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To the Graduate Council:

I am submitting herewith a dissertation written by James S. Keebler entitled "Antecedents and moderators of the state of supply chain logistics measurement and consequential perceived competitiveness." I have examined the final electronic copy of this dissertation for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy, with a major in Business Administration.

C. John Langley Jr., Major Professor

We have read this dissertation and recommend its acceptance:

John T. Mentzer, Mary C. Holcomb, Alan Schlottman

Accepted for the Council:

Carolyn R. Hodges

Vice Provost and Dean of the Graduate School

(Original signatures are on file with official student records.)

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Associate Vice Chancellor and
Dean of the Graduate School

# ANTECEDENTS AND MODERATORS OF THE STATE OF SUPPLY CHAIN LOGISTICS MEASUREMENT AND CONSEQUENTIAL PERCEIVED COMPETITIVENESS

A Dissertation

Presented for the

Doctor of Philosophy Degree

University of Tennessee, Knoxville

James S. Keebler

August 2000

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## DEDICATION

This dissertation is dedicated to my wife,

M. Kathryn Keebler,

whose love and respect are my greatest treasures.

# ACKNOWLEDGEMENTS

There are many people to whom I am grateful for help and encouragement during my doctoral program. Firstly, I would like to thank my dissertation committee - Dr. John T. Mentzer, Dr. Mary C. Holcomb, Dr. Alan Schlottman, and, particularly, Dr. C. John Langley, Jr., who volunteered to chair the committee - for their responsiveness and guidance in producing this manuscript.

Secondly, I am grateful to my favorite teachers - my parents. Dad taught me discipline and Mom encouraged me to be curious. Disciplined curiosity is a trait that should help me be a successful researcher as I leave the structure of this doctoral program and begin a tenure track faculty assignment.

Thirdly, I am grateful to my precious wife, Kathy, for her constant support and encouragement while I completed the doctoral program and for her willingness to move from Tennessee to Minnesota now that I have completed it. That is real support!

Fourthly, I have three special friends whom I would like to acknowledge. George Gecowets has impacted my professional life more than anyone has. I am extremely grateful to George for assisting me in my career. I appreciate the many opportunities to participate with him, his talented staff, and other volunteer professionals in performing the mission of the Council of Logistics Management. Dr. Bernard J. Hale, a former boss, a mentor, and another example of the ultimate business professional, has been an inspiration to me for twenty-five years. I am honored to be Bernie's friend. My good friend, Dave Durtsche and I have worked together on many occasions to facilitate improved logistics management. As a Partner of Computer

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Finally, participating in a doctoral program is a humbling experience. I believe God has a plan for me even though I might not know what it is. I thank Him for the many blessings in my life, including the opportunity to complete this doctoral program. Amen.

# ABSTRACT

The purpose of this research was to describe the state of logistics measurement in corporate America and to explore relationships between it and various antecedents, moderators, and perceived competitive advantage. This research, conducted in 1998-1999, builds on previous studies published by the Council of Logistics Management, validates previous findings about the state of logistics measurement, and provides exploratory insights into the current state. In addition, theory regarding the quality of logistics measures was tested.

The design of the research included the use of the Delphi technique, several case studies, and a mailed questionnaire completed by senior logistics and supply chain executives from 355 companies. Twenty-eight hypotheses were tested. Considerable post hoc analysis was performed to enhance the understanding of logistics measurement in the supply chain.

Major findings include:

(1) Logistics measurement is generally not considered to be one of the important issues facing the organization.

(2) Key logistics performance measures are not captured by a large percentage of firms, even though they are perceived to be important to the firm and to its customers.

(3) Even though a logistics performance measure is captured, organizations often fail to take action based upon the value of the measure.

(4) The quality of measures captured is often perceived to be deficient.

(5) Firms are more focused on measurement of activities or processes within the firm than on activities or processes between firms.

(6) The position of the firm in its dominant supply chain influences what it measures.

(7) Existing technologies that would facilitate measurement are not being considered for implementation by a large percentage of companies.

(8) Large firms are more likely to measure logistics processes/capabilities than small firms.

(9) Top management support is seen as the greatest enabler of logistics performance measurement.

Major conclusions of the research include:

(1) Most firms represented by respondents to the survey do not comprehensively measure logistics performance.

(2) Even the best performing firms fail to realize their productivity and service potential available from logistics performance measurement.

(3) There is a need for collaboration between trading partners on definitions of processes and measures of performance.

(4) Opportunities exist for improving the alignment of business strategies and logistics strategies. However, such alignment does not appear to affect the state of logistics measurement.

