The Impact and Dynamics of Centralization in Supply Chain Decision-making

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Abstract

Companies with a corporate supply chain department and multiple business units use one of two methods for their supply chain decision-making: centralized decision-making where supply chain decisions are made at the corporate level by the central supply chain department or decentralized decision-making where supply chain decisions are made at a business unit level. We investigate the hypothesis that a centralized organizational structure helps companies lower costs and a decentralized organization structure enables companies to quickly respond to customer needs on a real time basis and improve customer service. To evaluate our hypothesis we surveyed industry current practice. Based on our analysis from the survey, we identified three factors that influence companies to adopt either a centralized or decentralized organization structure: customer service, supply chain management cost, and organizational control. We identified that a "hybrid" structure, where strategic functions are centralized and operational functions are decentralized, had the lowest supply chain management cost percentage to sales.

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By Guruprakash

My heartfelt thanks...

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To my parents...
# Table of Contents

ABSTRACT .................................................................................................................. 2

ACKNOWLEDGEMENTS ................................................................................................. 3

LIST OF TABLES .................................................................................................................. 7

LIST OF FIGURES ........................................................................................................... 8

CHAPTER 1. INTRODUCTION ......................................................................................... 9

1.1. Research Questions and Hypotheses ........................................................................ 10

1.2. Roadmap of this Research Work ........................................................................... 12

CHAPTER 2. LITERATURE REVIEW ............................................................................. 15

2.1. Definition of Centralized and Decentralized Decision-Making ................................ 15

2.2. Cost Elements in Supply Chains ............................................................................ 17

2.3. Supply Chain Management Functions .................................................................... 19

2.4. Organizational Structure and Cost in Supply Chains .......................................... 20

2.5. Motivation from Literature Review ........................................................................ 21

CHAPTER 3. RESEARCH METHODOLOGY ................................................................... 23

3.1. Measurement Method ......................................................................................... 23

3.2. Sampling Approach ............................................................................................ 29

3.3. Analysis Methods ............................................................................................... 31

3.3.1. Centralization and Strategic Importance ....................................................... 31

4.3.2. Factors Influencing Centralization ................................................................ 32

4.3.3. Dynamics of Centralization and Decentralization ....................................... 33

4.3.4. Cost Structure and Centralization Analysis .................................................. 33

CHAPTER 4. RESULTS AND DISCUSSION .................................................................. 35

4.1. Characteristics of Supply Chain Management Organization ................................ 36

4.2. Centralization and Strategic Importance .............................................................. 38
4.3. Factors influencing Centralization ......................................................... 41

4.4. Cost Structure and Centralization ............................................................ 45
   4.4.1. Transportation Costs and Shipment Handling Centralization .............. 46
   4.4.2. Transportation Costs and Transportation Planning Centralization ...... 48
   4.4.3. Inventory Carrying Costs and Inventory Planning Centralization .......... 50
   4.4.4. Cluster Analysis on Centralization and Cost structure ....................... 52

4.5. Dynamics of Centralization ..................................................................... 58
   4.5.1. Cost Driver Dynamics ................................................................. 59
   4.5.2. Customer Service Driver Dynamics .................................................. 61
   4.5.3. Control Driver Dynamics ............................................................... 63
   4.5.4. An Integrated Framework ............................................................... 65

4.6. Case Studies ............................................................................................ 67
   4.6.1. Case Study 1: Sourcing at the Leading Consumer Products Company .... 67
   4.6.2. Case Study 2: Shipment Handling at the Pharmaceutical Company ...... 72

CHAPTER 5. CONCLUSIONS ............................................................................ 76
   5.1. Key Findings ........................................................................................ 76
   5.2. Contributions and Limitations ............................................................... 76
   5.3. Further Research .................................................................................. 77

APPENDIX ...................................................................................................... 79

BIBLIOGRAPHY .............................................................................................. 88
List of Tables

Table 1: Supply Chain Costs Break-up Practices ................................................................. 19
Table 2: Framework for Strategic Importance Grouping .......................................................... 26
Table 3: Key factors of centralization ...................................................................................... 27
Table 4: Respondent Statistics' ............................................................................................. 31
Table 5: Student's t-test Result of the Consumer Products Manufacturing Industry .......... 39
Table 6: Student's t-test Result of the Industrial Products Manufacturing Industry .......... 39
Table 7: Student's t-test Result of the Logistics Service Industry ............................................ 40
Table 8: Student's t-test Result of the Retail Industry ............................................................. 40
Table 9: Centralization vs. Strategic Importance Segmentation Analysis .............................. 40
Table 10: Influencing Factors of the Consumer Products Manufacturing Industry ............ 42
Table 11: Influencing Factors of the Industrial Products Manufacturing Industry .............. 42
Table 12: Influencing Factors of the Logistics Service Industry ............................................ 42
Table 13: Influencing Factors of the Retail Industry ............................................................... 42
Table 14: Influencing Factors for Each Industry with respect to Strategic Importance .......... 44
Table 15: Summary of Other Attributes for the clusters ......................................................... 54
Table 16: Chi-square Test Results ......................................................................................... 79
Table 17: Final Centers and Distances of Clusters ................................................................. 87
List of Figures

Figure 1: Cost Levels in supply chain Costing .......................................................... 17
Figure 2: Industry Categorization .............................................................................. 30
Figure 3: Senior Most Functionality of Supply Chain Department ............................. 36
Figure 4: Reporting Relationship of supply chain Leadership (SCL) ......................... 37
Figure 5: Various Functions Performed in supply chain Department .......................... 37
Figure 6: Centralization vs. Strategic Importance Segmentation Analysis .................. 41
Figure 7: Cost Structure Comparison for All Industries ............................................. 45
Figure 8: Transportation costs Percentage of Sales With Respect To Shipment Handling Centralization for All Industries ................................................................. 46
Figure 9: Transportation Costs Percentage of Sales With Respect To ........................... 49
Figure 10: Inventory Carrying Costs Percentage of Sales With Respect To Inventory Planning Centralization for All Industries .......................................................... 51
Figure 11: Three Segmentations By K-means Clustering ............................................ 53
Figure 12: Cost Analysis for Three Clusters ............................................................... 55
Figure 13: Cost Analysis for Three Clusters Excluding Inventory Carrying Costs ....... 57
Figure 14: Cost Driver Model .................................................................................. 60
Figure 15: Customer Service Driver Model ............................................................... 61
Figure 16: Integrated Decision-making and Incentive Conflict Model ......................... 63
Figure 17: An Integrated Framework that determines centralization of a function ........ 65
Figure 18: Causal Loop Diagram of Sourcing Function .............................................. 71
Figure 19: Case 1 - Decentralized Sourcing .............................................................. 72
Figure 20: Case 1 - Centralized Sourcing ................................................................. 72
Figure 21: Causal Loop Diagram of Shipment Handling Function .............................. 74
Figure 22: Actual Survey Used for This Research ..................................................... 81
Chapter 1. Introduction

Centralization is the policy of concentrating all decision making in the hands of a few people who are common across the different business units in an organization.

According to Stroh and Northcraft (2002), in a highly centralized organization all decisions are made by one individual and are implemented through formal channels of authority. Decentralization on the other hand refers to the policy of delegating authority to the individual business units in an organization. Stroh defines decentralization as an attempt to “push decision making authority and responsibility” lower in the organization. There is a constant debate in the supply chain field as to how supply chain departments in manufacturing, retail and logistics companies should be organized. Should the supply chain organizations be centralized or should they be decentralized? To illustrate this point, let us look at two examples that present contrasting outcomes where companies have adopted different organizational structures for their supply chain organizations.

While HP decided to decentralize a previously centralized structure (Moad, 2006), Office Depot decided to centralize a previously decentralized organizational structure (Abright, 2004). In June 2006, HP decided to decentralize its supply chain function. It disbanded its global supply chain function and decided to give responsibilities back to the core operating divisions. More precisely, HP adopted a hybrid approach where some responsibilities were clearly delineated between the two business units and some responsibilities were still executed by one of the two business units as a service to the other unit.
On the other hand, Office Depot, a leading office supplies retailer decided to consolidate its North American supply chain operations under a single supply chain organization. As narrated to Albright (2004), the Vice President of supply chain at Office Depot, Mark Holifield commented that the consolidated structure would help drive market share gains. He also commented that:

"If you're already in an industry-leading position, continuing to widen the gap becomes more challenging," he said. "We achieved that position as separate organizations. Now, consolidated as a single supply chain, where we can leverage all of the talents of all the people in those groups, I think we can unlock tremendous capabilities."

As we see from these cases, companies are motivated by different reasons for either centralizing or decentralizing their supply chain organization. Hence it is important to understand the impact and dynamics that influence where critical supply chain decisions have to be made – locally at each business units or centrally at the corporate level. This research paper explores this question in greater detail.

1.1. Research Questions and Hypotheses

In this thesis we compare and contrast the cost structure of companies that are opting for centralization or decentralization over the other structure in the supply chain organization as well as understand the various factors influencing centralization-decentralization
decision in the supply chain organization. The research questions can be summarized as follows:

a) How do companies centralize or decentralize their supply chain decision-making?

b) What is the cost structure of companies that centralize or decentralize their supply chain decision-making?

c) What are the factors influencing the centralization or decentralization of the supply chain department in manufacturing companies?

d) What are the underlying dynamics that shape the centralization or decentralization of supply chain decision-making?

Answers to the research questions listed above will help us validate our hypotheses on this topic, which are:

a) Companies centralize their strategic functions and decentralize their operational functions.

b) Companies that decentralize their decision-making do so to meet unique customer requirements in their businesses or to take advantage of supplier situations or to meet legal regulations or to take advantage of any other business conditions in their operating geographies and business units.

c) Companies centralize their supply chain decision-making for cost considerations.

d) Companies within the same industry that adopt centralized decision-making have lower supply chain costs as a percentage of sales compared to companies that decentralize in that industry.
In order to answer the research questions, we recognized that we would need information on the extent of centralization in supply chain functions and various cost figures from a cross section of companies across industries. We will also need information on the factors that motivate companies to adopt their chosen organization structures. The volume of data requirements for our research clearly pointed us to a survey for our research. The methodology that we adopted to collect and analyze data is described in detail in the paragraphs below.

1.2. Roadmap of this Research Work

The next chapter (Chapter 2) reviews literature on this topic to define the terms and framework examining centralization in decision-making and cost issues in Supply Chains. The literature review gives us a strong theoretical foundation and motivation for our research.

Chapter 3 describes our research questions and key hypotheses. The research questions and hypotheses can help the readers understand the direction of our research and the issues that we are exploring more closely.

Chapter 4 presents the methodology that we adopted for our research. This chapter describes the design of the survey that we used to collect data and the sampling approach for our research. This chapter also discusses the analysis methods used to extract insights from the survey. We also employ systems dynamics modeling approach to examine the macro influences that shape centralization of supply chain functions in organizations. We also explain the advanced techniques that we use to examine the impact of centralization on cost structure of companies in this chapter.
Chapter 5 discusses and documents the results of our analysis. In this chapter, the research hypotheses are evaluated on the basis of results obtained and insights from practicing managers are juxtaposed to compare and contrast the research results. In this chapter, we also dive deeper on the key questions that initiated the research namely, how do companies centralize or decentralize their supply chain management functions, and why and what is the impact of this centralization approach in terms of cost structure to those companies.

The last chapter (Chapter 6) summarizes lessons and limitations of this research. In this chapter we also propose further research possibilities in this area.
Chapter 2. Literature Review

We studied past research to investigate centralization in different supply chain functions in organizations and to explore centralization across industries. The literature survey helped us to refine our definitions of terms namely centralization (Stroh & Northcraft, 2002; Fredrickson, 1986) and cost structure (Seuring & Goldbach al, 2001), review the advantages and disadvantages of centralization and decentralization of decision making, and understand the current status of research on the correlations between cost structure, centralization and organization structure (Dai, Narasimhan & Wu, 2005; Johnson, 2003).

