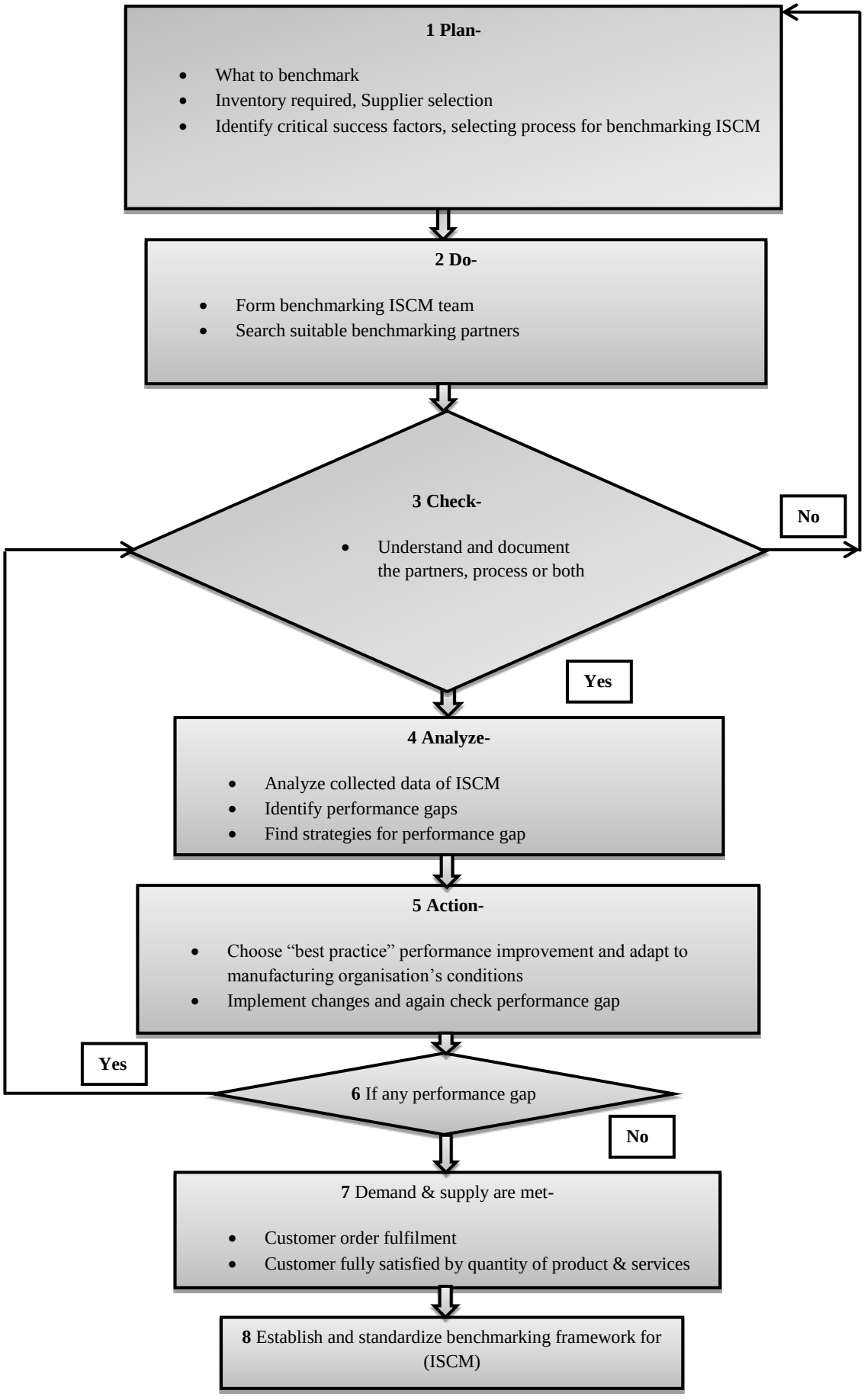

Figure 8.3 Flow Chart of Benchmarking Framework for ISCM

It is used to identify performance gap between functional activities of internal supply chain in manufacturing industry. This gap can be helpful in examining the root cause of problems of ISCM in the manufacturing firm. The members of benchmarking team are selected either from within or outside the organization. A benchmarking flow chart consists of different activity of benchmarking framework as mentioned below:

1. Functional activities of benchmarking are analyzed like: buying, making, movement, warehouse inventory, distribution, etc. from supplier's to customers.
2. Review decision making activity at planning, operation and tactical level.
3. Identify factors and functional activity responsible for ISCM in the organization.
4. Identify the gap in factors, sub factors and functional activities of manufacturing organization.
5. Implementing tool and techniques to conquer the gap for enhanced ISCM.

8.6 A CASE STUDY – IMPLEMENTATION OF BENCHMARKING FRAMEWORK FOR ISCM

The rapid changes in customers demand can create challenges and competition among Indian manufacturing industries. Therefore, benchmarking is a tool to optimize such condition in any organization. The benchmarking framework was implemented and final effective results were analyzed for X limited and Y limited (both X limited and Y limited are Indian manufacturing competitors which are situated in Faridabad, Haryana, with same manufacturing products: road rollers, mainframes, booms, crane cabin for Escorts Construction Equipment Limited (ECEL), heavy fabricating structures for crusher zone and cement plants). The turnover of X limited and Y limited are rupees 30 crores and rupees 45 crores. The customers of X limited and Y limited are ECEL, Metso mineral, Metso bawal, etc. After implementing this framework it was found that there exist some gap between internal supply chain performance parameters of X limited and Y limited. The idle time of inventory level for X and Y limited, at different stages is calculated in terms of hours as shown in table 8.1.

Table 8.1 Idle Time of Inventory in X Limited and Y Limited

S. No.	Stage	X limited Idle time (hours)	Y limited Idle time (hours)
a)	Local /Group/Company/Overseas supplier side inventory	10 days*24 hours=240 hours	6 days *24 hours =144 hours
b)	At factory gate inventory waiting time	2 days *24 hours =48 hours	2-4 hours
c)	Inventory waiting time in incoming quality control (IQC) department	1 day *24 hours =24 hours	6-8 hours
d)	Inventory waiting time in factory stores	10 days *24 hours = 240 hours	3 days *24 hours = 72 hours
e)	Inventory waiting time in Production line	2 days*24 hours =48 hours	1 days *24 hours =24 hours
f)	Inventory waiting time for items in outgoing quality control (OQC) department	1 days *24 hours = 24 hours	6-8 hours
g)	Inventory waiting time of finished goods in OEM's store	3 days *24 hours =72 hours	2 days *24 hours = 48 hours
h)	Inventory waiting time in warehouses	3 days *24 hours =72 hours	2 days *24 hours = 48 hours

When customers received the product from X limited and Y limited separately then they found that there exist a gap between performance of internal supply chain of X limited and Y limited with respect to their delivery time as per order. Therefore, a comparative analysis of internal supply chains of both X limited and Y limited through length of inventory in days from year 2011 to 2015 is carried out. The average consumption of raw material and the average production cost from year 2011 to year 2015 is 1200 and 8000, respectively. The number of days of raw material inventory, WIP inventory and finished goods inventory is calculated using equation no. 1, 2 and 3, respectively. The total length of internal supply chain is calculated by adding up the days of raw materials inventory, days of WIP inventory and days of finished goods inventory as shown in table 8.2.

- Days of raw material inventory = Average stock of raw material * 365 / Average cost of raw material consumption per day---------- (1)
- Days of WIP inventory = Average stock of semi-finished goods * 365 / Average cost of production per day---------- (2)
- Days of Finished Goods inventory = Average stock of finished goods * 365 / Average cost of goods sales per day---------- (3)
- Total length of internal supply chain in days = Days of raw material inventory (1) + Days of WIP inventory(2) + Days of finished goods inventory (3)

Table 8.2 Total Length of Internal Supply Chain

	X limited		Y limited		X limited		Y limited		X limited		Y limited		Total Length of Supply Chain	
Year	Average Stock of Raw Material	Days of Raw Material Inventory	Average Stock of Raw Mteri al	Days of Raw Material Inventory	Average Stock of WIP	Days of (WIP) Inventory	Average Stock of WIP	Days of (WIP) Inventory	Average Stock of Finished Material	Days of Finished Inventi on	Average Stock of Finished Material	Days of Finished Inventi on	X Ltd	Y Ltd
2011	238.32	72.49	180.164	54.8	134.795	6.15	130.411	5.95	478.904	21.85	430.247	19.63	100.49	80.38
2012	271.2	82.49	159.353	48.47	146.411	6.68	139.178	6.35	488.11	22.27	400	18.25	111.44	73.07
2013	222.73	67.75	139.595	42.46	232.548	10.61	195.507	8.92	374.795	17.10	287.123	13.1	95.46	64.48
2014	226.88	69.01	157.085	47.78	248.329	11.33	167.014	7.62	508.055	23.18	411.178	18.76	103.52	74.16
2015	239.80	72.94	159.058	48.38	190.466	8.69	158.027	7.21	462.466	21.1	382.027	17.43	102.73	73.02

Table 8.2 shows that "Y limited" have less length of internal supply chain as compare to the length of internal supply chain of "X limited". Therefore, Y limited, manufacturing industry is doing better practice of benchmarking framework for ISCM as compared to X limited. Y limited has fewer days of (raw material, WIP and finished goods inventory) as compared to its manufacturing competitor X limited as depicted in figure 8.4.

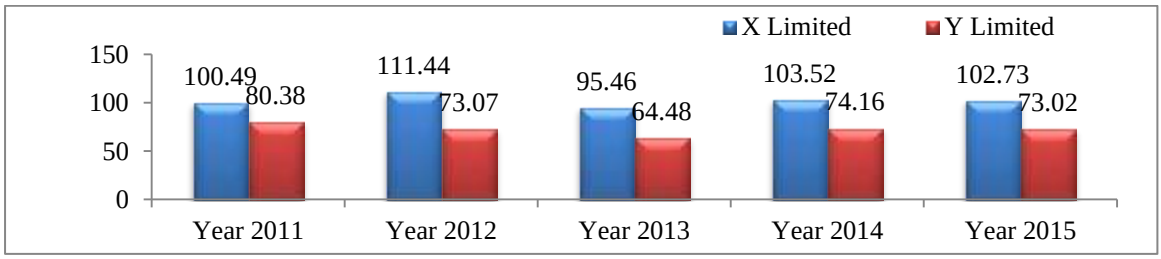

Figure 8.4 Comparison Bar Chart of Inventory Level

8.7 ANALYSIS

In X limited, the total length of inventory (days) from year 2011 to 2015, are 100.49, 11.44, 95.46, 103.52 and 102.73, respectively, while in Y limited, the total length of inventory (days) are 80.38, 73.07, 64.48, 74.16 and 73.02, respectively (table 8.2). The inventory carrying cost of X limited is high as compare to Y limited. So, the performance measures of Y limited act as a benchmark for performance measures of X limited as well as others competitors. In the same way, any manufacturing industry can identify the gap between performance parameters by implementing benchmarking framework.

CHAPTER IX

OPTIMIZE RETURN ON INVESTMENT TAKING CASES OF INDIAN MANUFACTURING INDUSTRIES

9.1 INTRODUCTION

Ample of literature is available on benchmarking, framework, SCM and ROI, however, the available literature on benchmarking of ISCM is not sufficient. ROI has been calculated while implementing benchmarking framework. The case study of two competitive manufacturing industries are used to understand the concept of ROI and optimization of ROI by taking corrective and preventive measures about ISCM problems. The objective of this research work is to identify ISCM performance gap then optimize ROI of existing performance of manufacturer by applications of ISCM.

9.2 VALUE CREATING ELEMENTS OF ISCM

Indian manufacturing industries are working under a competitive business environment which requires a regular re-check of ISCM constituents and the complete process of material/information/fund flow within industry. The practice of benchmarking provides the opportunities to improve the performance of ISCM of Indian manufacturing industries. ISCM includes effective passing of information from one to other till it reaches the final receiver. ISCM is a team of top level management at strategic level who control the flow of products, information and funds within manufacturing industry.

The objective of ISCM is to provide the right product to right customer on right time at low cost (Gilaninia et al, 2013). A well-managed ISCM provides high customer satisfaction as well as develop the performance of industry. ISCM of manufacturing industries has some value creator i.e. production, sales and distribution as shown in figure 9.1.

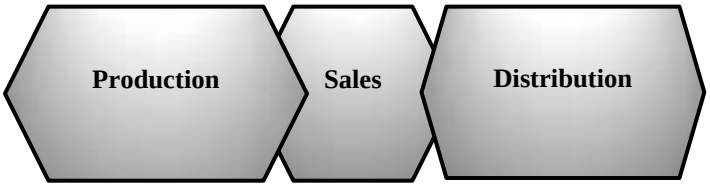

Figure 9.1 Value creating activities of ISCM

Proper coordination of various functional elements assists the industry to improve its own internal supply chain process (Flynn et al, 2010). Stewart (1997) utilized supply chain operations reference (SCOR) model to evaluate and develop the enterprise. Supply chain is a systematic and strategic coordination of flows within and across the organization. Sherah et al, (2014) projected a sustainable SCM framework making industries to appreciate their existing sustainable SCM maturity level, thus establishing an appropriate strategy to develop the maturity level. SCM is the team that lay focus on activities which involve transferring materials, funds and information from the supplier to customer end. It also includes supplier, manufacturer, retailors, warehouses, distributors and customers. Gunasekaran et al, (2007) used a case study of e-logistics to illustrate the role of information technology (IT) on the performance of logistics. Simatupang et al, (2003) emphasizes the use of benchmarking scheme to inspect the present status of supply chain association among the members and recognize performance gaps to regulate improvement. This can be achieved by following certain practices called the best practices benchmarking.

The aim of SCM is to reduce cost, improving customer satisfaction and gaining competitive advantage for companies. "SCM is the network of facilities to perform set of operations from procuring raw material, transforming the raw material into finished goods, storing them, distribution to the final customers and quality services through a team work of internal staff and external partners like suppliers, supplier's suppliers and distribution channel members" (Beamon, 1999). Kim et al, (2016) analyzes the efficiency of supply chain quality management (SCQM) by grouping buyers and suppliers and conducting an empirical analysis of aspects affecting SCQM efficiency from the supplier's perspective. Ocampo et al, (2015) adopted a fuzzy analytic network process approach to develop a sustainable manufacturing strategy under the influence of stakeholder's interests. Supply chain (SC) is a management viewpoint that recognizes and eradicates delay from the manufacturing system. SC is a complex network of business entities involved in the upstream and downstream flows of products and services, along with the related finances and information. Yinan et al, (2014) proposed the supply chain planning and corporation coordination mediating the relationship between organizational flatness and mass customization capability. The fundamental principle for survival of manufacturing industries is not to maximize the profit but also to avoid harmful loss.

9.3 METHODOLOGY USED

Implementation of conceptual benchmarking framework for ISCM has resulted in identification of performance gap. Further, it has been used to evaluate ROI & optimize ROI of selected Indian manufacturing industries.

9.4 A CASE STUDY – IMPLEMENTATION OF BENCHMARKING FRAMEWORK FOR ISCM

Market survey reveals that customers are not satisfied with cost of the product and its delivery time. The rapid changes in customers demand can also create challenges and competition in front of selected Indian manufacturing industries. The developed framework has been implemented in X limited and Y limited for evaluating the effective results which shows gap between ISCM performance parameters of X limited and Y limited. Various types of ISCM problems which are responsible for delay of internal supply chain in X limited are shown in table 9.1. The existing problems in X limited are responsible for the delayed performance of ISCM and thus affecting its ROI. Some corrective measures have been taken for ISCM performance which will be beneficial for X limited and others competitors.

Data Analysis

The relative performance of X limited and Y limited in sale, market share and its ISC depends primarily on its strategic decisions as well as finance, make, source, delivery, sale and customer services & satisfaction. Tipu et al, (2014) proposed a comparative study of small middle enterprises on the basis of supply chain strategy, flexibility and performance relationships in Canada and Pakistan. Mahour et al, (2014) have investigated the effectiveness of logistics and supply chain integration on firm competitiveness in manufacturing firms. Spillan et al, (2013) proposed "empirically comparison between logistics strategies in Chinese and US manufacturing firms". The internal supply chain would effectively make profit to the organization, either through effective distribution network or through economic transactions and defined information flow (Singh et al, 2015). Manufacturing industries usually, are aware of different manufacturing processes and latest technologies, but for being more profitable they focus on processing time of internal activities and their manufacturing process. ISCM can easily identify the actual time for completion of activity from initial stage of raw material to final stage of finished goods.

Table 9.1 X Limited - ISCM Problems, Root Cause, Corrective Measures and Its Effects

S. No.	ISCM Problems	Root Cause	Corrective Measure Action	Its Effects
1.	Leakage and testing time is 180 minute/item	Not easy to rotate manually due to Heavy weight of item	Use of rotating fixture	Leakage and testing time is 150 minute/item
2.	Loading and setting time is 40 minute/item	No clamping and locating devices	Use of special purpose C clamp and four supporting pad on lathe machine	Loading and setting time is 30 minute/item
3.	Thread cutting time is 240 minute/item	Manual thread cutting process	Use of thread cutting Jig	Thread cutting time is 180 minute/item
4.	Items are not available on time	Lack of item coding in store	Implement 5S and proper coding of each item	Searching time of items should be reduced
5.	WIP inventory waiting time is 30 minute/item-50 minute/item	Improper functioning of dial of MIG welding machines.	Dials replacement of MIG welding machines	Reduced WIP inventory waiting time is 10 minute /item - 30 minute/item
6.	WIP inventory waiting time is 180 minute /item-240 minute/item	Improper functioning of conventional rolling machine	In house rolling should be done on CNC rolling machine	WIP inventory waiting time is 60 minute/item, Reduced rolling cost up to rupees 4000/item - rupees 6000/item, Reduced transportation cost up to rupees 2000- rupees 3000, Reduced labor cost up to rupees 2000/item, Reduced idle time
7.	Idle time is 240-360 minute between activities	Random plant layout	Implementation of line layout	Idle time is 120 minute between activities

The performance parameters of ISCM depend upon the idle time between activities. In X limited the total idle time between activities was 1010 minutes due to internal supply chain problems. Thus, the root cause of ISCM problems were identified and corrective measure were taken which reduces the idle time from 1010 to 560 minutes. The X limited has save 450 minutes of existing idle time. Saving idle time can be utilized to increase the production of manufacturing items that also reducing the existing manufacturing cost of items. Y limited has implemented the tool and techniques of ISCM practices earlier. The Y limited having the idle time between

the activities is 240 minutes. So, there exists less scope of further improvement in performance parameters of ISCM. Thus, the performance parameters of Y limited acts a benchmark for its competitor i.e. X limited. The performance analysis of X limited and Y limited is shown in table 9.2.

Table 9.2 Comparative Performance Parameter Analysis of X Limited and Y Limited

		X Limited		Y limited
S. No.	**Particular Description**	**Before ISCM**	**After ISCM**	**Already using ISCM**
a)	i. Capital invested (Own capital) in rupees	4,00,00,000	3,00,00,000	5,00,00,000
	ii. Capital invested (Borrowed funds) in rupees	10,00,00,000	11,50,00,000	12,00,00,000
b)	Sales in rupees	30,00,00,000	33,60,00,000	45,00,00,000
c)	Growth in sales (%)	8%	12%	15%
d)	Profit before tax & investment in rupees	16,00,00,000	19,10,00,000	28,00,00,000
e)	Profit after tax & investment in rupees	14,08,00,000	16,80,80,000	24,64,00000
f)	Fixed assets in rupees	4,00,00,000	4,00,00,000	7,00,00,000
g)	Total assets in rupees	14,00,00,000	14,50,00,000	17,00,00,000
h)	Idle time between activities	1010 minute	560 minute	240 minute
i)	Number of items manufactured	26-28	30-32	36-40
j)	ROI = Profit before tax/Cost of investment	1.14286	1.31724	1.647

9.5 COMPARATIVE ANALYSIS

The idle time between activities in X limited was 1010 minutes. But after implementation of corrective measure action of ISCM, idle time between activities was reduced to 560 minutes. Therefore, 450 minutes of idle time was further used to increase the production from (26-28) numbers to (30-32) numbers of manufacturing items. The existing cost of product was also reduced in the form of rolling cost, transportation cost and labor cost as shown in table 9.1. The existing idle time between the activities can be reduced by benchmarking practice of ISCM tools and techniques. The ROI can be calculated by dividing profit before tax to cost of investment. The calculated ROI of X limited was 1.31724, which is optimizing ROI

as compare to existing ROI i.e. 1.14286. There exists a gap between ROI before and after implementation of corrective measure action related to ISCM. The calculated ROI of Y limited is 1.647, which is more than ROI of X limited as shown in figure 9.2. Therefore, ROI of Y limited act as benchmark for X limited. By the applications of benchmarking practice of ISCM tool and techniques, performance gap due to idle time may be reduced which are further used to optimize the existing ROI of manufacturing industry.

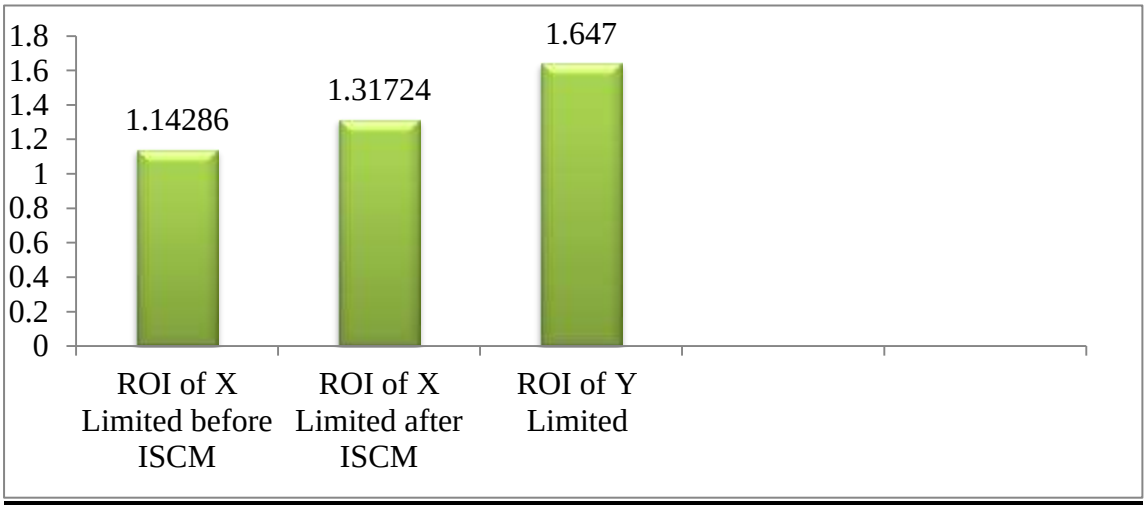

Figure 9.2 Comparative Analysis of ROI of X Limited and Y Limited

CHAPTER X

DEVELOPMENT OF A MODEL OF BENCHMARKING FOR INTERNAL SUPPLY CHAIN MANAGEMENT

10.1 INTRODUCTION

ISCM refers to the use of planning, organizing, commanding, controlling and coordinating the functions of enterprise in all aspects of circulation. Numerous models have been developed which were helpful to frame model of benchmarking of ISCM to analyze Indian manufacturing industries. The PMIs of benchmarking were analyzed by W-ISM technique. This research work consists of different analytical model of benchmarking using Fuzzy-AHP, ISM model for factors of ISCM.

10.2 DEVELOPMENT STEPS FOR MODEL OF BENCHMARKING OF ISCM

The development of model of benchmarking of ISCM is done only after the study of its functional elements and activities (Anand et al, 2008). The functional activities of manufacturing industries are – planning, purchase, make, sale and distribution. For best ISCM, customer satisfaction (quantity and quality of product) is necessary with lowest possible price. A benchmarking effective team is necessary, in order to achieve better response from market having capability to analyze the functional activities (Bhutta et al, 1999).

Each industry works better for survival in the competitive environment with the aim of increasing effectiveness and efficiency of whole industry. Customers demand to have best product and better service in minimum cost within less possible time, thus, industry requires reviewing and updating its system again and again through benchmarking of ISCM (Kristianto et al, 2012). The following steps are generally used to develop model of benchmarking of ISCM to analyze Indian manufacturing industries.

- **Proposed Data Collection Procedure:** Data collection is done with the help of different sources like: questionnaires, literature survey, discussions, interviews, databases, seminars and conferences, etc. The data compilation has been carried out by reviewing the research article published in several national and international journals of repute having information relevant to subject content.

- **Data Analysis:** The authentic investigation stage implies reviewing the concept in terms of frequency as well as identification of critical factors approach. Quality performance of manufacturing groups and quality problems faced by them has formed the basis of data collection which is further scrutinized and analyzed using various statistical and quantitative techniques. The analysis helped in identification of critical benchmarking PMIs for improving internal supply chain performance of manufacturing industries. Critical indicators were integrated to develop quality improvement frame work for manufacturing group. The developed frame work has been tested and validated in a manufacturing group.
- **Proposed Model:** A unique model has been developed which integrated various quality improvement techniques. The recent literature provides a meaningful insight regarding the state-of-art of ISCM activities undertaken by various types of Indian manufacturing industries (De-Boer et al, 2006). Different model of benchmarking of ISCM have been developed which is based on W-ISM technique, F-AHP technique and ISM technique with MICMAC analysis. The details study of techniques will be discussed in next section.

10.3 DEVELOPMENT OF MODEL OF BENCHMARKING OF ISCM USING W-ISM TECHNIQUE

ISCM includes various operations like: production, efficiency, source, distribution, delivery and effectiveness. In order to understand the benchmarking of ISCM, it is necessary to know various performance measures. The level of performance measures of benchmarking of ISCM depends on their driving power and dependent power (Cooper et al, 2001**)**. Hence, it makes true sense to identify and analyze the key performance measures of benchmarking of ISCM.

W-ISM approach is the combination of ISM approach and competitiveness index (CI) where ISM develops a structural modeling and CI is needed to identify the key areas. The analysis of risk factors has been done by W-ISM approach. In this research work, seven performance measures of benchmarking of ISCM were identified through literature and expert's opinion. The weight of performance measures was decided through industrial questionnaire survey and after that analyzed by W-ISM technique

and digraph approach. In this section, the main goals of this research work are as follows:

- To find out the performance measures of benchmarking of ISCM and decide the rank according to scores of individual measures.
- Establishing relationship among performance measures using W-ISM.
- Analyzing their driving power & dependence power using digraph and MICMAC analysis.

The identification of various performance measures through literature review and expert's opinion is presented in this chapter. W-ISM technique, digraph approach and MICMAC analysis is used for the analysis. ISM was first proposed by Warfield to analyze the factors of complex systems. He introduced ISM and provided detailed descriptions and operating procedures.

10.3.1 Methodology Used

W-ISM technique is used to interpret the link between performance measures. Interrelation of seven selected performance measures affecting benchmarking of ISCM has been explored. The relationship between structural self-interaction matrix (SSIM) is established to differentiate among variables.

10.3.2 Identification of Performance Measures affecting the Modeling of Benchmarking of ISCM

Development of a Model of benchmarking of ISCM is affected by benchmarking performance measures. In this matter, an attempt is made to identify seven performance measures of benchmarking of ISCM through literature and expert's brainstorming. The performance measures of benchmarking of ISCM are: financial performance (PM 1), plan performance (PM 2), source performance (PM 3), make performance (PM 4), delivery performance (PM 5), sales performance (PM 6) and customer sales and services (PM 7).

10.3.3 Significance of Heavy Fabrication Construction Equipment's Manufacturing Industry

Manufacturing industries consist of latest technology-, computer numerical control (CNC) machine, rolling machines and metal inert gas (MIG) welding machines.

Generally, fabrication work, machining work and rolling process are implemented for manufacturing of construction equipment's and heavy structures. Good qualities of sheet rolls are easily produced by this CNC rolling process. With the help of MIG, submerged arc welding (SAW), Plasma cutting machining process is used to produce better quality of fabricated sheet metal components in minimum possible of time. The fabricated items are further tested for strength and quality.

Questionnaire was based on five point likert scale where respondents were requested to deal with the benchmarking of ISCM measures and to rank them as shown in table 10.1. This was discussed in section 7.4.4. This section is the extension of development of benchmark using CI to analyze manufacturing industries.

Table 10.1 Performance Measures for Analysis of Manufacturing Industry

S. No.	Performance Measures	Total Mean Score	Rank
1	Financial Performance (PM 1)	16	2
2	Plan Performance (PM 2)	15.9	3
3	Source Performance (PM 3)	13.7	5
4	Make Performance (PM 4)	8.65	7
5	Delivery Performance (PM 5)	14.5	4
6	Sales Performance (PM 6)	13	6
7	Customer Service & Satisfaction (PM7)	16.16	1

10.3.4 W-ISM Overview for analyzing Performance Measures of Benchmarking of ISCM

W-ISM technique is the combination of ISM approach and competitive weight of individual performance measure. The W-ISM technique is used to analyze performance measure and their clusters classification. The framework of performance measure is developed by ISM and further used to evaluate CI of performance measure in ISCM.

10.3.5 ISM Technique

ISM is a widely used technique for performance measure analysis. George et al, (2013) proposed the concept of ISM approach for steel re-rolling mills (SRRMs). Steps of ISM methodology (Warfield, 1974) are shown in figure 10.1.

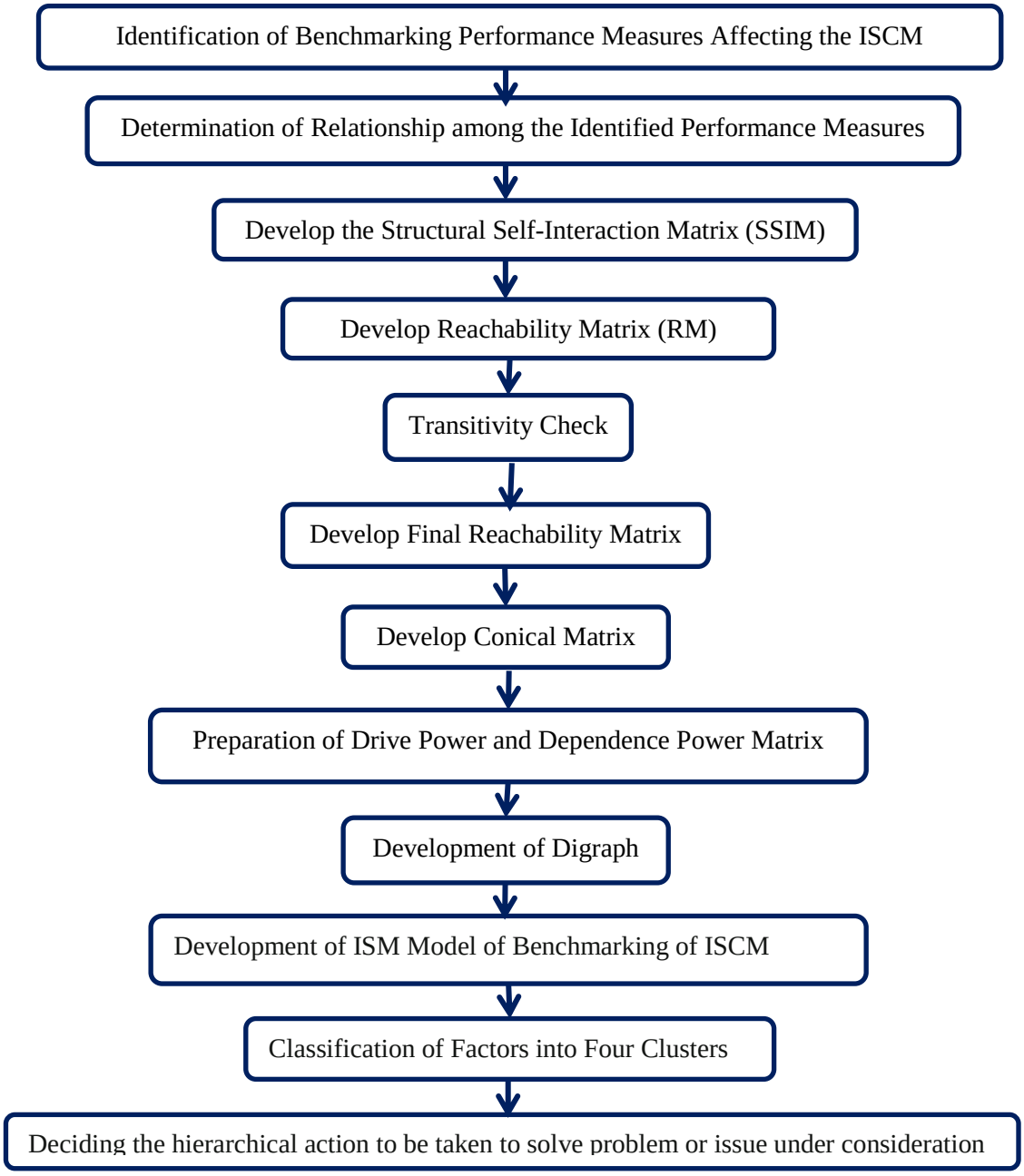

Figure 10.1 Flow Chart for ISM Methodology

10.3.6 Modeling of Performance Measures of Benchmarking of ISCM

The relationships among seven performance measures of ISCM have been identified based on expert opinion, their inter relationship has been shown in table 10.2.