(5) Supply chain management is a theory under development and not currently practiced.

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# CHAPTER 1

# INTRODUCTION

This dissertation consists of five chapters. Chapter 1 presents background on the importance and relevance of this research topic of logistics performance measurement. The major research questions and goals are described. A research model is illustrated. Definitions of key constructs are covered. Chapter 2 covers the literature review, provides antecedent justification for the research questions, and presents the research hypotheses. Chapter 3 describes the research methodology utilized. Chapter 4 presents an analysis of the data and testing of the hypotheses. Chapter 5 discusses the implications of the findings of this research and suggests future areas of research.

## Overview

The five most recent studies published by the Council of Logistics Management on the subject of performance measurement in logistics had three significant findings in common (Kearney 1984; Bowersox et al 1989; Byrne and Markham 1991; Global Logistics Research Team at Michigan State University 1995); Keebler et al, 1999):

(1) Most United States firms do not comprehensively measure logistics performance.

(2) Even the best performing firms fail to realize their productivity and service potential available from logistics performance measurement.

(3) Logistics competency will be increasingly viewed as a competitive differentiator and a key strategic resource for the firm.

There are three major reasons why firms measure their logistics performance: (1) reduce operating costs, (2) drive revenue growth, and (3) enhance shareholder value. Measuring operating costs helps to identify whether and where to make operational changes to control expenses and points out areas of improved asset management. To attract and retain valuable customers, the price/value of products offered can be enhanced through cost reductions and service improvements in logistics activities. The returns on stockholder investments and the market value of the firm are impacted by the of firm's logistics performance. These seem to be obvious reasons why companies should want to be competent in performance measurement. Based on the published empirical research that demonstrates insufficient progress in this important business competency, there is a need to explore what is occurring, and to discover what needs to occur for benefits of performance measurement to be realized. A research contribution would be made by (1) understanding the current state of logistics performance measurement, (2) discovering reasons why some firms are more competent in this area, and (3) laying the groundwork for further examination of performance measurement across the business boundaries of a supply chain.

**Research Questions and Goal of this Dissertation**

These were the compelling questions that provoked this dissertation research:

(1) What is the current state of logistics performance measurement?

(2) Why are there differences between firms, and what are specific barriers and enablers of progress in measuring and improving logistics performance?

(3) What are the antecedents and moderators of improved logistics measurement and performance?

(4) What is the relationship between level of performance measurement and perceived competitiveness?

It was the goal of this research to describe the current state of logistics measurement, updating the research published by the Council of Logistics Management in 1984, 1989, 1991, 1995, and 1999 and to provide an understanding of components of a measurement orientation and their association with actual measurement. The determinants and dimensions of logistics performance are described. The most important activities and processes to be measured are identified. Additionally, an examination of moderating variables, described as contextual factors, was conducted to determine their association with actual measurement. A conceptual framework that guided this research is presented (See Figure 1).

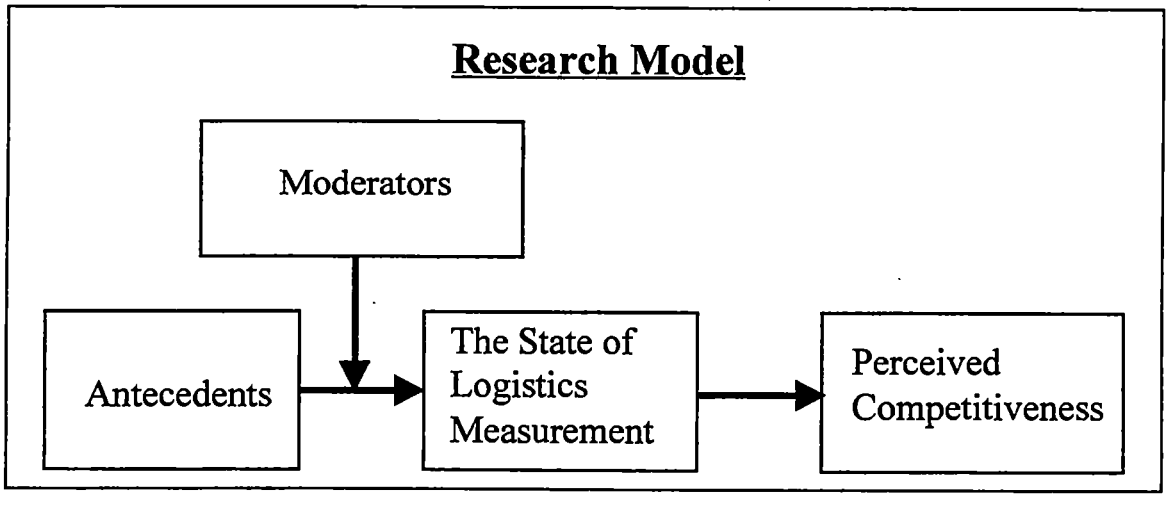



**Figure 1 Research Model**

**Definition of Constructs**

Using this research model, the following areas were explored: (1) the relationship between the state of logistics measurement in a firm and its perceived competitiveness; (2) the effect of a firm's measurement orientation on its state of logistics measurement; and (3) the contextual factors that serve as moderating variables on the main effects of the extant measurement orientation of the firm.