2.1. Definition of Centralized and Decentralized Decision-Making

A centralized organization is one in which the right to make decisions and evaluate activities is concentrated with a small coalition of top-level executives (Fredrickson, 1986). Decentralized control on the other hand refers to a business situation where each individual unit in the supply chain makes decisions based on local information (Lee & Billington, 1993). There are merits and demerits of centralized and decentralized decision-making. Centralized decision-making enables specialization in that function and mastery in making such decisions acquired through the experience of executing that process for various business units. Centralization enables economies of scale of procurement of products and services (Harrison, 2001). Centralized decision-making brings about uniformity of decisions and hence enables common processes across all business units. Centralized decision-making provides economies of scale – if individual business units negotiate deals, they are likely to have lesser bargaining power compared to a central organization with much larger budget to spend. Also, a centralized buyer can
reduce the number of suppliers and thereby increase the efficiencies of dealing with fewer suppliers. Centralization enables easy change of processes. For example a change in the inventory policy or a change in the transportation sourcing is easy to implement owing to minimal disruption to business.

Although centralized decision-making is beneficial for a variety of reasons there are certain drawbacks that are forcing businesses to take over the decision-making from the corporate supply chain organization and retain it locally. Centralized decision-making is not tailored to unique business conditions that exist locally. Centralized decision-making increases the response time because in some situations the corporate supply chain organization might be in a different time zone compared to the business unit. Centralized decision-making reduces the control of the local businesses on key decisions such as inventory or transportation where the supply chain person might be waiting for decisions to be made centrally. Centralized decision makers do not have all the information necessary to make good decisions (Stroh 2002). On the other hand, in a decentralized organization, there is a high potential incentive misalignment between the “principal” (the delegating authority) and “agents” (the delegates) (Lee & Whang, 1999).

Therefore, it is clear that centralization and decentralization can be effective in different situations. For different functions, businesses have evaluated the advantages and disadvantages of a centralized decision-making process in light of their unique business conditions, competitive situation and cost margins to decide which decision-making process is better suited.
2.2. Cost Elements in Supply Chains

It is also pertinent now to analyze the cost structure and the various costs as referenced by this paper in greater detail. Seuring and Goldbach (2002) provide a conceptual framework to understand supply chain costs into three cost levels:

a) Direct costs: the costs that are caused by the production of each single entity of a product and they include costs such as material cost and labor costs.

b) Activity-based costs: the costs caused by activities that cannot be directly attributed to products, but by administrative activities to manufacture and deliver products to customers and they include operational costs, transportation costs and inventory carrying costs.

c) Transaction costs: the costs caused by the supply chain organization's need for information and communication with suppliers and customers. This includes Information Technology costs, hardware costs such as computer costs.

The following diagram shows these cost items in a supply chain model.

![Figure 1: Cost Levels in supply chain Costing](image-url)

1 Seuring and Goldbach (2002)
Since in this research we are interested in costs pertaining to supply chain decision-making, we will consider the costs that pertain to activity-based costs and transaction costs as part of the cost structure to be analyzed, and exclude the direct costs, which heavily depend on external factors such as fuel, in our cost analysis. The selection of cost buckets identified in this research was influenced to a large extent by the cost categories identified by Davis (2001). Davis (2001) identified five different cost elements namely transportation (4.3% of sales), warehousing (1.8%), order entry (0.55%), administrative (0.36%) and inventory carrying (2.07%). Moreover, Stock and Lambert (1987) have identified logistics costs as falling mainly in five buckets: transportation, warehousing, order processing and information, inventory carrying and lot quantity. Wendell (1965) identified the logistics cost as a percentage of sales across all industries. He had identified transportation costs to be 10.7% of sales, warehousing costs to be 3.7%, inventory carrying costs to be 3.8%, order processing costs to be 1.2% and other administrative costs to be 2.4% of sales. Transportation was relatively higher than other cost items in his research, because transportation was regulated before 1980.

A similar cost breakup is also commonly seen in consulting research. The consulting firm, Supply Chain Consultants (2005), has identified four key cost buckets namely, transport, warehousing, inventory carrying, and customer service and administration in their online paper. They have identified transport costs to be 2.7% of sales, warehousing costs to be 1.5%, inventory charge of 2.5%, customer service and administrative costs at 0.9%.
We also noticed that Supply Chain Digest (2006), a popular online magazine on supply chain management, had employed a similar breakup of cost components namely warehousing costs, transportation costs, inventory carrying costs, customer service and reverse logistics costs for its annual logistics survey of 2006. The supply chain cost structure and ranges of cost as a percent of sales identified in academic and professional journals have shaped the cost structures and cost ranges identified in our research as well.

### 2.3. Supply Chain Management Functions

As we start analyzing the cost in a supply chain, it is pertinent to also enumerate the functions that are to be considered as part of the research. Miller (2002) has provided an excellent reference for identifying the different decisions involved in supply chain management in an organization. He breaks down the different decisions into three key buckets namely:

a) Strategic decisions: the decisions that have high risk, high costs and high impact (impact that lasts more than 2 years of the company’s activities)

b) Tactical decisions: the decisions that have medium risk, medium costs and medium impact (impact that lasts between 1 to 2 years of a company’s operations)
c) Operational decisions: the decisions that have low risk, low costs and low impact
(impact that lasts less than a year).

This framework has been used for categorizing the main supply chain functions for
result analysis in the analysis section of this paper.

2.4. Organizational Structure and Cost in Supply Chains

In order to understand the factors that motivate companies to centralize or decentralize
and to examine the impact of structure on cost, we reviewed past research exploring the
relationships between organizational structure, centralization and cost in the supply chain
organization of companies.

Johnson (2003) analyzed purchasing organization structure of companies and
identified important relationships between organizational structure and competitive
pressures such as cost, technology and market uncertainty. Likewise, in an attempt to
model buyer behavior in centralized and decentralized organizations, Dai, Narasimhan
and Wu (2005) have analyzed the structure of procurement organizations using queuing
theories and have provided an economic model that captures the fundamental trade-off in
a firm’s e-sourcing business process as characterized by communication complexity,
frequency of use and cost of delay. While the research papers provide an excellent
theoretical basis to model centralization and decentralization, it is applied to only the
purchasing function and does not differentiate the type of function namely strategic,
tactical or operational. However it does provide a basis to envisage the service level and
cost tradeoffs possible in centralized and decentralized organization structures.
Das and Tyagi (1996) identified centralization of inventory as providing the tradeoff between cost and customer assignments. Their research has focused on physical inventory management. However the cost advantages identified by them due to centralization of inventory allocation can be extended to other functions of supply chain management that are analyzed in this paper. Anupindi and Yehuda (1999) have identified a threshold level of “market search” at which both retailers and manufacturers benefit by the centralization of stocks. They identify a certain level of centralization for both manufacturers and retailers to be profitable. Nozick and Turnquist (2001) have also provided a comprehensive analysis of the location of distribution centers in influencing inventory, transportation costs and customer service. While there are a number of academic papers and articles on the centralization of physical inventory as a tactical approach to manage cost and customer service, not much focus has been given to centralization of decision making in the different functions of supply chain management.

Also, for companies that want to implement a change in their decision making process from either a centralized or decentralized organization to the other the transition is wrought with challenges. This has been illustrated by Johnson and Leenders (2004) as they point out the merits and demerits of centralization and decentralization and the pitfalls and issues one can face while migrating from one form of organization to the other.

2.5. Motivation from Literature Review

Although there is rich literature on the topic of physical inventory centralization, not much analysis has been done on the relationship between centralization of decision-
making, organizational structure and cost structure. Such an analysis would provide a valuable tool to business managers who would like to understand the implications of a particular organizational design on the cost structure of the companies. Also none of the papers that we examined went in detail analyzing the factors influencing companies in either centralizing or decentralizing their supply chain organizations. Such an analysis would be valuable to establish the context where one type of organizational structure can be more effective over the other. This paper attempts to bridge this knowledge gap through research. The extensive literature available provides us with a strong foundation to analyze the factors influencing centralization and understand the underlying dynamics shaping a particular organization structure.
Chapter 3. Research Methodology

We used a web based survey method to collect data from companies representing retailers, manufacturing (consumer products and industrial products) and logistics service companies.

3.1. Measurement Method

The survey method is adequate and appropriate for our research because majority of the data points that were collected are not available generally in publicly available information. Furthermore, this information is best collected from senior supply chain professionals within the organization who will have a better picture of the way the company is organized. In addition, in order to eliminate the possibility of subjectivity or bias by external observers it is best to collect information through an anonymous survey where senior supply chain professionals who are best placed to provide that information anonymously can provide the facts. At the same time, a survey method still has limitations in accuracy because of internal bias and subjectivity in data collection. However, for the considerations of our research this error is minimized through our selection process for respondents as described later in the chapter.

Our survey questionnaire consisted of five parts. Each part measured an attribute of the supply chain of our respondent companies related to centralization, business factors or cost structure. Besides, we also collected information pertaining to the company characteristics. The data collected was used to answer the research questions and derive important conclusions.
Supply Chain Management Organization Characteristics

The first part of the survey was designed to collect information about the supply chain department pertaining to its importance, reporting relationships, and key functions performed by the SCM department. We used the title of the top supply chain functionary to gauge the importance of the supply chain department in the organization and we also gave multiple options to respondents to collect information on relationships and functions to reflect business realities. Although these questions were not attached to any hypotheses, information collected gave us an indication of the interfaces that existed between the supply chain department and other departments within the company and the importance of supply chain organization within the company. A sample questionnaire of our survey is attached in the Appendix.

Degree of Centralization in Supply Chain Management Functions

The second section of our survey collected information about the level of centralization across the different sub-functions of the supply chain organization where respondents were asked to choose the level of centralization in the different functions.

Although supply chain literature has a number of definitions for supply chain management, for our research, the key functions of supply chain professionals have not been clearly enumerated. Miller (2002) has identified a number of decisions taken by supply chain professionals but it has been left to the readers to assume the key functions of supply chain management. Hence for the purposes of our research we list below the key functions of supply chain management in organizations:
a) Long-term capacity planning – the function that creates long range capacity investment plans for the business
b) Sourcing – function that is responsible for procurement of products and services for the company’s operations
c) Transportation planning - function that plans for Transportation assets and partners with carriers
d) Inventory planning - function that executes inventory planning
e) Short-term demand planning - function that develops short-term demand forecasts
f) Manufacturing planning - function that plans production and integrates the other teams with the manufacturing
g) Internal improvement - function that supports internal projects supporting supply chain strategy/quality
h) Order fulfillment - function that is involved in fulfilling demands using dedicated or/and private warehouses
i) Shipment handling - function that manages the day to day logistics and shipment handling/tracking
j) Order management and problem resolution - function that supports customers and expedites/consolidates delivery to customers

The above ten functions can be grouped into strategic, tactical and operational based on Miller (2002)’s framework as described earlier in the literature review section. Hence, the different supply chain functions can then be classified as below:
<table>
<thead>
<tr>
<th>Functions</th>
<th>Strategic</th>
<th>Tactical</th>
<th>Operational</th>
</tr>
</thead>
<tbody>
<tr>
<td>Timeline to Plan/Execute</td>
<td>Long - Yearly</td>
<td>Medium - Quarterly, Monthly</td>
<td>Short - Daily, Weekly</td>
</tr>
<tr>
<td>Impact on Business</td>
<td>High</td>
<td>Medium</td>
<td>Low</td>
</tr>
<tr>
<td>Risk</td>
<td>High</td>
<td>Medium</td>
<td>Low</td>
</tr>
<tr>
<td>Examples</td>
<td>Long-term Capacity Planning</td>
<td>Transportation Planning</td>
<td>Order Fulfillment</td>
</tr>
<tr>
<td></td>
<td>Sourcing</td>
<td>Inventory Planning</td>
<td>Order Management</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Short-term Demand Planning</td>
<td>Shipment Handling</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Manufacturing Planning</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Internal Improvement</td>
<td></td>
</tr>
</tbody>
</table>

**Table 2: Framework for Supply Chain Functions Grouping**

With the functions of supply chain management well laid out the respondents can now specify the degree of centralization of each of these functions in their organization based on their experience. The degree of centralization in each function is classified into four categories:

a) Most decisions (75% - 100%) made locally

b) Majority decisions (50% - 75%) made locally

c) Majority decisions (50% - 75%) made centrally

d) Most decisions (75% - 100%) made centrally

For the respondents, whose company did not have some functions, or who did not know how some functions operated, we allowed a “Not applicable” option as well.