Step 1 Identification of Performance Measures affecting the System

Benchmarking of ISCM has been affected through various performance measures identified through literature and expert's opinion.

Step 2 Development of Structural Self-Interactive Matrix (SSIM)

Structural self-interactive matrix has been developed where V, A, X and O symbols denote the direction of inter relationship between factors i and j.

• V shows factor i will influence the factor j.

• A shows factor j will influence the factor i.

• X shows factors i and j will influence each other.

• O shows factors i and j are unrelated.

The expert's opinion for SSIM resulted in the scrutiny of performance measures and their relationship on four different ways i.e. i and j, as depicted in table 10.2, where symbol V is assigned to cell (1, 4) because factor 1 influences the factor 4, Symbol A is assigned to cell (4, 6) because factor 6 influences the factor 4, Symbol X is assigned to cell (5, 6) because factors 5 and 6 influence each other and Symbol O is assigned to cell (3, 7) because factors 3 and 7 are unrelated.

Table 10.2 SSIM of Performance Measures of Benchmarking of ISCM

Performance Measures	PM 7	PM 6	PM 5	PM 4	PM 3	PM 2	PM 1
PM 1	O	A	V	V	O	A	-
PM 2	V	V	O	V	O	-	
PM 3	O	O	O	V	-		
PM 4	V	A	X	-			
PM 5	A	X	-				
PM 6	O	-					
PM 7	-						

Step 3 Development of Reachability Matrix (RM)

SSIM results into the development of reachability matrix representing the association among performance measures in binary form (table 10.3), represented by symbols V, A, X, O used earlier in SSIM are replaced by binary digits of 0 and 1. Reachability matrix is obtained as sequenced below -

• "If (i, j) entry in the SSIM is V, then (i, j) entry in the reachability matrix becomes 1 and the (j, i) entry becomes 0.

• If (i, j) entry in the SSIM is A, then (i, j) entry in the reachability matrix becomes 0 and the (j, i) entry becomes 1.

• If (i, j) entry in the SSIM is X, then the (i, j) entry in the reachability matrix becomes 1 and the (j, i) entry also becomes 1.

• If (i, j) entry in the SSIM is O, then (i, j) entry in the reachability matrix becomes 0 and the (j, i) entry also becomes 0" **(**Rajesh et al, 2007).

Table 10.3 Initial Reachability Matrices (RM)

Performance Measures	PM 1	PM 2	PM 3	PM 4	PM 5	PM 6	PM 7
PM 1	1	0	0	1	1	0	0
PM 2	1	1	0	1	0	1	1
PM 3	0	0	1	1	0	0	0
PM 4	0	0	0	1	1	0	1
PM 5	0	0	0	1	1	1	0
PM 6	1	0	0	1	1	1	0
PM 7	0	0	0	0	1	0	1

The steps for the transitivity were also considered to establish relationship between performance measures incorporating which the final reachability matrix is obtained. Transitivity explains the relation between any three performance measures i.e. if there exist a relationship among A and B & also among B and C then obviously relationship should exist between A and C (table 10.4), where transitivity is shown as 1*.

Table 10.4 Final Reachability Matrices with Transitivity

Performance Measures	PM 1	PM 2	PM 3	PM 4	PM 5	PM 6	PM 7
PM 1	1	0	0	1	1	1*	1*
PM 2	1	1	0	1	1*	1	1
PM 3	0	0	1	1	1*	0	1*
PM 4	0	0	0	1	1	1*	1
PM 5	1*	0	0	1	1	1	1*
PM 6	1	0	0	1	1	1	1*
PM 7	0	0	0	1*	1	1*	1

Step 4 Partitioning the Reachability Matrix (RM)

Mandal et al, (1994) proposed an ISM to illustrate the interrelationship of various criteria and their importance while selecting vendor. The performance measures present at top level in the hierarchy shall not assist to attain any other performance measure over its own level. Similarly, the process is repeated to determine the factors in next level (tables 10.5, 10.6 and 10.7). Then total numbers of 1's in each row in table 10.4 is used to calculate the driving power whereas total number of 1's in each column is used to calculate dependence power. Driving and dependence power's

number is obtained as 33 for both as shown in table 10.8. The driving and dependence power helps to categorize performance measures into four groups of clusters whose position is determined through separation of AS and RS used to organize the IS. Relationship of RS with AS to get intersection set (IS) and level I to III is shown in table 10.5, 10.6 and 10.7.

Table 10.5 Iteration 1

Performance Measures	Reachability Set (RS)	Antecedent Set(AS)	Intersection Set (IS)	Levels
PM 1	PM 1, PM 4, PM 5, PM 6, PM 7	PM 1, PM 2, PM 5, PM 6	PM 1, PM 5, PM 6	
PM 2	PM 1, PM 2, PM 4, PM 5, PM 6, PM 7	PM 2	PM 2	
PM 3	PM 3, PM 4, PM 5, PM 7	PM 3	PM 3	
PM 4	PM 4, PM 5, PM 6, PM 7	PM 1, PM 2, PM 3, PM 4, PM 5, PM 6, PM 7	PM 4, PM 5, PM 6, PM 7	I
PM 5	PM 1, PM 4, PM 5, PM 6, PM 7	PM 1, PM 2, PM 3, PM 4, PM 5, PM 6, PM 7	PM 1, PM 4, PM 5, PM 6, PM 7	
PM 6	PM 1, PM 4, PM 5, PM 6, PM 7	PM 1, PM 2, PM 4, PM 5, PM 6, PM 7	PM 1, PM 4, PM 5, PM 6, PM 7	
PM 7	PM 4, PM 5, PM 6, PM 7	PM 1, PM 2, PM 3, PM 4, PM 5, PM 6, PM 7	PM 4, PM 5, PM 6, PM 7	I

Table 10.6 Iteration 2

Performance Measures	Reachability Set (RS)	Antecedent Set(AS)	Intersection Set (IS)	Levels
PM 1	PM 1	PM 1, PM 2	PM 1	II
PM 2	PM 1, PM 2	PM 2	PM 2	
PM 3	PM 3	PM 3	PM 3	II
PM 5	PM 1	PM 1, PM 2	PM 1	II
PM 6	PM 1	PM 1, PM 2	PM 1	II

Table 10.7 Iteration 3

Performance Measures	Reachability Set (RS)	Antecedent Set(AS)	Intersection Set (IS)	Levels
PM 2	PM 2	PM 2	PM 2	III

Step 5 Development of Conical Matrix

Chidambaranathan et al, (2009) "developed the structural relationship among supplier development factors. The development of conical matrix should be done by clubbing together performance measures in same level, across rows and columns of final reachability matrix. The drive power and dependence power ranks are calculated by giving highest ranks to the performance measures that have the maximum number of 1s in rows and columns respectively" **(**Raj et al, 2007) as shown in table 10.8.

Table 10.8 Conical Matrix

Performance Measures	PM 4	PM 5	PM 6	PM 7	PM 1	PM 3	PM 2	Driving Power
PM 4	1	1	1	1	0	0	0	4
PM 5	1	1	1	1	1	0	0	5
PM 6	1	1	1	1	1	0	0	5
PM 7	1	1	1	1	0	0	0	4
PM 1	1	1	1	1	1	0	0	5
PM 3	1	1	0	1	0	1	0	4
PM 2	1	1	1	1	1	0	1	6
Dependence power	7	7	6	7	4	1	1	33/33

Step 6 Development of Digraph

In digraph, the positions are arranged in decreasing order starting from the top level till the lowest level as shown in figure 10.2.

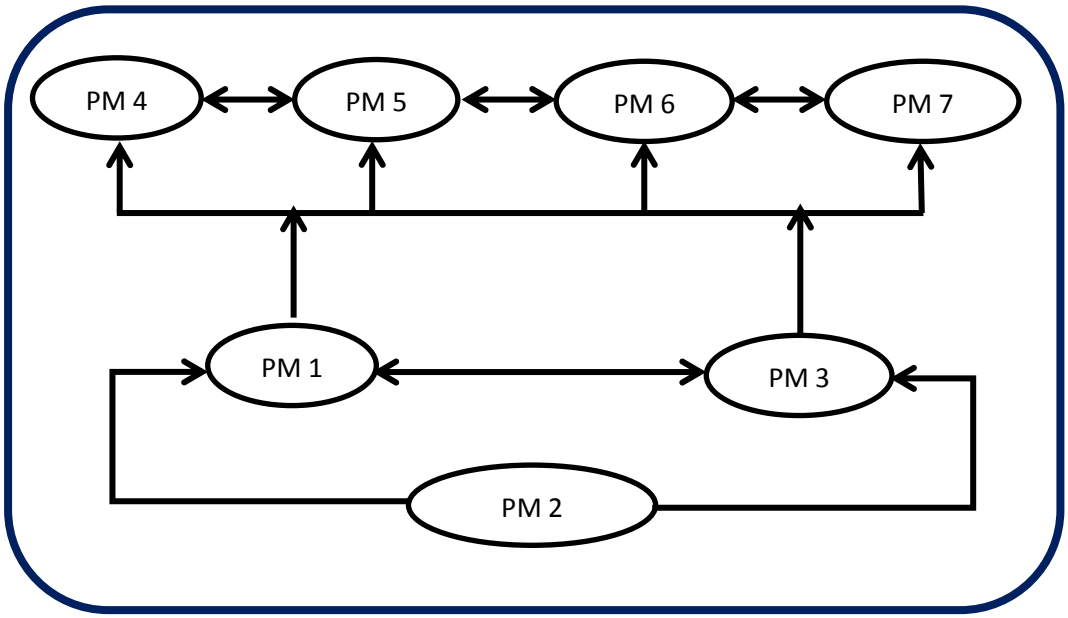

Figure 10.2 Digraph for Performance Measures of Benchmarking of ISCM

Step 7 Development of ISM Model of Benchmarking of ISCM

The digraph is converted into ISM model by replacing nodes with performance measures. Diabat et al, (2012) developed an ISM model which is used to examine risks involved in a food supply chain. ISM model of performance measures of benchmarking of ISCM for manufacturing industry is presented in figure 10.3.

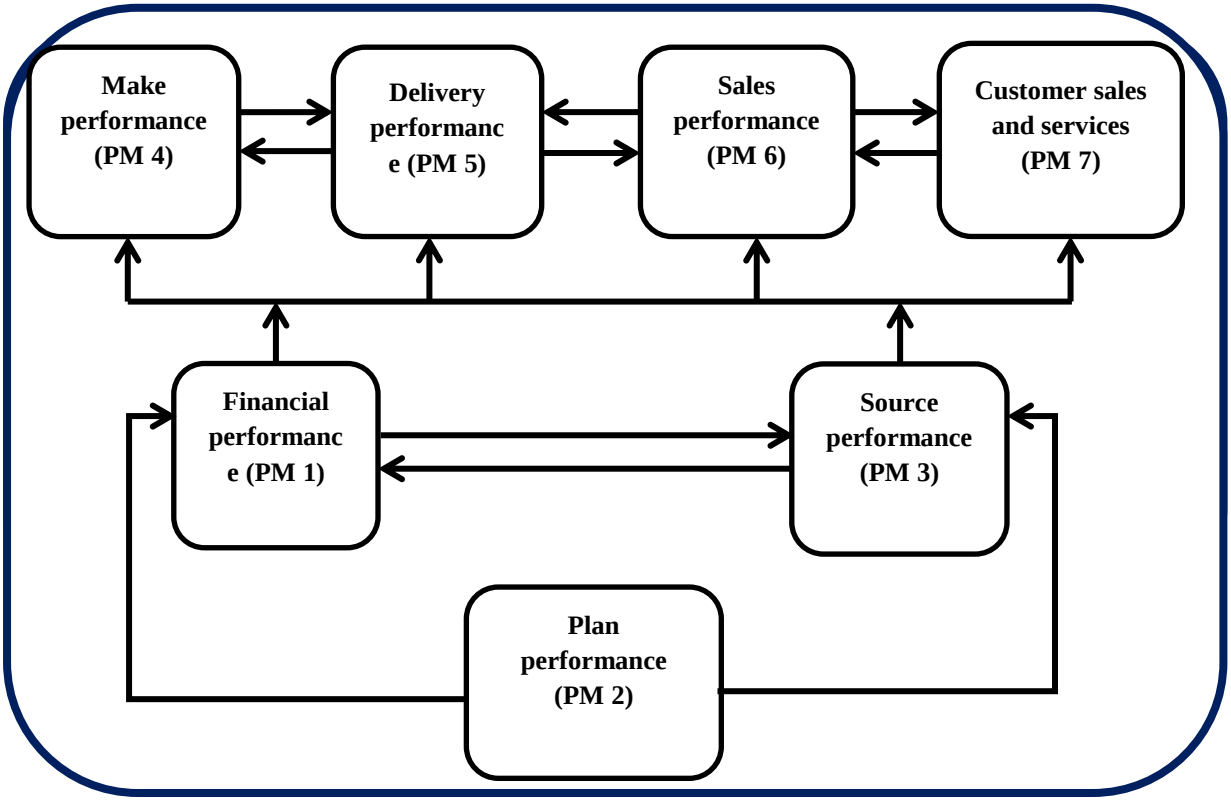

Figure 10.3 ISM Model of Benchmarking of ISCM

Step 8 Classification of Performance Measures into Clusters on the basis of MICMAC Analysis

MICMAC analysis is done to classify the performance measures as driving and dependence power (Saxena et al, 2012) and further categorized into four clusters like: autonomous, dependent, linkage and independent variables (Mandal et al, 1994) as shown in figure 10.4. Balaji et al, (2016) developed SSIM to identify the relationships between the enablers, followed by graph theoretic approach (GTA). In table 10.8, driving power is shown as ordinate and dependence power as abscissa. The driving power of variable PM 2 is 6 and dependence power is 1. There are four clusters classification like: Cluster I (autonomous variables) has low driving power and low dependence power. Cluster II (dependent variables) have low driving power and high dependence power. Cluster III (linkage variables) have high driving power and high

dependence power. Cluster IV (independents variables) has high driving power and low dependence power.

PM 7 PM 6 PM 5 PM 4	**IV** PM 2 PM 3	**III** PM 1 PM 6 PM 5 PM 4, PM 7
PM 3 PM 2 PM 1 ↑ Driving power	**I**	**II**
Dependence → power	PM 1 PM 2 PM 3	PM 4 PM 5 PM 6 PM 7

Figure 10.4 Clusters of Performance Measures

• **Cluster 1: Autonomous Performance Measures -** These measures have a weak drive power and weak dependence. In this cluster there is no performance measure.

• **Cluster 2: Dependence Performance Measures -** These measures have a weak drive power but strong dependence. In this cluster also there is no performance measure.

• **Cluster 3: Linkage Performance Measures -** These measures have a strong drive power as well as strong dependence power. In this cluster there are five performance measures i.e. financial performance (PM 1), make performance (PM 4), delivery performance (PM 5), sales performance (PM 6) and customer services & satisfaction performance (PM 7).

• **Cluster 4: Driving Performance Measures -** These performance measures have a strong drive power but weak dependence power. In this cluster there are two performance measures i.e. Plan performance (PM 2) and source performance (PM 3).

10.3.7 Evaluation of Weightage using Competitiveness Index

The mean score with their rank of performance measures has been calculated in order to compute competitiveness index as discussed in chapter 7 (table 7.4). After ranking, inverse rank and weight for each performance measures is evaluated (Cleveland et al, 1989). The weight of performance measures has been determined using the formula $W_i * \log K_i$ and is obtained as +0.78, +0.70, 0, 0, 0, -0.30 and +0.84 for PM1 to PM7, respectively.

10.3.8 W-ISM Model Analysis

The performance measures like plan performance (PM 2), source performance (PM 3) having high driving power need to be priorities. It means they can provide support to the other dependence factors. Remaining five performance measures have a strong drive power as well as strong dependence power. The calculated competitive weighted values of plan performance, financial performance and customer service and satisfaction are much better than other performance measures like: source performance, make performance, delivery performance and sales performance. This implies for further improvement in the factors i.e. source, make, delivery and sales performance.

10.4 DEVELOPMENT OF MODEL OF BENCHMARKING OF ISCM USING FUZZY-AHP TECHNIQUE

The ISCM concept is confined to movement of material, finance, information, internal marketing, sales, planning, manufacturing, procurement and finally co-ordination between departments within industry (Christopher, 1992). Benchmarking model and comparison bar charts are used by the top management for the purpose of comparative benchmarking analysis of ISCM performance (Wong et al, 2008). The main purpose of ISCM is to identify the idle time and reduces them by suitable qualitative and quantitative tool & technique. The manufacturing industries realized that a proper internal supply chain can be a single source of distinct competitive advantage in the market (Flynn et al, 2010).

A questionnaire survey is used to collect expert's opinion from industry which results as a tool to achieve ISCM performance comparative analysis of two selected Indian manufacturing industries. The main objectives of this study are:

- To find out performance indicators of ISCM through literature review and expert's opinion
- To develop theoretical model of benchmarking of ISCM
- For validation purpose, this model of benchmarking has implemented in two highly competitive heavy fabrication works manufacturing industries
- Comparative benchmarking analysis of each performance indicator in both industries using comparison bar charts.

10.4.1 Researchers Review

Wang et al, (2016) "dealt with an integrated scheduling problem for a multi item capacity constrained production and delivery system. Supply chain approach improves the ability of industry to sustain in market for better quality and economic & timely delivery (Gunasekaran et al, 2001). Md et al, (2016) proposed quality function deployment approach to measure supply chain performance of manufacturing industry. Gimenez et al, (2003) tested the effects of internal and external integration on performance using survey and structural equation modelling". Kalkar et al, (2010) proposed a balance score card conceptual framework for benchmarking of supply chain. Baby (2013) proposed "strategies built by strength, weakness, opportunity, and threat (SWOT), quantitative strategic planning matrix (QSPM) that would help the policy maker and to rationalize the dilemma in decision making to fabricate environmental protection policies, laws and standards". Hasan et al, (2016) proposed the "concept of bowl is extended to reconfigurable manufacturing systems planning and is explained with the help of a numerical illustration". Beamon, (1999) proposed evaluation of performance measures used in supply chain models and also presents a framework for the selection of performance measurement system for manufacturing supply chain. Bindu et al, (2010) introduced fuzzy set theory to address the real situation in the judgment and evaluation processes for improving the supply chain performance. Gou et al, (2013) used the fuzzy AHP method to evaluate the performance of service-oriented catering supply chain model.

Stewart G, (1997) developed a supply chain operations reference model for integrated SCM. Hausman et al, (2002) proposed a model to manufacturing-marketing integration and then integration to profits. Aggarwal et al, (2016) examined the design and implementation model for agile manufacturing system (AMS) which provided the inter-relationship among various factors and establishes the hierarchy among them. Shabani et al, (2012) developed a linear pair model for selecting the best sales agents as a "Benchmark" in the presence of non-discretionary factors and imprecise data under free disposability assumption. Jun et al, (2008) used benchmarking approach to optimize the comparison result and continuous improvement.

10.4.2 Methodology Used

The regular benchmarking practice of model is used to identify ISCM performance gap. Further, a hybrid approach of fuzzy logic and AHP method is used to analyze internal supply chain performance indicators of selected Indian manufacturing industries. The purpose of fuzzy logic is to convert uncertain data into certain form like fuzzy number after that convert fuzzy number into crisp score. The objective of AHP method is to determine weight of performance indicators.

10.4.3 Integrated Structural Modelling of ISCM

The ISCM of any industry is effectively influenced by external suppliers and customers. Singh et al, (2014) used structural equation modelling (SEM) for analyzing the supply chain integration and performance of Australian manufacturing industries. A supporting platform is also necessary for performance improvement of industry through comparison to its competitors in the market (Gunasekaran et al, 2001). The other sources like: customers, government, media, investors and suppliers also create pressure on manufacturing industries and indirectly enforce them to add ISCM processes into their existing systems. The main function of integrated structure modeling is to interconnect various functional activities of ISCM in such a way that they approach towards the same goal of industry. The interrelation of team members of different departments like: finance, manufacturing, logistics, human resource management, marketing, purchasing and supply management, material management and physical distribution of ISCM are shown in figure 10.5.

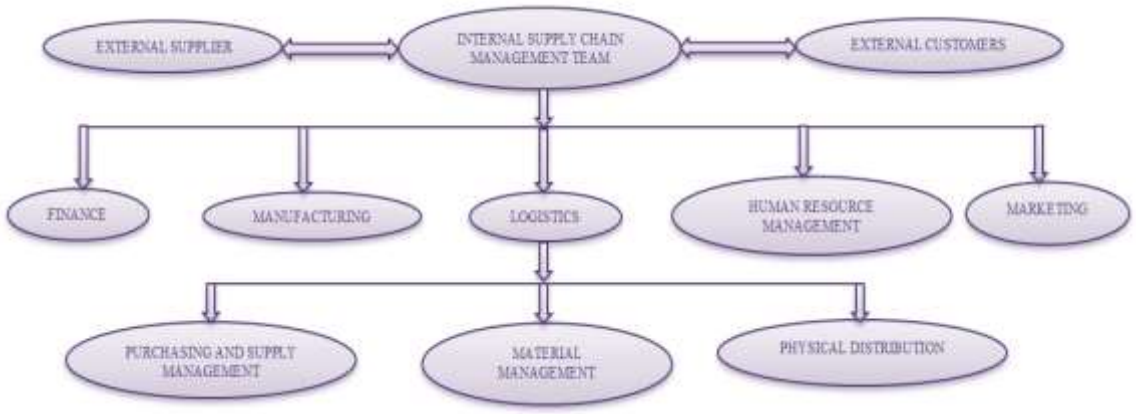

Figure 10.5 Integrated Structures Modelling of ISCM

10.4.4 Development of Theoretical Model of Benchmarking

Based on extensive literature review and discussion with experts, this research work has come across various performance indicators of ISCM. This model of benchmarking consists of performance indicators of ISCM. This theoretical model of benchmarking consists of following phases like: planning phase, analysis phase, integration phase, action phase and maturity phase as shown in figure 10.6. The cyclic process of all phases of model of benchmarking is commonly used to find out the performance of ISCM as well as it provides help to reduce the performance gap between competitors.

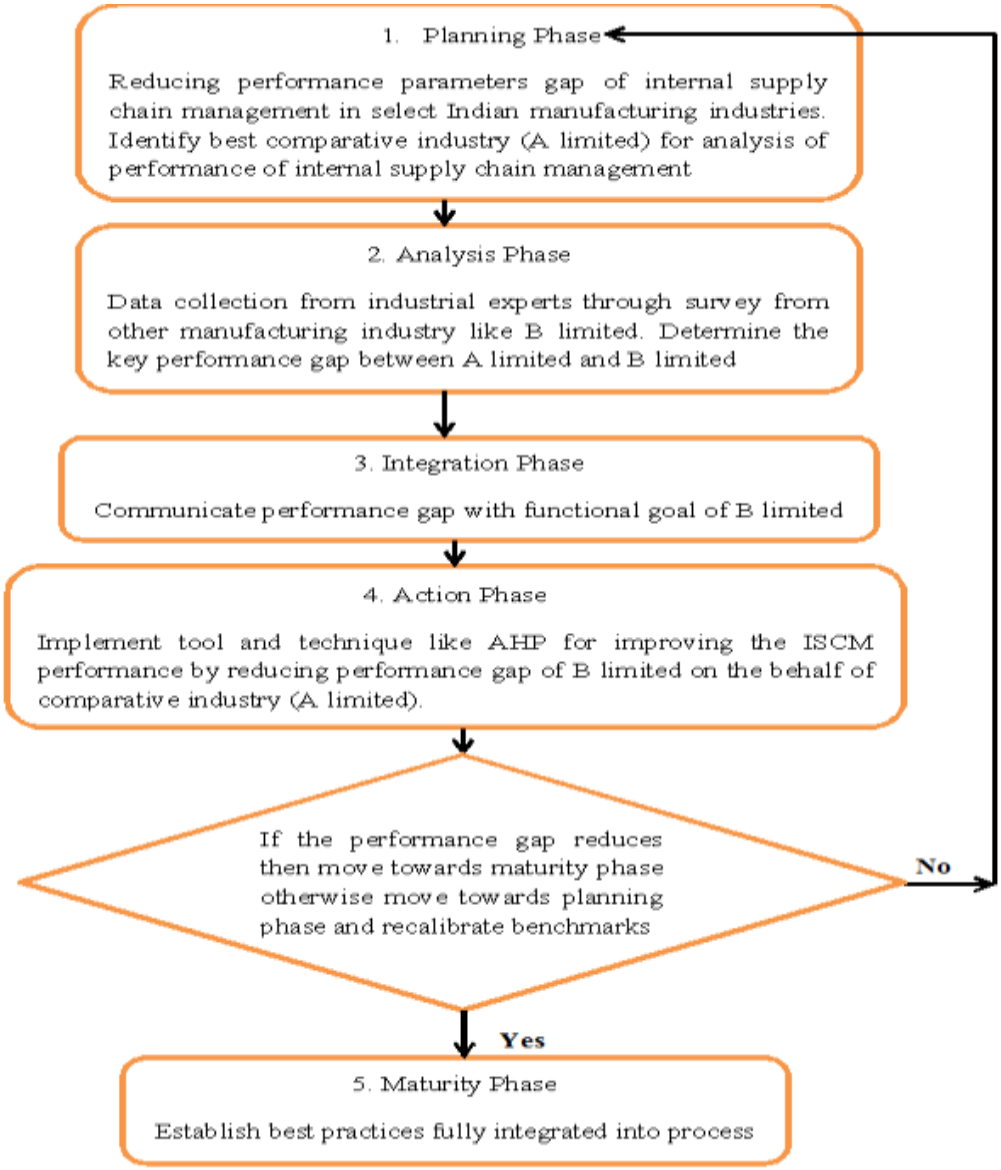

Figure 10.6 Model of Benchmarking to Analyze ISCM Performance of Selected Indian Manufacturing Industries

10.4.5 Data Collection & Analysis

The respondents were asked to indicate the level of difficulty in managing the performance indicators in ISCM on five point likert scale where point 1 stands for low and 5 for high weightage. Two manufacturing industries (A and B) were compared to validate the developed model and the calculated total score of each performance indicator since Year 2013 - 2015 as shown in table 10.9, which is developed through Weightage Score Card (table 7.2). Following particulars need to be kept in mind while developing model of benchmarking for ISCM.

- Five point likert scales for computing the total score of performance indicators.
- The scores of each performance indicator must be provided independently by the experts.
- Total score of performance indicators of each manufacturing industries should be calculated for at least three years.

Table 10.9 Total Score of Performance Indicators of ISCM in Manufacturing Industries

S. No.	Performance indicators	Strategy Objective	Total Score					
			Year 2013		Year 2014		Year 2015	
			A	B	A	B	A	B
1.	Financial Performance (P1)	Profitable Growth	2.0	3.0	2.0	3.4	2.4	3.0
2.	Plan Performance (P2)	Reduce delay	1.7	2.6	2.2	3.2	2.9	3.7
3.	Source Performance (P3)	Existence	1.6	2.3	2.1	3.0	3.0	3.5
4.	Make Performance (P4)	Facilities	0.95	1.36	1.07	1.56	1.34	1.60
5.	Delivery Performance (P5)	Customer Satisfaction	1.25	2.46	2.12	2.92	2.35	3.46
6.	Sales Performance (P6)	Company Growth	1.0	1.4	1.6	3.1	2.2	4.0
7.	Customer Service and Satisfaction (P7)	Market Share, Customer Satisfaction	1.2	2.4	2.8	3.3	2.8	3.6

10.4.6 Analysis of Performance Indicators using Fuzzy AHP Technique

Chen et al, (1992) proposed fuzzy logic principle to solve MCDM problems. The linguistic terms are converted into fuzzy numbers and then into crisp scores. An eleven-point scale is used to crisp score as shown in table 10.10.

Table 10.10 Conversion of Linguistic Terms into Fuzzy Scores (11-point scale)

Linguistic Term	Fuzzy Number	Crisp Number
Exceptionally low	M1	0.045
Extremely low	M2	0.135
Very low	M3	0.255
Low	M4	0.335
Below average	M5	0.410
Average	M6	0.500
Above average	M7	0.590
High	M8	0.665
Very high	M9	0.745
Extremely high	M10	0.865
Exceptionally high	M11	0.955

Various performance indicators of both competitors with fuzzy numbers and crisp scores are shown in table 10.11. AHP, proposed by Saaty, (1986) is most useful technique for comparing performance parameters of complex problems (Kumar et al, 2009**)**.

Table 10.11 Fuzzy No. and Crisp Score of Performance Indicators of Benchmarking of ISCM

S. No.	Performance Indicators	Fuzzy Number and Crisp Score					
		Year 2013		Year2014		Year2015	
		A	B	A	B	A	B
1	Financial Performance (P1)	M6=0.5	M9=0.745	M6=0.5	M10=0.865	M7=0.59	M9=0.745
2	Plan Performance (P2)	M5=0.41	M8=0.665	M7=0.59	M9=0.745	M9=0.745	M11=0.955
3	Source Performance (P3)	M5=0.41	M7=0.59	M6=0.5	M9=0.745	M9=0.745	M10=0.865
4	Make Performance (P4)	M3=0.255	M4=0.335	M3=0.255	M5=0.41	M4=0.335	M5=0.41
5	Delivery Performance (P5)	M4=0.335	M7=0.59	M6=0.5	M9=0.745	M7=0.59	M10=0.865
6	Sales Performance (P6)	M1=0.045	M4=0.335	M5=0.41	M9=0.745	M7=0.59	M11=0.955
7	Customer Service and Satisfaction (P7)	M4=0.335	M7=0.59	M8=0.665	M10=0.865	M8=0.665	M10=0.865

It can be applied in all field of decision making where decisions related to choice, ranking, and resource allocation and benchmarking is to be made (Singh H, et al, 2015). This can help to estimate the relative weights of several different objects using pair wise comparison matrix consisting of the following steps:

- Formulation of the problem
- Determination of the relative weights of the comparison attributes
- Comparison of the alternatives on each attribute
- Aggregation of weights to produce final evaluation

Mutingi, (2016) proposed "A fuzzy multi-objective genetic algorithm approach (FMGA) to effectively handle the fuzzy goals and constraints of multi-objective decision problem". During research work two construction equipment manufacturing industries "A" and "B" limited from Faridabad (Haryana) were considered. Using AHP technique, comparative benchmarking analysis of internal supply chain performance indicators from P1 to P7 has been completed. In both manufacturing industries A limited and B limited from year 2013-2015 the internal supply chain's performance comparative matrices with seven multiple criteria were designed based on weighted score of each performance indicator. Online matrix ([7*7] and [3*3]) determinant calculator has been used to find the determinant of performance of A limited and B limited from year 2013-2015, separately as shown in matrix comparison table 10.12, 10.13, 10.14, 10.15, 10.16, 10.17, 10.18 and 10.19 (http://matrix.reshish.com/detCalculation.php).