**Key factors influencing centralization**

The next section in the survey focused on understanding the factors influencing centralization or decentralization of supply chain functions. The respondents were asked to select the most influencing factor for centralization in each function among six factors, shown below:
Although there could be several factors influencing centralization or decentralization of supply chain decision making in companies, the list identified above captures the key external stakeholders that could influence any company and important internal factors that force companies to adopt a particular organization structure. Respondents could choose only one factor for each function hence their answers can be regarded as the most important factor to determine centralization of the function.

**Cost structure information**

The next section of our survey collected cost information. We established five cost buckets based on prior research on this topic as identified in the literature review section:
inventory carrying costs, transportation costs, information costs, operational costs, and other supply chain costs. The different cost elements that fall under these five cost buckets were:

Inventory Carrying costs as a % of Sales: This is the cost of maintaining inventory which includes inventory financing charges, inventory insurance and taxes, inventory shrinkage, inventory control and cycle counting expenses.

Transportation costs as a % of Sales: This is the cost of engaging third party transportation charges or private fleet costs including fuel, driver and depreciation charges.

Information costs as a % of Sales: This includes costs related to the setup of IT systems for supply chain activities including service charges, hardware and software charges.

Operational costs as a % of Sales: This includes the cost of labor, warehouse rent, utilities, cost of warranty, lease payments or depreciation on material handling equipment and other operational charges.

Other supply chain costs as a % of Sales: This includes all other supply chain charges not included in the above buckets.

Cost figures in those five cost buckets were obtained as a percentage of sales. Respondents were asked to choose from among different options with each option representing a range of percentages. The different options given to respondents were 0-1.4%, 1.5–2.9%, 3.1 to 4.4%, 4.5 to 5.9%, 6 to 7.4%, 7.5 to 8.9%, 9 to 10.5% and more than 10.5%. The choice of the cost structure ranges were influenced by the representative cost structure identified in the literature survey.
Basic information of the company

Lastly, we asked basic information about the company to learn organizational characteristics of the whole company. In this part, we asked respondents to provide information about the employee count of their company and the supply chain organization along with annual revenue size and the range of countries their company operated. This section helped us capture the extent of globalization of respondent companies and their size.

3.2. Sampling Approach

We conducted a pre-test survey with supply chain professionals from industry and academia, and modified the survey after incorporating feedback. For the actual survey, we employed a web-based questionnaire to collect responses and administered the questionnaire over a period of 21 days to senior supply chain professionals including C-level, president, senior vice president, and other vice president level executives numbering more than 2800 in the industry. We received a fairly encouraging response from more than 145 supply chain professionals across 15 different industries. The survey respondents were part of a professional club and were carefully selected after making sure that they are operational professionals at a level of manager and above. The survey responses were carefully cleaned with due consistency checks and the clean responses numbering 97 in total were used for further analysis for a usable yield of 3.46%.

Industry Categorization
We classified our respondent companies into the following four categories based on their position in consumer and industrial supply chains:

- **Industrial Products Manufacturer**
- **Logistic Service Provider**
- **Consumer Products Manufacturer**
- **Retailer**

**Figure 2: Industry Categorization**

a) Consumer products manufacturers (CPM): All consumer product companies operating in food and beverage products, clothing goods, pharmaceuticals, consumer electronics, and other consumer products will fall under this category.

b) Industrial products manufacturers (IPM): Companies operating in the paper, chemical goods, industrial machinery, automobile component products, industrial materials, industrial electronics products and other industrial products manufacturers will fall in this category.

c) Logistics service providers (LSP): This industry group covers third part logistics companies and wholesale distributors, whose main business focuses on distribution and warehouse management services.

d) Retailers (RET): All retailers fall under this category.

Table 2 summarizes the sample characteristics according to the industry categories, annual revenue, company size in terms of total employees, and number of countries, in which they operate.
Manufacturing Industry | Logistics Service Provider | Retail Industry | Total
---|---|---|---
No. of Respondents  
Annual Revenue  
<= $49M  
$50M - $499M  
$500M - $999M  
$1.00B - $2.99B  
>= $10B  
No Response  
Total  
CPM  
IPM  
Provider  
No. of Respondents  
Total Employees*  
Small  
Medium  
Large  
No Response  
Total  
No. of Countries  
1  
2 - 4  
5 - 10  
11 - 29  
>= 30  
No Response  
Total  

Table 4: Respondent Statistics

As you can see, most of our respondents (81.4%) are large companies and more than 80% of respondent companies operate in more than 5 countries and more than 60% of respondents have revenue with more than $1 billion.

3.3. Analysis Methods

3.3.1. Centralization and Strategic Importance

The objective of this analysis is to prove the hypothesis that strategic level functions are centralized, while operational level functions are decentralized. We conducted a student’s t-test on the data obtained through the survey to determine which functions were centralized and which functions were not. Our analysis focused on accepting or rejecting the null hypothesis shown below:

a) \( H_0 \) (null hypothesis) – The survey result is not different from a random choice result.

---

2 Total employees size - small: 1 - 99, medium: 100 - 499, large: > 500
3 Annual revenue is the data of FY 2007, total employees and number of countries in which their supply chain operates are collected in March, 2008
b) $H_1$ (Alternate hypothesis) – The survey result is different from a random choice result.

The results of our analysis are shown in the next chapter. We analyzed the results for a statistical significance of 95% confidence level for a one sided hypothesis test.

4.3.2. Factors Influencing Centralization

The objective of this analysis is to find the factor that influences a particular supply chain function most. Respondents were asked to select the most influencing factor among six factors for each function. The various factors given for selection were: supply conditions, customer requirements, government regulations, competitive situation, cost considerations and capacity constraints as explained in Table 2.

We validated the data using chi-square test for 95% confidence level. The hypotheses were:

a) $H_0$ (null hypothesis) – The factor selection for each function is not different from a random choice

b) $H_1$ (Alternate hypothesis) – The factor selection for each function is different from a random choice.

Based on the data collected we were able to identify the critical factors for each industry at the individual function level as well as at a macro function level aggregated by strategic importance (strategic functions, tactical functions and operational functions).
4.3.3. Dynamics of Centralization and Decentralization

We also employed system dynamics principles to analyze the organizational influences to centralize or decentralize and built a framework to capture the patterns that we learnt through interviews with supply chain professionals in industries.

System Dynamics is a method to understand the behavior of complex systems over time, using the causal loop diagrams a fundamental tool to capture the modeler’s hypotheses about the causes and critical feedbacks (Sterman, 2000).

4.3.4. Cost Structure and Centralization Analysis

Cost Structure and Centralization Analysis

We analyzed the cost structure across different industries and did a correlation test between centralization in a particular function and cost consideration in that function. This helped us answer our research question: does cost consideration propel companies to centralize their supply chain functions? We will discuss our results in detail in the next chapter.

We also analyzed the relationship between certain key cost elements and the level of centralization in corresponding supply chain function, namely, we compared transportation cost and its relationship with transportation planning, transportation cost and its relationship with shipment scheduling and inventory costs and its relationship with inventory planning. The results were insightful and interesting as revealed in the next chapter.
Cluster Analysis on Centralization and Supply Chain Cost Structure

We also evaluated the relationship between the total supply chain costs and organizational structure over all industries through cluster analysis. This analysis will help us validate our final hypothesis: companies with centralized supply chain functions have lower total supply chain costs.

We adopted k-means clustering method to evaluate this hypothesis. With centralization index as independent variable and through iterative clustering for different values of k, we found that a three group clustering (k=3) had the most differentiated grouping: a highly centralized group, a highly decentralized group, and a hybrid group.

By analyzing the attributes of those groups, with respect to centralization, cost structure, company size, revenue, and the number of countries where the company operates we were able to understand the correlation between the total supply chain cost for the three distinct groups and the level of centralization namely high level of centralization, high level of decentralization and a balanced level of centralization called the “hybrid”.
Chapter 4. Results and Discussion

The data collected from the survey was analyzed for inaccuracies and adequate steps were taken to eliminate incorrect entries. The cleaned data was then validated using simple rules matching the consistency of the data provided for the cost structure and supply chain management costs. The cleaned and validated data was then analyzed to arrive at aggregated metrics as well as segmented metrics in each industry. Our analysis helped us to arrive at the following results as an outcome of our research. We were able to:

a) Analyze the correlation between centralization and strategic importance of supply chain functions
b) Identify factors and constraints that drove the centralization decision in companies.
c) Assess the influence of centralization and decentralization of supply chain functions on the cost structure.

Further, in-depth analysis of the results gave us insights on the business strategy of companies that adopt centralized decision-making over decentralized decision-making. We were also able to understand the tradeoffs that companies face while deciding the decision-making approach in the supply chain organization of companies.
4.1. Characteristics of Supply Chain Management Organization

The companies that responded to our survey had supply chain departments that played fairly important roles in their companies. Senior functionaries of supply chain departments in our respondent companies held positions of importance. 77% of companies were lead by vice presidents and above, as seen in Figure 3.

Also the supply chain leadership (84%) in our respondent companies reported directly to the top management\(^4\), including C-level, vice president and above. The result is included in Figure 4.

![Figure 3: Senior Most Functionary in Supply Chain Department](image)

\(^4\) This was a multiple choice question with multiple response options – the sum of all choices is greater than 100% because Supply Chain departments are in reality related to many other departments

Also the Supply Chain leadership (84%) in our respondent companies reported directly to the top management\(^5\), including C-level, vice president and above. The result is included in Figure 4.

\(^5\) This was a multiple choice question with multiple response options – the sum of all choices is greater than 100% because Supply Chain departments are in reality related to many other departments
Another important data point that we collected pertained to the scope of functions performed in the supply chain department. It varied across industries as seen in Figure 5. Traditional logistics management functions such as transportation planning and shipment handling, are being performed in most of the companies in all industries.
In manufacturing industries, inventory planning and short-term demand planning functions were also the responsibility of the SCM department showing that the supply chain department generally deals with supply and demand balancing - a fundamental role of supply chain management.

As expected, manufacturing planning is not part of logistics service providers and retailers. Sourcing functions are rarely implemented within the supply chain department. The reason for this phenomenon was revealed during an interview with a food retailer; the sourcing function is so critical for the retailer that they usually have a separate sourcing department.

As we see above the survey results indicate a fairly well distributed group of respondents occupying senior positions in supply chain organizations of companies and playing a critical role in shaping their company’s strategy.

4.2. Centralization and Strategic Importance

In order to evaluate our first hypothesis that centralization of a function depended on its strategic importance, we asked respondents to evaluate the centralization of key supply chain functions in their companies.

While letting respondents choose the centralization of that function in their organization, we made an important assumption on the strategic importance of supply chain functions as identified in Table 1. On the basis of the horizon of the decision and the impact of the decision we were able to group functions into three categories namely strategic, tactical and operational. Table 3 illustrates the statistical significance of the results that we obtained from the survey for different supply chain functions across
industries. While we were able to see consistency in responses (p < 0.05) in strategic (long term capacity planning and sourcing) and operational functions (shipment handling) for the question on centralization, the consistency was markedly less prominent in the tactical functions. Although the p-values were more than 5% for all the other functions, this inconsistency in observations is in line with our hypothesis that some tactical functions are centralized and some are decentralized.

<table>
<thead>
<tr>
<th></th>
<th>Deg of Cent</th>
<th>Statistical Significant Test</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>p-value</td>
<td>t-statistic</td>
</tr>
<tr>
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<td>0.00%</td>
</tr>
<tr>
<td>Sourcing</td>
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<td>0.03%</td>
</tr>
<tr>
<td>Transportation planning</td>
<td>2.79</td>
<td>12.58%</td>
</tr>
<tr>
<td>Inventory planning</td>
<td>2.75</td>
<td>14.93%</td>
</tr>
<tr>
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<td>2.42</td>
<td>36.59%</td>
</tr>
<tr>
<td>Manufacturing planning</td>
<td>2.58</td>
<td>36.59%</td>
</tr>
<tr>
<td>Internal improvement</td>
<td>2.67</td>
<td>22.23%</td>
</tr>
<tr>
<td>Order fulfillment</td>
<td>2.36</td>
<td>29.58%</td>
</tr>
<tr>
<td>Order management</td>
<td>2.50</td>
<td>50.00%</td>
</tr>
<tr>
<td>Shipment handling</td>
<td>1.96</td>
<td>0.88%</td>
</tr>
</tbody>
</table>

Table 5: Student's t-test Result for Consumer Products Industry

<table>
<thead>
<tr>
<th></th>
<th>Deg of Cent</th>
<th>Statistical Significant Test</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>p-value</td>
<td>t-statistic</td>
</tr>
<tr>
<td>Long-term capacity planning</td>
<td>3.27</td>
<td>0.00%</td>
</tr>
<tr>
<td>Sourcing</td>
<td>3.06</td>
<td>0.08%</td>
</tr>
<tr>
<td>Transportation planning</td>
<td>3.00</td>
<td>0.12%</td>
</tr>
<tr>
<td>Inventory planning</td>
<td>2.68</td>
<td>17.57%</td>
</tr>
<tr>
<td>Short-term demand planning</td>
<td>2.18</td>
<td>4.99%</td>
</tr>
<tr>
<td>Manufacturing planning</td>
<td>2.27</td>
<td>12.99%</td>
</tr>
<tr>
<td>Internal improvement</td>
<td>2.48</td>
<td>46.44%</td>
</tr>
<tr>
<td>Order fulfillment</td>
<td>2.06</td>
<td>1.94%</td>
</tr>
<tr>
<td>Order management</td>
<td>2.23</td>
<td>9.75%</td>
</tr>
<tr>
<td>Shipment handling</td>
<td>1.97</td>
<td>0.96%</td>
</tr>
</tbody>
</table>

Table 6: Student's t-test Result for Industrial Products Industry
Table 7: Student's t-test Result for Logistics Service Industry

<table>
<thead>
<tr>
<th>Function</th>
<th>Degree of Centralization</th>
<th>Statistical Significance</th>
<th>t-statistic</th>
<th>k</th>
<th>SE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Long-term capacity planning</td>
<td>3.00</td>
<td>2.91%</td>
<td>2.01</td>
<td>20</td>
<td>0.25</td>
</tr>
<tr>
<td>Sourcing</td>
<td>3.26</td>
<td>0.03%</td>
<td>4.13</td>
<td>18</td>
<td>0.18</td>
</tr>
<tr>
<td>Transportation planning</td>
<td>2.81</td>
<td>11.92%</td>
<td>1.22</td>
<td>20</td>
<td>0.25</td>
</tr>
<tr>
<td>Inventory planning</td>
<td>2.69</td>
<td>28.42%</td>
<td>0.59</td>
<td>12</td>
<td>0.33</td>
</tr>
<tr>
<td>Short-term demand planning</td>
<td>2.12</td>
<td>8.76%</td>
<td>1.42</td>
<td>16</td>
<td>0.27</td>
</tr>
<tr>
<td>Manufacturing planning</td>
<td>2.13</td>
<td>18.88%</td>
<td>0.94</td>
<td>7</td>
<td>0.40</td>
</tr>
<tr>
<td>Internal improvement</td>
<td>2.33</td>
<td>20.63%</td>
<td>0.84</td>
<td>20</td>
<td>0.20</td>
</tr>
<tr>
<td>Order fulfillment</td>
<td>2.31</td>
<td>28.66%</td>
<td>0.58</td>
<td>15</td>
<td>0.33</td>
</tr>
<tr>
<td>Order management</td>
<td>2.14</td>
<td>7.22%</td>
<td>1.52</td>
<td>21</td>
<td>0.24</td>
</tr>
<tr>
<td>Shipment handling</td>
<td>1.81</td>
<td>0.30%</td>
<td>3.07</td>
<td>20</td>
<td>0.22</td>
</tr>
</tbody>
</table>

Table 8: Student's t-test Result for Retail Industry

Also, the results bear out our hypothesis that in almost all industries except retail industry, long-term capacity planning, and sourcing functions are centralized, while, shipment handling function is decentralized. In tactical decisions, companies have adopted different strategies for centralization depending on their specific business context. The average centralization scores of the functions across different industries are shown below for reference:

Table 9: Centralization vs. Strategic Importance Segmentation Analysis
Additionally, Figure 6 depicts the average centralization scores in different functions across industries in a graphical form. It is clear from the graph that strategic functions are centralized and operational functions are decentralized, while tactical functions tend to be centralized or decentralized depending on the business context. We also observed on the basis of the average centralization scores across industries that retail organizations tend to be more centralized whereas logistic service provider companies tend to be least centralized in their overall operations.

![Figure 6: Centralization vs. Strategic Importance Segmentation Analysis](image)

4.3. Factors influencing Centralization

We also examined the factors that are influencing companies to centralize or decentralize their supply chain functions. By elucidating the influencing factors on each function we were able to identify the most common factor that influences centralization of a particular function. The results of our survey are shown in the table below:
<table>
<thead>
<tr>
<th>Functions</th>
<th>Deg. of Supply</th>
<th>Customer</th>
<th>Government</th>
<th>Competitive</th>
<th>Cost</th>
<th>Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Long-term capacity planning</td>
<td>3.40</td>
<td>8.00%</td>
<td>20.00%</td>
<td>0.00%</td>
<td>12.00%</td>
<td>16.00%</td>
</tr>
<tr>
<td>Sourcing</td>
<td>3.35</td>
<td>27.27%</td>
<td>9.00%</td>
<td>0.00%</td>
<td>13.64%</td>
<td>50.00%</td>
</tr>
<tr>
<td>Transportation planning</td>
<td>2.79</td>
<td>4.17%</td>
<td>33.33%</td>
<td>0.00%</td>
<td>12.50%</td>
<td>0.00%</td>
</tr>
<tr>
<td>Inventory planning</td>
<td>2.75</td>
<td>32.00%</td>
<td>0.00%</td>
<td>0.00%</td>
<td>4.00%</td>
<td>0.00%</td>
</tr>
<tr>
<td>Short-term demand planning</td>
<td>2.42</td>
<td>8.33%</td>
<td>62.50%</td>
<td>0.00%</td>
<td>0.00%</td>
<td>0.00%</td>
</tr>
<tr>
<td>Manufacturing planning</td>
<td>2.58</td>
<td>8.70%</td>
<td>30.43%</td>
<td>0.00%</td>
<td>0.00%</td>
<td>4.17%</td>
</tr>
<tr>
<td>Internal improvement</td>
<td>2.67</td>
<td>0.00%</td>
<td>23.81%</td>
<td>0.00%</td>
<td>9.52%</td>
<td>66.67%</td>
</tr>
<tr>
<td>Order fulfillment</td>
<td>2.36</td>
<td>4.00%</td>
<td>76.00%</td>
<td>0.00%</td>
<td>12.00%</td>
<td>8.00%</td>
</tr>
<tr>
<td>Order management</td>
<td>2.50</td>
<td>0.00%</td>
<td>87.50%</td>
<td>0.00%</td>
<td>8.33%</td>
<td>4.17%</td>
</tr>
<tr>
<td>Shipment handling</td>
<td>1.96</td>
<td>8.70%</td>
<td>69.7%</td>
<td>0.00%</td>
<td>8.72%</td>
<td>13.04%</td>
</tr>
</tbody>
</table>

Table 10: Influencing Factors for Consumer Products Industry

<table>
<thead>
<tr>
<th>Functions</th>
<th>Deg. of Supply</th>
<th>Customer</th>
<th>Government</th>
<th>Competitive</th>
<th>Cost</th>
<th>Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Long-term capacity planning</td>
<td>3.27</td>
<td>6.25%</td>
<td>21.88%</td>
<td>0.00%</td>
<td>9.38%</td>
<td>31.25%</td>
</tr>
<tr>
<td>Sourcing</td>
<td>3.06</td>
<td>26.67%</td>
<td>6.67%</td>
<td>0.00%</td>
<td>13.33%</td>
<td>50.00%</td>
</tr>
<tr>
<td>Transportation planning</td>
<td>3.00</td>
<td>14.29%</td>
<td>17.14%</td>
<td>2.86%</td>
<td>11.43%</td>
<td>54.29%</td>
</tr>
<tr>
<td>Inventory planning</td>
<td>2.68</td>
<td>11.43%</td>
<td>22.86%</td>
<td>0.00%</td>
<td>5.71%</td>
<td>48.57%</td>
</tr>
<tr>
<td>Short-term demand planning</td>
<td>2.18</td>
<td>12.50%</td>
<td>50.00%</td>
<td>0.00%</td>
<td>3.13%</td>
<td>9.38%</td>
</tr>
<tr>
<td>Manufacturing planning</td>
<td>2.27</td>
<td>6.67%</td>
<td>13.33%</td>
<td>0.00%</td>
<td>3.33%</td>
<td>16.67%</td>
</tr>
<tr>
<td>Internal improvement</td>
<td>2.48</td>
<td>6.25%</td>
<td>12.50%</td>
<td>0.00%</td>
<td>31.25%</td>
<td>50.00%</td>
</tr>
<tr>
<td>Order fulfillment</td>
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<td>6.45%</td>
<td>51.61%</td>
<td>0.00%</td>
<td>3.23%</td>
<td>25.81%</td>
</tr>
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<td>Order management</td>
<td>2.23</td>
<td>3.23%</td>
<td>67.74%</td>
<td>0.00%</td>
<td>16.13%</td>
<td>3.23%</td>
</tr>
<tr>
<td>Shipment handling</td>
<td>1.97</td>
<td>6.25%</td>
<td>68.88%</td>
<td>0.00%</td>
<td>3.13%</td>
<td>42.75%</td>
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</tbody>
</table>