10.4.7 Weights Calculation using AHP Technique

The weight of each criterion in comparison matrices are calculated by geometric mean of individual criteria. Following are the main steps used in calculation of weights of every performance measures:

1. The performance indicators of ISCM are: financial performance (P1), plan performance (P2), source performance (P3), make performance (P4), delivery performance (P5), sales performance (P6) and customer services & satisfaction (P7).
2. The relative importance of each performance indicator is determined from industrial expert's opinion. The weights of different performance indicator were found by a pair wise comparison matrix, prepared from the geometric mean of various scores given by the industrial experts (Chakraborty et al, 2011**)**.
3. The weights of each performance measures criteria were calculated.

Table 10.12 AHP Pair Wise Comparison Matrix of A Limited in 2013

Performance Criteria	PC1	PC2	PC3	PC4	PC5	PC6	PC7	Geometric Mean	Weights
PC1	1	0.3	0.4	1.05	0.75	1.0	0.8	0.6915	0.0883
PC2	3.3	1	0.1	0.75	0.45	0.7	0.5	0.6291	0.0804
PC3	2.5	10	1	0.65	0.35	0.6	0.4	1.0455	0.1336
PC4	0.95	1.3	1.5	1	3.3	20	4	2.4221	0.3094
PC5	1.3	2.2	2.86	0.3	1	0.25	0.05	0.6079	0.0777
PC6	1	1.43	1.67	0.05	4	1	5	0.1324	0.1447
PC7	1.25	2	2.5	0.25	20	0.2	1	1.2992	0.1660

Determinant of $[A_{2013}] = |A_{2013}| = 114748.52$

Table 10.13 AHP Pair Wise Comparisons Matrix of A Limited in 2014

Performance Criteria	PC1	PC2	PC3	PC4	PC5	PC6	PC7	Geometric Mean	Weights
PC1	1	5	10	0.93	8.3	0.4	1.25	2.12	0.265
PC2	0.2	1	0.1	1.13	0.08	0.6	1.67	0.41	0.051
PC3	0.1	10	1	1.03	50	0.5	1.43	1.67	0.209
PC4	1.08	0.88	0.97	1	0.95	1.89	0.58	0.99	0.124
PC5	0.12	12.5	0.02	1.05	1	0.52	1.47	0.59	0.738
PC6	2.5	1.67	2	0.53	1.92	1	1.83	1.32	0.165
PC7	0.8	0.6	0.7	1.73	0.68	1.2	1	0.90	0.113

Determinant of $[A_{2014}] = |A_{2014}| = 22534.37$

Table 10.14 AHP Pair Wise Comparisons Matrix of A Limited in 2015

Performance Criteria	PC1	PC2	PC3	PC4	PC5	PC6	PC7	Geometric Mean	Weights
PC1	1	2	1.67	1.06	0.05	0.2	2	0.6851	0.0880
PC2	0.5	1	10	1.56	0.55	0.7	0.1	0.8421	0.1083
PC3	0.6	0.1	1	1.66	0.65	0.8	0.1	0.4715	0.0606
PC4	0.94	0.64	0.60	1	0.99	1.16	0.64	0.8273	0.1064
PC5	20	1.82	1.54	1.01	1	0.15	1.82	1.4787	0.1901
PC6	5	1.43	1.25	0.86	6.67	1	1.43	1.8469	0.2375
PC7	0.5	10	10	1.56	0.55	0.7	1	1.6258	0.2090

Determinant of $[A_{2015}] = |A_{2015}| = 19698.87$

Table 10.15 AHP Pair Wise Comparisons Matrix of A Limited from 2013 to 2015

Performance Criteria	PC1	PC2	PC3
PC1	114748.52	0.0000108	95049.65
PC2	92214.15	22534.37	2835.5
PC3	0.00001052	0.0003527	1969.87

Determinant of $[A_{2013\text{-}2015}] = |A_{2013\text{-}2015}| = 50937057447402.2$

Table 10.16 AHP Pair Wise Comparisons Matrix of B Limited in 2013

Performance criteria	PC1	PC2	PC3	PC4	PC5	PC6	PC7	Geometric mean	Weights
PC1	1	0.4	0.7	1.64	0.54	1.6	0.6	0.8146	0.1038
PC2	2.5	1	0.3	1.24	0.14	1.2	0.2	0.6095	0.0777
PC3	1.43	3.33	1	0.94	6.25	0.9	10	2.2029	0.2807
PC4	0.61	0.81	1.06	1	0.91	25	0.96	1.4164	0.1805
PC5	1.85	7.14	0.16	1.1	1	1.06	0.06	0.7610	0.0970
PC6	0.63	0.83	1.11	0.04	0.94	1	1.0	0.5790	0.0738
PC7	1.67	5	0.1	1.04	16.67	1.0	1	1.4649	0.1867

Determinant of $[B_{2013}] = |B_{2013}| = 72155.95$

Table 10.17 AHP Pair Wise Comparisons Matrix of B Limited in 2014

Performance Criteria	PC1	PC2	PC3	PC4	PC5	PC6	PC7	Geometric Mean	Weights
PC1	1	0.2	0.4	1.84	0.48	0.4	0.1	0.4324	0.0501
PC2	5	1	0.2	1.64	1.28	0.2	10	0.9184	0.1065
PC3	2.5	5	1	1.44	0.08	10	3.33	1.7383	0.2016
PC4	0.54	0.61	0.69	1	0.74	0.69	0.57	0.6784	0.0787
PC5	2.08	3.57	12.5	1.36	1	12.5	2.63	3.2875	0.3813
PC6	2.5	5	0.1	1.44	0.08	1	3.3	0.8992	0.1043
PC7	10	0.1	0.3	1.74	0.38	0.3	1	0.6683	0.0775

Determinant of $[B_{2014}] = |B_{2014}| = 34676.50$

Table 10.18 AHP Pair Wise Comparisons Matrix of B Limited in 2015

Performance Criteria	PC1	PC2	PC3	PC4	PC5	PC6	PC7	Geometric Mean	Weights
PC1	1	1.43	2	1.4	2.17	1	1.67	1.4654	0.1796
PC2	0.7	1	0.2	2.1	0.24	3.33	0.1	0.5852	0.0717
PC3	0.5	5	1	1.9	0.04	2	10	1.2101	0.1483
PC4	0.71	0.48	0.53	1	0.54	0.42	0.5	0.5738	0.0703
PC5	0.46	4.17	25	1.86	1	1.85	7.14	2.7463	0.3366
PC6	1	0.3	0.5	2.4	0.54	1	0.4	0.6943	0.08510
PC7	0.6	10	0.1	2	0.14	2.5	1	0.8834	0.1083

Determinant of $[B_{2015}] = |B_{2015}| = 5182.70$

Table 10.19 AHP Pair Wise Comparisons Matrix of B Limited from 2013 to 2015

Performance Criteria	PC1	PC2	PC3
PC1	72155.95	37479.45	66973.25
PC2	0.0000267	34676.50	29493.8
PC3	0.0000149	0.0000339	5182.70

Determinant of $[B_{2013\text{-}2015}] = |B_{2014\text{-}2015}| = 12967714812803.6$

10.4.8 Comparative Analysis using Comparison Bar Charts

Bar charts are used to compare the performance indicator gap where lower the bar height, lower is the significance of performance measure as shown in figure 10.7.

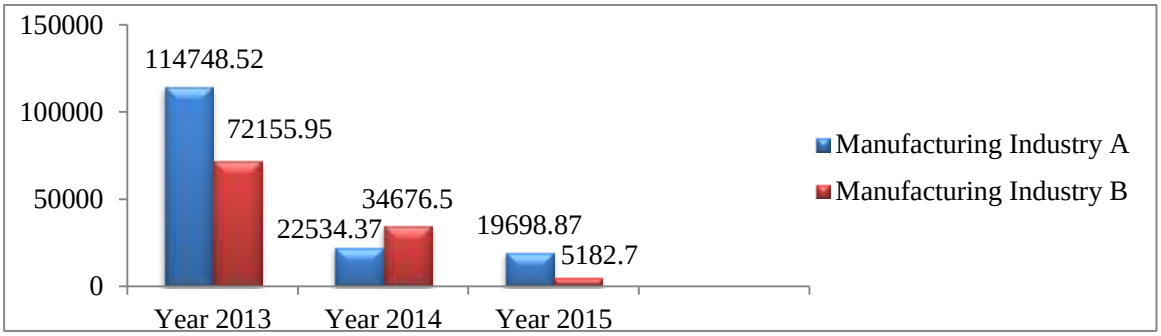

Figure 10.7 Comparison Bar Chart of Performance Measure of ISCM in A Limited & B Limited from 2013 - 2015

10.4.9 Analysis

In A limited, the determinant values of comparison matrices are 114748.52, 22534.37 and 19698.87 in the year 2013, 2014 and 2015, respectively, while in B limited the values are 72155.95, 34676.50 and 5182.70 for year 2013, 2014 and 2015, respectively. The geometric mean and weightage of each performance indicator in both industries A and B corresponding to year 2013-2015, have been calculated depicting the performance of A limited to be better than B limited. The overall determinant value of A limited is 50937057447402.2 and B limited is 12967714812803.6. Therefore, A limited acts as a benchmark for manufacturing industry B limited as shown in figure 10.8

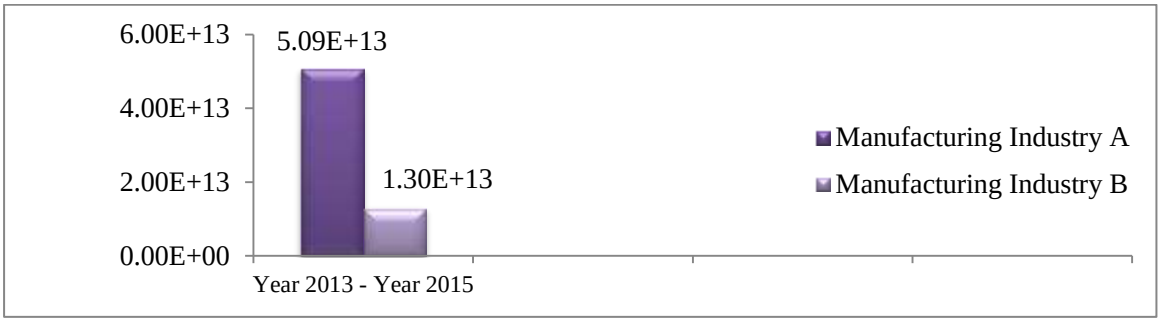

Figure 10.8 Comparison Bar Chart of Performance Measures of ISCM of A Limited & B Limited

10.5 DEVELOPMENT OF MODEL OF BENCHMARKING OF ISCM USING ISM AND MICMAC ANALYSIS

In a traditional manufacturing system, the shop floor has been viewed regularly where in the industry operates as an autonomous unit, with its own set of goals and parameters (Seth et al, 2005**)**. Each factors of ISCM is important in customer oriented manufacturing system, making new customer while retaining the old ones. Identification of these factors provides great benefit in developing blue print to adopt benchmarking of ISCM.

Fifteen factors were recognized through literature and expert's opinions (table 10.20) and their relationships is identified and ranked using ISM approach and MICMAC analysis with further classification into clusters according to their driving power and dependence power.

10.5.1 Variable Factors Identification

The internal supply chain activity of departments depends upon multiple numbers of direct and indirect variable factors. Out of all possible factors, research work has come across fifteen major factors of benchmarking of ISCM. These factors are identified from various literature sources and discussion with experts (Enshassi et al, 2007). These factors are: "human resources orientation, inbound logistics, operational logistics, outbound logistics, economies of scale, flexibility, logistics strategies, new product development system, material follow up and procurement, production operation process, production programming, quality system, products delivery, foreign trade and service management and transport reception custom decision" (details of all factors have already been explained in chapter 5).

10.5.2 Methodology Used

(A) Questionnaire Survey

The identified fifteen factors of ISCM are variable in nature as per flexibility of customer demand. Factors along with their mean scores and rank are shown in table 10.20. The responses of variable factors were collected on 5 point likert scale where "1" indicates the low importance and "5" indicates the high importance of factor effectiveness on ISCM.

Table 10.20 Variable Factors of Benchmarking of ISCM

S. No.	Variable Factors	Average Score	Rank
1	Human Resources Orientation	14.04285714	8
2	Inbound logistics	24.28571429	2
3	Operational logistics	12.5	11
4	Outbound logistics	12.14285714	12
5	Economies of scale	8.828571429	13
6	Flexibility	8.3	15
7	Logistics strategies	12.82857143	10
8	New Product development system	8.342857143	14
9	Material follow up and Procurement	22.35714286	3
10	Production Operation Process	14.14285714	7
11	Production Programming	13.54285714	9
12	Quality System	24.82857143	1
13	Products delivery	21.32857143	4
14	Foreign trade and service management	20.77142857	5
15	Transport Reception Custom decision	19.3	6

10.5.3 ISM Methodology

ISM technique, recognizing the relation between variable factors, is a systematic model of direct or indirect related factors (Raj et al, 2008; Sandbhor et al, 2014; Talib et al, 2011) whose steps are as follows:

1. To Identify Factors

In first step the variable factors affecting ISCM systems are identified (Faisal, 2010).

2. To evaluate reachability matrix

The contextual relationship, among the factor determined in step 1, is established using expert's opinion.

3. To develop Structural Self-Interaction Matrix

In ISM, factors are compared with each other and then SSIM is developed through expert's opinion. Compare is made pair wise i.e. i^{th} factor is compared separately to rest of the factors from $(i+1)^{th}$ which provides the direction of factors relationship (table 10.21). Four alphabets (V, A, X, and O) are used to show the relation between two criteria i and j.

- 1st alphabet-V indicates that the criterion *i* will help to achieve criterion *j*.
- 2nd alphabet-A indicates that the criterion *i* will be achieved by criterion *j*.
- 3rd alphabet-X indicates that the criterion *i* and *j* will help to achieve each other.
- 4^{th} alphabet-O indicates that the criterion *i* and *j* are unrelated.

Table 10.21 Structural Self-Interaction Matrix

Variable Factors (VF)	15	14	13	12	11	10	9	8	7	6	5	4	3	2
1	O	O	O	V	O	O	A	O	O	O	O	O	O	O
2	A	O	O	O	O	V	A	O	O	O	O	O	X	
3	O	O	O	V	O	O	A	O	O	O	O	V		
4	O	O	O	V	O	O	O	O	A	V	V			
5	O	O	O	O	O	A	A	O	V	V				
6	O	O	O	O	O	O	O	O	O					
7	O	A	A	O	O	O	O	O						
8	O	O	O	O	O	X	A							
9	A	A	O	O	O	O								
10	O	O	O	O	A									
11	O	O	X	O										
12	O	O	O											
13	A	O												
14	O													

4. To develop Reachability Matrix

Reachability matrix (RM), developed on the basis of SSIM, is generally used for checking transitivity (Raj et al, 2011). The SSIM is converted into binary matrix replacing X, A, V and O by corresponding values 1 and 0, followed by transitivity check. If SSIM having V then i-j binary value is 1 in RM matrix and j-i binary value is 0. If SSIM have A then i-j binary value is 0 in RM matrix and j-i binary value is 1. If SSIM have X then i-j binary value is 1 in RM matrix and j-i binary value is 1. If SSIM have O then i-j binary value is 0 in RM matrix and j-i binary value is 0. Following these rules, an initial RM for the factors is prepared as shown in table 10.22. This matrix is further iterated into a final RM as shown in table 10.23. When transitivity is implemented in initial RM then final RM is generated.

Table 10.22 Initial Reachability Matrix

Variable Factors	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0
2	0	1	1	0	0	0	0	0	0	1	0	0	0	0	0
3	0	1	1	1	0	0	0	0	0	0	0	1	0	0	0
4	0	0	0	1	1	1	0	0	0	0	0	1	0	0	0
5	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0
6	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
7	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0
9	1	1	1	0	1	0	0	1	1	0	0	0	0	0	0
10	0	0	0	0	1	0	0	1	0	1	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	1	1	0	1	0	0
12	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0

13	0	0	0	0	0	0	1	0	0	0	1	0	1	0	0
14	0	0	0	0	0	0	1	0	1	0	0	0	0	1	0
15	0	1	0	0	0	0	0	0	1	0	0	0	1	0	1

Table 10.23 Final Reachability Matrix

Variable Factors	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
1	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0
2	0	1	1	1*	1*	0	0	1*	0	1	0	1*	0	0	0
3	0	1	1	1	1*	1*	0	0	0	1*	0	1	0	0	0
4	0	0	0	1	1	1	1*	0	0	0	0	1	0	0	0
5	0	0	0	1*	1	1	1	0	0	0	0	0	0	0	0
6	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
7	0	0	0	1	1*	1*	1	0	0	0	0	1*	0	0	0
8	0	0	0	0	1*	0	0	1	0	1	0	0	0	0	0
9	1	1	1	1*	1	1*	1*	1	1	1*	0	1*	0	0	0
10	0	0	0	0	1	1*	1*	1	0	1	0	0	0	0	0
11	0	0	0	0	1*	0	1*	1*	0	1	1	0	1	0	0
12	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
13	0	0	0	1*	0	0	1	0	0	1*	1	0	1	0	0
14	1*	1*	1*	1*	1*	0	1	1*	1	0	0	0	0	1	0
15	1*	1	1*	0	1*	0	1*	1*	1	1*	1*	0	1	0	1

Note: * sign is used for transitivity.

5. To develop Levels from RM

The development of level partition from RM is carried out to know the placement of level-wise factors (Warfield, 1974) which is used to create RS and AS. The RS consists of the horizontal values while AS consist of vertical values. The values of IS are created by the intersection of RS and AS. First level is created when factors of RS and IS are common that are at top level in ISM hierarchy level. Now, all factors of first level are separated out from the others factors. Similarly, other factors in the next level are determined as shown in tables 10.24, 10.25, 10.26, 10.27, 10.28 and 10.29. Finally diagraph and ISM model are developed from all levels-first level to sixth level.

Table 10.24 Iteration 1

Variable Factors	**Reachability Set (RS)**	**Antecedent Set (AS)**	**Intersection Set (IS)**	**Level**
1	1,12	1,9,14,15	1	
2	2,3,4,5,8,10,12	2,3,9,14,15	2,3	
3	2,3,4,5,6,10,12	2,3,9,14,15	2,3	

4	4,5,6,7,12	2,3,4,5,7,9,13,14	4,5,7	
5	4,5,6,7	2,3,4,5,7,8,9,10,11,14,15	4,5,7	
6	**6**	3,4,5,6,7,9,10	**6**	**I**
7	4,5,6,7,12	4,5,7,9,10,11,13,14,15	4,5,7	
8	5,8,10	2,8,9,10,11,14,15	8,10	
9	1,2,3,4,5,6,7,8,9,12	9,10,14,15	9	
10	5,6,7,8,10	2,3,4,8,9,10,11,13,15	8,10	
11	5,7,8,10,11,13	11,13,15	11,13	
12	**12**	1,2,3,4,7,9,12	**12**	**I**
13	4,7,10,11,13	11,13,15	11,13	
14	1,2,3,4,5,7,8,9,14	14	14	
15	1,2,3,5,7,8,9,10,11, 13,15	15	15	

Table 10.25 Iteration 2

Variable Factors	Reachability Set (RS)	Antecedent Set (AS)	Intersection Set (IS)	Level
1	**1**	1,9,14,15	**1**	**II**
2	2,3,4,5,8,10	2,3,9,14,15	2,3	
3	2,3,4,5,10	2,3,9,14,15	2,3	
4	**4,5,7**	2,3,4,5,7,9,13,14	**4,5,7**	**II**
5	**4,5,7**	2,3,4,5,7,8,9,10,11,14,15	**4,5,7**	**II**
7	**4,5,7**	4,5,7,9,10,11,13,14,15	**4,5,7**	**II**
8	5,8,10	2,8,9,10,11,14,15	8,10	
9	1,2,3,4,5,7,8,9	9,10,14,15	9	
10	5,7,8,10	2,3,4,8,9,10,11,13,15	8,10	
11	5,7,8,10,11,13	11,13,15	11,13	
13	4,7,10,11,13	11,13,15	11,13	
14	1,2,3,4,5,7,8,9,14	14	14	
15	1,2,3,5,7,8,9,10,11,13, 15	15	15	

Table 10.26 Iteration 3

Variable Factors	Reachability Set (RS)	Antecedent Set (AS)	Intersection Set (Is)	Level
2	2,3,8,10	2,3,9,14,15	2,3	
3	2,3,10	2,3,9,14,15	2,3	
8	**8,10**	2,8,9,10,11,14,15	**8,10**	**III**
9	2,3,8,9	9,10,14,15	9	
10	**8,10**	2,3,8,9,10,11,13,15	**8,10**	**III**
11	8,10,11,13	11,13,15	11,13	
13	10,11,13	11,13,15	11,13	
14	2,3,8,9,14	14	14	
15	2,3,8,9,10,11,13,15	15	15	

Table 10.27 Iteration 4

Variable Factors	Reachability Set (RS)	Antecedent Set (AS)	Intersection Set (IS)	Level
2	**2,3**	2,3,9,14,15	**2,3**	**IV**
3	**2,3**	2,3,9,14,15	**2,3**	**IV**
9	2,3,9	9,14,15	9	
11	**11,13**	11,13,15	**11,13**	**IV**
13	**11,13**	11,13,15	**11,13**	**IV**
14	2,3,9,14	14	14	
15	2,3,9,11,13,15	15	15	

Table 10.28 Iteration 5

Variable Factors	Reachability Set (RS)	Antecedent Set (AS)	Intersection Set	Level
9	**9**	9,14,15	**9**	**V**
14	9,14	14	14	
15	9,15	15	15	

Table 10.29 Iteration 6

Variable Factors	Reachability Set (RS)	Antecedent Set (AS)	Intersection Set (IS)	Level
14	**14**	14	**14**	**VI**
15	**15**	15	**15**	**VI**

6. To develop Conical Matrix

It is developed by combining variables that arises at identical level along rows and columns of RM (Balaji et al, 2016). Now, first rank of driving power and dependence power of each factor depends upon the maximum scores of ones in row and column respectively as shown in table 10.30.

Table 10.30 Conical Matrix (CM)

Variable Factors	6	12	1	4	5	7	8	10	2	3	11	13	9	14	15	Driving Power	Rank
6	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	IX
12	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	IX
1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	2	VIII
4	1	1	0	1	1	1	0	0	0	0	0	0	0	0	0	5	V
5	1	0	0	1	1	1	0	0	0	0	0	0	0	0	0	4	VI
7	1	1	0	1	1	1	0	0	0	0	0	0	0	0	0	5	V
8	0	0	0	0	1	0	1	1	0	0	0	0	0	0	0	3	VII
10	1	0	0	0	1	1	1	1	0	0	0	0	0	0	0	5	V
2	0	1	0	1	1	0	1	1	1	1	0	0	0	0	0	7	III
3	1	1	0	1	1	0	0	1	1	1	0	0	0	0	0	7	III
11	0	0	0	0	1	1	1	1	0	0	1	1	0	0	0	6	IV

13	0	0	0	1	0	1	0	1	0	0	1	1	0	0	0	5	V
9	1	1	1	1	1	1	1	1	1	1	0	0	1	0	0	11	I
14	0	0	1	1	1	1	1	0	1	1	0	0	1	1	0	9	II
15	0	0	1	0	1	1	1	1	1	1	1	1	1	0	1	11	I
Dependence Power	7	7	4	8	11	9	7	8	5	5	3	3	3	1	1	82/82	
Rank	IV	IV	VII	III	I	II	IV	III	V	V	VII	VII	VIII	VIII	VIII		

7. To Develop Digraph Diagram

The identified factors are structured in levels as their existing links according to the relationships proposed in RM (Mishra et al, 2015; George et al, 2014; Thakkar et al, 2008; Qureshi, 2008). In a diagraph, factors are arranged according to levels from top to bottom as shown in figure 10.9.

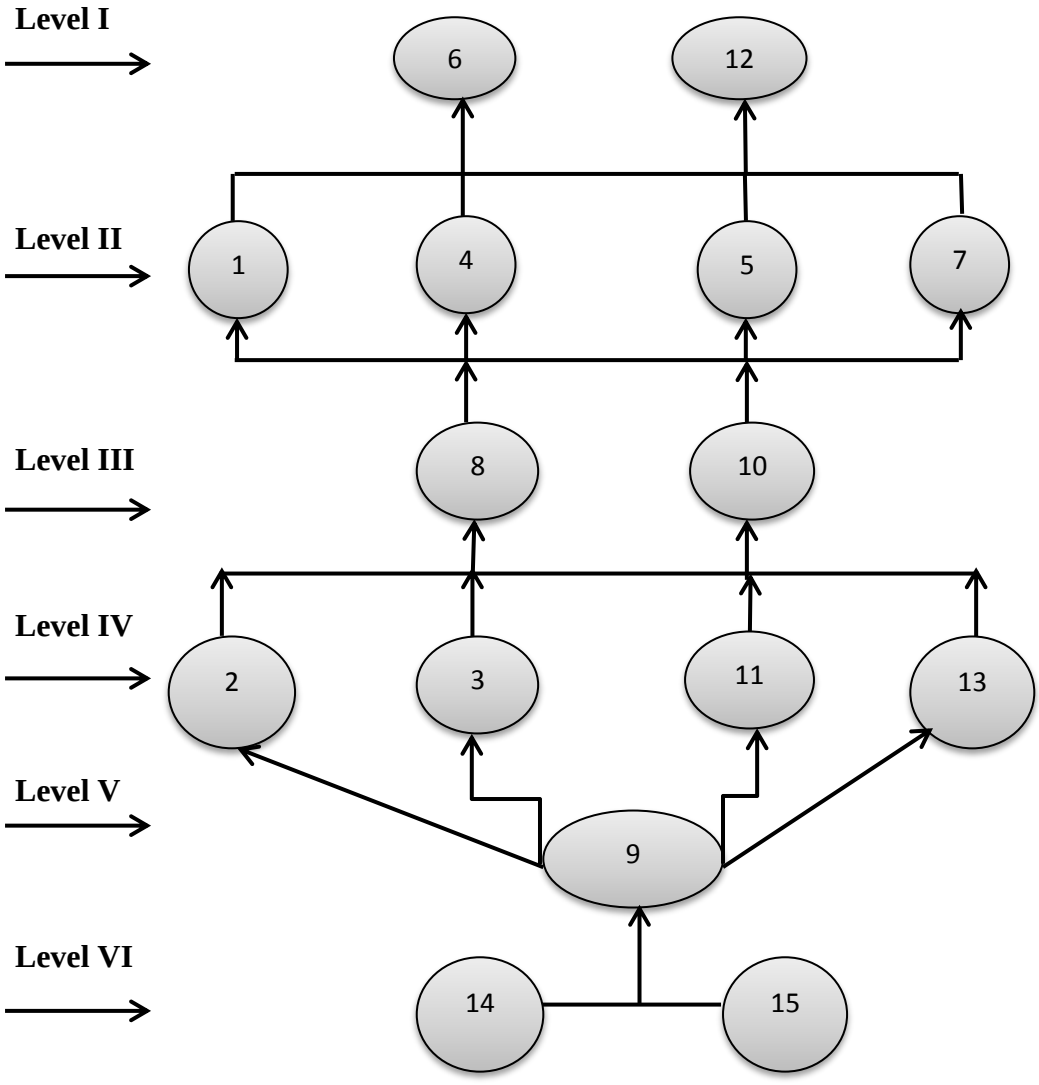

Figure 10.9 Digraph Diagram of Benchmarking of ISCM Factors with Levels

8. Development of a Model of Benchmarking for ISCM

Developed model is tested for consistency and necessary modifications are implemented (Diabat et al, 2012). ISM model for variable factors, ISCM and its benchmarking of manufacturing industry are presented in figure 10.10.

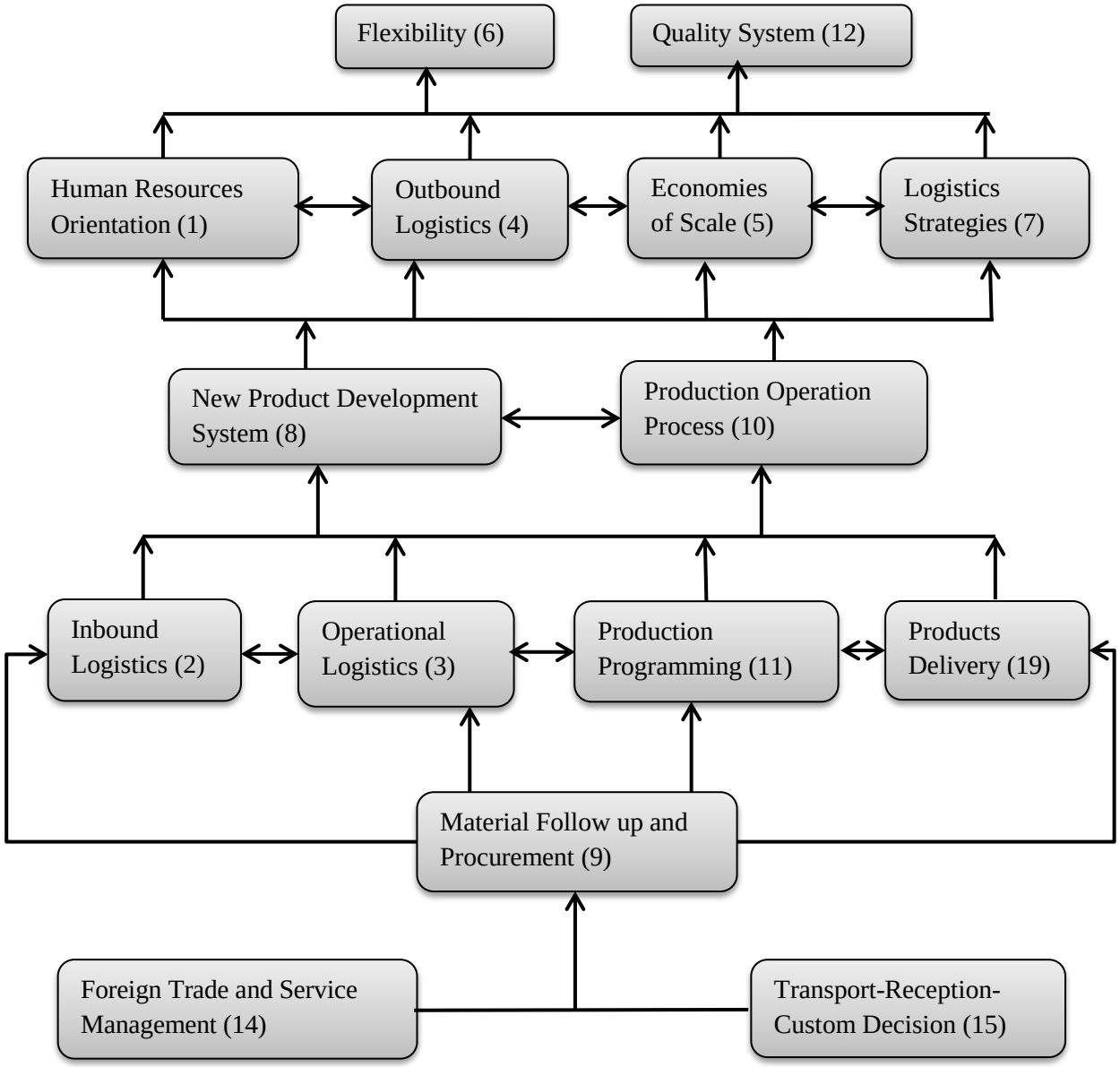

Figure 10.10 ISM Model of Benchmarking of ISCM of Manufacturing Industries

9. To classify Variable Factors into Clusters

Based on the driving and dependence power of factors they have been placed in the hierarchy levels where the factor 5, 7, 10, and 4 are highly dependent factors while the factors like 15, 14, and 9 are highly driving factors as shown in figure 10.11. Rest factors have both less dependent and less driving power.