Table 11: Influencing Factors for Industrial Products Industry

<table>
<thead>
<tr>
<th>Functions</th>
<th>Deg. of Supply</th>
<th>Customer</th>
<th>Government</th>
<th>Competitive</th>
<th>Cost</th>
<th>Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Long-term capacity planning</td>
<td>3.00</td>
<td>4.76%</td>
<td>61.90%</td>
<td>0.00%</td>
<td>4.76%</td>
<td>23.81%</td>
</tr>
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<td>Sourcing</td>
<td>3.26</td>
<td>5.56%</td>
<td>33.33%</td>
<td>5.56%</td>
<td>11.11%</td>
<td>38.89%</td>
</tr>
<tr>
<td>Transportation planning</td>
<td>2.81</td>
<td>10.00%</td>
<td>50.00%</td>
<td>0.00%</td>
<td>10.00%</td>
<td>20.00%</td>
</tr>
<tr>
<td>Inventory planning</td>
<td>2.69</td>
<td>5.56%</td>
<td>61.11%</td>
<td>0.00%</td>
<td>5.56%</td>
<td>22.22%</td>
</tr>
<tr>
<td>Short-term demand planning</td>
<td>2.12</td>
<td>0.00%</td>
<td>70.59%</td>
<td>0.00%</td>
<td>5.56%</td>
<td>22.22%</td>
</tr>
<tr>
<td>Manufacturing planning</td>
<td>2.13</td>
<td>0.00%</td>
<td>61.54%</td>
<td>0.00%</td>
<td>15.38%</td>
<td>7.69%</td>
</tr>
<tr>
<td>Internal improvement</td>
<td>2.33</td>
<td>0.00%</td>
<td>59.05%</td>
<td>0.00%</td>
<td>9.09%</td>
<td>27.27%</td>
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<tr>
<td>Order fulfillment</td>
<td>2.31</td>
<td>0.00%</td>
<td>80.00%</td>
<td>0.00%</td>
<td>5.00%</td>
<td>10.00%</td>
</tr>
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<td>Order management</td>
<td>1.81</td>
<td>0.00%</td>
<td>76.19%</td>
<td>0.00%</td>
<td>9.52%</td>
<td>9.52%</td>
</tr>
<tr>
<td>Shipment handling</td>
<td>2.14</td>
<td>0.00%</td>
<td>85.71%</td>
<td>0.00%</td>
<td>9.52%</td>
<td>9.52%</td>
</tr>
</tbody>
</table>

Table 12: Influencing Factors for Logistics Service Industry

<table>
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<tr>
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<th>Deg. of Supply</th>
<th>Customer</th>
<th>Government</th>
<th>Competitive</th>
<th>Cost</th>
<th>Capacity</th>
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<td>Long-term capacity planning</td>
<td>3.75</td>
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<td>8.33%</td>
<td>0.00%</td>
<td>25.00%</td>
<td>16.67%</td>
</tr>
<tr>
<td>Sourcing</td>
<td>3.08</td>
<td>18.18%</td>
<td>9.09%</td>
<td>0.00%</td>
<td>27.27%</td>
<td>45.45%</td>
</tr>
<tr>
<td>Transportation planning</td>
<td>2.64</td>
<td>0.00%</td>
<td>16.67%</td>
<td>0.00%</td>
<td>8.33%</td>
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</tr>
<tr>
<td>Inventory planning</td>
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<td>15.38%</td>
<td>53.95%</td>
<td>0.00%</td>
<td>23.08%</td>
<td>0.00%</td>
</tr>
<tr>
<td>Short-term demand planning</td>
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<td>61.54%</td>
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<td>7.69%</td>
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<tr>
<td>Manufacturing planning</td>
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<td>42.86%</td>
<td>14.29%</td>
<td>0.00%</td>
<td>0.00%</td>
<td>14.29%</td>
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<tr>
<td>Internal improvement</td>
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<td>8.33%</td>
<td>8.33%</td>
<td>0.00%</td>
<td>16.67%</td>
<td>50.00%</td>
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<tr>
<td>Order fulfillment</td>
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<td>25.00%</td>
<td>50.33%</td>
<td>0.00%</td>
<td>0.00%</td>
<td>16.67%</td>
</tr>
<tr>
<td>Order management</td>
<td>2.00</td>
<td>18.18%</td>
<td>54.55%</td>
<td>0.00%</td>
<td>9.09%</td>
<td>18.18%</td>
</tr>
<tr>
<td>Shipment handling</td>
<td>2.00</td>
<td>7.69%</td>
<td>38.46%</td>
<td>0.00%</td>
<td>9.09%</td>
<td>18.18%</td>
</tr>
</tbody>
</table>

Table 13: Influencing Factors for Retail Industry
This factor analysis revealed interesting insights:

Firstly, the two most important factors for centralizing or decentralizing in any function across industries were customer requirements and cost considerations. Although other factors, such as, capacity constraints did play an important role in motivating companies to centralize or decentralize.

Secondly, customer requirements were the critical driving factor for logistics service providers. This is rightly so considering that third-party companies compete largely on the basis of their relationship with customers and their ability to match customer needs. Thus “customer requirements” emerges as the most important factor for logistics service providers among all six factors.

Third, industrial product manufacturers and consumer product manufacturers have similar trends for their factors. However, industrial product manufacturers have cost as a dominant factor, while customer requirements are dominant for consumer product companies. The reason for this behavior can be found from the demand variability of industrial products and consumer products. Industrial products in general have low demand variability while consumer products have high variability. The low demand variability of industrial products translates to a focus on cost reduction by the consumers of industrial products. This explains why cost is a key driver for industrial product companies. The high demand variability of consumer product companies translates into high customer service requirements. This explains why customer service is a key driver for consumer product companies.
All the survey results, except long-term capacity planning, sourcing, and manufacturing planning in the retailing industry were validated to be statistically significant (p<0.05) (Appendix 1) in the chi-square tests conducted.

<table>
<thead>
<tr>
<th>Functions</th>
<th>Deg. of Cent.</th>
<th>Supply Condition</th>
<th>Customer Requirement</th>
<th>Government Regulation</th>
<th>Competitive Situation</th>
<th>Cost Consideration</th>
<th>Capacity Constraint</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strategic Functions</td>
<td>3.38</td>
<td>17.02%</td>
<td>14.89%</td>
<td>0%</td>
<td>12.77%</td>
<td>31.61%</td>
<td>23.40%</td>
</tr>
<tr>
<td>Tactical Functions</td>
<td>2.53</td>
<td>11.11%</td>
<td>37.61%</td>
<td>0%</td>
<td>5.13%</td>
<td>31.62%</td>
<td>14.53%</td>
</tr>
<tr>
<td>Operational Functions</td>
<td>2.27</td>
<td>4.17%</td>
<td>77.78%</td>
<td>0%</td>
<td>9.72%</td>
<td>8.33%</td>
<td>0.00%</td>
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<th>Supply Condition</th>
<th>Customer Requirement</th>
<th>Government Regulation</th>
<th>Competitive Situation</th>
<th>Cost Consideration</th>
<th>Capacity Constraint</th>
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</tr>
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<td>Tactical Functions</td>
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<td>10.37%</td>
<td>23.17%</td>
<td>0.61%</td>
<td>10.96%</td>
<td>36.58%</td>
<td>18.29%</td>
</tr>
<tr>
<td>Operational Functions</td>
<td>2.09</td>
<td>5.32%</td>
<td>65.52%</td>
<td>0%</td>
<td>7.45%</td>
<td>24.47%</td>
<td>7.45%</td>
</tr>
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<th>Supply Condition</th>
<th>Customer Requirement</th>
<th>Government Regulation</th>
<th>Competitive Situation</th>
<th>Cost Consideration</th>
<th>Capacity Constraint</th>
</tr>
</thead>
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<tr>
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<td>3.13</td>
<td>5.13%</td>
<td>68.22%</td>
<td>2.56%</td>
<td>7.78%</td>
<td>30.77%</td>
<td>5.13%</td>
</tr>
<tr>
<td>Tactical Functions</td>
<td>2.45</td>
<td>3.33%</td>
<td>80.62%</td>
<td>0%</td>
<td>7.78%</td>
<td>18.67%</td>
<td>12.22%</td>
</tr>
<tr>
<td>Operational Functions</td>
<td>2.07</td>
<td>0.00%</td>
<td>80.66%</td>
<td>0%</td>
<td>4.84%</td>
<td>8.06%</td>
<td>6.45%</td>
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<table>
<thead>
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<th>Customer Requirement</th>
<th>Government Regulation</th>
<th>Competitive Situation</th>
<th>Cost Consideration</th>
<th>Capacity Constraint</th>
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<td>Strategic Functions</td>
<td>3.42</td>
<td>13.04%</td>
<td>8.70%</td>
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<td>26.09%</td>
<td>30.43%</td>
<td>21.74%</td>
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<tr>
<td>Tactical Functions</td>
<td>2.86</td>
<td>15.79%</td>
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<td>0%</td>
<td>12.28%</td>
<td>28.82%</td>
<td>8.77%</td>
</tr>
<tr>
<td>Operational Functions</td>
<td>2.13</td>
<td>16.67%</td>
<td>50.00%</td>
<td>0%</td>
<td>2.78%</td>
<td>30.56%</td>
<td>0.00%</td>
</tr>
</tbody>
</table>

Table 14: Influencing Factors for Each Industry with respect to Strategic Importance

The results from this factor analysis also confirmed that strategic functions were centralized for cost considerations and operational functions were influenced by customer requirements. This insight is easy to recognize considering the fact that for strategic functions, the focus is primarily to achieve global optimization. Hence cost becomes an important driver for strategic functions. Individual customer demands are relegated to the local managers to handle and manage. Hence in operational functions, customer service becomes a key driver.

The dynamics of these factors in shaping the centralization or decentralization of decisions are explored in greater detail in the later chapters.
4.4. Cost Structure and Centralization

In this section we analyze the correlation of different cost elements with centralization. We evaluated the relationship between basic cost elements and individual supply chain functions besides analyzing the relationship between total supply chain cost and the organizational structure.

Our survey gave us insights on the supply chain cost structure of companies in manufacturing (CPM, IPM), retail and logistics service industries. The cost structure of companies varied across different industries as illustrated in the graph shown below.

![Cost Structure Comparison for All Industries](image)

*Figure 7: Cost Structure Comparison for All Industries*

We were able to draw a few insightful conclusions from the data collected:

a) Retail industry showed one of the lowest supply chain cost structure possible followed by industrial product manufacturers, then CPM and finally logistic service providers. Logistics service providers had the highest supply chain cost structure owing to their business model.
b) Operational cost was the largest cost bucket for all companies followed by transportation, then inventory carrying costs and other supply chain costs.

c) Third, total supply chain costs varied from 10.6% for retail, 16.1% for consumer products manufacturers, and 15.7% for industrial manufacturers. Supply chain costs for logistics providers ranged from 23% to as much as 81% depending upon the business model and service offered by the service provider.

4.4.1. Transportation Costs and Shipment Handling Centralization

An interesting observation in our survey was the relationship between transportation cost and shipment handling. We noticed that the transportation cost as a percentage of sales grew as the centralization of shipment handling increased. Transportation cost ranged from 1% to 6% of sales. The maximum transportation cost as a percent of sales was observed in companies that had partially centralized their shipment handling function.

![Figure 8: Transportation costs Percentage of Sales With Respect To Shipment Handling Centralization for All Industries](image-url)
A careful analysis can reveal the dynamics of this relationship. One has to keep in mind that our survey is a post facto analysis of cost structures and centralization of supply chain functions. It captures a snapshot of the transportation cost as a percent of sales and centralization of the shipment handling function. The results indicate that in companies that have a high transportation cost as a percentage of sales, the shipment handling was centralized, while companies that had low transportation cost as a percentage of sales, the shipment handling function was decentralized.

Shipment handling is an operational function in the supply chain department that is typically carried out by individual business units in remote geographies. Such an organizational structure enables companies to provide the minimum level of service to customers. However this comes with a cost. Maintaining teams in different geographies requires companies to incur cost that cannot be supported by all companies. Only companies that have a low transportation cost as a percent of sales can afford to decentralize their shipment handling function. Companies that have a high transportation cost as a percent of sales tend to centralize their shipment handling function to obtain economy of scale.

An example of a company with decentralized shipment handling and low transportation cost percentage could be a traditional fast moving consumer goods organization that has logistics teams in different geographies and has low transportation cost as a percent of sales. Common examples include beverages, food products, beauty and cosmetics etc. An example of a company with centralized shipment handling and high transportation cost percentage could be medical products. For example, a manufacturer of dialysis machines meets the demand for its products from a central
location in the US. The vast distribution of its customer base is pushing the transportation costs of this medical products company. In order to reduce costs this company has centralized its shipment handling function in order to obtain economies of costs in shipment handling.

The results of our survey are pointing to an important result that reinforces our hypothesis that companies use centralization to reduce their transportation costs. As transportation costs increase as a percent of sales, companies are increasingly resorting to centralization of their core supply chain functions such as shipment handling that are driving cost elements to reduce their cost.

4.4.2. Transportation Costs and Transportation Planning Centralization

Another key relationship we noticed was the interplay between transportation cost and transportation planning. Transportation cost as a percent of sales grew as the centralization of transportation planning increased. Although the growth was not linear and transportation cost as a percentage of sales dipped for companies that were partially centralized, we observed an upward trend in transportation cost as a percentage of sales as centralization of transportation planning increased. Transportation cost ranged from 0.5% to 6% of sales for different levels of transportation planning centralization. The maximum transportation cost as a percent of sales was observed in companies that had fully centralized their transportation planning function.
Transportation planning is a tactical function and is concerned with activities such as transportation asset utilization, resource scheduling, carrier selection and payment, and performance assessment. As a tactical activity, this function is occasionally centralized and occasionally decentralized – as identified in an earlier discussion of centralization of functions in Figure 6. This tactical nature of this function can explain the non-linear nature of the curve. As shown in the graph, a partially centralized or decentralized execution of this function is associated with low transportation cost as a percent of sales. Although there is an upward tendency in the curve with an increase in transportation cost as a percentage of sales with increase in the centralization of transportation planning function, the differences between the transportation costs as a percentage of sales for a decentralized transportation planning function to a centralized transportation planning function is not markedly significant as compared to the relationship seen between transportation cost percentage of sales and centralization of shipment handling function.

Figure 9: Transportation Costs Percentage of Sales With Respect To Transportation Planning Centralization for All Industries
Centralized transportation planning can be observed in many mature manufacturing and retail companies. A central transportation-planning department enables these companies to reduce their transportation cost as a percentage of sales by allowing them to optimize globally. Also, companies whose transportation cost as a percentage of sales is high tend to explore options to reduce their transportation costs and a centralized transportation planning function enables them to identify consolidation opportunities that can reduce their transportation costs. Decentralized transportation planning is observed in companies that do not have opportunities for consolidation. Examples are companies that tend to operate in last mile logistics. A retailer selling fresh food might have a decentralized transportation planning in select geographies. Transportation cost as a percent of sales for such companies are typically lower, owing to the high product costs, than that for companies with a centralized transportation planning function and comparatively higher transportation cost as a percent of sales.

It is clear from the above results and analysis that companies tend to adopt centralized transportation planning as a response to the high costs observed in their transportation. Centralized transportation planning enables these companies to evaluate consolidation opportunities and optimization possibilities to reduce their total transportation cost.

4.4.3. Inventory Carrying Costs and Inventory Planning Centralization

Inventory planning is also a tactical function, which is executed centrally in some companies or executed locally in other companies. Inventory carrying costs range from a low of 0.5% to 6%. Inventory carrying costs was observed to be fairly uniform across
different levels of centralization in organizations. The highest level of inventory carrying cost is about 6% observed in organizations where inventory planning is partially centralized. As a tactical decision, Inventory planning centralization was expected to have minimal influence on the inventory carrying costs and the results obtained are on expected lines. We will explain the results observed in the subsequent paragraphs below.

![Inventory Carrying Costs Percentage of Sales With Respect To Inventory Planning Centralization for All Industries](image)

Figure 10: Inventory Carrying Costs Percentage of Sales With Respect To Inventory Planning Centralization for All Industries

Inventory planning is done either for raw material or for end items. A decentralized raw material inventory planning would imply that the inventory planning is being carried out at each and every factory of the company. Likewise, a decentralized finished goods inventory planning would imply planning for end items at every demand region. While centralized inventory planning would be able to achieve economies of scale through consolidation of supply and demand, a decentralized inventory planning can take into account regional constraints and requirements and respond on a real time basis. The advantages offered by a centralized inventory planning system are as valuable to companies as the advantages of a decentralized inventory planning system. Hence
companies adopt a middle path of a partially centralized inventory planning system or a partially decentralized inventory planning system with a marked preference for a partially centralized inventory planning system.

Centralized inventory planning is observed in large retailers and manufacturing companies that have a high inventory carrying cost for their finished goods inventory. Decentralized inventory planning is seen in manufacturing firms with distributed facilities for production with low inventory carrying costs on their raw material side. Also a large portion of inventory carrying costs is a function of the inventory level and less dependent on the economies of centralization of the inventory planning function.

Inventory carrying costs are largely independent of inventory planning centralization. Centralization and decentralization of Inventory planning is done as a response to the inventory level requirements of companies at the raw material side (near factories) or at the finished goods side (near customer regions) or centrally (common to both raw material and finished goods).

4.4.4. Cluster Analysis on Centralization and Cost Structure

We grouped the respondent companies on the basis of the centralization of their supply chain functions through ‘cluster analysis’ (k-means clustering at k=3) techniques and arrived at three distinct groups that we call highly centralized, hybrid and highly decentralized.

The three groups of companies can be diagrammatically shown as below and are defined as follows below:
Figure 11: Three Segmentations By K-means Clustering

a) Centralized organizations: these are companies where most of the functions are centralized

b) Decentralized organization: companies that are decentralized for almost all supply chain functions

c) Hybrid organizations: companies that have some functions (strategic functions) that are centralized and some functions (operational functions) that are decentralized.

Characteristics of hybrid, centralized and decentralized clusters

In the grouping that we did for the cluster analysis, the characteristics of the three groups are described as below:

“Centralized” cluster companies were typically consumer or industrial product manufacturers with a large portion of companies operating in fairly smaller geographic
spread (though spread over more than 10 countries on an average) and with fairly high revenue.

“Hybrid” cluster companies were typically large retailers or industrial or consumer product manufacturers with a large portion of companies operating in more than 30 countries and with high revenue.

“Decentralized” cluster companies were typically companies spanning retail and manufacturing industries and with operations spanning a large number of countries and with fairly moderate revenues.

<table>
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<tr>
<th>Centralized</th>
<th>Hybrid</th>
<th>Decentralized</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Number</td>
<td>14</td>
<td>22</td>
</tr>
<tr>
<td>Industry</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CPM</td>
<td>57%</td>
<td>41%</td>
</tr>
<tr>
<td>IPM</td>
<td>36%</td>
<td>32%</td>
</tr>
<tr>
<td>LSP</td>
<td>7%</td>
<td>9%</td>
</tr>
<tr>
<td>RET</td>
<td>0%</td>
<td>18%</td>
</tr>
<tr>
<td>Total</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>Size</td>
<td></td>
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</tr>
<tr>
<td>Small</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Medium</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Large</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>Total</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>Revenue</td>
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<td></td>
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<tr>
<td>&lt; $49M</td>
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<td>0%</td>
</tr>
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</tr>
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<tr>
<td>1 Country</td>
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</tr>
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<td>&gt; 30 Countries</td>
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</tr>
<tr>
<td>Total</td>
<td>100%</td>
<td>100%</td>
</tr>
</tbody>
</table>

Table 15: Summary of Other Attributes for the clusters
Clusters and their relationship to costs

On examining the relationship between the extent of centralization in companies that have been grouped as centralized, hybrid or decentralized and the cost structure (total supply chain costs) we noticed a very interesting relationship. We noticed that the lowest cost is achieved by companies that have a hybrid structure.

The results are an excellent insight that centralization of all functions does not result in low costs. From the results, we can see that companies that are highly centralized have a higher percentage of supply chain cost as a percentage of sales compared to companies that have adopted a hybrid strategy. Likewise, companies that are highly decentralized have a higher percentage of supply chain cost as a percentage of sales. Let us now review the reasons why a hybrid cluster is able to achieve lower costs as a percentage of sales by analyzing the various cost elements.

We can see that the transportation costs decreases from a centralized cluster to a decentralized cluster. This was expected because transportation costs typically increase...
with centralization of transportation planning and shipment handling as explained in the previous section. Hence, a hybrid cluster, which has decentralized transportation planning and shipment handling, has lower transportation costs compared to centralized clusters. Extending this line of discussion, a decentralized cluster has the lowest transportation cost but other costs go up faster than the reduction in transportation costs for decentralized clusters as described in the following paragraphs.

We can see that operational costs increase from a centralized cluster to a decentralized cluster. This is also along expected lines because a decentralized cluster has redundant overheads in managing the decentralized business units, which results in higher operational costs. For the same reason, operational cost percentages are lower for centralized organizations.

We also noticed that information costs were more or less identical for all the three clusters though they were marginally higher for centralized and decentralized clusters. The observation was on expected lines because information costs as a percentage of sales should not significantly differ from one organizational structure to the other.

In our observations we noticed that Inventory carrying costs as a percent of sales did not follow a pattern from a centralized cluster to a decentralized cluster. In fact inventory carrying costs were lower for decentralized clusters and higher for centralized clusters. This observation was different from our expectation. We expected that for a centralized cluster for a given product, risk pooling arising as a result of centralization can lower the levels of safety stock and hence lower inventory carrying costs. The observation obviously points to a different direction. The reason the observation did not match our expectation could be because of the product cost differential. Since inventory
carrying costs are a function of product costs, we believe that inventory carrying costs could have added an unexpected distortion to our results. Hence we decided to reexamine the total supply chain costs for the three clusters after eliminating the inventory carrying costs.

![Figure 13: Cost Analysis for Three Clusters Excluding Inventory Carrying Costs](image)

Upon re-examining the total supply chain costs (excluding inventory carrying costs) as a percentage of sales, we see that the pattern has not changed. The hybrid clusters once again have the lowest total supply chain costs as a percentage of sales over the other clusters. The hybrid cluster strikes a fine balance of managing the different cost elements and is able to achieve the lowest cost as a percentage of sales.

This is an important result because it runs counter to our hypothesis that centralization can lower the costs. A hybrid cluster is a balance and combination of both centralization and decentralization. The balance is achieved through centralization of strategic functions, which inherently lowers costs and decentralization of operational functions, which enhances the ability to provide better customer service. Both these key
factors enable the hybrid cluster to boost revenues (Table 8) as well as lower costs, which translate into lower total supply chain costs as a percentage of sales.

4.5. Dynamics of Centralization

Having looked at the empirical data in detail, we now present below frameworks to understand the factors that are influencing companies to adopt a particular organization structure (centralized or decentralized) for their supply chain functions. The empirical data collected and the qualitative information obtained through interviews point us to three key factors influencing organizational (centralization or decentralization) structure. They are:

   a) Cost
   b) Customer Service
   c) Control (risk and incentive)

   We present below the influences of these factors individually. Each factor has a specific tendency towards a particular organizational structure as will be revealed below. However in an organizational context the dominance of a particular factor over the other factors determines the eventual organizational structure for that function. Although, there are still more factors that play a role in the centralization of supply chain functions, it is still meaningful to capture the main drivers that determine centralization or decentralization of supply chain decision-making.

   In the first part of this section, we explain the simple causality of each of the factors cost, customer service, and control in shaping the organizational structure, through diagrams called as “causal loop diagrams”, which are pictorial representations of the
underlying structure that is thought to explain the reference model behavior (Sterman, 2000). We illustrate the influence of these factors in shaping the structure for three key supply chain functions namely, Sourcing, long-term capacity planning, and shipment handling.

Each of the three factors can be explained using “goal seeking models” (Sterman, 2000). The goal seeking model is used to explain how systems tend towards an equilibrium level, which means a goal, for their end-states whereas an “oscillation model” is used to explain how systems switch from one state to the other. Since each of these factors stabilize at a particular state, the goal seeking model is more appropriate for the three driver dynamics.

In the later portion of this section, we present an integrated framework that illustrates the interplay among the factors and an oscillation model that can be used to explain the long run transitions to migrate from one organization structure to another arising out of a result of dominating factors.