Strong	15															
	14															
	13			**IV**									**III**			
	12															
	11	15		9												
	10															
	9	14														
	8															
Driving power	7					2,3										
	6			11												
	5			13					4,10	7						
	4											5				
	3			**I**				8					**II**			
	2				1											
	1						6	12								
Weak	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	Weak → Dependence power → Strong															

Figure 10.11 Classifications of Variable Factor into Clusters (Driving Power and Dependence Power Diagram)

Cluster I: Autonomous Variables – Factors which have low driving & dependence power are 1, 2, 3, 6, 8, 11, 12, and 13.

Cluster II: Dependent Variables – Factors having low driving power & high dependency (known as resultant variables) are 4, 5, 7, and 10

Cluster III: Linkage Variables – variables having high influence and high dependency

Cluster IV: Driving Variables – variables having high driving power & low dependency are (9, 14, and 15)

10.5.4 Ranking of Variable Factors

Rank of each variable factor is calculated by industrial questionnaire surveys and ISM approach as shown in figure 10.12.

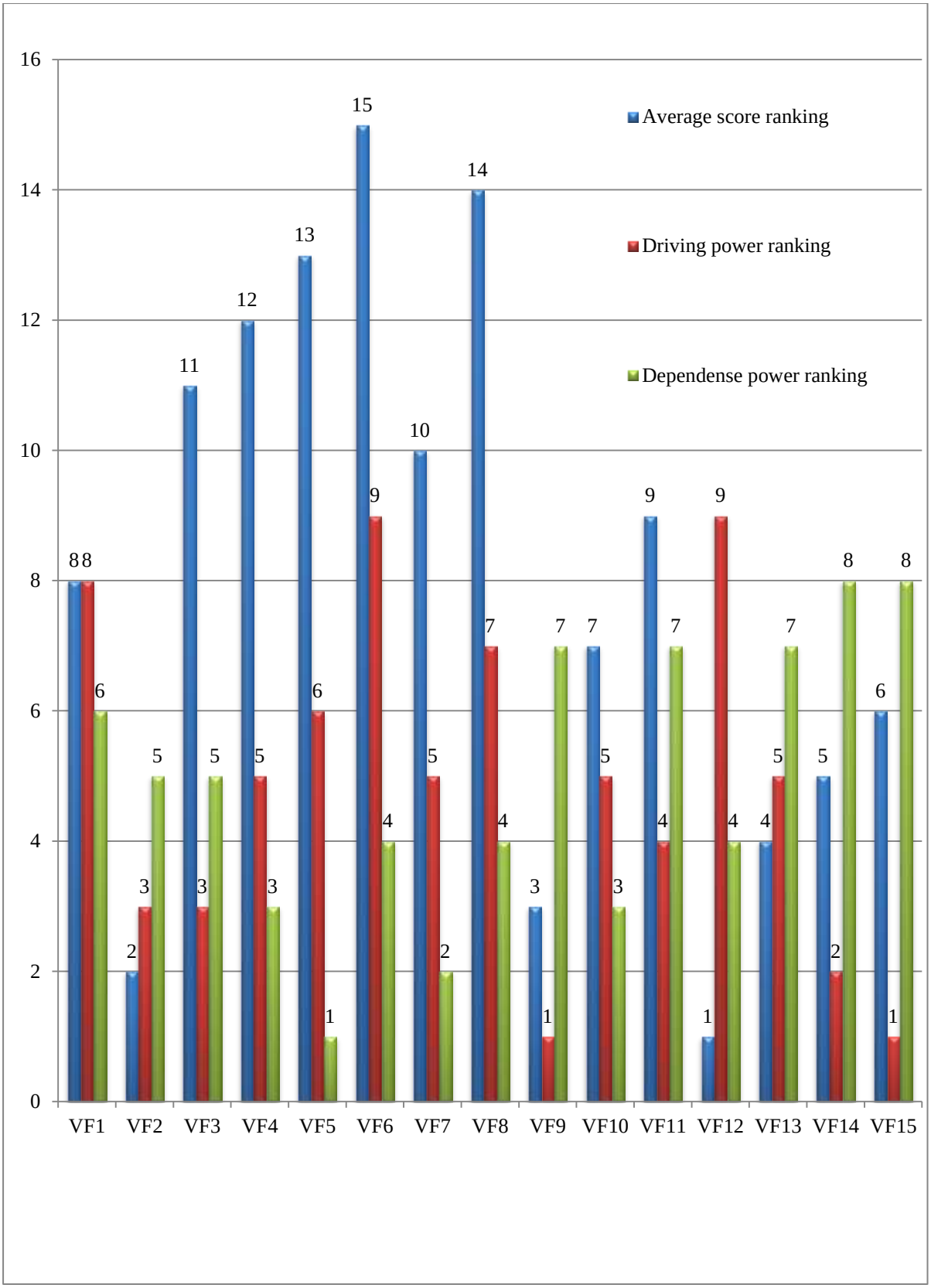

Figure 10.12 Ranking of Variable Factors of Benchmarking of ISCM Based on Industrial Surveys & ISM Approach

10.5.5 ISM Model Analysis

From the driver-dependence diagram, factors 15 (Transport-Reception-Custom Decision) and 9 (Material Follow up and Procurement) have highest driving power while factor 5 (Economies of Scale) has highest dependence power. It is observed that factor-14 (Foreign Trade and Service Management) and factor-15 (Transport Reception Custom Decision) should be implemented first and simultaneously.

CHAPTER-XI
CONCLUSION AND SUMMARY

11.1 INTRODUCTION

High customer demand and global challenges has made benchmarking of ISCM as an important aspect to be implemented in any manufacturing industry. Although various problems related to benchmarking of supply chain are extensively explored during the past decades by researchers but they have not fully justified. This is due to the wide gap existing between theoretical research and practical expectations of manufacturing industries. Low awareness regarding benchmarking practice of ISCM in selected Indian manufacturing industries motivated the researchers to pursue their research by exploring and analyzing the benchmarking practice of ISCM. It contains contributions, key findings, implication, synthesis, summary and limitation of research work, etc. The scope of future work and concluding remarks is also presented in this research work.

11.2 CONTRIBUTIONS OF RESEARCH WORK

Benchmarking of ISCM always provide help to check the existing performance of manufacturing industry and improve it by reducing performance gap. Contributions of the present study are summarized below:

- Review of concern literature has made a comprehensive background to the study.
- Identification of PMIs of benchmarking and factors, sub factors related to ISCM of selected Indian manufacturing industries.
- Extract various obstacles to implement benchmarking of ISCM.
- It provides the analysis of PMIs of benchmarking and factors of ISCM by comparative benchmarking, VIKOR methodology and DEMATEL technique.
- To find the pre-disposition of selected Indian manufacturing industries towards the importance of benchmarking of ISCM.
- CI has been found and used as a benchmark to analyze performance of selected Indian manufacturing industries.
- Benchmarking framework has been developed on the basis of literature review.
- After implementation of benchmarking framework, identify the problems related to benchmarking of ISCM in selected Indian manufacturing industries.

- Evaluate and optimize ROI taking the cases of selected Indian manufacturing industries.
- Based on W-ISM technique, Fuzzy-AHP technique, ISM technique and comparatives benchmarking technique, model of benchmarking have been developed for ISCM.
- The drive power and dependence power of variables factors have been analyzed and most significant performance measures of benchmarking, factors of ISCM have been extracted.

11.3 KEY FINDINGS OF RESEARCH WORK

The key findings of the present research work are as follows:

- Most of the Indian manufacturing industries really want to mitigate the benchmarking practice in ISCM.
- PMIs of benchmarking practice and factors of ISCM both are the most important aspects for benchmarking of ISCM.
- Improper flow of information, product and process persistently affect the operation in ISCM.
- Lack of standardization, improper use of four M's is treated as the root cause of all ISCM measures. These measures may be treated as the PMIs of benchmarking and factors of ISCM for affecting ISCM operation.
- The calculated value of CI acts as a benchmark to analyze other competitive manufacturing industries.
- Performance gap in term of idle time between the activities can be identified and analyzed on the basis of benchmarking framework.
- After reducing idle time, the calculated ROI value of X limited is better as compare to its previous value. While the ROI value of Y limited is much better as compare to X limited. Therefore, any manufacturing industry may optimize ROI by implementing benchmarking practice of ISCM.
- ISCM factors performance gap can also be analyzed through comparative benchmarking, VIKOR methodology, DEMATEL technique, WSC method, and model of benchmarking using W-ISM, Fuzzy-AHP and ISM techniques.
- Some PMIs have weak driving power but strongly depend on other PMIs.

- Linkage factors are: “Financial performance (PM 1), make performance (PM 4), delivery performance (PM 5), sales performance (PM 6) and customer services & satisfaction performance (PM 7)”. Each factor has strong driving power as well as strong dependence power.
- Plan performance (PM 2), source performance (PM 3) both have a strong driving power but weak dependence power.
- “Transport reception custom decision” & “Material follow up and procurement” both have high driving power whereas “Economies of scale” has high dependence power.

11.4 IMPLICATIONS OF RESEARCH WORK

The present research implications are useful to improve the ISCM performance of manufacturing industries. Researchers can use benchmarking for taking the appropriate decision in a competitive environment. Different type of tool and techniques are suggested to deal with benchmarking of ISCM. Questionnaire survey can be used as an instrument to carry out further research in the domain of benchmarking of ISCM. The calculation of CI may lead to develop similar indexes for different parts of ISCM. The developed benchmarking framework, optimize ROI and W-ISM, Fuzzy-AHP and ISM models of benchmarking help to impose order and direction on the complexity and relationship in different factors. Decision makers can adopt the best ISCM by modelling and analyzing different factors. The implication of quantitative/qualitative techniques is highly desirable and can fetch maximum benefit to improve the ISCM performance. Necessary actions to improve the weak areas of benchmarking of ISCM to address the highly influenced factors can be taken for the benefit of any organization.

11.5 SYNTHESIS OF RESEARCH WORK

In a competitive environment, benchmarking practice of ISCM may reduce the idle time or improve the performance of manufacturing sectors. This section presented the overview of research work which includes all previous chapters. The introduction of benchmarking of ISCM has been discussed in chapter I. In chapter II, effective factors, different tool/techniques, framework and model have been explored on the basis of literature review. Research methodology has been presented in chapter III.

Chapter IV consist of proposed and achieved research objectives. The PMIs of benchmarking and factors, sub factors of ISCM have been identified in chapter V. In chapter VI, data collection has been done through questionnaire after that comparative benchmarking, VIKOR methodology, DEMATEL techniques have been used to carry out factor analysis. Chapter VII consists of development of benchmark using WSC, Supplier selection criteria and CI which can be used to analyze the selected Indian manufacturing industries. Chapter VIII consist of benchmarking framework for Indian manufacturing industries which was developed on the basis of literature and industrial survey. The evaluation of ROI and its optimization after implementation of benchmarking framework in manufacturing industries has been discussed in chapter IX. Different model of benchmarking using W-ISM, Fuzzy AHP and ISM techniques have been presented in chapter X. At last stage chapter XI consist of the ultimate conclusion and summary. In present research work, following methodologies have been used in achieving research objectives as shown in table 11.1.

Table 11.1 Methodologies Used in Research Work

S. No.	Objectives	Methodology used
1	Identification of PMIs of Benchmarking	• Literature review • Expert's opinion (Academics/Industries) • Industrial questionnaire survey • Comparative benchmarking, VIKOR methodology and DEMATEL technique have been used for factor analysis
2	Development of a Benchmark for analyzing Indian Manufacturing Industries	• Supplier selection criteria • Comparative benchmarking using WSC • Competitiveness Index (CI)
3	To develop Benchmarking Framework for ISCM in Manufacturing Organization	• Literature review • Case studies • Comparative analysis • Flow chart • Benchmarking practice
4	To Optimize ROI taking cases of Indian Manufacturing Industries	• Literature review • Implementation of benchmarking framework in heavy fabrication works manufacturing industries
5	To Develop a Model of Benchmarking for ISCM	• W-ISM technique • Fuzzy-AHP technique • ISM technique

11.6 SUMMARY OF RESEARCH WORK

Role of benchmarking in the field of ISCM has been studied. This research work includes the following:

- It describes the objective of research, benchmarking and ISCM, importance of benchmarking of ISCM in selected Indian manufacturing industries, obstacles in ISCM implementation, benefits of ISCM implementation, key issues & challenges and gaps in literature, etc.
- Propagation of research on benchmarking and SCM in the last 31years has been reviewed. The survey of literature provides the information about benchmarking, their types, process, methodology and various other types of classification and categorization of benchmarking publications in different areas, different outcomes related to research publications applied in different fields like manufacturing industries, education, engineering, automobile industry, library, textile, publication, service sectors, etc.
- Extensive literature review was conducted to identify some relevant PMIs of benchmarking, factors, sub factors of ISCM. A questionnaire was designed to obtain responses from industrial and academic experts that helped to understand the impact of benchmarking of ISCM in some selected Indian manufacturing industries.
- PMIs of benchmarking and factors of ISCM were studied based on survey responses. Some manufacturing industries focused on PMIs of benchmarking and factors of ISCM of manufacturing industry. Followings PMIs of benchmarking and factors of ISCM were considered:

  PMIs of Benchmarking: "Financial performances, plan performance, source performance, make performance, delivery performance, sales performance, customer service and satisfaction".

  Factors of ISCM: "Human resources orientation, inbound logistics, operational logistics, outbound logistics economies of scale, flexibility, logistics strategies, new product development system, material follow up and procurement, production operation process, production programming, quality system, products delivery, foreign trade and service management and transport reception custom decision, etc."

- A comprehensive literature review on ISCM relationship, benchmarking and SCM has been presented. Different authors have developed different frameworks and models to study the supply chain relationship and benchmarking. However, the work published in the field of benchmarking of ISCM is not significant. Therefore, benchmarking practice in ISCM of Indian manufacturing industries should be improved and augmented.
- Out of the various PMIs, the calculated maximum score of inbound logistics and quality systems is 24.29 and 24.83, respectively. Therefore, these factors act as a benchmark for remaining thirteen factors for continuous improvement of less scoring factors. The qualitative and quantitative techniques are helpful to improve the scores of factors while persistent comparative benchmarking practice can assist to find the gap between factors.
- VIKOR methodology has been used to analyze different PMIs of benchmarking and factors of ISCM. It is very helpful for considering best alternatives out of all available multiple factors based on their ranking. The selection of best factors of ISCM benchmarking is a challenge for manufacturing industries. Researchers and industrialist can easily use VIKOR methodology to distinguish best and worst alternative variable factors providing insight to focus on worst factors and then improved them without wastage of time to improve the performance of ISCM. Thus, it is clear that attribute (factor F_8-New product development system) is the best factor and attribute (factor F_{12}-Quality system) is the worst factor.
- DEMATEL technique has been used to analyze different PMIs of benchmarking and factors of ISCM considering different factors associated with benchmarking of ISCM. The implementation of DEMATEL technique yielded the priorities of different factors. These factors are based on extensive review of literature. The direct influence matrix has been prepared on the basis of brainstorming activity with experienced managers like: Mr. Kamal Kant Bhandari (General Manager), Mr. Sanjay Singh (Manager), Mr. Gajender Sharma (Manager), Mr. Sarabjeet Singh (Genaral Manager), Mr. Ahibhushan Dviwedi (Manager), etc of heavy fabrication works manufacturing industries. After that the normalized influence matrix, total influence matrix have been developed, establishing a cause and effect relationship amongst the factors. The cause group consists of seven factors

("human resources orientation, inbound logistics, flexibility, logistics strategies, material follow up and procurement, foreign trade and service management, and transport reception custom decision") while effects group consists eight factors ("operational logistics, outbound logistics, and economies of scale, new product development system, production operation process, production programming, quality system and products delivery"). From the result obtained, it is clear that quality system is highest degree of relationship as compare to other factors. Therefore, quality system receives the maximum influence from other factors.

- Supplier selection rating criteria based on AHP model is developed containing multiple factors like: location of supplier, quality of product, quantity of product, trust of supplier, price of product, goodwill of vendors, environment preference, experience of vendor, etc. Expectations of customers, integration of ISCM, distribution process, role of distributors, classification of distribution, role of delivery person, AHP hierarchy model for supplier selection, supplier rating, etc, were also considered for the study. Thus, the major importance of each constituent of supply chain is studied. These constituents continuously affect the ISCM performance of manufacturing industries and hence, provide help to develop a benchmark. The selection of supplier is based on those factors which has the highest score. Therefore, "while selecting best supplier, factors like location of supplier, quality of product, quantity of product, trust are very important factors as compare to other factors".
- The comparative benchmarking practice has been used to quantify the ISCM performance gap in selected Indian manufacturing industries. PMIs affecting the operation of WSC for comparative benchmarking of ISCM are identified. The weight score for comparative benchmarking of ISCM is determined that can be evaluated through manufacturing industries.
- The weight scores of each PMIs of both manufacturing organisation A and B have compared through bar charts. The performance of B is better than A for year 2013 and 2015 except production performance (P4) in 2014. This concludes that organisation B implemented best benchmarking practices and has better weight score of benchmarking for ISCM as compared to organisation A. While organization A act as a benchmark only in case of production performance (P4) in 2014. Therefore, organization A can identify the areas for improvement of

ISCM with respect to organization B. Organization A need to improve in areas of "financial performance, plan performance, source performance, delivery performance, sales performances, customer service and satisfaction".

- The competitive benchmarking index has been used to analyze the variables and determine the weak areas of selected Indian manufacturing industries. A benchmark using various performance measures like: "finance performance (P1), plan performance (P2), source performance (P3), make performance (P4), delivery performance (P5), sales performance (P6), customer services and satisfaction (P7)" was presented and applied in ABC limited. The benchmark using competitiveness index (CI) can improve the performance in weakest areas manufacturing industries.
- The value of benchmark for analyzing ABC limited using CI is obtained as 2.02, while theoretically the CI value may range between –3.70 to +3.70. The value of CI lies below the theoretical value of CI. Therefore, less scoring performance measures have to be improved. Hence, CI value of ABC limited can act as a benchmark for its competitors. However, any type of manufacturing industries can use this benchmark based on CI to identify the weak performance measure of supply chain and also perform analysis of manufacturing industries.
- Benchmarking framework has been developed which includes different PMIs of benchmarking, factors of ISCM. The objective of flow chart of benchmarking framework is to identify the performance gap. A theoretical benchmarking framework for ISCM is developed and implemented in selected Indian manufacturing industries (X limited and Y limited) to analyze the interactions of ISCM and its effects on customer satisfaction. The internal supply chain of X limited & Y limited is observed and then ISCM problems and its root cause are identified and implemented the corrective measure actions with their effect by reducing idle time between activities and existing cost of the product. The effective implementation of ISCM should also increase the safety, reduces the fatigue of employees and increase the existing production rate of manufacturing industries. The calculated length of inventory in days of X limited is more than the inventory length of Y limited; therefore, the performance of ISCM of Y limited is better than X limited. Thus, implementation of benchmarking framework for ISCM practice in X limited is needed. Y limited is top heavy

fabrication construction equipment's manufacturing industry and the performance measures of Y limited acts as a benchmark for other competitors including X limited.

- The benchmarking framework for ISCM increases the competition in the market and provides help to the manufacturer willing improve their existing performance. Calculation on ROI and its optimization is done for theoretical benchmarking framework. It was found that the ROI of Y limited is more and act as benchmark for X limited.
- W-ISM technique, ISM and MICMAC analysis are used to find out the driving power and dependence power of factors and to develop various models of benchmarking of ISCM. The developed W-ISM, ISM models helped in understanding the mutual relationship of factors affecting the benchmarking of ISCM. MICMAC analysis indicates the interaction among variables of benchmarking of ISCM and its effects for creating better commercial composition in heavy fabrication construction equipment's manufacturing industry necessary to enhance the ISCM systems. The relationship between variables and issues of benchmarking of ISCM is shown by digraph approach. The presented model provides relationship among various performance measures and establishes hierarchy among them by identifying the root performance measures. "Plan performance (PM 2), source performance (PM 3) measures have a strong drive power but weak dependence power. While other performance measures: financial performance (PM 1), make performance (PM 4), delivery performance (PM 5), sales performance (PM 6) and customer services & satisfaction performance (PM 7) have a strong drive power as well as strong dependence power. The calculated competitive weight values of plan performance, financial performance and customer service and satisfaction are much better as compare to other performance measures of benchmarking".
- Fuzzy AHP technique has been used to analyze factors. PMIs weightage is identified and its significant effect on the operation of model of benchmarking of ISCM. An ISM and fuzzy - AHP techniques are used to find out the interrelationship between PMIs of benchmarking of ISCM. The overall performance determinant value of A limited is 50937057447402.2, which is more as compared to its competitor B limited determinant value

12967714812803.6. Thus, A limited have used best practices of benchmarking and also have better model of benchmarking for ISCM as compared to B limited. It has been observed that B limited needs improvement in area of "financial performance, plan performance, source performance, make performance, delivery performance, sales performances, customer service and satisfaction".

- Based on ranks of factors, ISCM performance gap between variable factors can be easily identified. Therefore, manufacturing industry could improve low ranked factors while retaining high ranked factor. This model of benchmarking based on ISM technique would be helpful for manufacturing industries in initiation and implementation activity of benchmarking of ISCM system. The decision makers can easily identify and classify the variable factors that have either strong dependence power or strong driving power or both. For example: "Factors like Human resources orientation (1), inbound logistics (2), operational logistics (3), flexibility (6), new product development system (8), production programming (11), quality system (12) and products delivery (13) have low driving & dependence power, whereas factors like outbound logistics (4), economies of scale (5), logistics strategies (7), and production operation process (10) have low driving power & high dependency, and factors like material follow up and procurement (9), foreign trade and service management (14) and transport reception custom decision (15) have high driving power & low dependency.
- ISCM benchmarking strategy is needed through senior executives. Senior managers understand the importance of benchmarking of ISCM and realize that benchmarking practice is a necessity to provide the information for best ISCM decisions. Therefore, this concept of benchmarking in the field of ISCM may be efficient for improving the existing performance of traditional manufacturing industries as compared to conventional working of manufacturing industries in India.

11.7 LIMITATION OF RESEARCH WORK

The present study explains only about benchmarking, PMIs of benchmarking, factors of ISCM for improving the performance of ISCM of some selected Indian manufacturing industries. Efforts have been made to analyze the impact of variables like: PMIs of benchmarking and factors of ISCM. However, the present research is

not free from lacunas. The major limitation is that all problems related to ISCM were not considered in the present study, only the problems related to idle time in ISCM were identified for analysis. Expert's opinions are also required to develop the contextual relationships for different models of benchmarking, benchmarking framework for ISCM and benchmark for analyzing selected Indian manufacturing industries while the study was conducted specifically for selected heavy fabricated work only. The outcome of such study may differ slightly in industries in other countries depending upon their geographical locations. However, further research can be extended to following directions:

- The models developed during the study by techniques like W-ISM; Fuzzy-AHP and ISM, can be validated using structural equation modelling (SEM).
- Different supply chain problems affecting the ISCM of manufacturing industries can be identified to develop models of benchmarking based on W-ISM; Fuzzy-AHP and ISM techniques based models.
- Interaction among the variable factors can be analyzed using VIKOR methodology, DEMATEL, W-ISM, Fuzzy-AHP and ISM techniques.
- Different types of benchmarking like product, process, functional and generic benchmarking, etc can be considered to analyze ISCM of selected Indian manufacturing industries.
- The comparative study can be carried out by some other techniques like total interpretive structure modelling (TISM), genetic algorithm (GA), simple additive weighting (SAW) method and weighted product method (WPM), etc.
- Case study regarding different problems related to ISCM for some specific manufacturing industries can be done.

11.8 SCOPE FOR FUTURE WORK

Attempts can also be made to verify the same results for other industries excluding Indian manufacturing industries. The present literature on benchmarking and ISCM are inadequate to understand the industrial need and thus they offer scope for further research and exploration in the area of benchmarking of ISCM.

- This study results in classification & categorizations of research papers on the basis of (year, functional area, national/international journals and national/international conferences, etc). Manufacturer can analyze various

functional areas focusing on weak functional area of industry and find solutions to turn them into strengths. The work can be extended to benchmarking of ISCM as well as ESCM in manufacturing industries.

- The study utilized comparative benchmarking practice in ISCM for identification of performance factor's gap.
- PMIs of benchmarking, benchmark, benchmarking framework and models of benchmarking are helpful for executives to focus on transition to advanced ISCM system from conventional system.
- "Using SEM, the ISM model may be verified since it has the capability of testing the validity of such hypothetical models. It is worth mentioning that SEM can't develop an initial model for testing, whereas ISM has this capability." This work is based only on questionnaire survey and experts opinions. The data analysis has been used only for manufacturing industries.
- Seven key performance indicators were used for additional analysis and this work can also be included specifically for the analysis of any business organisations in the word. A weight score card for comparative benchmarking of ISCM is used. With such type of modelling approach, the supply chain managers can easily benchmark the performance of ISCM and analyze the effectiveness of their strategies leading to identification of the potential opportunities.

11.9 CONCLUDING REMARKS

Benchmarking is a continuous practice tool which may be implemented in multidisciplinary areas to overcome the existing gap indicating the necessity of benchmarking of ISCM in manufacturing industries. The literature identifies the gap between past and present, then distinguishing the scope of benchmarking of ISCM in Indian manufacturing industries. Adequate literature is available on benchmarking and SCM. Benchmarking practice is a way to overcome barriers of entire ISCM process.

The present study was objected to review and analyze the benchmarking of ISCM and develop benchmarking frameworks and models of benchmarking in selected Indian manufacturing industries. Questionnaires were developed on the basis of identified variable factors. A benchmark has been developed on the basis of CI. Case studies of Indian manufacturing industries have been carried out to identify the problem related

to ISCM. Implementation of benchmarking frameworks, performance gap identification and evaluation of optimized ROI of manufacturing industries has been done in research. W-ISM, Fuzzy AHP and ISM techniques have been used to develop different model of benchmarking. Conclusion of all chapters can be briefed as follows:

- Benchmarking of ISCM is a continuous practice process which may be used to find the performance gap between the existing ISCM processes. It helps to address the benchmarking of ISCM and to identify influence of benchmarking & ISCM factors in different areas of manufacturing industries.
- The comparative benchmarking technique provides hint to identifying and eliminate ISCM performance factor's gaps for growth of Indian economy.
- Only relevant PMIs of benchmarking, factors and sub factors of ISCM are identified. Similarly, other PMIs of benchmarking and factors of ISCM can also be identified through literature review. Research on critical benchmarking PMIs can be a valuable step towards enhancing chances of improvement of ISCM performance in selected Indian manufacturing industries.
- Industrial questionnaire survey is best way to collect the expert's opinions. The analysis of factors can be done using comparative benchmarking, VIKOR methodology and DEMATEL technique, etc. Variable factors of benchmarking of ISCM not only enable manufacturing industries to change the system as per business needs but also give them edge and act as benchmark over other competitors.
- Firms can identify areas of opportunity for improvement in their ISCM using CI as a benchmark. The best practice of this conceptual benchmark would be helpful to analyze the performance measures of manufacturing industries.
- The decision making activity at all levels i.e. strategic level, operational level and tactical level have been identified. In order to analyze benchmark, this research work has come across a case study in some selected Indian manufacturing industries. The gap related to factors, sub factors, functional activities of manufacturing industry and its competitors has been identified. Therefore, benchmarking framework would be helpful to overcome the ISCM performance gap between competitors, to optimize ROI of manufacturing industries.

- The contribution of hybrid approach like W-ISM technique may be used by engineers and managers to analyze as well as determine the interrelationship between variables. It is good to evaluate the effect of factors for their better treatment.
- Fuzzy AHP technique may also be used to find out the interrelationship between PMIs of manufacturing, design and thermal sectors. The model of benchmarking and comparison bar charts is used to achieve precise and accurate results of data analysis.
- ISM model would be helpful for manufacturing industries in initiation and implementation activity of benchmarking of ISCM system. Thus, decision makers can easily identify and classify variable factors that have either strong dependence power or strong driving power or both.

REFERENCES

Abdul Rahman N S F, Ismail A and Lun V Y H, (2016), 'Preliminary study on new container stacking/storage system due to space limitations in container yard', Maritime Business Review, Vol.1, No.1, pp.21-39.

Abdullah H, (2009), 'Major challenges to the effective management of human resource training and development activities', The Journal of International Social Research, Vol.2, No.8, pp.11-25.

Ahmed, Z H, (2014) 'Improved genetic algorithms for the travelling salesman problem', International Journal of Process Management and Benchmarking, Vol.4, No.1, pp.109-124.

Abdulrahman M D, Gunasekaran A and Subramanian N, (2014), 'Critical barriers in implementing reverse logistics in the Chinese manufacturing sectors', International Journal Production Economics, Vol.147, pp.460-471.

Adam P and Vandewater R, (1995), 'Benchmarking and the bottom line: Translating business reengineering into bottom line results', Industrial Engineering-Norcross, Vol.27, No.2, pp.24-27.

Adis A A A and Jublee E, (2010), 'Market orientation and new product performance: The mediating role of product advantage', African Journal of Marketing Management, Vol.2, No.5, pp.91-100.

Agboyi M R, Obiri Y and Ackah D, (2015), 'The impact of sourcing on the delivery of raw material', International Journal of Advanced Research in Computer Science and Software Engineering, Vol.5, No.8, pp.108-122.

Aggarwal A K, Kumar S and Singh V, (2016), 'Reliability and availability analysis of the serial processes in skim milk powder system of a dairy plant: a case study', International Journal of Industrial and Systems Engineering, Vol.22, No.1, pp.36-62.

Agha S R, (2008), 'Evaluating and benchmarking non-governmental training programs: an analytic hierarchy approach', Jordan Journal of Mechanical and Industrial Engineering, Vol.2, No.2, pp.77-84.

Agrawal J, Richardson P S and Grimm P E, (1996), 'The relationship between warranty and product reliability', Journal of Consumer Affairs, Vol.30, No.2, pp.421-443.

Ahmed P K and Zairi M, (1999), 'Supply chain partnerships-theory and example of best practice', Benchmarking: An International Journal, Vol.6, No.1, pp.78-95.

Aishah T N, Pyeman J and Tajuddin R M, (2013), 'Integration of the internal supply chain management (SCM) towards long run competitiveness', Management, Vol.3, No.1, pp.12-15.

Alad A H and Deshpande V A, (2014), 'A review of various tools and techniques for lead time reduction', International Journal of Engineering Development and Research, Vol.2, No.1, pp.1159-1164.

Albarune A R B and Habib D M M, (2015), 'A study of forecasting practices in supply chain management', International Journal of Supply Chain Management, Vol.4, No.2, pp.55-61.

Alexander K and Stefan S, (2016), 'The effect of logistics outsourcing on the supply chain vulnerability of shippers: Development of a conceptual risk management framework', International Journal of Logistics Management, Vol.27, No.1, pp.122-141.

Al-kuhali K, Zain Z M and Hussein M I, (2012), 'Production planning of LCDs: optimal linear programming and sensitivity analysis', Industrial Engineering Letters, Vol.2, No.9, pp.1-10.