4.5.1. Cost Driver Dynamics

A primary factor influencing companies to adopt centralization is cost. As the diagram below explains, companies striving to achieve a target cost based on competitor prices are motivated to explore avenues for reducing redundancies. This translates into centralization of supply chain functions that yield the economies of scale and enable companies to lower their unit costs.
Motivation to Reduce Centralization of Redundancies

Target Cost

Pressure to Lower Cost

Centralization of the Functions

Consolidation of Operations

Cost Reduction

Unit Cost

Figure 14: Cost Driver Model

The above diagram illustrates the economies of scale achieved through centralization.

The cost dynamic can be explained as follows:

(a) If the company's unit costs increase relative to the target cost defined on the basis of profitability targets, the company's supply chain managers are under pressure to lower costs.

(b) This pressure motivates the company to identify ways to reduce costs – centralization being one of them.

(c) Centralization enables the company to also consolidate its operations.

(d) Thus centralization lowers the unit costs for the company and keeps the company to retain a centralized operation for that function.

The analysis presented here could be applied to any supply chain function though it is applicable very well to a sourcing function. Some of the "economies" of centralization from a sourcing context are:

a) Reinforced bargaining power
This is perhaps the most important reason companies tend to centralize the sourcing function. Consolidation of sourcing strengthens the company’s bargaining power. Companies can, thus, negotiate better with their suppliers to reduce their unit costs.

b) Knowledge sharing

Centralization enables companies to achieve improvement in their sourcing processes because of availability of better information.

c) Standardized operations

Centralization enables companies to also standardize the sourcing process, which helps in standardizing operations and reducing errors.

The extent of centralization that companies employ is also defined to some extent by the competitive pressures on companies and the other influences as discussed in the following paragraphs. As observed in earlier paragraphs in this thesis, economies of scale are achieved in strategic functions such as long term capacity planning besides sourcing.

4.5.2. Customer Service Driver Dynamics

![Figure 15: Customer Service Driver Model](image)

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61
A second factor influencing companies in choosing between a centralized or a decentralized architecture is the level of customer service that they can provide through a particular organization structure. A decentralized architecture helps companies provide better service to their customers. This is illustrated through the causal diagram shown.

a) The company sets a threshold customer service level to provide to its customers.

b) If the service level provided does not match the threshold, the company’s management is under pressure to improve customer service level. This pressure forces the management to discourage centralization of supply chain functions such as shipment handling or order management.

c) The company’s management now decentralizes its supply chain functions and achieves lower response time to customer needs.

d) As customer response time reduces and customer requirements are better understood, the customer service level given to customers increase resulting in an overall reaffirmation of the current policy of the management.

e) The management is thus encouraged to continue this policy of increased decentralization to improve customer service.

The key benefits of a decentralized customer service stems out of two key reasons:

a) Reaction time: decentralized structures help companies to react faster to customer demands.

b) Service customization: A decentralized operation can help companies achieve better customer insight and thereby provide customized solutions to customers and develop products meeting customer needs more precisely.
Customized service is an important driver in many functions such as order management, shipment handling, and something like that. Where proximity to the customer becomes a competitive advantage.

4.5.3. Control Driver Dynamics

![Diagram of Control Driver Dynamics]

**Figure 16: Integrated Decision-making and Incentive Conflict Model**

The third factor besides cost and customer service that influences companies to adopt either a centralized or decentralized structure is “control”. “Control” is a soft factor as against the other two factors cost and customer service because whereas the other factors have a clear tendency to either a centralized organization or decentralized organization, control factor does not have a specific tendency. The tendency for centralization or decentralization for control reasons depends on the locus of control in that organization. If the locus of control is tilted to the centre of the organization the function is centralized, whereas if the locus of control is tilted to the regions the function is decentralized. This can be explained through two key dimensions within the control factor: namely risk and incentive.
The Risk effect means the functions that have a very high impact on the organization tend to be centralized to mitigate the risk and achieve global optimization, while functions where the risk impact was not high tend to be decentralized.

For example, to make long-term capacity planning decision, the organization needs the expertise of diverse individuals to identify a globally optimal long-term capacity plan. Developing a long-term capacity plan without full visibility to demands and supplies might be sub optimal and undesirable. An attempt to take a decision at a central location using all available data is centralization.

The risks in such a centralized long-term decision-making are:

a) The company requires information up to a good level of detail. Data that is inaccurate can lead to incorrect results. Hence a central decision making is more appropriate for this function

b) Misaligned incentives – a local organization that is governed by local performance metrics is not the right team to make organization wide decisions.

c) A centralized function can help integrating resources, such as human talent, finance, information, skills and knowledge for decision-making.

d) With these integrated resources, the company can make a more comprehensive decision.

e) This diminished uncertainty reduces the risk, and as a result, the centralization of the function becomes stabilized.

Another important factor is the Incentive. In some situations, Incentive misalignment can be a resistance to centralization of functions and can in fact cause decentralization resulting in sub optimal organizational structures in companies.
Control can thus result in a centralized organization or decentralized organization depending upon whether risk or incentive dominates within this factor.

4.5.4. An Integrated Framework

Based on our analysis we present below an integrated framework in Figure 17, to understand the interplay of the three dominating factors that shape centralization or decentralization of functions in an organization.

![Figure 17: An Integrated Framework that determines centralization of a function](image)

One important feature of this framework is the goal seeking behavior. Any of the three factors cost concerns, customer service, or control concerns can dominate in an organization and position the architecture to be either centralized or decentralized. A company that is faced with significant competition on cost, might be forced to centralize whereas a company that is facing pressures to achieve market share might decentralize its operations to strengthen its customer relationship and a company that is concerned with risks and control might adopt a centralized or a decentralized structure depending upon the need to achieve better coordination.
Another important feature is the oscillatory behavior. The three key factors not only explain the architecture achieved by companies in the steady state but also the states reached during times of transition. The oscillations or transitions are caused because of a change in priorities when the product matures or when the company matures.

When a company launches a new product the company would like the supply chain functions to be centralized because of the coordination required for a new supply chain, in other words, control is the dominant factor. As the product matures and the needs of the individual markets start diverging the company is forced to decentralize its supply chain functions because of unique needs in every geography, that is, customer service is the dominant factor. However as the product sales starts declining, the company switches gears to a cost focus and pushes them to centralize their supply chain functions to reduce total landed costs, which means cost is the dominant factor. Thus we see that the three key factors play an important role in shaping the organizational structure which in turn shapes the organization’s response to business needs.

We see this oscillatory behavior in organizational life cycle as well. As companies are launched they start off with centralized supply chain functions purely for control reasons. As the business starts maturing in different geographies, the company adopts a more decentralized supply chain organization to service its customers better. Finally as companies start losing market share to competitors with declining sales, they are forced to centralize their supply chain functions to cut costs.

The integrated framework proposed here enables us to understand the short term and long term dynamics that shape the centralization or decentralization of supply chain functions in organizations.
4.6. Case Studies

In this section, we present cases that illustrate the influence of key drivers in shaping organization structure and in turn cost structure. The case studies document the tendencies for certain organizational structures in functions such as sourcing and shipment handling. The case studies also illustrate the challenges that companies face when migrating from one organizational structure to another.

In the first case, the sourcing function in the Consumer Products Company was once centralized to reduce the cost, after few years, reverted to decentralize the function because of high customer service requirements and conflicts with the local incentive systems.

The second case shows that process of the shipment handling function in the decentralized to meet the high customer service requirements using the case of the Pharmaceutical Company.

4.6.1. Case Study 1: Sourcing at the Leading Consumer Products Company

A leading consumer products company wanted to centralize its sourcing activities to a central location. The company, a maker of mobile computing cases and accessories and based in Southern California sources majority of its products from manufacturers in China. The company itself is a large supplier to retailers, electronic goods manufacturers and direct consumers. The company’s business units were spread across US, Europe and Asia Pacific. The different business units bought goods directly from suppliers in China and Taiwan. The company recognized the potential of integrating the sourcing functions
of the different business units in order to have benefits from economy of scale (refer to Figure 19).

Integrating the procurement processes would have helped the company obtain greater economies of scale. The company would have been able to obtain discounts for the volume of purchase as well as achieve economies of shipping the goods to its different business units as shown as the B1 loop in Figure 18. The company also recognized the value in integration and pursued the path of centralizing the procurement (B2).

However it faced a number of challenges in implementing the process:

Firstly, a centralized sourcing process did not help the regional business units maintain the high level of customer service that they traditionally provided to their retail customers. The pressure to deliver goods on time now fell on the central procurement team. However, it did not fare as well compared to an external supplier who had the responsibility in the past to deliver the goods to the regional warehouses. The decision-making time on the sourcing decisions took longer than before (B3), and the centralized sourcing team faced difficulties in meeting the needs from the local customers (B4).

Secondly, their incentive system on the local divisions made the local managers to resist the centralization because the incentive system was designed to maximize the local optimization. For example, the local managers were evaluated in terms of their local inventory level or spend on the sourcing. Thus, they are strongly interested in their local efficiencies, not in a global cost reduction of whole supply chains. Hence, when the centralized sourcing made them lose their control on their inventory level or spend on
sourcing, they apparently had strong incentives to resist the change of centralization. (B6)

Lastly, the original terms of the contract negotiated by individual business units included the cost of transporting the goods to their warehouses in the different countries. The central procurement on the other hand involved purchase of all goods at a central place which meant that the company had to transport the goods itself to its business units in different countries. The volume of goods shipped by the central procurement team to the regional business units was not of an economical size and the company realized very high transportation cost as a result of centralization.

Additionally, uncertainty and impact of each individual sourcing decision is not relatively significant to affect on the bottom line. Therefore, the company’s risk driver of centralization was small (B5).

This resulted in a situation where the company decided to discontinue the centralized procurement process and revert to the previous approach of decentralized procurement.

This case illustrates the challenges companies face while implementing a structural change such as this as well as identifying the importance of organizational fit while implementing such a change within the company. Although procurement is a commonly cited example for centralization, it is not always applicable in all corporate situations. The selection of centralization or decentralization in an organization will depend on the business context. Also, implementing a change will require supporting processes to be implemented. If the company under discussion had adopted suitable strategies and processes that will enable centralized procurement at the same time ensure timely
delivery of the products to the different regional business units, the change would have been successful. Also a change like this should involve accompanying changes in compensation structure and incentives to all parties involved in order to make this change successful.
Figure 18: Causal Loop Diagram of Sourcing Function
4.6.2. Case Study 2: Shipment Handling at the Pharmaceutical Company

This pharmaceutical company is a world leading animal health company that provides medical products and vaccines for livestock, pets and wildlife. The company is headquartered in Atlanta, Georgia with factories in Georgia, US, Puerto Rico and France. It has a modest 3 DC distribution network which it uses to ship drugs as parcels to veterinary clinics and distributors in the US, Europe and Japan.
The company has a very high market share with more than 60 to 70% in its top selling products. It has superior quality products than competitors. Since competition in the market is very fierce, high customer service level is a critical success factor for the company. If the company's product is not available in the customer's refrigerator, the company might lose not just the present sale but also all future sales. The cost of lost sales for this company is very high compared to the cost of holding additional inventory. It could take a long time for the company to recover if it loses the shelf space.

Therefore the company had to decentralize its shipment handling function to make decisions closer to the customers (B3 & B4). This decentralization of shipment handling caused additional inventory holding and redundant operations (B1 & B2), but since the cost of lost sales for the company was very high compared to the inventory costs, they were willing to incur the additional costs.

Despite significant pressure to maintain high customer service, the company is able to manage the challenge through decentralized shipment handling that enables the regional distribution centres to respond to demands quickly and using the cheapest alternative available to them. The company uses third parties distribution centres and the third parties take the decision on how to deliver the shipments including the selection of carriers. The company is thus able to lower transportation costs and improve levels of product availability by delegating authority to regions and allowing the regions to make the optimal decisions under the constraints.
Figure 21: Causal Loop Diagram of Shipment Handling Function
Chapter 5. Conclusions

In this section we summarize the key findings of our research, identify contributions and limitations of our study, and suggest further research in this area.

5.1. Key Findings

We investigated the strategic, tactical, and operational supply chain functions that were centralized or decentralized by companies, the reasons companies chose to centralize or decentralize and the impact of centralization and decentralization on supply chain costs.

Our research made clear that strategic functions were centralized, and operational functions were decentralized. We identified that strategic functions were centralized for cost considerations, while operational functions were decentralized to improve customer service.

We identified three clusters of companies: a 14-company cluster where the majority of decisions were made centrally, a 10-company cluster where majority of decisions were made locally, and a 22-company cluster (named as “hybrid cluster”), where strategic functions were centralized and operational functions were decentralized. The cluster analysis demonstrated that the “hybrid cluster” companies had the lowest supply chain costs as a percentage of sales.

5.2. Contributions and Limitations

This section highlights the contributions and limitations of this thesis, since these attributes can be helpful to understand this thesis more precisely.

The research work has contributed in the following areas:
a) Identification of cost structure data that can be used as a benchmark for different cost buckets and across industries.

b) Development of a framework that can be used to understand whether a function is centralized or decentralized.

There are limitations to our research work that should be considered to meaningfully interpret the results and for future research in this area.

The cost data used in this research work was collected in percentage range buckets, not in a continuous value format. This was done for two reasons: first, in most companies, specific supply chain cost figures are not clarified for practical reasons; also supply chain managers have only ranges not specific figures for supply chain costs, as the numbers change over the years.

Our sample mainly consists of large and global companies. Hence it is not appropriate to generalize the results and the framework more widely.

Lastly, centralization of supply chain functions can be captured in many ways. We collected research data based on the experiences of supply chain professionals and their intuition. Hence, the research is limited by the accuracy of data provided by the respondents.

5.3. Further Research

During the research, we found additional subjects that we identified as possible candidates for future research in this area. They are:

We employed cost structure for performance index, however there are other meaningful performance indices like market share, net profit, operational excellence index, and other financial ratios to analyze the impact of centralization.
Change management and risk management within centralization are other important areas that have not been explored by researchers. Centralization is an important subject influencing corporate performance and sustainability. Hence any attempt to change organizational structure should be accompanied with appropriate change management and risk management strategies. Therefore, we believe that additional research on the risk management and change management aspects of centralization can add significant value in this area.
## Appendix

### Table 16: Chi-square Test Results

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Figure 22: Actual Survey Used for This Research

<table>
<thead>
<tr>
<th>Economics of Centralization in Supply Chain Decision-making</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. Type of Business and Supply Chain Department</td>
</tr>
</tbody>
</table>

1. Indicate the type of business that best reflects your company's operation (Please choose only one answer):

- [ ] Food and Beverage Products
- [ ] Textile Products
- [ ] Paper and Allied Products
- [ ] Chemical and Allied Products
- [ ] Petroleum Refining and Related Industries
- [ ] Primary Metal Industries
- [ ] Industrial and Commercial Machinery
- [ ] Electronics and Allied Products
- [ ] Automobile Products
- [ ] Pharmaceutical Products
- [ ] Third Party Logistics
- [ ] Retail
- [ ] Others (please specify):

2. What is the title of the senior most functionary in your supply chain department?

- [ ] Manager
- [ ] Senior Manager
- [ ] Director
- [ ] Vice President
- [ ] Senior Vice President
- [ ] Other (please specify):
Economics of Centralization in Supply Chain Decision-making

3. In your company, what is the usual reporting relationship between the supply chain leadership and other departments? (multiple choices possible)

- Supply chain leadership reports into Finance
- Supply chain leadership reports into Manufacturing
- Supply chain leadership reports into Marketing/Sales
- Supply chain leadership reports directly to the top management
- Other departments report to the supply chain leadership
- Other (please specify)

4. In your company what are the various functions performed by the Supply Chain department? (multiple choices possible)

- Long-term Capacity Planning (Function that creates long range capacity investment plans for the business)
- Internal Improvement (Function that supports internal projects supporting Supply Chain Strategy/Quality)
- Transportation Planning (Function that plans for Transportation assets and partners with carriers)
- Inventory Planning (Function that executes Inventory Planning)
- Short-term Demand Planning (Function that develops short-term demand forecasts)
- Manufacturing Planning (Function that plans production and integrates the other teams with the manufacturing)
- Order Fulfillment (Function that is involved in fulfilling demands using dedicated or/and private warehouses)
- Shipment Handling (Function that manages the day to day logistics and shipment handling/tracking)
- Order Management and Problem Resolution (Function that supports customers and expedites/consolidates delivery to customers)
- Sourcing (Function that manages suppliers, writes contracts and executes the purchasing and procurement processes)
5. How would you characterize the decision making authority (Centrally made or Locally made) for various functions in the supply chain department of your company?

<table>
<thead>
<tr>
<th>Function Description</th>
<th>Most decisions (75-100%)</th>
<th>Majority decisions (50-75%)</th>
<th>Majority decisions (0-25%)</th>
<th>N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Most decisions (75-100%) made locally</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Majority decisions (50-75%) made locally</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Majority decisions (0-25%) made locally</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>N/A</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

- Long-term Capacity Planning (Function that creates long range capacity investment plans for the business):
- Internal Improvement (Function that supports internal projects supporting Supply Chain Strategy/Quality):
- Transportation Planning (Function that plans for Transportation assets and partners with carriers):
- Inventory Planning (Function that executes Inventory Planning):
- Short-term Demand Planning (Function that develops short-term demand forecasts):
- Manufacturing Planning (Function that plans production and integrates the other teams with the manufacturing):
- Order Fulfillment (Function that is involved in fulfilling demands using dedicated or and private warehouses):
- Shipment Handling (Function that manages the day to day logistics and shipment handling/tracking):
- Order Management and Problem Resolution (Function that supports customers and expedites/consolidates delivery to customers):
- Sourcing (Function that manages suppliers, writes contracts and executes the purchasing and procurement processes):
## Economics of Centralization in Supply Chain Decision-making

### 4. Factors influencing decision making locus

#### 6. What is the key factor that is influencing centralized or localized decision making in the various functions of your supply chain organization?

<table>
<thead>
<tr>
<th>Function</th>
<th>Supply Conditions</th>
<th>Customer Requirements</th>
<th>Government Regulations</th>
<th>Competitive Considerations</th>
<th>Cost Considerations</th>
<th>Capacity Constraints</th>
<th>Other Reasons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Long-term Capacity Planning (Function that creates long range capacity investment plans for the business):</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Internal Improvement (Function that supports internal projects supporting Supply Chain):</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Transportation Planning (Function that plans for transportation assets and partners with carriers):</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Inventory Planning (Function that executes Inventory Planning):</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Short-term Demand Planning (Function that develops short-term demand forecasts):</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Manufacturing Planning (Function that plans production and integrates the other teams with the manufacturing):</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Order Fulfillment (Function that is involved in fulfilling demands using dedicated or and private warehouses):</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Shipment Handling (Function that manages the day to day logistics and shipment handling/tracking):</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Order Management and Problem Resolution (Function that supports customers and expedites/consolidates delivery to customers):</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Sourcing (Function that manages suppliers, writes contracts and executes the purchasing and procurement processes):</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Others (please specify):</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>
### Economics of Centralization in Supply Chain Decision-making

#### 5. Cost Structure in the company

7. Please provide an approximate breakdown of your total supply chain costs among the following cost buckets in your organization? (Please specify cost % to Sales)

<table>
<thead>
<tr>
<th>Cost Component</th>
<th>0 - 1.4%</th>
<th>1.5 - 2.9%</th>
<th>3.0 - 4.4%</th>
<th>4.5 - 5.9%</th>
<th>6.0 - 7.4%</th>
<th>7.5 - 8.9%</th>
<th>9.0 - 10.4%</th>
<th>More than 10.5%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inventory Carrying costs as a % of Sales:  (Cost of maintaining inventory which includes inventory financing charges, inventory insurance and taxes, inventory shrinkage, inventory control and cycle counting expenses)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transportation costs as a % of Sales: (Costs which include third party transportation charges and private fleet costs including fuel, driver and depreciation charges)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Information costs as a % of Sales: (Costs related to the setup of IT systems for supply chain activities including service charges, hardware and software charges)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operational costs as a % of Sales: (Includes cost of labor, warehouse rent, utilities, cost of warranty, lease payments or depreciation on material handling equipment and other operational charges)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other Supply Chain Costs as a % of Sales</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

8. What percentage of total costs is your supply chain cost? (Supply chain cost refers to the sum of the cost components listed above)

Supply Chain Costs as a % of Cost of Goods Sold

Supply Chain Costs as a % of Sales
Economics of Centralization in Supply Chain Decision-making

6. Basic Information

9. How many total employees are working in your company?
   - 1 - 99
   - 100 - 499
   - 500 - 999
   - 1,000 - 4,999
   - 5000 - 9,999
   - More than 10,000

10. How many employees are currently working in the supply chain department? If your company does not have a separate supply chain department, please indicate the number of employees who execute supply chain related activities.
   - 1 - 9
   - 10 - 49
   - 50 - 99
   - 100 - 199
   - 200 - 499
   - More than 500

11. What is the annual revenue of your company in FY 2007?
   - Less than $45M
   - $50M - $499M
   - $500M - $999M
   - $1,000M - $9,998
   - More than $10,008

12. In how many countries does your company’s supply chain operate?
   - 1
   - 2 - 4
   - 5 - 10
   - 10 - 29
   - More than 30
Table 17: Final Centers and Distances of Clusters

<table>
<thead>
<tr>
<th>Cluster Names</th>
<th>Centralized</th>
<th>Hybrid</th>
<th>Decentralized</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Number of Cases</strong></td>
<td>14</td>
<td>22</td>
<td>10</td>
</tr>
<tr>
<td><strong>Final Cluster Centers</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Long-term Capacity</td>
<td>3.57</td>
<td>3.68</td>
<td>2.58</td>
</tr>
<tr>
<td>Internal Improvement</td>
<td>2.86</td>
<td>2.80</td>
<td>1.92</td>
</tr>
<tr>
<td>Transportation Planning</td>
<td>3.71</td>
<td>2.72</td>
<td>2.17</td>
</tr>
<tr>
<td>Inventory Planning</td>
<td>3.64</td>
<td>2.72</td>
<td>1.25</td>
</tr>
<tr>
<td>Short-term Demand</td>
<td>3.29</td>
<td>2.32</td>
<td>1.08</td>
</tr>
<tr>
<td>Manufacturing Planning</td>
<td>2.64</td>
<td>2.92</td>
<td>1.08</td>
</tr>
<tr>
<td>Order Fulfillment</td>
<td>3.71</td>
<td>1.88</td>
<td>1.08</td>
</tr>
<tr>
<td>Shipment Handling</td>
<td>3.14</td>
<td>1.48</td>
<td>1.50</td>
</tr>
<tr>
<td>Order Management</td>
<td>3.71</td>
<td>1.72</td>
<td>1.50</td>
</tr>
<tr>
<td>Sourcing</td>
<td>3.57</td>
<td>3.48</td>
<td>2.67</td>
</tr>
<tr>
<td><strong>Distance Between Centers</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Centralized</td>
<td></td>
<td>5.71</td>
<td>3.60</td>
</tr>
<tr>
<td>Hybrid</td>
<td>5.71</td>
<td></td>
<td>3.27</td>
</tr>
<tr>
<td>Decentralized</td>
<td>3.60</td>
<td>3.27</td>
<td></td>
</tr>
</tbody>
</table>
Bibliography


Miller, T.C. (2002), *Hierarchical operations and supply chain planning (2nd ed.)*, Springer.