Allan F C, (1993), 'Practical aspects for information professionals', Special Libraries, Vol.84, No.3, pp. 123-130.

Al Zaabi S, Al Dhaheri N and Diabat A, (2013), 'Analysis of interaction between the barriers for the implementation of sustainable supply chain management', The International Journal of Advanced Manufacturing Technology, Vol.68, No.(1-4), pp.895-905.

Ambe I M and Badenhorst Weiss J A (2011), 'An automotive supply chain model for a demand-driven environment', Journal of Transport and Supply Chain Management, Vol.5, No.1, pp.1-22.

American Productivity & Quality Center, (1996), 'Emerging Best Practice in Knowledge Management', American Productivity & Quality Center, Houston, TX.

Amiri M, Sadaghiyania J S, Payanib N and Shafieezadeh M, (2011), 'Developing a DEMATEL method to prioritize distribution centers in supply chain', Management Science Letters, Vol.1, No.3, pp.279-288.

Anand G and Kodali R, (2008), 'Benchmarking the benchmarking models', Benchmarking: An International Journal, Vol.15, No.3, pp.257-291.

Anbanandam R, Banwet D K and Shankar R, (2011), 'Evaluation of supply chain collaboration: a case of apparel retail industry in India', International Journal of Productivity and Performance Management, Vol.60, No.2, pp.82-98.

Anderson J C and Narus J A, (1984), 'A model of the distributor's perspective of distributor-manufacturer working relationships', The Journal of Marketing, Vol. 48, No.4, pp. 62-74.

Anderson B, (1994), 'A benchmarking process model-The benchmarking wheel', Proceedings from the 10th International conference of the Israel society for quality Jerusalem.

Angkiriwang R, Pujawan, I N and Santosa B, (2014), 'Managing uncertainty through supply chain flexibility: reactive vs. proactive approaches', Production & Manufacturing Research, Vol.2, No.1, pp.50-70.

Anuja A and Arulrajah A A, (2013), 'Team working practices and team orientation of employee: A Comparative Study between the State and Private Banks in Sri Lanka', Sri Lankan Journal of Human Resource Management, Vol.4, No.1, pp.49-61.

Anwar R S and Ali S, (2015), 'Economies of Scale', International Interdisciplinary Journal of Scholarly Research, Vol.1, No.1, pp.51-57.

Aref W, Catlin A C, Elmagarmid A, Fan J, Hammad M, Ilyas I and Zhu X, (2004), 'VDBMS: A test bed facility for research in video database benchmarking', Multimedia Systems, Vol.9, No.6, pp.575-585.

Armstrong, Harvey, Ballas D, and Staines A, (2006), 'A comparative analysis of the economic performance of Greek and British small Islands', In 36th regional science association international (British and Irish Section) conference, Jersey, Channel Islands, pp.16-18.

Ashrafuzzaman Md, Al-Maruf A, Mahbubul I M, Abdul Malek A B M and Mukaddes A M M, (2016), 'Quality function deployment approach to measure supply chain performance: a case study on garments accessories industries', International Journal of Industrial and Systems Engineering, Vol.22, No.1, pp.96-120.

Azadegan A and Dooley K J, (2010), 'Supplier innovativeness, organizational learning styles and manufacturer performance: An empirical assessment', Journal of Operations Management, Vol.28, No.6, pp.488-505.

Baby S, (2013), 'AHP modeling for multi criteria decision-making and to optimize strategies for protecting coastal landscape resources', International Journal of Innovation, Management and Technology, Vol.4, No.2, pp.218-227.

Bacidore J M, Boquist J A, Milbourn T T and Thakor A V, (1997), 'The search for the best financial performance measure', Financial Analysts Journal, Vol.53, No.3, pp.11-20.

Badrinath R, Mahesh K, Larre Orono H, Khari M and Williams C, (1998), 'Benchmarking for small enterprises: the international competitive gauge', International Trade Forum, No. 2, pp. 14-19.

Bag S, Anand N, and Pandey K K, (2014), 'A framework for the analysis of sustainable supply chain management: An insight from Indian rubber industry', Journal of Supply Chain Management Systems, Vol.3, No.1, pp.68-83.

Bai C and Sarkis J, (2010), 'Green supplier development: analytical evaluation using rough set theory, Journal of Cleaner Production, Vol.18, No.12, pp.1200-1210.

Balaji M, Swathi S and RajBenno J B, (2016), 'Interpretive structural models in assessment of supply chain agility index', International Journal of Advances in Engineering Research, Vol.11, No.4, pp.96-102.

Balm G J, (1996), 'Benchmarking and Gap analysis: what is the next milestone?', Benchmarking for Quality Management and Technology, Vol.3, No.4, pp. 28-33.

Balogun O S**,** Jolayemi E T, Akingbade T J and Muazu H G, (2012), 'use of linear programming for optimal production in a production line in Coca-Cola bottling company', Ilorin, International Journal of Engineering Research and Applications, Vol.2, No.5, pp.2004-2007.

Baltacioglu T, Ada E, Kaplan M D, Yurt And O and Cem KaplanY, (2007), 'A new framework for service supply chains', The Service Industries Journal, Vol.27, No.2, pp.105-124.

Baltacioglu T and Kaplan M D, (2006), 'The Era of collaboration through supply chain networks', Proceedings of 4th International Logistics and Supply Chain Congress, Izmir Turkey.

Banduka N, Veza I and Bilic B, (2016), 'An integrated lean approach to Process Failure Mode and Effect Analysis (PFMEA): A case study from automotive industry', Advances in Production Engineering & Management Journal, Vol.11, No.4, pp.355-365.

Bartlett P A, Julien D M and Baines T S, (2007), 'Improving supply chain performance through improved visibility', The International Journal of Logistics Management, Vol.18, No.2, pp.294-313.

Batson R G and McGough K D, (2007), 'A new direction in quality engineering: supply chain quality modeling', International Journal of Production Research, Vol.45, No.23, pp.5455-5464.

Batuhan K, Gulsun B and Tanyaş M, (2013), 'A SCOR based approach for measuring a benchmarkable supply chain performance,' Journal of Intelligent Manufacturing, Vol.24, No.1, pp.113-132.

Beach R, Muhlemann A P, Price D H R, Paterson A and Sharp J, (2000), 'A review of manufacturing flexibility', European journal of operational research, Vol.122, No.1, pp.41-57.

Beamon B M, (1999), 'Measuring supply chain performance', International Journal of operations & Production Management, Vol.19, No.3, pp.275-292.

Bean T J and Gros J G (1992), 'Quality in R&D: R&D Benchmarking at AT&T', Research-Technology Management, Vol.35, No.4, pp.32-37.

Bekaert G and Harvey C R, (2002), 'Research in emerging markets finance: looking to the future', Emerging markets review, Vol.3, No.4, pp.429-448.

Bell R A and Morey R C, (1994), 'The search for appropriate benchmarking partners: a macro approach and application to corporate travel management', Omega, Vol.22, No.5, pp.477-490.

Bello and Suarez M J, (2003), 'A case study approach to the supplier selection process', Master of engineering, Management Systems Engineering, University of Puertorico mayaguez campus.

Beretta S, Dossi A and Grove H, (1998), 'Methodological strategies for benchmarking accounting processes', Benchmarking for Quality Management & Technology, Vol.5, No.3, pp.165-183.

Berry S T, (1994), 'Estimating discrete-choice models of product differentiation', The RAND Journal of Economics, pp. 242-262.

Bertsimas D and Simchi Levi D, (1994), 'The New Generation of Vehicle Routing Research: Robust Algorithms Addressing Uncertainty', Operations Research, Vol.44, No.2, pp. 286-304.

Bettayeb B, Bassetto S J, Sahnoun M, (2014), 'Quality control planning to prevent excessive scrap production', Journal of Manufacturing Systems, Vol.33, No.3, pp.400-411.

Bhagwat R and Sharma M K, (2007), 'Performance measurement of supply chain management using the analytical hierarchy process', Production Planning & Control, Vol.18, No.8, pp.666-680.

Bhargava M G, Chaitanya Kumar J D, (2015), 'State of Art of Usage of Alternative Materials in Concrete', International Journal of Engineering Sciences & Management Research, Vol.2, No.12, pp.32-37.

Bhat V N, (1995), 'Benchmarking for environmental excellence', Industrial Management, Vol.37, No.1, pp.9-11.

Bhuiyan N, (2011), 'A framework for successful new product development', Journal of Industrial Engineering and Management, Vol.4, No.4, pp.746-770.

Bhutta K S and Huq F, (1999), 'Benchmarking-best practices: an integrated approach', Benchmarking: An International Journal, Vol.6, No.3, pp.254-268.

Bienstock D, Bramel J and Simchi Levi D, (1993), 'A Probabilistic Analysis of Tour Partitioning Heuristics for the Capacitated Vehicle Routing Problem with un split Demands', Mathematics of Operations Research, Vol.18, No.4, pp.786-802.

Bigliardi B and Bottani E, (2014), 'Supply chain performance measurement: a literature review and pilot study among Italian manufacturing companies', International Journal of Engineering, Science and Technology, Vol.6, No.3, pp.1-16.

Bin Y, Wang K, Wang, C and Yao B, (2017), 'Ship scheduling problems in tramp shipping considering static and spot cargoes', International Journal of Shipping and Transport Logistics, Vol.9, No.4, pp.391-416.

Bindu R S and Ahuja B B, (2010), 'Rejuvenating the supply chain by benchmarking using fuzzy cross boundary performance evaluation approach', International Journal of Engineering and Technology, Vol.2, No.6, pp.547-555.

Binshan L, (1991), 'Quality control information systems in manufacturing: considerations and concerns for management', International Journal of Operations & Production Management, Vol.11, No.1, pp.41-50.

Blackwell M, (1994), 'Building strong ties', Distribution, Vol.93, No.16, pp.42-43.

Blanquart C and Burmeister A, (2009), 'Evaluating the performance of freight transport: a service approach', European Transport Research Review, Vol.1, No.3, pp.135-145.

Blaser J and Westbrook B, (1995), 'The supply chain revolution: is your company its own worst enemy?', APICS-the Performance Advantage, Vol.5, No.1, pp.43-48.

Blinn J D, (1998), 'Benchmarking can help control cost of risk', National Underwriter, Vol.26, pp.24-25.

Bloom N and Reenen J V, (2010), 'Human Resource Management and Productivity', National Bureau of Economic Research Working Paper 16019, pp.1-88.

Boer D L, Labro E and Morlacchi P, (2001), 'A review of methods supporting supplier selection', European Journal of Purchasing and Supply Management, Vol.7, No.2, pp.75-89.

Bogan C E and English M J, (1994), 'Benchmarking for Best Practices: Winning through Innovative Adaptation', McGraw-Hill, New York.

Bolanos R, Fontela E, Nenclares A and Paster P, (2005), 'Using interpretative structural modeling in strategic decision-making groups', Management Decision, Vol.43, No.6, pp.877-895.

Boubekri N, (2001), 'Technology enablers for supply chain management', Integrated Manufacturing Systems, Vol.12, No.6, pp.394-399.

Bowman C and Faulkner D, (1994), 'Measuring product advantage using competitive benchmarking and customer perceptions', Long Range Planning, Vol.27, No.1, pp.119-132.

Bracken D W, (1992), 'Benchmarking employee attitudes', Training and Development, Vol.46, No.6, pp.49-54.

Brah S A, Lin O A and Madhu R B, (2000), 'Understanding the benchmarking process in Singapore', Benchmarking: an International Journal, Vol.17, No.3, pp. 259-275.

Bramel J E G, Coffman W S and Simchi Levi D, (1992), 'Probabilistic Analysis of Capacitated Vehicle Routing Problem with un split Demands', Operations Research, Vol.40, No.6, pp.1095-1106.

Brandenburg M, (2011), 'Impacts of supply chain management on company value: benchmarking companies from the fast moving consumer goods industry', Logistics Research, Vol.3, No.4, pp.233-248.

Bredin A, (1993), 'Benchmarking: is it right for your operation?' Computer World, Vol.27, No.40, pp.123.

Bruder K A and Gray E M, (1994), 'Public sector benchmarking: a practical approach', Public Management, Vol.76, No.9, pp. S9-S9.

Bruno A V and Leidecker J K, (1984), 'Identifying and using critical success factors", Long Range Planning', Vol.17, No.1, pp.23-32.

Burak E, Vural A V and Reisman A (2009), 'The vehicle routing problem: A taxonomic review', Computers & Industrial Engineering, Vol.57, No.4, pp.1472-1483.

Buscaglia E, (1997), 'Benchmarking procedural times: a quality control approach to court delays', Benchmarking for Quality Management and Technology, Vol.4, No.2, pp.84-95.

Camp R C, (1993), 'A bible for benchmarking, by Xerox', Financial Executive, Vol.9, No.4, pp.23-28.

Carpinetti, Luiz C R and De Melo, Alexandre M, (2000), 'What to benchmark? A systematic approach and cases', Benchmarking: an International Journal, Vol.9, No.3, pp.244-255.

Cavenato J, (1988), 'How to benchmark logistics operations', Distribution, Vol.87, No.8, pp.93-96.

Cecil R and Ferraro R, (1992), 'IEs fill facilitator role in benchmarking operations to improve performance', Industrial Engineering, Vol.24, No.4, pp.30-33.

Celik O, (2013), 'Optimization of Safety Stock Level in a Manufacturing Company', Project Report, School of Industrial Engineering and Telecommunication, University of Cantabria.

Celli M, (2013), 'Determinants of Economies of Scale in Large Businesses-A Survey on UE Listed Firms', American Journal of Industrial and Business Management, Vol.3, No.3, pp.255-261.

Cetinkaya S, Uster H, Easwaran G and Keskin B B, (2009), 'An Integrated Outbound Logistics Model for Frito-Lay: Coordinating Aggregate-Level Production and Distribution Decisions', Interfaces, Vol.39, No.5, pp.460-475.

Chakraborty A and Mandal P, (2014), 'Understanding challenges of supply chain sustainability in Asia', International Journal of Process Management and Benchmarking, Vol.4, No.1, pp.51-68.

Chakraborty T, Ghosh T, and Dan P K, (2011), 'Application of analytical hierarchy process and heuristic algorithm in solving vendor selection problem', Business Intelligence Journal, Vol.4, No.1, pp.167-177.

Chan C W N, Cheng C H, Gunasekaran A and Wong K F, (2012), 'A framework for applying real options analysis to information technology investments', International Journal of Industrial and Systems Engineering, Vol.10, No.2, pp.217-237.

Chandra C and Grabis J, (2016), 'Scope of Supply Chain Configuration Problem', Supply Chain Configuration: Concepts, Solutions and Applications, pp.17-45.

Chandra P and Jain N, (2007), 'The Logistics Sector in India: Overview and Challenges', Research and Publications, W.P. No.2007-03-07, pp.1-34.

Charles X W and Webster S, (2007), 'Channel Coordination for a Supply Chain with a Risk-Neutral Manufacturer and a Loss-Averse Retailer', Decision Sciences, Vol. 38, No. 3, pp. 361-389.

Charnsirisakskul K, Griffin P M and Keskinocak P, (2004), 'Order selection and scheduling with lead time flexibility', IIE transactions, Vol.36, No.7, pp. 697-707.

Charnsirisakskul K, Griffin P M and Keskinocak P, (2006), 'Pricing and Scheduling Decisions with Lead time Flexibility', European Journal of Operational Research, Vol.171, No.1, pp.153-169.

Chatzigeorgiou A and Stiakakis E, (2010), 'Benchmarking library and application software with Data Envelopment Analysis', Software Quality Journal, Vol.19, No.3, pp.553-578.

Chen C W and Wong V, (2012), 'Design and delivery of new product preannouncement messages', Journal of Marketing Theory & Practice, Vol.20, No.2, pp.203-222.

Chen F, (1994), 'Benchmarking preventive maintenance practices at Japanese transplants', International Journal of Quality & Reliability Management, Vol.1, No.6, pp.19-26.

Chen S J and Hwang C L, (1992), 'Fuzzy multiple attribute decision making methods, In Fuzzy multiple attribute decision making, Springer, Berlin, Heidelberg, pp.289-486.

Chen T, (2013), 'A Systematic Cycle Time Reduction Procedure for Enhancing the Competitiveness and Sustainability of a Semiconductor Manufacturer', Sustainability, Vol.5, No.11, pp.4637-4652.

Chen X, (2010), 'Suggestions on Effective Corporate New Employee Orientation Program for Human Resource Specialists', Online Journal of Workforce Education and Development, Vol.4, No.3, pp.1-11.

Chia P L, Yahya K K and Yean T F, (2016), 'The Relationship between Commitment-based HR Practices and Organizational Performance: The Role of Organizational Learning Capabilities as a Mediator', Information Management and Business Review, Vol.8, No.2, pp.63-75.

Chidambaranathan S, Muralidharan C and Deshmukh S G (2009), 'Analyzing the interaction of critical factors of supplier development using Interpretive Structural Modeling-an empirical study', International Journal of Advance Manufacturing Technology, Vol.43, No. (11-12), pp.1081-1093.

Chod J, Rudi N and Mieghem J A V, (2010), 'Mix, Time and Volume Flexibility: Valuation and Corporate Diversification', Review of Business and Economic Literature, Vol.57, No.3, pp.262-282.

Chopra S, (2003), 'Designing the distribution network in a supply chain', Transportation Research Part E Logistics and Transportation Review, Vol.39, No.2, pp.123-140.

Christopher M L, (1992), 'Logistics and Supply Chain Management' 5th Edition, London, Pitman Publishing.

Chung R K, (1993), 'TQM: benchmarking performance in credit function', Business Credit, New York, Vol.95, pp.19-19.

Clarke A and Manton S, (1997), 'A benchmarking tool for change management', Business Process Management Journal, Vol.3, No.3, pp.248-255.

Cleveland J N, Murphy K R and Williams R E, (1989), 'Multiple uses of performance appraisal: prevalence and correlates', Journal of Applied Psychology, Vol.74, No.1, pp.130-135.

Coe C, (1999), 'Local government benchmarking: lessons from two major multi government efforts', Public Administration Review, Vol.59, No.2, pp.110-124.

Colledani M and Tolio T, (2011), 'Integrated analysis of quality and production logistics performance in manufacturing lines', International Journal of Production Research, Vol.49, No.2, pp.485-518.

Cooper M B and Fawcett S, (2001), 'Process Integration for Competitive Success: Benchmarking Barriers and Bridges', Benchmarking for Quality Management: An International Journal, Vol.8, No.5, pp.396-412.

Cooper M C and Ellram L M, (1993), 'Characteristics of Supply Chain Management and the implications for Purchasing and Logistics Strategy', the International journal of Logistics Management, Vol.4, No.2, pp.13-24.

Costes N F and Jahre M, (2008), 'Supply chain integration and performance: a review of the evidence', The International Journal of Logistics Management, Vol.19, No.2, pp.130-154.

Cowling, Peter, and Johansson M, (2002), 'Using real time information for effective dynamic scheduling', European journal of operational research, Vol.139, No.2, pp.230-244.

Cox J F, Blackstone J H and Spencer M S, (Eds), (1995), 'APICS Dictionary 8th Edition, American Production and Inventory Control Society', Falls Church, VA.

Croom S, Romano P and Giannakis M, (2000), 'Supply chain management: an analytical framework for critical literature review', European Journal of Purchasing & Supply Management, Vol.6, No.200, pp.67-83.

Damir Zec M L and Francic V, (2016), 'Model of the Adaptive Information System on a Navigational Bridge', The Journal of Navigation, Vol.69, No.6, pp.1247-1260.

Dangayach, G S and Deshmukh S G (2006), 'An exploratory study of manufacturing strategy practices of machinery manufacturing companies in India' Omega, Vol.34, No.3, pp.254-273.

Dashore K, Pawar S S, Sohani N and Verma D S, (2013), 'Product evaluation using entropy and multi criteria decision making methods', International Journal of Engineering Trends and Technology, Vol.4, No.5, pp.2183-2187.

Dattakumar R and Jagadeesh R, (2003), 'A review of literature on benchmarking', Benchmarking: An International Journal, Vol.10, No.3, pp.176-209.

David T and Christopher R, (2006), 'The international competitiveness of the UK cereals sector" presentation at the 98th EAAE Seminar 'Marketing Dynamics within the Global Trading System: New Perspectives', Chania, Crete, Vol.29, pp.1-24.

David W U, Storer R H, and Vega L A M, (1999), 'Special issue on manufacturing logistics: an overview', IIE Transactions, Vol.31, No.11, pp.4-6.

Davies A J and Kochhar A K, (2000), 'Manufacturing best practice and performance studies: a critique', International Journal of Operations & Production Management, Vol.22, No.3, pp.289-305.

Davis P, (1998), 'The burgeoning of benchmarking in British local government-the value of 'learning by looking' in the public services', Benchmarking for Quality Management and Technology, Vol. 5, No. 4, pp. 260-270.

De Boer L, Gaytan J and Arroyo P, (2006), 'A satisficing model of outsourcing', Supply Chain Management: An International Journal, Vol.11, No.5, pp.444-455.

Delarue A, Hootegem G V, Procter S and Burridge M, (2008), 'Team working and organizational performance: A review of survey-based research, International Journal of Management Reviews, Vol.10, No.2 pp.127-148.

Deshmukh, Ashish J and Chaudhari A A, (2011), 'A review for supplier selection criteria and methods', Technology systems and management, Springer, Berlin, Heidelberg, pp. 283-291.

Desrochers M, Lenstra J K and Savelsbergh M W P, (1990), 'A classification scheme for vehicle routing and scheduling problems', European Journal of Operation Research, Vol.46, No.3, pp.322-332.

Diabat A, Govindan Kand Panicker V V, (2012), 'Supply chain risk management and its mitigation in a food industry', International Journal of Production Research, Vol.50, No.11, pp.3039-3050.

Diamantopoulos A, Schlegelmilch B B and Tse K Y K, (1993), 'Understanding the Role of Export Marketing Assistance: Empirical Evidence and Research Needs', European Journal of Marketing, Vol.27, No.4, pp.5-18.

Dittmann J P and Vitasek K, (2016), 'Selecting and managing a third party logistics provider: best practices', The second in the innovations in supply chain series of UT's Haslam College of business supply chain management white papers.

Domjan P, (2004), 'The Supplier Development in the Oil and Gas Sector of Kazakhstan, in Getting Competitive', Staying Competitive: The Challenge of Managing Kazakhstan's Oil Boom, Background Paper No.5.

Dornhofer M, Schroder F, and Gunthner W A, (2016), 'Logistics performance measurement system for the automotive industry', Logist. Res., Vol.9, No.11, pp.1-26.

Dorsch J J and Yasin M M, (1998), 'A framework for benchmarking in the public sector literature review and directions for future research', International Journal of Public Sector Management, Vol.11, No.2/3, pp.91-115.

Drozdowski T E, (1983), 'GTE uses benchmarking to measure purchasing', Purchasing, Vol.94, No.6, pp.21-24.

Dubey R, Gunasekaran A and Ali S S, (2015), 'Exploring the relationship between leadership, operational practices, Institutional pressures and environmental performance: A framework for green supply chain', International Journal of Production Economics, Vol.160, pp.120-132.

Lefaix-Durand A, Poulin-Dubois D, Kozak R and Beauregard R A, (2005), 'Interfirm relationships and value creation: A synthesis, Conceptual model and implications for future research', Network Organization Technology Research Centre, Quebec, Canada, Working paper DT-2005- DP-1, pp.1-29.

Eccles R G, (1991), 'The performance measurement manifesto', Harward Business Review, Vol.69, No.1, pp.131-137.

Eldanfour I and Abushaiba I A, (2014), 'Benchmarking of performance measurement system to support cost competitive advantage and financial performance - a conceptual paper', International Journal of Humanities and Management Sciences, Vol.2, No.3, pp.115-119.

Eksioglua B, Vural A V and Reisman A, (2009), 'The vehicle routing problem: A taxonomic review', Computers & Industrial Engineering, Vol.57, No.4, pp.1472-1483.

Ellram L M, (1991), 'Supply chain management: the industrial organization perspective', International Journal of Physical Distribution & Logistics Management, Vol.21, No.1, pp.13-22.

Emiliani M L and Stec D J, (2001), 'Online reverse auction purchasing contracts', Supply Chain Management: An International Journal, Vol.6, No.3, pp.101-105.

Enshassi A, Mohamed S, Mustafa Z A and Mayer P E, (2007), 'Factors Affecting Labour Productivity in Building Projects in the Gaza Strip', Journal of Civil Engineering and Management, Vol.13, No.4, pp.245-254.

Epperheimer J, (1997), 'Benchmarking career management', HR Focus, Vol.74, No.11, pp.9-10.

El Sayed H, (2013), 'Supply chain key performance indicators analysis', International Journal of Application or Innovation in Engineering & Management, Vol.2, No.1, pp.201-210.

Ertogral, Kadir, and Wu S D, (2000), 'Auction-theoretic coordination of production planning in the supply chain', IIE transactions, Vol.32, No.10, pp.931-940.

Facchin, Tiago, and Sellitto M A, (2012), 'Measurement of work-in-process and manufacturing lead time by petri nets modeling and throughput diagram', In Petri Nets-Manufacturing and Computer Science, InTech.

Faisal M N, (2010), 'Analyzing the barriers to corporate social responsibility in supply chains: an interpretive structural modeling approach', International Journal of Logistics: Research and Applications, Vol.13, No.3, pp.179-195.

Fapohunda T M, (2013), 'Towards Effective Team Building in the Workplace', International Journal of Education and Research, Vol.1, No.4, pp.1-12.

Faroque A R and Takahashi Y, (2015), 'Export marketing assistance and early internationalizing firm performance: Does export commitment matter?', Asia Pacific Journal of Marketing and Logistics, Vol.27, No.3, pp.421-443.

Fekete M and Hulvej J, (2004), 'Production planning and production leveling', Comenius Management Review, Vol.9, No.1, pp.41-52.

Fernald J G (2015), 'Productivity and Potential Output before, during, and after the Great Recession', NBER macroeconomics annual, Vol.29, No.1, pp.1-51.

Floch M, Sekscenski E, Cultice J, Plitzer R, Hardwick H and Traxler H, (1997), 'Benchmarking the physician workforce', The Journal of the American Medical Association, Vol.277, No.12, pp.964-965.

Flynn B B, Huo B and Zhao X, (2010), 'The impact of supply chain integration on performance: A contingency and configuration approach', Journal of Operations Management, Vol.28, No.1, pp.58-71.

Foggin J H, Mentzer J T and Monroe C L (2004), 'A supply chain diagnostic tool', International Journal of Physical Distribution & Logistics Management, Vol.34, No.10, pp.827-855.

Fontela E and Gabus A, (1976), 'The DEMATEL Observer', DEMATEL 1976 Report. Geneva: Battelle Geneva Research Centre.

Ford D J, (1993), 'Benchmarking HRD', Training and Development, Vol.47, No.6, pp.36-41.

Forslund H and Jonsson P, (2010), 'Integrating the performance management process of on-time delivery with suppliers', International Journal of Logistics Research and Applications, Vol.13, No.3, pp.225-241.

Foster T A, (1992), 'Searching for the best, Distribution', Vol.91, No.3, pp.30-36.

Fredendall L D and Hill E, (2001), 'Basics of Supply Chain Management', FL: St Lucie Press, APICS, and Delray.

Frederickson H G, (1996), 'Comparing the reinventing government movement with new public administration', Public Administration Review, Vol.56, No.3, pp. 263-270.

Fu M C and Kaku B K, (1997), 'Minimizing work-in-process and material handling in the facilities layout problem', IIE Transactions, Vol.29, No.1, pp.29-36.

Fuller C W, (1997), 'Key performance indicators for benchmarking health and safety management in intra-and inter-company comparisons', Benchmarking for Quality Management and Technology, Vol.4, No.3, pp. 165-174.

Gable M, Fairhurst A and Dickinson R, (1993), 'The use of benchmarking to enhance Marketing decision making', Journal of consumer Marketing, Vol.10, No.1, pp.52-60.

Gamble R, (1993), 'Benchmarking credit', Corporate Cash Flow, pp. 32-3.

Gammelgaard B, (2007), 'Editorial' special issue on supply chain learning & change, International Journal Learning and Change, Vol.2, No.2, pp. 127-129.

Ganeshan R and Terry P H, (1995), 'An introduction to supply chain management', Department of Management Science and Information Systems, Penn State University, pp.1-7.

Gawankar S, Kamble S S, and Raut R, (2015), 'Performance Measurement using Balance Score Card and its Applications: A Review', Journal of Supply Chain Management Systems, Vol.4, No.3, pp.6-21.

George J P and Pramod V R, (2014), 'An Interpretive Structural Modeling (ISM) analysis approach in steel re rolling mills (SRRMs', International Journal of Research in Engineering & Technology, Vol.2, No.4, pp.161-174.

George, J P and Pramod, V R, (2013), 'ISM for analyzing the safety of SRRMs, International Journal of Scientific and Research Publications', Vol.3, No.12, pp.161-174.

Gift R G and Kinney C E, (1996), 'Overcoming barriers to benchmarking in healthcare organizations', Best practice and benchmarking in healthcare, Vol.l, No.l, pp.3-9.

Gift R G, Stoddart T D and Wilson K B, (1994), 'Collaborative benchmarking in a health Care System', Healthcare Financial Management, Vol.48, No.9, pp.80-88.

Gilaninia S, Ganjinia H, Mahdikhanmahaleh B A, (2013), 'Difference between internal and external supply chain risks on its performance', Singaporean Journal of Business Economics and Management Studies, Vol.1, No.8, pp. 12-18.

Gilmour P, (1999), ‘Benchmarking supply chain operations’, International Journal of Physical Distribution & Logistics Management, Vol. 29, No. 4, pp. 283-90.

Gilnduz U and lkiz I, (2001), ‘Benchmarking best manufacturing practices; A study into four sectors of Turkish industry, International Journal of Operations & Production Management, Vol.21, No.7, pp.1020-1043.

Gimenez C, and Ventura E, (2003), ‘Supply chain management as a competitive advantage in the Spanish grocery sector’, International Journal of Logistics Management, Vol.14, No.1, pp.77-88.

Giovanni P D, (2012), ‘Do Internal and External Environmental Management Contribute to the Triple Bottom Line?’, International Journal of Operations and Production Management, Vol.32, No.3, pp.265-290.

Giunipero L C and Brand R R, (1996), ‘Purchasing's role in supply chain management’, The International Journal of Logistics Management, Vol.7, No.1, pp.29-38.

Goff L, (1993), ‘Benchmarking resources grow for IS managers’, Computer World, Vol.27, No.46, pp.136-137.

Gogi V S and Badarinarayana K S, (2016), ‘Flexible Manufacturing Systems Scheduling: A Systematic Review’, Bonfring International Journal of Industrial Engineering and Management Science, Vol.6, No.3, pp.61-62.

Goodman D C, Fisher E S, Bubolz T A, Mohr J E, Poage J F and Wennberg J E, (1996), ‘Benchmarking the US physician workforce: an alternative to needs-based or demand-based planning’, The Journal of the American Medical Association, Vol.276, No.22, pp.1811-1817.

Gou J S and Chai R, (2013), ‘Model of service-oriented catering supply chain performance evaluation’, Journal of Industrial Engineering and Management, Vol.6, No.1, pp. 215-226.

Goulding I, (1983), ‘New Product Development: A Literature Review’, European Journal of Marketing, Vol.17, No.3, pp.3-30.

Govind J K and Rajaram G, (2015), ‘Lead Time Reduction In Camshaft Manufacturing’, International Journal of Science and Research, Vol.4, No.5, pp.968-972.

Govindan K, Kannan D and Noorul Haq A, (2010), ‘Analyzing supplier development criteria for an automobile industry’, Industrial Management & Data Systems, Vol.110, No.1, pp.43-62.

Goyal T M, (2013), 'FDI in Services Sector in India', Foreign Trade Review, Vol.48, No.3, pp.413-430.

Goyal T M, (2012), 'Employment Conditions in Organized and Unorganized Retail: Implications for FDI Policy in India with Arpita Mukherjee', Journal of Business and Retail Management Research, Vol.6, No.2, pp.26-37.

Gram M, (2013), 'A Systematic Methodology to Reduce Losses in Production with the Balanced Scorecard Approach', Manufacturing Science and Technology, Vol.1, No.1, pp.12-22.

Graves S C, (1988), 'Safety Stocks in Manufacturing Systems', Journal of Manufacturing and Operations Management, Vol.1, No.1, pp.67-101.

Grigore S D, (2007), 'Supply Chain Flexibility', Romanian Economic and Business Review, Vol.2, No.1, pp.66-70.

Gunasekaran A and Ngai E W, (2004), 'Information systems in supply chain integration and management', European Journal of Operational Research, Vol.159, No.2, pp.269-295.

Gunasekaran A, Rai B K and Griffin M (2011), 'Resilience and competitiveness of small and medium size enterprises: an empirical research', International Journal of Production Research, Vol.49, No.18, pp.5489-5509.

Gunasekaran A and Kobu B, (2002), 'Modeling and analysis of business process reengineering', International Journal of Production Research, Vol.40, No.11, pp.2521-2546.

Gunasekaran A and Ngai E W, (2004), 'Information systems in supply chain integration and management', European Journal of Operational Research, Vol.159, No.2, pp.269-295.

Gunasekaran A and Spalanzani A, (2012), 'Sustainability of manufacturing and services: Investigations for research and applications', International Journal of Production Economics, Vol.140, No.1, pp.35-47.

Gunasekaran A, and Ngai E W T, (2003), 'The successful management of a small logistics company', International Journal of Physical Distribution & Logistics Management, Vol.33, No.9, pp.825-842.

Gunasekaran A, Patel C and Tirtiroglu E, (2001), 'Performance measures and metrics in a supply chain environment', International Journal of Operations & Production, Vol.21, Nos.1/2, pp.71-87.

Gunasekaran A, Rai B K and Griffin M, (2011), 'Resilience and competitiveness of small and medium size enterprises: an empirical research', International Journal of Production Research, Vol.49, No.18, pp.5489-5509.

Gunasekarana A and Ngaib E W, (2005), 'Build-to-order supply chain management: a literature review and framework for development', Journal of Operations Management, Vol.23, No.5, pp.423-451.

Gunasekarana A, Patel C and McGaughey R E, (2004), 'A framework for supply chain performance measurement', International Journal of Production Economics, Vol.87, No.3, pp.333-347.

Gunasekarana A, Ngai E W and Cheng T E, (2007), 'Developing an E-logistics System: A case study', International Journal of Logistics: Research & Applications, Vol.10, No.4, pp.333-349.

Gunasekarana A, Lai K H and Cheng T E, (2008), 'Responsive supply chain: A competitive strategy in a networked economy', Omega the International Journal of Management Science, Vol.36, No.4, pp.549-564.

Gunduz U and Ikiz I, (2001), 'Benchmarking best manufacturing practices; A study into four sectors of Turkish industry', International Journal of Operations & Production Management, Vol.21, No.7, pp.1020-1043.

Guta A L, (2013), 'Organizational Learning and Performance, A Conceptual Model', Proceedings of the 7th International Management Conference, New Management for the New Economy, Bucharest, Romania, pp. 547-556.

Giannakis, M. (2011) 'Management of service supply chains with a service oriented reference model: the case of management consulting', Supply Chain Management: An International Journal, Vol.16, No.5, pp.346-361.

Hall R E and Jones C I, (1999), 'Why do some countries produce so much more output per worker than others?', The Quarterly Journal of Economics, Vol.114, No.1, pp.83-116.

Hallgren M and Olhager J, (2009), 'Flexibility configurations: Empirical analysis of volume and product mix flexibility', International Journal of Management Science, Vol.37, No.4, pp.746-756.

Hamilton M R and Gibson Jr G E, (1996), 'Benchmarking pre project planning effort', Journal of Management in Engineering, Vol.12, No.2, pp.25-33.

Hammel T R and Kopczak L R, (1993), 'Tightening the supply chain', Production and Inventory Management Journal, Vol.34, No.2, pp.63-70.

Hanson O Y, Ackah D and Agboyi M R, (2015), 'Assessing the Impact of Efficient Inventory Management in on Organization', International Journal of Advanced Research in Computer Science and Software Engineering, Vol.5, No.8, pp.86-103.

Harriet T, Poku K and Anin E K (2013), 'Logistics Inefficiencies of Urban Transportation System in Ghana', International Journal of Humanities and Social Science, Vol.3, No.6, pp.308-314.

Hart M, Lukoszova X and Kubikova J, (2013), 'Logistics Management Based on Demand Forecasting', Research in Logistic and Management, Vol.3, No.1, pp.71-80.

Hasan F, Jain P K and Kumar D, (2016), 'Scalability of reconfigurable manufacturing systems based on bowl phenomenon: an implication of modular machines', International Journal Industrial and Systems Engineering, Vol.22, No.1, pp.73-95.

Hausman W H, Montgomery D B and Roth A V, (2002), 'Why should marketing and manufacturing work together? Some exploratory empirical results', Journal of Operations Management, Vol. 20, No. 3, pp. 241-257.

He Y T and Down D G, (2009), 'On Accommodating Customer Flexibility in Service Systems', INFOR Information Systems and Operational Research, Vol.47, No.4, pp.289-295.

Hervani A A, Helms M M and Sarkis J, (2005), 'Performance measurement for green supply chain management', Benchmarking: An international journal, Vol.12, No.4, pp.330-353.

Hill A, (2016), '12 Best Practices of Inventory Optimization, Minimize Costs, Maximize Uptime with MRO Inventory Control', Executive summary, Oniqua Intelligent MRO.

Hiltrop J M and Despris C, (1997), 'Benchmarking HR practices', World Executives Digest, pp.56-8.

Ho C F, (1996), 'Information technology implementation strategies for manufacturing organizations: A strategic alignment approach", International Journal of Operations & Production Management, Vol.16, No.7, pp.77-100.

Hoek R V, (2001), 'E-supply chains-virtually non-existing', Supply Chain Management: An International Journal, Vol.6, No.1, pp.21-28.

Holanda F D, Jorge S and Silva F D, (2015), 'Export assistance: A literature review and challenges for future research', Discussion paper 191, published by Institute of Applied Economic Research, Brasilia.

Holloway J, Francis G, Hinton M and Mayle D, (1998), 'Best practice benchmarking: delivering the goods?', Total Quality Management, Vol.9, No.(4-5), pp.121-125.

Holt B, (1994), 'Benchmarking comes to HR', Personnel Management, Vol. 26, No.6, pp.32-35.

Hong P, Hong S W, Roh J J and Park K, (2012), 'Evolving benchmarking practices: a review for research perspectives', Benchmarking: An International Journal, Vol.19, No.4/5, pp.444-462.

http://matrix.reshish.com/detCalculation.php

Husseina N, Mohamadb A, Noordina F and Ishak N A, (2014), 'Learning Organization and its Effect on Organizational Performance and Organizational Innovativeness: A Proposed Framework for Malaysian Public Institutions of Higher Education', Procedia - Social and Behavioral Sciences, Vol.130, pp. 299-304.

Ian L, (2001), 'Internal marketing and supply chain management', Journal of Services Marketing, Vol.14, No.1, pp.27-43.

Ibrahim S and Hamid A A, (2014), 'Supply Chain Management Practices and Supply Chain Performance Effectiveness', International Journal of Science and Research, Vol.3, No.8, pp. 187-195.

Imam T and Hassan F, (2009), 'Linear Programming and Sensitivity Analysis in Production Planning', International Journal of Computer Science and Network Security, Vol.9, No.2, pp.456-465.

Inger M, (1993), 'Healthcare: A Lesson in Benchmarking for Educators', IEE Brief, Vol. 9, pp. 2-5.

Jabnoun N, (2002), 'Control processes for total quality management and quality assurance', Work Study, Vol.51, No.4, pp.182-190.

Jackson A E, Safford R R and Swart W W, (1994), 'Roadmap to current benchmarking literature', Journal of Management in Engineering, Vol.10, No.6, pp.60-65.

Jain R and Yadav O P, (2006), 'Driving improvement opportunities in the food processing industry through benchmarking', International Journal of Process Management and Benchmarking, Vol.1, No.4, pp.352-369.

Jain R, Chandrasekaran A and Gunasekaran A, (2010), 'Benchmarking the redesign of "business process reengineering" curriculum a continuous process

improvement (CPI)', Benchmarking: An International Journal, Vol.17, No.1, pp.77-94.

Jajimoggala S, Kesava Rao V V S and Beelab S, (2011), 'Supplier Evaluation Using Fuzzy Analytical Network Process and Fussy TOPSIS', Jordan Journal of Mechanical and Industrial Engineering, Vol.5, No.6, pp. 543-551.

Jayant A and Ghagra H S, (2013), 'Supply Chain Flexibility Configurations: Perspectives, Empirical Studies and Research Directions', International Journal of supply chain management, Vol.2, No.1, pp.21-29.

Jayant A, Azhar M and Singh P, (2015), 'Interpretive Structural Modeling (ISM) Approach: A State of the Art Literature Review', International Journal of Research in Mechanical Engineering & Technology, Vol.5, No.1, pp.15-21.

Jeffcoate J, Caroline C and Sylvie F, (2002), 'Best practice in SME adoption of ecommerce', Benchmarking: an International Journal, Vol.9, No.2, pp.122-132.

Jiao J, Tseng M M, Ma Q and Zou Y, (2000), 'Generic Bill of material and operations for high variety Production management', Concurrent Engineering: Research and Applications, Vol.8, No.4, pp.297-322.

Jirsak P, et al, (2012), 'Customer Orientation and Marketing in Containerized Freight Distribution and Logistics-Perspectives of the Czech Republic', Central European Business Review, Vol.1, No.3, pp.46-50.

Johnson M E and Davis T, (1995), 'Gaining an edge with supply chain management', APIC- the Performance Advantage, Vol.5, No.12, pp.26-31.

Johnson S E, (1992), 'Benchmarking facility management practices', Modern Office Technology, Vol.37, No.6, pp.64-66.

Jourquin B and Beuthe M, (1996), 'Transportation policy analysis with a geographic information system: the virtual network of freight transportation in Europe', Transportation Research Part C, Vol.4, No.6, pp. 359-371.

Jovanovic J R, Milanovic D D, Djukic R D, (2014), 'Manufacturing Cycle Time Analysis and Scheduling to Optimize Its Duration', Journal of Mechanical Engineering, Vol.60, No.7-8, pp.512-524.

Jun T, Md-Deros B and Rahman M A, (2008), 'Practical application of benchmarking technique in semiconductor company', Seminar 1- AMReG, Seremban, Malaysia, Vol. 8, pp. 211-221.

Jafari H, (2015), 'Logistics flexibility: a systematic review', International Journal of Productivity and Performance Management, Vol.64, No.7, pp.947-970.

Kalkar P C and Borgave S, (2010), 'Benchmarking supply chain with balanced scorecard: A conceptual framework', Journal of Business Excellence, Vol.1, No.2, pp.1-5.

Kampen T J V, Donk D P V and Der Zee D J V, (2010), 'Safety stock or safety lead time: coping with unreliability in demand and supply', International Journal of Production Research, Taylor & Francis, Vol.48, No.24, pp.7463-7481.

Kannan G, Kannan D and Haq A N, (2010), 'Analyzing supplier development criteria for an automobile industry', Industrial Management & Data Systems, Vol.110, No.1, pp.43-62.

Kannan V R and Tan K C, (2003), 'Attitudes of US and European managers to supplier selection and assessment and implications for business performance', Benchmarking: An International Journal, Vol.10, No.5, pp.472-489.

Kaplan R S and Norton D P, (2006), 'Alignment: Using the Balanced Scorecard to Create Corporate Synergies', Harvard Business Press, ISBN-13: 978-1591396901.

Karch K M, (1992), 'Getting organizational buy in for benchmarking: environmental management at Weyerhaeuser', National Productivity Review, Vol.12, No.1, pp.13-22.

Karim M A, Samaranayake P, Smith A J R and Halgamuge S K, (2010), 'An on-time delivery improvement model for manufacturing organizations', International Journal of Production Research, Vol.48, No.8, pp.2373-2394.

Kasarin C, Griffin P and Keskinocak P, (2006), 'Pricing and Scheduling Decisions with Lead time Flexibility', Journal of Operational Research, Vol.171, No.1, pp.153-169.

Kasarin C, Griffin P M and Keskinocak P, (2004), 'Order selection and scheduling with lead time flexibility', IIE transactions, Vol.36, No.7, pp.697-707.

Kazerooni M and Kazerooni A, (2004), 'An Activity Based Bill of Materials, a New Concept for Production Planning', In Proceedings of the International conference on Flexible Automation and Intelligent Manufacturing, Toronto, Canada, pp. 848-854.

Keehley P and Mac-Bride S A, (1997), 'Can benchmarking for best practices work for government?', Quality Progress, Vol.30, No.3, pp. 75.

Kerr W R and Nanda R, (2014), 'Financing Innovation', Harvard Business School Working Paper 15-034, pp.1-15.

Kesavan S, Staats B R and Gilland W, (2014), 'Volume Flexibility in Services: The Costs and Benefits of Flexible Labor Resources', Management Science, Vol.60, No.8, pp.1884-1906.

Khairnar V D and Kotecha K, (2013), 'Performance of Vehicle-to-Vehicle Communication using IEEE 802.11p in Vehicular Ad-hoc Network Environment', International Journal of Network Security & Its Applications, Vol.5, No.2, pp.143-170.

Khaskhelly D, (2015), 'Comparative Analysis of performance of Islamic Vis a Vis Conventional Banking of Pakistan during Global Financial Crisis 2007-2010', Revista Romana de Statistica -Supliment, Vol.3, pp.29-42.

Kim and Seongmoon, (2009), 'The toll plaza optimization problem: Design, operations, and strategies', Transportation Research Part E: Logistics and Transportation Review, Vol.45, No.1, pp.125-137.

Kim H J, Son J and Kim S W (2016), 'Strategy for Improving Efficiency of Supply Chain Quality Management in Buyer-Supplier Dyads: The Suppliers' Perspective', Hindawi Publishing Corporation, Mathematical Problems in Engineering, Article ID 8641702, 10 pages, http://dx.doi.org/10.1155/2016/8641702.

Kim C S, Son B G and Bourlakis M, (2012), 'Factors affecting successful adoption of ubiquitous computing technology in supply chain contexts: A comparative analysis of UK and Korea', The International Journal of Logistics Management, Vol.23, No.2, pp.280-306.

Kissani, Ilham and Bouya W, (2014), 'Analysis of WIP Inventory Control and Simulation of KANBAN System within Wiring Harness Company', In Proceedings of the 2014 International Conference on Industrial Engineering and Operations Management, Bali, Indonesia.

Konig A and Spinler S, (2016), 'The effect of logistics outsourcing on the supply chain vulnerability of shippers: Development of a conceptual risk management framework', International Journal of Logistics Management, Vol.27, No.1, pp.122-141.

Korgaonker M G, (1999a), 'Integrated supply chain management- Part I', MM-The Industry Magazine, February, pp.73-82.

Korgaonker M G, (1999b), 'Integrated supply chain management- Part II', MM-The Industry Magazine, March, pp.73-83.

Koster D, Rene, Duc T L and Roodbergen K J, (2007), 'Design and control of warehouse order picking: A literature review', European Journal of Operational Research, Vol.182, No.2, pp.481-501.

Kotzab H, Teller C, Grant D B and Sparks L (2011), 'Antecedents for the adoption and execution of supply chain management', Supply Chain Management: An International Journal, Vol.16, No.4, pp.231-245.

Krajewska M A and Kopfer H, (2009), 'Transportation planning in freight forwarding companies: Tabu search algorithm for the integrated operational transportation planning problem', European Journal of Operational Research, Vol.197, No.2, pp.741-751.

Krause I and Liu J, (1993), 'Benchmarking R&D productivity', Planning Review, Vol.21 No.1, pp.16-53.

Kristensen T, Olsen K R, Kilsmark J and Pedersen K M, (2008), 'Economies of scale and optimal size of hospitals: Empirical results for Danish public hospitals', Working paper No. 13, Health Economics, University of Southern Denmark.

Kristianto Y, Gunasekaran A, Helo P and Sandhu M, (2012), 'A decision support system for integrating manufacturing and product design into the reconfiguration of the supply chain networks', Decision Support Systems, Vol.52, No.4, pp.790-801.

Kumar A and Motwani, (1999), 'A quality competitiveness index for benchmarking', Benchmarking: An International Journal, Vol.6, No.1, pp.12-21.

Kumar G S and Shirisha P, (2014), 'Transportation The Key Player In Logistics Management', Journal of Business Management & Social Sciences Research, Vol.3, No.1, pp.14-20.

Kumar P, Shankar R and Yadav S S, (2008), 'Flexibility in global supply chain: modeling the enablers', Journal of Modeling in Management, Vol.3, No.3, pp.277-297.

Kumar R, Singh R K and Shankar R, (2012), 'Supply Chain Management Issues in an Indian SME: A Sap-Lap Analysis', Journal of Supply Chain Management Systems, Vol.1, No.2, pp.34-44.

Kumar R, Singh R K and Shankar R, (2015), 'Critical success factors for implementation of supply chain management in Indian small and medium enterprises and their impact on performance', IIMB Management Review, Vol.27, No.2, pp.92-104.

Kumar S and Chandra C, (2001), 'Enhancing the effectiveness of benchmarking in manufacturing organizations', Industrial Management and Data Systems, Vol.101, No.2, pp.80-89.

Kumar S and Raj T, (2016), 'Selection of Material Handling Equipment for Flexible Manufacturing System Using FAHP', International Journal of Recent advances in Mechanical Engineering, Vol.5, No.1, pp.25-45.

Kumar S M, Jeffrey A J and Raj M S, (2017), 'Production Lead Time Reduction in a Hydraulic Machine Manufacturing Industry by Applying Lean Techniques, American Journal of Engineering Research, Vol.6, No.1, pp.365-373.

Kumar S, Parashar N, and Haleem A, (2009), 'Analytical hierarchy process applied to vendor selection problem: small scale, medium scale and large scale industries', Business Intelligence Journal, Vol.2, No.2, pp.355-362.

Kume K and Fujiwara T, (2016), 'Production Flexibility of Real Options in Daily Supply Chain', Global Journal of Flexible Systems Management, Vol. 17, No. 3, pp. 249-264.

Kurnia, Sherah, Rahim M M, Samson D and Prakash S, (2014), 'Sustainable supply chain management capability maturity: Framework Development and Initial Evaluation', Twenty Second European Conference on Information Systems, Tel Aviv, pp.1-10.

Kwateng K O, John F M, and Richard O M, (2014), 'Outbound Logistics Management in Manufacturing Companies in Ghana', Review of Business & Finance Studies, Vol.5, No.1, pp.83-92.

Lages L F and Montgomery D B, (2005), 'The relationship between export assistance and performance improvement in Portuguese export ventures', European Journal of Marketing, Vol.39, No.7/8, pp.755-784.

Lages, Filipe L, Montgomery and David B, (2004), 'The Relationship among Export Assistance, Pricing Strategy Adaptation to the Foreign Market, and Performance Improvement', Research Collection Lee Kong Chian School of Business.

Lavastre O, Gunasekaran A and Spalanzani A, (2012), 'Supply chain risk management in French companies', Decision Support Systems, Vol.52, No.4, pp. 828-838.

Le Sueur M and Dale B G, (1997), 'Benchmarking: a study in the supply and distribution of spare parts in a utility', Benchmarking for Quality Management and Technology, Vol.4, No.3, pp.189-201.

Leachman R C, et al, (2002), 'SLIM: Short Cycle Time and Low Inventory in Manufacturing at Samsung Electronics', Interfaces, Vol.32, No.1, pp.61-77.

Leahey E, (2006), 'Gender Differences in Productivity', Gender & Society, Vol.20, No.6, pp.754-780.

Lee Y and Kincade D H, (2003), 'US apparel manufacturers' company characteristic differences based on SCM activities', Journal of Fashion Marketing and Management, Vol.7, No.1, pp.31-48.

Lee Y C, Hsieh Y F and Guo Y B, (2013), 'Construct DTPB model by using DEMATEL: a study of a university library website', Program: electronic library and information systems, Vol.47, No.2, pp.155-169.

Lenckus D, (1993), 'Risk managers warming up to benchmarking projects', Business Insurance, Vol.27, No.50, pp.3-5.

Lenin K, (2015), 'A study on the Air Cargo Logistics Operations in Dubai', Management, Vol.4, No.5, pp.313-315.

Leung, Ngai-Hang Z, Chen A, Yadav P and Gallien J, (2016), 'The impact of inventory management on stock-outs of essential drugs in Sub-Saharan Africa: secondary analysis of a field experiment in Zambia', PloS one, Vol.11, No.5.

Lewis B C, Albert E and Crews E, (1985), 'The evolution of benchmarking as a computer performance evaluation technique', MIS Quarterly, Vol.9, No.1, pp.7-16.

Li X, (2014), 'Operations Management of Logistics and Supply Chain: Issues and Directions', Discrete Dynamics in Nature and Society, pp.1-7.

Lieberman, Marvin B and Demeester L, (1999), 'Inventory reduction and productivity growth: linkages in the Japanese automotive industry', Management Science, Vol.45, No.4, pp.466-485.

Lin Y, Li W, Qiu F and Xu H, (2012), 'Research on optimization of vehicle routing problem for ride-sharing taxi', Procedia-Social and Behavioral Sciences, Vol.43, pp.494-502.

Little D, Kenworthy K, Jarvis P and Porter K, (1995), 'Scheduling across the supply chain', Logistics Information Management, Vol.8, No.1, pp.42-48.

Liu C, Hong J, (2016), 'Strategies and service innovations of Haitao business in the Chinese market: A comparative case study of Amazon.cn vs Gmarket.co.kr', Asia Pacific Journal of Innovation and Entrepreneurship, Vol.10, No.1, pp.101-121.

Liu X and Sun Y, (2011), 'Information Flow Management of Vendor Managed Inventory System in Automobile Parts Inbound Logistics Based on Internet of Things', Journal of Software, Vol.6, No.7, pp.1374-1380.

Logan R M, (2015), 'Acoustic calibration in mass production', The Journal of the Acoustical Society of America, Vol.138, No.3, pp.1822-1822.

Lonn S and Stuart J A, (2003), 'Increasing service through aggressive dealer inventory return policies', International Journal of Physical Distribution & Logistics Management, Vol.33, No.6, pp.519-530.

Lorence D, (1994), 'Benchmarking quality under USA healthcare reform: the next generation', Quality Progress, Vol.27, No.4, pp.103-107.

Luca Z and Reggiani A, (2007), 'Freight Transport and the Value of Travel Time Savings: A Meta-analysis of Empirical Studies', Transport Reviews, Vol.27, No.5, pp.621-636.

Lummus, Rhonda R and Robert J V, (1999), 'Defining Supply Chain Management: A historical perspective and practical guidelines', Industrial Management and Data Systems, MCB University Press, Vol.99, No.1 pp.11-17.

Madhusudhana Rao C, PrahladaRao K and Muniswamy V V, (2011), 'Delivery performance measurement in an Integrated supply chain management: case study in batteries manufacturing firm, Serbian Journal of Management, Vol.6, No.2, pp.205-220.

Mahour M P and John E S, (2014), 'Logistics and supply chain process integration as a source of competitive advantage: An empirical analysis', International Journal of Logistics Management, Vol.25, No.2, pp.289-314.

Malak A N and Brodsky A, (2008), 'Unifying simulation and optimization of strategic sourcing and transportation', In Proceedings of the 40th Conference on Winter Simulation, pp.2616-2624.

Maleki R A and Reimche J, (2011), 'Managing Returnable Containers Logistics -a Case Study Part I -physical and Information Flow Analysis', International Journal of Engineering Business Management, Vol.3, No.2, pp.1-8.

Malhotra M K and Grover V, (1998), 'An assessment of survey research in POM: from constructs to theory', Journal of Operations Management, Vol.16, No.4, pp.407-425.

Mandal A and Deshmukh S G, (1994), 'Vendor selection using interpretive structural modeling (ISM)', International Journal of Operations & Production Management, Vol.14 No.6, pp.52-59.

Mann L, Samson D and Dow D, (1998), 'A field experiment on the effects of benchmarking and goal setting on company sales performance', Journal of Management, Vol.24, No.1, pp.73-96.

Marchesini M M P and Alcantara R L C, (2016), 'Logistics activities in supply chain business process: A conceptual framework to guide their implementation', The International Journal of Logistics Management, Vol.27, No.1, pp.6-30.

Markus G, (2013), 'A Systematic Methodology to Reduce Losses in Production with the Balanced Scorecard Approach', Manufacturing Science and Technology, Vol.1, No.1, pp.12-22.

Martynova N, (2015), 'Effect of bank capital requirements on economic growth: a survey', De Nederlandsche Bank, NV, Amsterdam, The Netherland, DNB Working Paper No. 467, pp.1-21.

Matear S and Gray R, (1993), 'Factors Influencing Freight Service Choice for Shippers and Freight Suppliers', International Journal of Physical Distribution & Logistics Management, Vol.23, No.2, pp.25-35.

Matias J C D O and Coelho D A, (2002), 'The integration of the standards systems of quality management, environmental management and occupational health and safety management', International Journal of Production Research, Vol.40, No.15, pp.3857-3866.

Matook S, Lasch R and Tamaschke R, (2009), 'Supplier development with benchmarking as part of a comprehensive supplier risk management framework', International Journal of Operations and Production Management, Vol.29, No.3, pp.241-267.

Matzko M and Wingfield C, (1995), 'Coming: a source of competitive benchmarking for retail distribution strategy', Journal of Retail Banking, Vol.17, No.2, pp.9-14.

McAdam R and Kelly M, (2002), 'A business excellence approaches to generic benchmarking in SMEs', Benchmarking: An International Journal, Vol.9, No.1, pp.7-27.

McFarland H, (1984), 'Transport cost and processing', Journal of Transport Policy and Economy, Vol.18, No.3, pp.311-315.

McKay K N and Wiers V C S, (2003), 'Integrated decision support for planning, scheduling, and dispatching tasks in a focus factory', Computers in Industry, Vol.50, No.1, pp.5-14.

McKinnon A, (2001), 'Integrated logistics strategies', In Handbook of Logistics and Supply Chain Management, London: Pergamon, pp.157-170.

Md A, Al-Maruf A, Mahbubul I M, Abdul Malek A B M and Mukaddes A M M, (2016), 'Quality function deployment approach to measure supply chain performance: a case study on garments accessories industries', International Journal of Industrial and Systems Engineering, Vol.22, No.1, pp.96-120.

Mehta N and Sharma L, (2013), 'A Modification over Ratio Estimator using Empirical Data', Statistics, Vol.2, No.1, pp. 65-67.

Mentzer J T, Witt W D, Keebler J S, Min S, Nix N W, Smith C D, and Zacharia Z G, (2001), 'Defining Supply chain Management', Journal of Business Logistics, Vol.22, No.2, pp.1-25.

Mentzer J, (1999), 'Benchmarking sales forecasting management', Business Horizons, Vol.42, No.3, pp.48-56.

Michal B, Vodak R, Kubecek J, Bilova M and Sedonik J, (2015), 'Evaluating road network damage caused by natural disasters in the Czech Republic between 1997 and 2010', Transportation Research Part A: Policy and Practice, Vol.80, pp.90-103.

Mihail L A, (2015), 'Applying Quality Tools for Managing the Production of Automotive Parts', Applied Mechanics & Materials, Vol.809/810, pp.1299-1304.

Miller J, (1992a), 'Benchmarking performance', CMA Magazine, June, pp. 23.

Min H and Galle W P, (1999), 'Electronic commerce usage in business-to-business purchasing', International Journal of Operations & Production Management, Vol.19, No.9, pp.909- 921.

Min H and Galle W P, (2001), 'Green purchasing practices of US firms', International Journal of Operations & Production Management, Vol.21, No.9, pp.1222-1238.

Min H and Min H, (1996), 'Competitive benchmarking of Korean luxury hotels using analytic hierarchy process and competitive gap analysis', The Journal of Services Marketing, Vol.10, No.3, pp.58-72.

Min H, (2009), 'The best practice supplier diversity program at Caterpillar', Supply Chain Management: An International Journal, Vol.14, No.3, pp.167-170.

Mishra P and Sharma R K, (2014), 'Benchmarking SCM performance and empirical analysis: a case from paint industry', Logist. Res, Vol.7, No.113, pp.1-16.

Mishra P, et al, (2015), 'Integration of Six Sigma and ISM to improve Supply Chain Coordination-A conceptual framework', International Journal of Production Management Engineering, Vol.3, No.1, pp.75-85.

Mishra R P (2014), 'Structural modeling and analysis of world-class maintenance system: a graph theoretic approach', International Journal of Process Management and Benchmarking, Vol.4, No.1, pp.69-88.

Moazzam M, Garnevska E and Marr N, (2012), 'Benchmarking Agro-food Supply Chain Networks: A Conceptual Framework', In World business capability congress, Vol.2012, pp.1-12.

Mogre R, Wong C Y and Lalwani C S, (2014), 'Mitigating supply and production uncertainties with dynamic scheduling using real-time transport information', International Journal of Production Research, Vol.52, No.17 , pp.5223-5235.

Mohanraj S, Venkatesan R, Sri M R V (2016), 'A Study on Manufacturing Lead Time in Apparel Industry With Special Reference To Apparel Exporters in Tirupura City', Indian Journal of Research, Vol.5, No.4, pp.173-175.

Mohanty M K and Gahan P, (2012), 'Buyer supplier relationship in manufacturing industry-findings from Indian manufacturing sector', Business Intelligence Journal, Vol.5, No.2, pp.319-333.

Monczka R and Morgan J P, (1996), 'Supplier integration a new level of supply chain management', Purchasing, Vol.120, No.1, pp.110-113.

Monkhouse E, (1995), 'Role of competitive benchmarking in small and medium enterprises', Benchmarking for Quality Management and Technology, Vol.2, No.4, pp.41-50.

Moore G, (2015), 'How paper and digital integration is shaping the future of communications', Article published through Ricoh Europe.

Morey R C and Dittman D A, (1995), 'Evaluating a hotel GM's performance: a case study in benchmarking', Cornell Hotel and Restaurant Administration Quarterly, Vol.36, No.5, pp.30-35.

Mukherjee A, (2002), 'Performance benchmarking and strategic homogeneity of Indian banks', The International Journal of Bank Marketing, Vol.20, No.3, pp. 122-139.

Mukherjee D, (2007), 'Comparative Analysis of Indian Stock Market with International Markets', Great Lakes Herald, Great Lakes Institute of Management, Chennai, Vol.1, No.1, pp.39-71.

Mulang A, (2015), 'The Importance of Training for Human Resource Development in Organization', Journal of Public Administration and Governance, Vol.5, No.1, pp.190-197.

Mulky A G, (2013), 'Distribution challenges and workable solutions', IIMB Management Review, Vol.25, No.3, pp.179-195.

Murthy D N P (2006), 'Product warranty and reliability', Annals of Operations Research, Vol.143, No.1, pp.133-146.

Murthy D N P (2007), 'Product reliability and warranty: an overview and future research', Production, Vol.17, No.3, pp. 426-434.

Musa A, Gunasekaran A, Yusuf Y, Azua S and Terwase Y, (2013), 'An assessment of location data requirements in logistics', International Journal of Process Management and Benchmarking, Vol.3, No.2, pp.173-212.

Muthu S and Devadasan S R, (2000), 'Benchmarking for strategic maintenance quality improvement', Benchmarking: An International Journal, Vol.7, No.4, pp.292-303.

Mutingi M, (2016), 'A fuzzy multi-objective genetic algorithm for system reliability optimization', International Journal Industrial and Systems Engineering, Vol.22, No.1, pp.1-16.

Nacker M, (1997), 'Telecommunications: Benchmarking proven practices', Credit World, pp.5-17.

Naslund D and Hulthen H, (2012), 'Supply chain management integration: a critical analysis', Benchmarking: An International Journal, Vol.19, No.4/5, pp.481-501.

Nath P and Mrinalini M, (2000), 'Benchmarking the best practices of non-corporate R & D organizations', Benchmarking: An International Journal, Vol.7, No.2, pp.86-97.

Naworyta W, Sypniowski S and Benndorf J, (2015), 'Planning for reliable coal quality delivery considering geological variability: A case study in polish lignite mining', Journal of Quality and Reliability Engineering, Vol.2015.

Neely, A., (1993), 'Production / Operations Management: Research Process and Content during the 1980s', International Journal of Operations & Production Management, Vol.13, No.1, pp.5-18.

Neely, A., Gregory, M., & Platts, K. (1995), Performance measurement system design: a literature review and research agenda. International Journal of Operations & Production Management, Vol.15, No.4, pp.80-116.

Neto M S, Pires S R I, Desouza F B, (2009), 'Performance Measurement in Supply Chains: A Study in the Automotive Industry', Proceeding of the POMS 20th Annual Conference held at Orlando, Florida, USA, May 1-4.

Nurizman N J and Singla V, (2017), 'Investigation of Barriers and Enablers of Supply Chain Management Practices Success: Case of Ethiopian Textile and Garment Factories', Journal of Supply Chain Management Systems, Vol.6, No.2, pp.14-43.

Ocampo (2015), 'A hierarchical framework for index computation in sustainable manufacturing', Advances in Production Engineering & Management Journal, Vol.10, No.1, pp.40-50.

Ocampo L A, Clark E E, Tanudtanud K V G, Ocampo C O V, Impas Sr C G, Vergara V G, Pastoril J and Tordillo J A S, (2015), 'An integrated sustainable manufacturing strategy framework using fuzzy analytic network process', Advances in Production Engineering & Management Journal, Vol.10, No.3, pp.125-139.

Ogawa D and Ketner L, (1997), 'Benchmarking product development-service providers need to assess and compare product development performance levels with those of competitors. How does your company measure up?', Telephony, Vol.232, No.4, pp.34-39.

Oliveira A and Gimeno A, (2014), 'Customer Service Environment, in Supply Chain Management', Models for Achieving Customer, Satisfaction, Supply Chain Performance, and Shareholder Value, Pearson Publications, New York.

Oliveira A and Gimeno A, (2014), 'A Guide to Supply Chain Management: The Evolution of SCM Models, Strategies, and Practices', P H Professional Business, ISBN: 9780133820959.

Omega R S, Noel V M, Masbad J G and Ocampo L A, (2016), 'Modeling supply risks in interdependent manufacturing systems: A case study', Advances in Production Engineering & Management Journal, Vol.11, No.2, pp.115-125.

Opricovic S and Tzeng G H, (2004), 'Compromise solution by MCDM methods: A comparative analysis of VIKOR and TOPSIS', European journal of operational research, Vol.156, No.2, pp.445-455.

Otchere A F, Annan J and Quansah E, (2013), 'Assessing the Challenges and Implementation of Supply Chain Integration in the Cocoa Industry: a factor of Cocoa Farmers in Ashanti Region of Ghana', International Journal of Business and Social Science, Vol.4, No.5, pp.112-123.

Owen J V, (1992), 'Benchmarking world-class manufacturing', Manufacturing Engineering, Vol.108, No.3, pp. 29-34.

Ozer O and Wei W, (2004), 'Inventory Control with Limited Capacity and Advance Demand Information', Operations Research, Vol.52, No.6, pp.988-1000.

Parker N, (1998), 'The employment service benchmarking study: internal vacancy filling', Benchmarking for Quality Management and Technology, Vol.5, No.3, pp.200-224.

Parmar V and Shah H G, (2016), 'A literature review on supply chain management barriers in manufacturing organization', International Journal of Engineering Development and Research, Vol.4, No.1, pp.26-42.

Partovi F Y, (1994), 'Determining what to benchmark: an analytic hierarchy approach', International Journal of Operations and Production Management, Vol.14, No.6, pp.25-39.

Pathak S, (2016), 'Benchmarking Supplier Network Collaboration', Journal of Supply Chain Management Systems, Vol.5, No.1, pp.1-13.

Paul B and Jayadas N H, (2013), 'A generalized algorithm for the demand prediction of a short life cycle product supply chain and Its implementation in a baked product', International Journal of Mechanical Engineering & Technology, Vol.4, No.1, pp.44-53.

Pekgun P, Griffin P M and Keskinocak P, (2008), 'Coordination of marketing and production for price and lead time decisions', IIE Transactions, Vol.40, No.1, pp.12-30.

Per V F and Hollensen S, (2001), 'The process of benchmarking, bench learning and bench action', TQM Magazine, Vol.13, No.1, pp.25-33.

Pfohl H C and Ester B, (1999), 'Benchmarking for spare parts logistics', Benchmarking: an International Journal, Vol.6, No.l, pp.22-39.

Porter M E, (1985), 'The Competitive Advantage: Creating and Sustaining Superior Performance', NY: Free Press, Vol.43, No.1985, pp.214.

Power D, (2005), 'Supply chain management integration and implementation: a literature review', Supply chain management: An International Journal, Vol.10, No.4, pp.252-263.

Powers T L and Valentine D B, (2009), 'Response quality in consumer satisfaction research', Journal of Consumer Marketing, Vol.26, No.4, pp.232-240.

Press G, (1991), 'Benchmarking is your research department best?', Marketing News, Vol.28, No.18, pp.24.

Prior Smith K and Perrin M, (1996), 'Ideas on motivating people, addressing complaints and training (IMPACT): an application of benchmarking', Benchmarking for Quality Management and Technology, Vol.2, No.1, pp.7-25.

Quality and Productivity Management Association (1991), 'Benchmarking, the IBM-Rochester way', Commitment Plus, Vol.66, No.12, pp.2-4.

Qureshi M N, Kumar D, Kumar P, (2008), 'An integrated model to identify and classify the key criteria and their role in the assessment of 3PL services providers', Asia Pacific Journal of Marketing and Logistics, Vol.20, No.2, pp.227-249.

Radauer A and Walter L, (2010), 'Elements of good practice for providers of publicly funded patent information services for SMEs-selected and amended results of benchmarking exercise', Vol.32, No.3, pp.237-245.

Raj T and Attri R, (2011), 'Identification and modeling of barriers in the implementation of TQM', International Journal of Productivity and Quality Management, Vol.8, No.2, pp.153-179.

Raj T, Attri R and Jain V, (2012), 'Modeling the factors affecting flexibility in FMS', International Journal of Industrial and System Engineering, Vol.11, No.4, pp.350-374.

Raj T, Shankar R and Suhaib M, (2007), 'An ISM approach for modeling the enablers of flexible manufacturing system: The case for India', International Journal of Production Research, Vol.46, No.24, pp.1-30.

Raj T, Shankar R and Suhaib M, (2008), 'An ISM approach for modeling the enablers of flexible manufacturing system: the case for India', International Journal of Production Research, Vol.26, No.24, pp.6883-6912.

Rajesh K S, Suresh K G and Deshmukh S G (2007), 'Interpretive structural modeling of factors for improving competitiveness of SMEs', International Journal of Productivity and Quality Management, Vol.2, No.4, pp.423-440.

Rakicevic Z and Vujosevic M, (2015), 'Focus forecasting in supply chain: The case study of fast moving consumer goods company in Serbia', Serbian Journal of Management, Vol.10, No.1, pp.3-17.

Ralston P M, Grawe S J and Daugherty P J, (2013), 'Logistics Salience Impact on Logistics Capabilities and Performance', International Journal of Logistics Management, Vol.24, No.2, pp.136-152.

Ramaa A, (2012), 'Impact of Warehouse Management System in a Supply Chain', International Journal of Computer Applications, Vol.54, No.1, pp.14-20.

Ramabadron R, Dean J W and James E R, (1997), 'Benchmarking and project management; a review and organizational model', Benchmarking for Quality Management and Technology, Vol.4, No. l, pp. 47-58.

Rana S and Chopra P, (2015), 'Transition Approach in Analyzing Organizational Learning Capability: From Employer Perspective to Employee Concern', The International Journal of Business & Management, Vol.3, No.8, pp.90-97.

Rao S, Perry C and Frazer L, (2003), 'The Impact of Internet Use on Inter-Firm Relationships in Australian Service Industries', Australasian Marketing Journal, Vol.1, No.2, pp.10-22.

Ray C N and Mishra A, (2011), 'Vendors and Informal Sector A Case-Study of Street Vendors of Surat City', Centre for Urban Equity (An NRC for Ministry of Housing and Urban Poverty Alleviation, Government of India) CEPT University, Working Paper-15, pp.1-32.

Razmi J, Zairi M, and Jarrar Y F, (2000), 'The application of Graphical techniques in evaluating benchmarking partners', Benchmarking: an International Journal, Vol.7, No.4, pp.304-314.

Relihan K A, (1997), 'The role of benchmarking analysis in measuring and improving workplace safety', Professional Safety, ASSE, Vol.42, No.2, pp.28-31.

Rene D K, Duc T L and Roodbergen K J (2007), 'Design and control of warehouse order picking: A literature review', European Journal of Operational Research, Vol.182, No.2, pp.481-501.

Report by ARC Advisory group, (2004), 'Operational Excellence in Inbound Logistics: A Strategy for Profitable Growth in Retail', Thought Leaders for Logistics & Supply Chain Management.

Richardson H L, (1992), 'Improve quality through benchmarking', Transportation and Distribution, Vol.33, No.l, pp.30-37.

Richman T and Koontz C, (1993), 'How benchmarking can improve business re-engineering', Planning Review, Vol.21, No.6, pp. 26-55.

Rodrigue J P, (2006), 'Transportation and the geographical and functional integration of global production networks', Growth and Change, Vol.37, No.4, pp. 510-525.

Rodwell J J, Lam J and Fastenau M, (2000), 'Benchmarking human resources and benchmarking of benchmarking, Employee Relations, Vol.22, No.4, pp.356-374.

Roger B, Muhlemann A P, Price D H, Paterson A and Sharp J A, (2000), 'A review of manufacturing flexibility', European Journal of Operational Research, Vol.122, No.1, pp.41-57.

Rushton A and Saw R, (1992), 'A Methodology for Logistics Strategy Planning', The International Journal of Logistics Management, Vol.3, No.1, pp.46-62.

Rico R, de la Hera, C M A and Tabernero C, (2011), 'Work team effectiveness, A review of research from the last decade (1999-2009)', Psychology in Spain, Vol.15, No.1, pp.57-79.

Saad M and Patel B, (2006), 'An investigation of supply chain performance measurement in the Indian automotive sector', Benchmarking: An International Journal, Vol.13, No.(1/2), pp.36-53.

Saad A M, Mat N B and Awadh A M, (2013), 'Review of Theory of Human Resources Development Training (learning) Participation', The West East Institute, WEI International Academic Conference Proceedings, Antalya, Turkey, pp.85-93.

Saaty T L, (1986), 'Axiomatic foundation of the analytic hierarchy process', Management Science, Vol.32, No.7, pp.841-855.

Sadeh E, Mousavi L and Sadeh S, (2011), 'Presenting a framework to study linkages among TQM practices, supply chain management practices', and performance using DEMATEL technique', Australian Journal of Basic and Applied Sciences, Vol.5, No.9, pp.885-890.

Saenz M J and Koufteros X, (2015), 'Special issue on literature reviews in supply chain management and logistics', International Journal of Physical Distribution & Logistics Management, Vol.45, No.½.

Sahay B S and Ramneesh M, (2003), 'Supply Chain Management Practices in Indian Industry', International Journal of Physical Distribution and Logistics Management, MCB University Press Limited, Vol.33, No.7, pp.582-606.

Sahay B S, (2000), 'Supply Chain Management for Twenty First Century Macmillan India Ltd', New Delhi.

Salehi M, (2008), 'The role of financial intermediaries in capital market', Zagreb International Review of Economics & Business, Vol.11, No.1, pp.97-109.

Salem M S M, (2013), 'A Review of Benchmarking Implementation Problems: The Case of UAE Industrial Companies', The Journal of International Management Studies, Vol.8, No.2, pp.134-153.

Sanchez A M and Perez M, (2005), 'Supply chain flexibility and firm performance: A conceptual model and empirical study in the automotive industry', International Journal of Operations & Production Management, Vol.25, No.7, pp.681-700.

Sandbhor S and Botre R, (2014), 'Applying total interpretive structural modeling to study factors affecting construction labor productivity', Australasian Journal of Construction Economics and Building, Vol.14, No.1, pp.20-31.

Sarjono H, (2014), 'The Calculation of Extra Carrying Cost (ECC) and Stock out Cost (SOC) to Determine the Raw Material's Optimal Arrival Lead Time', Applied Mathematical Sciences, Vol.8, No.83, pp.4115-4124.

Sarkis J, (2001), 'Benchmarking for agility', Benchmarking: An International Journal, Vol.8, No.2, pp.88-107.

Saxena A and Seth N, (2012), 'Supply chain risk and security management: an interpretive structural modeling approach', International Journal of Logistics Economics and Globalisation, Vol.4, No.1/2, pp.117-132.

Scharf K, (2014), 'Private Provision of Public Goods and Information Diffusion in Social Groups', International Economic Review, Vol.55, No.4, pp.1019-1042.

Schefczyk M, (1993), 'Industrial benchmarking: a case study of performance analysis techniques', International Journal of Production Economics, Vol.33, No.l, pp.1-11.

Schlosser F K, Templer A, and Ghanam D, (2006), 'An integrated agenda for understanding the impact of HR outsourcing on organizational learning orientation', Journal of Labor Research, Special Issue on Outsourcing Management, Vol.27, No.3, pp. 291-303.

Schmidt J A, (1992), 'The link between benchmarking and the shareholder value', Journal of Business Strategy, Vol.13, No.3, pp.7-12.

Schroeder S, (1996), 'How can we tell whether there are too many or too physicians? The case for benchmarking', The Journal of the American Medical Association, Vol.276, No.22, pp.1841-1843.

Schwartz H and Davis S M, (1981), 'Matching corporate culture and business strategy', Organizational Dynamics, Vol.10, No.1, pp.30-48.

Schwarz L, (2008), 'Building Intuition: Insights from Basic Operations Management Models and Principles, chapter the economic order-quantity (EOQ) model', Springer, Vol. 280, pp.135-154.

Schwarz L B, Graves S C, Hausman W H, (1978), 'Scheduling policies for automatic warehousing systems: simulation results', AIIE transactions, Vol.10, No.3, pp.260-270.

Scott C and Westbrook R, (1991), 'New Strategic Tools for Supply Chain Management', International Journal of Physical Distribution & Logistics Management, Vol.21, No.1, pp.23-33.

Senk M K, Metlikovic P, Maletic M and Gomiscek B, (2010), 'Development of new product/process development procedure for SMEs', Organizacija, Vol.43, No.2, pp.76-86.

Seongmoon K, (2009), 'The toll plaza optimization problem: design, operations, and strategies', Transportation Research Part E: Logistics and Transportation Review, Vol.45, No.1, pp.125-137.

Seth N and Deshmukh S G, (2005), 'Service quality models: a review', International Journal of Quality & Reliability Management, Vol.22, No.9, pp.913-949.

Shabani A, (2012), 'A new benchmarking approach in Cold Chain', Applied Mathematical Modeling, Vol.36, No.1, pp.212-224.

Shahadat K, (2003), 'Supplier choice criteria of executing agencies in developing countries', International Journal of Operations and Production Management, Vol.16, No.4, pp.261-285.

Sharif A M, (2002), 'Benchmarking performance management systems', Benchmarking: an International Journal, Vol.9, No. l, pp. 62-85.

Sharma A, Grag D and Agarwal A, (2012), 'Quality management in supply chains: the literature review', International Journal for Quality research, Vol.6, No.3, pp.193-206.

Sharman P, (1992), 'Benchmarking: opportunity for accountants', CMA Magazine, Vol.66, No.6, pp.16-18.

Shaughnessy T W, (1993), 'Benchmarking: total quality management and libraries', Library Administration and Management, Vol.7, No.1, pp.7-12.

Shaw S, Grant D B and Mangan J, (2010), 'Developing environmental supply chain performance measures', Benchmarking: An International Journal, Vol.17, No.3, pp. 320-339.

Sheely R, (2009), 'The Role of Institutions in Providing Public Goods and Preventing Public Bads: Evidence from a Public Sanitation Field Experiment in Rural Kenya', Working paper.

Shen Y C, Lin G T and Tzeng G H, (2012), 'A novel multi-criteria decision-making combining decision making trial and evaluation laboratory technique for technology evaluation', Foresight, Vol.14, No.2, pp.139-153.

Sherah K, Rahim, M M, Samson D, and Prakash S, (2014), 'Sustainable supply chain management capability maturity: Framework Development and Initial Evaluation', Twenty Second European Conference on Information Systems, Tel Aviv, pp.1-10.

Sheu J B, (2007), 'Challenges of emergency logistics management', Transportation Research Part E, Vol.43, pp.655-659.

Shieh J I and Wu H H, (2016), 'Measures of Consistency for DEMATEL Method', Communications in Statistics - Simulation and Computation, Vol.45, No.3, pp.781-790.

Shieh J I, Wu, H H and Huang K K, (2010), 'A DEMATEL method in identifying key success factors of hospital service quality', Knowledge-Based Systems, Vol.23, No.3, pp.277-282.

Sila C, Uster H, Easwaran G and Keskin B B, (2009), 'An integrated outbound logistics model for Frito-Lay: Coordinating aggregate-level production and distribution decisions', Interfaces, Vol.39, No.5, pp.460-475.

Simatupang T M and Sridharan R, (2003), 'A Benchmarking Scheme for Supply Chain Collaboration', Benchmarking: An International Journal, Vol.9, No.6, pp.1-31.

Simpson M, Kondouli D and Wai P H, (1999), 'From benchmarking to business process re-engineering: a case study', Total Quality Management, Vol.10, No.(4-5), pp.717-724.

Singh A B and Tandon P, (2012), 'A Study of Financial Performance: A Comparative Analysis of SBI and ICICI Bank', International Journal of Marketing, Financial Services & Management Research, Vol.1, No.11, pp. 56-71.

Singh H, Sachdeva A and Kaur G, (2015) 'Benchmarking internal supply chain performance: development of a framework', International Journal of Mechanical Engineering and Technology, Vol.6, No.6, pp.119-126.

Singh M D and Kant R, (2008), 'Knowledge management barriers: an interpretive structural modeling approach', International Journal of Management Science and Engineering Management, Vol.3, No.2, pp.141-150.

Singh M D, Shankar R, Narain R and Agarwal A, (2003), 'An interpretive structural modeling of knowledge management in engineering industries', Journal of Advances in Management Research, Vol.1, No.1, pp.28-40.

Singh P J and Power D, (2014), 'Innovative knowledge sharing, supply chain integration and firm performance of Australian manufacturing firms', International Journal of Production Research, Vol.52 , No.21, pp. 6416-6433.

Singh R K and Acharya P, (2013), 'Supply Chain Flexibility: A Frame Work of Research Dimensions', Global Journal of Flexible Systems Management, Vol.14, No.3, pp.157-166.

Singh R K and Acharya P, (2014), 'Identification and evaluation of supply chain flexibilities in Indian FMCG sector using DEMATEL', Global Journal of Flexible Systems Management, Vol.15, No.2, PP. 91-100.

Singh R K, (2011), 'Developing the framework for coordination in supply chain of SMEs', Business Process Management Journal, Vol.17, No.4, pp.619-638.

Sodhi S M M, (2003), 'How to do strategic supply chain planning', Fall Magazine.

Song D P and Carter J, (2009), 'Empty container repositioning in liner shipping', Maritime Policy & Management, Vol.36, No.4, pp.291-307.

Spekman R E, Spear F and Kamauff, J, (2002), 'Supply chain competency: learning as a key component', Supply Chain Management, Vol.7, No.1, pp.41-55.

Spillan J E, McGinnis M A, Kara A and Liu Yi G, (2013), 'A comparison of the effect of logistic strategy and logistics integration on firm competitiveness in the USA and China', The International Journal of Logistics Management, Vol.24, No.2, pp.153-179.

Spitzer R D, (1993), 'Valuing TQM through rigorous financial analyses', Quality Progress, Vol.26, No.7, pp.49-54.

Sreejith B, (2012), 'A hierarchical framework of barriers to green supply chain management in the construction sector', Journal of Sustainable Development, Vol. 5, No.10, pp.15-27.

Stawowy A and Duda J, (2012), 'Models and algorithms for production planning and scheduling in foundries-current state and development perspectives', Archives of Foundry Engineering, Vol.12, No.2, pp.69-74.

Stefanovic N and Stefanovic D, (2011), 'Supply chain performance measurement system based on scorecards and web portals', Computer Science and Information Systems, Vol.8, No.1, pp.167-192.

Stevens G C, (1989), 'Integrating the supply chain', International Journal of Physical Distribution & Materials Management, Vol.19, No.8, pp.3-8.

Stevens M J, (1994), 'The knowledge, skill and ability requirements for team work: Implications for Human Resource management', Journal of Management, Vol.20, No.2, pp.503-530.

Stevenson M and Spring M, (2009), 'Supply chain flexibility: an inter-firm empirical study', International Journal of Operations & Production Management, Vol.29, No.9, pp.946-971.

Stewart G, (1997), 'Supply chain operations reference model (SCOR): the first cross industry framework for integrated supply chain management', Logistics Information Management, Vol.10, No.2, pp.62-67.

Subramani J and Kumarapandiyan G, (2012), 'Modified ratio estimators for population mean using function of quartiles of auxiliary variable', Bonfring International Journal of Industrial Engineering and Management Science, Vol.2, No.2, pp.19-23.

Sueur M Le and Dale B G, (1997), 'Benchmarking: a study in the supply and distribution of spare parts in a utility', Benchmarking for Quality Management and Technology, Vol.4, No.3, pp.189-201.

Svensson G, (2002), 'A conceptual framework of vulnerability in firms inbound and outbound logistics flows', International Journal of Physical Distribution & Logistics Management, Vol.32, No.2, pp.110-134.

Swain A K P C and Das M, (2015), 'some classes of modified ratio type estimators in sample surveys', Statistics In Transition new series, Vol.16, No.1, pp.37-52.

Sweeney M T, (1994), 'Benchmarking for strategic manufacturing management', International Journal of Operations & Production Management, Vol.14, No.9, pp.4-15.

Syed J, (2007), 'A dyadic perspective of knowledge oriented human resource management', Working Paper No. 157, University of Kent Canterbury, Canterbury.

Taghipour M, Bagheri M, Khodarezaei M and Farid F, (2015), 'Supply chain performance evaluation in the IT industry', International Journal of Recent Research and Applied Studies, Vol.23, No.2, pp.144-156.

Talib F, Rahman Z and Qureshi M N, (2011), 'An interpretive structural modeling approach for modeling the practices of total quality management in service sector', International Journal of Model Operational Management, Vol.1, No.3, pp.223-250.

Talluri S, (2000), 'A benchmarking method for business process reengineering and improvement', International Journal of Flexible Manufacturing Systems, Vol.12, No.4, pp.291-304.

Tan K C (2001), 'A framework of supply chain management literature', European Journal of Purchasing & Supply Management, Vol.7, No.1, pp. 39-48.

Tan K C, Kannan V R and Handfield R B, (1998), 'Supply chain management: supplier performance and firm performance', Journal of Supply Chain Management, Vol.34, No.3, pp.2-9.

Tan X C, Wang Y Y, Gu B H, Mu Z K and Yang C, (2011), 'Improved methods for production manufacturing processes in environmentally benign manufacturing', Energies, Vol.4, No. 9, pp.1391-1409.

Tangen S, (2002), 'Understanding the concept of productivity', Proceedings of the 7th Asia Pacific Industrial Engineering and Management Systems Conference, Taipei.

Tavasszy L A, Ruijgrok K and Davydenko I, (2012), 'Incorporating logistics in freight transport demand models: state of the art and research opportunities', Transport Reviews, Vol.32, No.2, pp.203-219.

Thakkar J, Kanda A, Deshmukh S G (2008), 'Evaluation of buyer supplier relationships using an integrated mathematical approach of interpretive structural modeling (ISM) and graph theoretic approach', Journal of Manufacturing Technology Management, Vol.19, No.1, pp.92-124.

Thomas J J, (2003), ‘Economies of scale, technical progress and regional growth disparities: Indian industry, 1959-98’, Conference on Economics for the Future, organized by the Cambridge Journal of Economics. Cambridge, UK, September.

Thomas M and Harald P, (2013), ‘A partition-based framework for building and validating regression models’, IEEE Transactions on Visualization and Computer Graphics, Vol.19, No.12, pp.1962-1971.

Tilokavichai V, Sophatsathit P and Chandrachai A, (2012), ‘Innovative logistics management under uncertainty using markov model information and knowledge management’, Vol.2, No.5, pp.19-30.

Tipu SAA and Fantazy K A, (2014), ‘Supply chain strategy, flexibility, and performance: A comparative study of SMEs in Pakistan and Canada’, The International Journal of Logistics Management, Vol.25, No.2, pp.399-416.

Tong L I, Chen C C and Wang C H (2007), ‘Optimization of multi response processes using the VIKOR method’, The International Journal of Advanced Manufacturing Technology, Vol.31, No.(11-12), pp.1049-1057.

Torres M, Jairo R, Franco JL, Isaza S N, Jimenez H F and Herazo-Padilla N, (2015), ‘A literature review on the vehicle routing problem with multiple depots’, Computers & Industrial Engineering, Vol.79, pp.115-129.

Tosun O and Uysal F, (2016), ‘Physical distribution flexibility in logistics systems and its impact on productivity’, Journal of Advanced Management Science, Vol. 4, No.1, pp. 53-56.

Towill D R, Childerhouse P and Disney S M, (2000), ‘Speeding up the progress curve towards effective supply chain management’, An International Journal of Supply Chain Management, Vol.5, No.3, pp.122-130.

Tracey M and Tan C L, (2001), ‘Empirical analysis of supplier selection and involvement, customer satisfaction, and firm performance’, Supply Chain Management: An International Journal, Vol.6, No.4, pp.174-188.

Treadwell B, (1998), ‘Benchmarking Treasury: looking for standards-determining the productivity and efficiency of treasury functions is an important but difficult task. AUSTRALIAN CPA 68, pp.49-51.

Tseng Y Y, Yue W L and Taylor M A P, (2005), ‘The role of transportation in logistics chain’, Proceedings of the Eastern Asia Society for Transportation Studies, Vol.5, pp.1657-1672.

Tuominen T, Kitaygorodskaya N and Helo P, (2009), 'Benchmarking Russian and Finnish food industry supply chains', Benchmarking: An International Journal, Vol.16, No.3, pp.415-431.

Tutcher G, (1994), 'How successful companies improve through internal benchmarking', Managing Service Quality: An International Journal, Vol.4, No.2, pp.44-46.

Tzeng G H, Chiang C H and Li C W, (2007), 'Evaluating intertwined effects in e-learning programs: a novel hybrid MCDM model based on factor analysis and DEMATEL', Expert Systems with Applications, Vol.32, No.4, pp.1028-1044.

Ulusoy and Ikiz I, (2001), 'Benchmarking best manufacturing practices: a study into four sectors of Turkish industry', International Journal of Operations & Production Management, Vol.21, No.7, pp.1020-1043.

Umble, E J, Haft R R and Umble M M, (2003), 'Enterprise resource planning: Implementation procedures and critical success factors', European Journal of Operational Research, Vol.146, pp.241-257.

Van Kampen T J, Van Donk D P, Van Der Zee D J, (2010), 'Safety stock or safety lead time: coping with unreliability in demand and supply', International Journal of Production Research, Taylor & Francis, Vol.48, No.24, pp.7463-7481.

Vemic J, (2007), 'Employee training and development and the learning organization', Economics and Organization, Vol.4, No.2, pp.209-216.

Verschoor C C, (1993), 'Benchmarking the Audit Committee', Journal of Accountancy, Vol.176, No.3, pp.59-64.

Vig S N, (1995), 'Benchmarking: a select bibliography', Published in Productivity, Vol.36, No.3, pp.521-524.

Vinesh, (2014), 'Role of training & development in an organizational development', International Journal of Management and International Business Studies, Vol.4, No.2, pp.213-220.

Voss C A and Blackmon K, (1997), 'Benchmarking and operational performance: some empirical results', International Journal of Operations & Production Management, Vol.17, No.10, pp.1046-1058.

Voss C A, (1994), 'Developing and testing benchmarking and self-assessment frameworks in manufacturing', International Journal of Operations & Production Management, Vol.14, No.3, pp.83-100.

Vrat P, (2014), 'Basic concepts in inventory management in materials management: An integrated systems approach', Springer Texts in Business and Economics, pp.21-36.

Walden J L, (2009), 'Modeling and benchmarking supply chain leadership: setting the conditions for excellence (resource management)', hardcover, CRC Press.

Wallace J B, (1995), 'Treasury benchmarking', Journal of Working Capital Management, Vol.2, No.2, pp.37-41.

Wang D Y, Grunder O and Zhu K J, (2016), 'A hybrid coding SA method for multi-item capacity constrained production and delivery scheduling problem with arbitrary job volumes and customer inventory considerations', International Journal of Industrial and Systems Engineering, Vol.22, No.1, pp.17-35.

Wang S, (2000), 'Managing the organizational aspects of electronic commerce', Human Systems Management, Vol.19, No.1, pp.49-59.

Wang Y C, (2008), 'Evaluating flexibility on order quantity and delivery lead time for a supply chain system', International Journal of Systems Science, Vol.39, No.12, pp.1193-1202.

Warfield J N, (1974), 'Developing interconnection matrices in structural modeling', IEEE Transactions on Systems Man and Cybernetics, Vol.4, No.1, pp.81-87.

Wei P L, Huang J H, Tzeng G H and Wu S I, (2010), 'Causal modeling of web advertising effects by improving SEM based on DEMATEL technique', International Journal of Information Technology & Decision Making, Vol.9, No.5, pp.799-829.

Wendel C, (1993), '4 sharp tools for measuring how your bank measures up', American Banker, Vol.27, pp.18-19.

Whymark J, (1998), 'Benchmarking and credit risk management in financial services', Benchmarking for Quality Management and Technology, Vol.5, No.2, pp.126-137.

Wieser R, (2009), 'Automated Route Control boosts productivity', An executive summary, Process -Worldwide, Vol.2, pp.26-28.

Wijaya J and Purwanto, (2013), 'The relationship between price, lead time, and delay toward the order quantity in steel manufacturer', Universal Journal of Industrial and Business Management, Vol.1, No.1, pp.1-7.

Williams J, Brown C and Anita, (2012), 'Overcoming benchmarking reluctance: a literature review', Benchmarking: An International Journal, Vol.19, No.2, pp.255-276.

Wong W P and Wong K Y, (2008), 'A review on benchmarking of supply chain performance measures', Benchmarking: An International Journal, Vol.15, No.1, pp.25-51.

World Economic Forum (2016), 'The future of jobs: employment, skills and workforce strategy for the fourth industrial revolution', World Economic Forum, Geneva, Switzerland.

Wu H H and Tsai Y N, (2011), 'A DEMATEL method to evaluate the causal relations among the criteria in auto spare parts industry', Applied Mathematics and Computation, Vol.218, No.5, pp.2334-2342.

Wu H H, Chen H K and Shieh J I, (2010), 'Evaluating performance criteria of employment service outreach program personnel by DEMATEL method', Expert Systems with Applications, Vol.37, No.7, pp.5219-5223.

Yadav S K, Gupta S, Mishra S S and Shukla S K, (2016), 'Modified ratio and product estimators for estimating population mean in two-phase sampling', American Journal of Operational Research, Vol.6, No.3, pp.61-68.

Yamada T, Imai K, Nakamura T and Taniguchi E, (2011), 'A supply chain-transport super network equilibrium model with the behavior of freight carriers', Transportation Research E, Vol.47, No.6, pp.887-907.

Yan Yeung J H, Selen W, Deming Z and Min Z, (2007), 'Postponement strategy from a supply chain perspective: cases from China', International Journal of Physical Distribution & Logistics Management, Vol.37, No.4, pp.331-356.

Yang B and Geunes J, (2007), 'Inventory and lead time planning with lead time sensitive demand', IIE Transactions, Vol.39, No.5, pp.439-452.

Yang G, Dekker R, Gabor A F, Axsater S, (2013), 'Service Parts Inventory Control with Lateral Transshipments and Pipeline Stock Flexibility', International Journal of Production Economics, Vol.142, No.2, pp.278-289.

Yang X, (2013), 'A Review of Distribution Related Problems in Logistics and Supply Chain Research', International Journal of Supply Chain Management, Vol.2, No.4, pp.1-8.

Yang Y P O, Shieh H M, Leu J D and Tzeng G H, (2008), 'A novel hybrid MCDM model combined with DEMATEL and ANP with applications', International Journal Operational Research, Vol.5, No.3, pp.160-168.

Yasin M M, (2002), 'Theory and practice of benchmarking: then and now', Benchmarking: An International Journal, Vol.9, No.3, pp.217-243.

Yinan Q, Tang M and Zhang M, (2014), 'Mass Customization in Flat Organization: The Mediating Role of Supply Chain Planning and Corporation Coordination', Journal of Applied Research and Technology, Vol.12, No.2, pp.171-181.

Yu B, Wang K, Wang C and Yao B, (2017), 'Ship scheduling problems in tramp shipping considering static and spot cargoes', International Journal of Shipping and Transport Logistics, Vol.9, No.4, pp.391-416.

Yu Lin C and Hui Ho Y, (2008), 'An Empirical Study on Logistics services provider, intention to adopt Green Innovations', Journal of Technology, Management and Innovation, Vol.3, No.1, pp.17-26.

Yu, T Y and Huang P T, (2014), 'Border innovation management, improved passenger services and satisfaction acceptance', International Journal Process Management and Benchmarking, Vol.4, No.1, pp.89-108.

Yuan W, Zhang D, Liu Q, Shen F and Lee L H, (2016), 'Towards enhancing the last-mile delivery: An effective crowd-tasking model with scalable solutions', Transportation Research Part E: Logistics and Transportation Review, Vol.93, pp.279-293.

Yuvaraj V R and Zhang S, (2013), 'Reducing WIP Inventory of Production Line in AQ Segerström & Svensson AB'.

Zairi M and Ahmed P K, (1999), 'Benchmarking maturity as we approach the millennium?, Total Quality Management, Vol.10, No.(4-5), pp.810-816.

Zairi M and Whymark J, (2000), Transfer of best practices - How to build a culture of benchmarking and continuous learning: Part-II, Benchmarking: A International Journal, Vol.7, No.2, pp.146-167.

Zairi M and Youssef M A, (1995c, 1996), 'Review of key publications on benchmarking': Part I, Benchmarking for Quality Management and Technology, Vol.2, No.1, pp.65-72, Part II 'Benchmarking for Quality Management and Technology', Vol.3, No.1, pp.45-49.

Zayed T M, Daniel W H and Ismail M B, (2005), 'Productivity and delays assessment for concrete batch plant-truck mixer operations', Construction Management and Economics, Vol.23, No.8, pp.839-850.

Zeytinoglu I U, (2005), 'Flexibility in Workplaces: Effects on Workers', Work Environment and the Unions, Geneva: IIRA/ILO.

Zijm W H and Buitenhek R, (1996), 'Capacity planning and lead time management', International Journal of Production Economics, Vol.46, pp.165-179.

APPENDIX – 1

QUESTIONNAIRE

Research Supervisors 1) Dr. Rajeev Kumar Saha, JCBUST, YMCA, Faridabad

2) Dr. Sanjeev Goyal, JCBUST, YMCA, Faridabad

To

M/S ……..……

……..……

Subject: A research project on "Benchmarking of internal supply chain management (ISCM) in select Indian manufacturing industries"

Respected Sir/Madam,

Benchmarking of ISCM is a type of practice to improve the performance of supply chain by reducing the idle time between the activities. Keeping in view the important role of benchmarking of ISCM in Indian economy, a research work entitled **"Benchmarking of internal supply chain management in select Indian manufacturing industries"** is being undertaken for PhD thesis at the Mechanical Engineering Department of J.C. Bose University of Science & Technology, YMCA, Faridabad. As a part of my PhD research, I am conducting a survey of Indian manufacturing industries on different issues related to ISCM, mentioned in questionnaire. To make it possible, the industry is requested to share their views. Your feedback in this regard would be a significant input to this study. The **objective** of the survey is **purely research and academic only**. Therefore, **all responses would be kept strictly confidential** and would be used only for this academic work. A humble request you kindly spare your valuable time in responding to the enclosed questionnaire as soon as possible.

Thanks with warm regards

Kailash

(Research Scholar)

A. Company profile

1. General information related to manufacturing industry.

S. No.	Details of manufacturer
a)	Name of Manufacturing Industry……..
b)	Name of Manufacturing Items……..
c)	Type of Manufacturing ……
d)	Manufacturing process time of single piece is …….
e)	Manufacturing cost of one piece is…….
f)	Labor cost per piece is……..
g)	Number of shift in one day is…….
h)	How many number of product (variety) being manufactured? (a) Less than 5 □ (b) 6-10 □ (c) 11-20 □ (d) More than 20 □
i)	How much percentage of components being manufactured in house? (a) 0≤ 25 □ (b) >25≤50 □ (c) >50≤75 □ (d) >75≤100 □
j)	Please indicate the number of employees in your industry. (a) 0 ≤ 100 □ (b) >100 ≤ 200 □ (c) >200≤ 300 □ (d) >300 ≤ 400 □ (e) More than 400 □
k)	How much day's raw material takes to arrive in Inventory from vendor? (a) 10 days □ (b) 20 days □ (c) 30 days □ (d) 40 days □ (e) 50 days □ (f) above 50 days □
l)	How much days work in process takes in Inventory? (a) 10 days □ (b) 20 days □ (c) 30 days □ (d) 40 days □ (e) 50 days □ (f) above 50 days □
m)	How much days finished goods takes in Inventory? (a) 10 days □ (b) 20 days □ (c) 30 days □ (d) 40 days □ (e) 50 days □ (f) above 50 days □
n)	How much is your Inventory carrying cost per annum? (a) 0.05 □ (b) 0.10 □ (c) 0.15 □ (d) 0.2 □ (e) 0.25 □ (f) above 0.25 □
o)	How much is your distribution cost per annum? (a) 50 cr □ (b) 100 cr □ (c) 150 cr □ (d) 200 cr □ (e) 250 cr □ (f) above 250cr □
p)	How much is your supply chain working capital productivity? (a) Less than 4 □ (b) 7 □ (c) 8 □ (d) 9 □ (e) 10 □ (f) above 11 □
q)	How much is your supply chain inefficiency ratio? (a) Less than 0.05 □ (b) 0.06 □ (c) 0.07 □ (d) 0.08 □ (e) 0.09 □ (f) above 0.09 □
r)	How much is your a/c receivable in your current asset per annum? (a) Less than 100cr □ (b) 150 cr □ (c) 200 cr □ (d) 250 cr □ (e) 300cr □ (f) above 300cr □
s)	How much is your a/c payable in your current liability per annum? (a) Less than 100 cr □ (b) 150 cr □ (c) 200 cr □ (d) 250 cr □ (e) 300cr □ (f) above 300cr □
t)	How much is your working capital per annum? (a) Less than 100 cr □ (b) 150 cr □ (c) 200 cr □ (d) 250 cr □ (e) 300 cr □ (f) above 300 cr □
u)	How much is your net sales per annum? (a) Below100 cr □ (b) 200 cr □ (c) 300 cr □ (d) 400 cr □ (e) 500 cr □ (f) above 500 cr □

2. Idle time of Inventory from supplier to customer in your manufacturing Industry.

S. No.	Stage	Idle time (hours)
a)	Local /Group/Company/Overseas supplier side inventory	
b)	At factory gate inventory waiting time	
c)	Inventory waiting time in incoming quality control department	
d)	Inventory waiting time in factory stores	
e)	Inventory waiting time in production line	
f)	Inventory waiting time for items in outgoing quality control department	
g)	Inventory waiting time of finished goods in original equipment manufacturers store	
h)	Inventory waiting time in warehouses	
i)	Inventory waiting time at distributor's site	
j)	Inventory waiting time at retailer's site	
k)	End customer's	

3. Distance of suppliers and dealers from your manufacturing Industry.

S. No.	Distance	Suppliers %	Dealers %
a)	Within 5 km radius		
b)	Between 5 km and 30 km radius		
c)	Between 30 km to 100 km radius		
d)	Beyond 100 km radius or from abroad		

4. Different sections productivity.

		Productivity		
S. No.	Description	(2012-2013) No. of Pcs./time	(2013-2014) No. of Pcs./time	(2014-2015) No. of Pcs./time
a)	Sheet metal section			
b)	Machining section			
c)	Welding section			

d)	Casting section			
e)	Forging section			
f)	Paint shop section			
g)	Assembly section			
h)	Testing section			
i)	Packaging section			
j)	Manufacturing section (others than above mentioned)			

5. Process results.

		(2012-2013)		(2013-2014)		(2014-2015)	
S. No.	Description	Target	Achieve	Target	Achieve	Target	Achieve
a)	Rejection (PPM)						
b)	Rework (%)						
c)	Items delivery (%)						

6. Performance and comparative analysis.

S. No.	Particular description	(2012-2013)	(2013-2014)	(2014-2015)
a)	i. Capital invested (Own capital)			
	ii. Capital invested (Borrowed funds)			
b)	Sales in rupees			
c)	Growth in sales (%)			
d)	Growth in total income (%)			
e)	Profit before tax & investment			
f)	Profit after tax			
g)	Fixed assets			
h)	Total assets			
i)	Return on investment (ROI) = Profit after tax/Cost of investment			

7. Please rank the followings performance indicators of ISCM from very low importance- rank 1 to very high importance rank 5. (Rank 1= 0% to 20%, Rank 2= 20% to 40%, Rank 3= 40% to 60, Rank 4= 60% to 80%, Rank 5= 80% to 100%).

S. No.	Performance Indicators of ISCM	Very Low	Low	Moderate	High	Very High
		1	2	3	4	5
7.1	Human Resources Orientation					
a)	Education, training and development					
b)	Team work					
c)	Organizational learning					
d)	Provision of public goods					
e)	Export market assistance					
f)	Importance of capital and finance					
g)	Inter-firm relationship					
7.2	Inbound Logistics					
a)	Information flow & analysis					
b)	Inventory level & control					
c)	Integration of group companies					
d)	Vendor development in nearly region					
e)	Underutilization of software facilities					
f)	Scientific methods for forecasting					
g)	Orientation & customer service					
h)	Market penetration					
i)	Flexibility to change					
j)	Ineffective transportation					
k)	Integrated planning					
l)	Vendor rating					
7.3	Operational Logistics					
a)	Frequent change in production schedules					
b)	Production loss due to lack of material					

c)	Frequent changes cause high work in process (WIP) of sub assembly					
d)	Reduction in WIP inventory level					
e)	Manufacturing lead times					
f)	Material handling for WIP from one place to another					
7.4	Outbound Logistics					
a)	Transportation lead time					
b)	Outgoing quality control					
c)	Allocation of warehouses to different factories					
d)	Distribution strategies					
e)	Information flow about current market trends					
f)	Finished goods inventory level					
g)	Demand forecasting					
h)	Inventory level at different warehouses					
7.5	Economies of Scale					
a)	Buffer/safety stock held by user					
b)	Cycle stock					
c)	Anticipation stock					
d)	Pipeline stock					
7.6	Flexibility					
a)	Customer service flexibility					
b)	Order flexibility					
c)	Location flexibility					
d)	Delivery time flexibility					
7.7	Logistics Strategies					
a)	Supply chain planning					
b)	Transportation system planning					
c)	Vehicle routing					
d)	Warehousing planning					
e)	Scheduling planning					

7.8	New Product Development System					
a)	Product Performance					
b)	Technology & Innovation					
c)	Product development cost					
d)	Reliability of product					
e)	Warranty of product					
f)	Responsiveness of product					
g)	Flexibility of product					
7.9	Material Follow Up and Procurement					
a)	Order modification ratio					
b)	Frequency of urgent material requests from suppliers					
c)	% of incoherencies between physical and system record of material					
d)	Production with missing parts					
e)	Line-stop durations and frequency					
f)	Items transported by air, express, cargo					
g)	Money spent for transportation by air, cargo charged to suppliers					
h)	Performance of early delivery					
i)	Performance of late delivery					
j)	Time spent for part missing product completions					
k)	Number of alternative material usage					
l)	Items supplied from alternative suppliers					
m)	Indirect labor hour for follow up					
n)	No. of items used which are not in bill of material (BOM)					
7.10	Production Operation Process					
a)	PO decision meeting lead time					
b)	Percent deviation PO forecasts from the realized sales					

c)	Modification frequency of PO's					
d)	Lead time of monthly production plan preparation					
e)	Realization of dealer sales target					
f)	Correctness of data transfer					
g)	Late orders quantity					
h)	Make to stock quantity					
i)	Flexibility of material handling system					
7.11	Production Programming					
a)	Coherence b/w realized program &material requirement planning (MRP)					
b)	Frequency of postponed validation					
c)	Re-treatment quantity & frequency (based on type, period, vehicle)					
d)	Urgent request fulfillment cycle time					
e)	No. of simulations to correct the mistakes					
f)	Number of items simulated					
g)	% of critical items w.r.t. total items					
h)	Production cycle time					
i)	Quantity & frequency of scrap orders					
7.12	Quality System					
a)	Product quality planning process					
b)	ISO/TS-16949 system related activities					
c)	Process quality control plan					
d)	Process capability analysis					
e)	Supplier selection and approval					
f)	Production parts approval process (PPAP) Validation					
g)	Quality control (incoming/outgoing)					
h)	Calibration of equipment					
i)	Field failure analysis					

j)	Inspection (incoming, in process, final)					
7.13	Products Delivery					
a)	Delivery cost per component					
b)	Number of items returned from dealer					
c)	Transport cycle time from invoicing until delivery to dealer					
d)	Factory stock (assembly line output to assignment point)					
e)	Lead time from point assignment to dealer					
f)	Ready-to-deliver stock levels more than 3,6,9,12 months					
g)	Performance of transporters (lead time)					
h)	Damaged items during transportation					
i)	Final checking time per item (at assignment point)					
7.14	Foreign Trade and Service Management					
a)	Packaging mistakes of suppliers					
b)	Number of air shipments					
c)	% of air shipments charged to supplier					
d)	Packaging cost percentage in total cost					
e)	Percentage of on-time deliveries					
f)	Correct programs sent to suppliers					
g)	Cycle time (waiting at warehouse)					
h)	Stock level for export					
i)	% of warehouse usage					
j)	Undeclared missing parts					
k)	Protection fault					
7.15	Transport Reception Custom Decision					
a)	Vehicle routing problem description					
b)	Model review to address transportation problems in supply chain					

c)	Supply chain integration and IT					
d)	Transport costs					
e)	Transport lead times and deviations					
f)	Extra customs clearance cost					
g)	Cycle time of the trucks in the plant					
h)	Import material customs clearance lead time					
i)	Information system incoherencies					
j)	Amount of empty area of full containers					
k)	Container/special packaging equipment returning cost					

B. Supplier Selection Criterion based on Experts opinion.

8. Please rank the followings criterion for supplier selection from very low importance (rank 1) to very high importance (rank 9).

Criterion	Rating R(1)	Rating R(2)	Rating R(3)	Average
Location				
Quality				
Quantity				
Trust				
Price of Product				
Goodwill of vendor				
Environment Preference				
Experience of Vendor				

C. Questions related to Weightage Score Card for comparative benchmarking of ISCM key performance indicators

9. Please assign weightage the followings factors from very low importance to very high importance (0 to1-very low important, 2-low important, 3-moderate important, 4-high important, 5-very high important).

S. No.	Key Performance Indicators	Strategy Objective	Performance Measures	Weightage	A ltd		
					Year 2013	Year 2014	Year 2015
1.	Financial performance (P1)	Profitable Growth	Turnover: Sales through Channels				
			Funds Allocations				

			Total score				
			Weight score				
2.	Plan performance (P2)	Reduce delay	Product developed cycle time				
			Order entry methods				
			Total cycle time				
			Accuracy of forecasting techniques				
			Range of product and service				
			Total cash flow time				
			Net profit verses productivity ratio				
			Order lead time				
			Information carrying cost				
			Rate of return on investment				
			Total score				
			Weight score				
3.	Source performance (P3)	Existence	Supplier interest in developing Partnerships				
			Supplier cost saving initiatives				
			Supplier delivery performances				
			Supplier lead time against industry norms				
			Supplier delivery pricing against market				
			Supplier booking procedures				
			Achievements of defects free delivery				
			Mutual assistance in solving problems				
			Mutual ability to respond quality problems				
			Purchase order cycle time				
			Total score				
			Weight score				
4.	Make performance (P4)	Facilities	Production Capacity				
			% of Utilization - Under/ Over				

			Theoretical and Actual flow/cycle time of Production				
			% of Product Variety				
			Idle time				
			Average Production Batch Size.				
			Manufacturing cost				
			Economic order quantity				
			Effectiveness of master production schedule				
			Capacity utilization				
			Production/process cycle time				
		Inventory Management	No. of Stock-keeping unit				
			% of Inbounds and out bounds				
			% level of service / Order fill rate				
			% of Quality rejections				
			% Average Safety Inventory				
			% fraction of time out of stocks				
			% of Seasonal Inventory				
			Inventory level as scrap				
			Inventory level as waste				
			Inventory level as work in process				
			Inventory level as finish goods				
			Inventory level as incoming stock				
			Inventory level as inventory in transit				
		Transportation	No. of Vehicles operated				
			% of Outbound Shipments				
			Average Outbound Shipment Size				
			% of Inbound Shipments				
			% Average Inbound Shipment Size				

			Fraction of Transportation Mode				
			% on Timely Delivery				
			% of Accidents				
			Avg. km vehicles running full load and empty per day				
		Warehouses	No. of Warehouses				
			Avg. cost of warehousing per SKU				
			Avg. carpet area covered				
			Avg. time required to access per SKU				
			% of SKUs placed in automated shelves				
			Avg. variable cost of material handling equipment				
		Data Synchronization	No. of servers				
			% of break downs of servers				
			% of data damages				
			% of data not accessed or least accessed				
			% of internal & external complaints or data unavailability				
			% of software inaccuracy				
			% of inaccuracies in Invoices				
			Total score				
			Weight score				
5.	Delivery performance (P5)	Customer satisfaction	Deliver lead time				
			Number of faultless delivery				
			Effectiveness of deliveries invoice methods				
			Information richness in carrying out delivery				
			Response to number of urgent deliveries				
			Total distribution cost				
			% of suppliers involvement in				

			Aligning Co's SCM				
			% of Supplier's contribution in R&D				
			% of Suppliers involved in VMI				
			Total score				
			Weight score				
6.	Sales performance (P6)	Company growth	Sales forecasting				
			Demand planning				
			Total score				
			Weight score				
7.	Customer service and satisfaction (P7)	Market share	Channels Market Share of Customer's purchase				
		Customer satisfaction	Flexibility to meet particular customer needs				
			Customer satisfaction Index-(Survey)				
			Number of Complaints				
			Customer query time				
			Percentage of Orders with complaints				
			Total score				
			Weight score				

D. Questions related to competitive benchmark based on competitiveness index

10. Please rank the followings performance measures of benchmark from very low importance to very high importance (1-very low important, 2-low important, 3-moderate important, 4-high important, 5-very high important).

S. No.	Performance Measures of Benchmark	Functions	Five Point Likert Scale				
			1	2	3	4	5
1.	Finance performance (P1)	Turnover: Sales through Channels					
		Funds Allocations					
2.	Planning performance (P2)	Material					
		Production Capacity					
		Transportation					

		Promotion effectiveness					
		Product developed cycle time					
		Order entry methods					
		Total cycle time					
		Accuracy of forecasting techniques					
		Range of product and service					
		Total cash flow time					
		Net profit verses productivity ratio					
		Order lead time					
		Information carrying cost					
		Rate of return on investment					
3.	Source performance (P3)	Supplier interest in developing partnerships					
		Supplier cost saving initiatives					
		Supplier delivery performances					
		Supplier lead time against industry norms					
		Supplier delivery pricing against market					
		Supplier booking procedures					
		Achievements of defects free delivery					
		Mutual assistance in solving problems					
		Mutual ability to respond quality problems					
		Purchase order cycle time					
4.	Make performance (P4)	Production Capacity					
		% of Utilization -Under/ Over					
		Theoretical and Actual flow/cycle time of Production					
		% of Product Variety					
		Idle time					
		Average Production Batch Size.					
		Manufacturing cost					
		Economic order quantity					
		Effectiveness of master production schedule					

		Capacity utilization						
		Production/process cycle time						
5.	Delivery performance (P5)	Deliver lead time						
		Number of faultless delivery						
		Effectiveness of deliveries invoice methods						
		Information richness in carrying out delivery						
		Response to number of urgent deliveries						
		Total distribution cost						
		% of suppliers involvement in Aligning Co's SCM						
		% of Supplier's contribution in R&D						
		% of Suppliers involved in VMI						
6.	Sales performance (P6)	Sales forecasting						
		Sales growth						
		Demand planning						
7.	Customer Service and Satisfaction (P7)	Channels Market Share of Customers' purchase						
		Flexibility to meet particular customer needs						
		Customer query time						
		Level of customer perceived value of product Customer satisfaction Index-(Survey)						
		Number of Complaints						
		Percentage of Orders with complaints						

E. Questions related to influence of factors for DEMATEL technique.

11. Kindly assign the influence of one factor on the other factors between rating point scale 1 and 5 (1-very low influence, 2-low influence, 3-moderate influence, 4-high influence, 5-very high influence).

ISCM Factors	Human Resources Orientation	Inbound logistics	Operational logistics	Outbound logistics	Economies of scale	Flexibility	Logistics strategies	New Product development system	Material follow up and Procurement	Production Operation Process	Production Programming	Quality System	Products delivery	Foreign trade and service management	Transport ReceptionCustom decision
Human Resources Orientation															

Inbound logistics															
Operational logistics															
Outbound logistics															
Economies of scale															
Flexibility															
Logistics strategies															
New Product development system															
Material follow up and Procurement															
Production Operation Process															
Production Programming															
Quality System															
Products delivery															
Foreign trade and service management															
Transport reception custom decision															

F. Questions related to interrelationship between factors for W-ISM technique and ISM technique.

12. Kindly assign the influence of one factor on other factors in given below tables.

I. Structural Self-Interactive Matrix (SSIM) for benchmarking performance measures:

In structural self - interactive matrix generally V, A, X and O symbols are used to denote the direction of inter relationship between factors i and j. Where

- V shows factor i will influence the factor j.
- A shows factor j will influence the factor i.
- X shows factors i and j will influence each other.
- O shows factors i and j are unrelated.

Performance Measures (PMs)	PM 7	PM 6	PM 5	PM 4	PM 3	PM 2	PM 1
Financial Performance (PM 1)							
Plan Performance (PM 2)							
Source Performance (PM 3)							
Make Performance (PM 4)							
Delivery Performance (PM 5)							
Sales Performance (PM 6)							
Customer Service and Satisfaction (PM 7)							

II. Structural Self-Interactive Matrix (SSIM) for ISCM:

Variable factors (VF)	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Human Resources Orientation (1)															
Inbound logistics (2)															
Operational logistics (3)															
Outbound logistics (4)															
Economies of scale (5)															
Flexibility (6)															
Logistics strategies (7)															
New Product development system (8)															
Material follow up and Procurement (9)															
Production Operation Process (10)															
Production Programming (11)															
Quality System (12)															
Products delivery (13)															
Foreign trade and service management (14)															
Transport reception custom decision (15)															

Responding Person

Note: Please fill or tick the appropriate option out of the following.

a) Name (If you please): ……..

b) Designation:

(a) CEO □ (b) Sr. Manager □ (c) Manager □ (d) Dept. Manager □

(e) Engineer □ (f) Junior Staff □

c) Department:

(a) H.R.D/Personal □ (b) R&D □ (c) Manufacturing/ Production □

(d) Q.A/Q.C □ (e) Purchase/Sales/Marketing □

d) Your association in years with current organization:

(a) Less than 5 □ (b) 5-7 □ (c) 8-10 □ (d) More than 10 □

Thanking you sir for sparing your highly valuable time. Kindly send this back to following address:

Kailash (Research Scholar)

C/o Dr. Rajeev Kumar Saha

Department of Mechanical Engineering

J.C. Bose University of Science & Technology, YMCA, Faridabad - 121006 (HR)

Mob. No. - 09013864894

E-mail - kailashattri.257@gmail.com, kailash_mech1984@yahoo.co.in

APPENDIX - 2

BRIEF PROFILE OF THE RESEARCH SCHOLAR

Kailash is working as an Assistant Professor in the Mechanical Engineering Department at Satyug Darshan Institute of Engineering & Technology, Faridabad, Haryana, India. He is working in the field of supply chain management, operation management, industrial engineering and manufacturing technology & automation. He has passed his Bachelor of Engineering in Mechanical Engineering from B.S. Anangpuria Institute of Technology & Management, Faridabad in year 2007, Master of Technology in Manufacturing Technology and Automation from YMCA University of Science and Technology, Faridabad, Haryana, India in year 2011. He is pursuing his PhD in Mechanical Engineering from J.C. Bose University of Science & Technology, YMCA, Faridabad, Haryana, India. His topic of research is "Benchmarking of Internal Supply Chain Management in Select Indian Manufacturing Industries". He has published research papers in peer reviewed national and internationals journals and conferences.

APPENDIX- 3

LIST OF PUBLICATIONS OUT OF THESIS

List of Papers Published in International Journals

S. No.	Title of Paper	Name of Journal	Vol. & Issue No.	Year of Publication	Page No.
1	Benchmarking model to analyze ISCM performance of selected Indian manufacturing industries using fuzzy AHP technique	International Journal of Industrial & System Engineering (impact factor-0.36) (Inderscience publisher) Scopus (Elsevier) Index	Vol.33, No.1	2019	1-16
2	Benchmarking of Internal Supply Chain Management: factors analysis and ranking using ISM approach, MICMAC analysis	International Journal of Productivity & Quality Management (Inderscience publisher) Scopus (Elsevier) Index	Vol.27, No.4	2019	394-419
3	Benchmarking Framework For Internal Supply Chain Management: A Case Study for Comparative Analysis.	International Journal of Manufacturing Technology and Management (impact factor-0.54) (Inderscience publisher) Scopus (Elsevier) Index	Vol.32, No.(4/5)	2018	412-429
4	Systematic literature Review of Classification and Categorization of Benchmarking in Supply Chain Management.	International Journal of Process Management and Benchmarking (Inderscience publisher) Scopus (Elsevier) Index	Vol.7, No.2	2017	183-205
5	Benchmarking Practice for Identification of Internal Supply Chain Management Performance Factors Gap	Journal of Supply Chain Management System (impact factor-0.767) (Publishing India Group)	Vol.6, No.4	2017	33-38
6	Factors Analysis of ISCM Benchmarking Using DEMATEL Technique	Journal of Supply Chain Management System (impact factor-0.767) (Publishing India)	Vol.8, No.1	2019	1-14
7	Performance Indicators for Benchmarking of Internal Supply Chain Management.	International Journal of Social, Behavioral, Educational, Economic, Business and Industrial Engineering	Vol.11, No.7	2017	1940-1944

8	Scope of Internal Supply Chain Management Benchmarking in Indian Manufacturing Industries.	International Journal of Social, Behavioral, Educational, Economic, Business and Industrial Engineering	Vol.11, No 6	2017	1638-1641
9	Benchmarking Role in Internal Supply Chain Management of Indian Manufacturing Industries.	International Journal of Social, Behavioral, Educational, Economic, Business and Industrial Engineering	Vol.11, No.6	2017	1646-1654
10	Integrity of Supplier and Distributor with Manufacturing Company in Supply Chain Management.	Invertis Journal of Science & Technology, (Indian Journal)	Vol.8, No.2	2015	95-100
11	Effects of Kaizen on the Productivity and Quality of Select Indian Manufacturing Industry.	International Journal of Engineering Research and Technology	Vol.6, No.5	2013	71-77

List of Paper Accepted in International Journals

S. No.	Title of the paper	Name of Journal	Present Status	Vol. & Issue No.	Year of Publication
1	Ranking of ISCM Benchmarking Factors Using VIKOR Methodology	Journal of Supply Chain Management System (impact factor-0.767) (Publishing India Group)	In press	Not Assigned	2019

List of Paper Published in International Conferences

S. No.	Title of the paper	Name of Conference	Year of Conference	Place of Conference
1	To Study Integration of the Internal Supply Chain Management: An Overview.	International Conference on Sustainable Development Through Research in Engineering and Management	2016	YMCAUST, Faridabad

List of Papers Published in National Conferences

S. No.	Title of the paper	Name of Conference	Year of Conference	Place of Conference
1	Identification of Performance Measurement Indicators of Benchmarking	National Conference on Role of Science and Technology towards 'Make in India'	March 05-07, 2016	YMCAUST, Faridabad (Haryana)

2	Enhancing Factors and Implementation Strategy Used to Develop Benchmarking Model of Internal Supply Chain Management for Analyzing Indian Manufacturing Industries.	National Conference on Trends and Advances in Mechanical Engineering	March 16-17, 2017	YMCAUST, Faridabad (Haryana)
3	Development of a Benchmark for Analyzing Indian Manufacturing Industries	National Conference on Role of Science and Technology towards 'Make in India'	March 05-07, 2016	YMCAUST, Faridabad (Haryana)
4	Integrity of Supplier and Distributor with Manufacturing Company in Supply Chain Management	National Conference on Recent Advancement in Mechanical Engineering	April 30, 2015	DCTM, Palwal (Haryana)
5	A Review Paper: Supply Chain Management & Its Dimensions	National Conference on Recent Trends in Mechanical Engineering	January 24, 2015	RIET, Faridabad (Haryana)
6	Effects of Kaizen on the Productivity and Quality. of Select Indian Manufacturing Industry	National Conference on "Recent Trends in Engineering, Technology & Management For Sustainable Development"	August 13,2013	MVN University, Palwal (Haryana)
7	To Study the Implementation of Pareto Analysis in SME Indian Manufacturing Industries by Using Cause and Effect Diagram: A Case Study	National Conference on Trends and Advances in Mechanical Engineering	October 19-20, 2012	YMCAUST, Faridabad (Haryana)

List of Communicated Papers in International Journals

S. No.	Title of the paper	Name of Journal	Present Status	Year
1	Weighted Interpretive structural modeling approach for exploration of performance measures of Benchmarking of Internal supply chain management	International Journal of Agile & System Management (Inderscience Publisher) Scopus (Elsevier) Index	Under review	2019
2	Comparative Benchmarking of Internal Supply Chain Management in Competitive Manufacturing Organizations: Using Weightage Score Card	International Journal of Production Research (Taylor & Francis Publisher) Science Citation Index	Under review	2019