The antecedents included:

(1) the perceived importance of logistics measures

a. for the logistics function,

b. for the division or firm,

c. to customers and suppliers;

(2) the perception of barriers and enablers of logistics measurement;

(3) the perception of the adequacy of current logistics measures; and

(4) the degree of focus on activities within the firm versus activities between it and trading partners.

The moderators included eight dimensions:

(1) industry;

(2) size of firm;

(3) business strategy of the firm;

(4) the organization's view of the logistics function;

(5) the degree of segmentation by the firm;

(6) the span of control of the logistics organization;

(7) the use of technology by the firm; and

(8) the location of the firm in its dominant supply chain.

The state of logistics measurement construct was described by:

(1) what logistics measures are actually captured by firms;

(2) how these measures are determined; and

(3) to what degree the measures are acted upon.

The perceived competitiveness construct was described by the senior logistics executives' self-evaluation of their firm's advantage or disadvantage in performance among several key logistics processes compared to their primary competitor.

**Research Methodology**

As Chapter 2 describes, there has been considerable theoretical and empirical research on the constructs and application of measurement in logistics. One of the areas needing exploration is the firm's orientation toward measurement, especially the differences in its emphasis between the logistics activities within a firm and the supply chain activities between and across firms. Recent research has begun to inform practitioners of this requisite shift in orientation and emphasis needed to achieve improved firm efficiency *and* supply chain integration and effectiveness.

To address the research questions stated above, this study employed multiple methods to understand the issues relevant to performance measurement. Firstly, the Delphi technique was employed to solicit best thinking from logistics and supply chain thought and practice experts. Learning from the Delphi study helped guide the

construction of an interview outline for the case studies, and a questionnaire for a mail survey. Secondly, interviews were conducted with multiple firms from different industries to understand the current state of logistics measurement of key processes within and between firms. Thirdly, a comprehensive questionnaire was completed by 355 senior logistics and supply chain managers. Their responses provided information about the antecedents and moderators of logistics measurement, their firm's state of logistics measurement, and their perception of its competitiveness position. Extensive analysis and statistical treatment of the survey responses was conducted to test the twenty-eight hypotheses developed in Chapter 2. This research has replicated and extended previous theoretical and empirical research and has made new contributions to this body of knowledge. It has also provoked new questions to be explored in future research.

**Importance of this Research**

Over the last thirty years logistics has evolved from a backroom function with about as much strategic impact as the mailroom to become a *major* factor in establishing competitive advantage. Logistics has many "moving parts" - products, orders, information on orders, and so on - that flow through numerous points (factories, wholesalers, retailers, and carriers) around the world. This complexity creates many places where things can go wrong. Few business areas need to be measured more extensively, more frequently, and more effectively than logistics. Measurement ends fingerpointing and blaming behaviors, permits objective analysis of what performance is, and directs discovery of improvement opportunities. Measurement helps build trust

within the firm and between trading partners. The costs and service capabilities of logistics are important to the firm and need to be well understood and managed. Knowing what to measure and what to improve are critical competencies in understanding how the firm is performing for its customers and how suppliers are performing for the firm. Logistics measurement enables companies from one end of the supply chain to the other to work collaboratively and productively toward mutually beneficial goals.

Improved logistics performance measurement will help companies to further reduce costs, drive revenue growth, and enhance shareholder value. This research is important and useful to researchers and practitioners because it: (1) describes the current state of logistics measurement and measurement improvement opportunities; (2) demonstrates the need for shifting measurement focus from internal activities to key interfaces with supply chain partners; and (3) establishes a foundation for future research about logistics measurement across multiple business boundaries of a supply chain.

**Organization of this Dissertation**

This dissertation consists of five chapters, including this first one. The relevant literature is reviewed and hypotheses are developed in Chapter 2. The research design and methodology is explained in Chapter 3. In Chapter 4, the findings from data analyses and hypotheses testing is presented. Conclusions of this study, together with both theoretical and managerial implications, are provided in Chapter 5.

# CHAPTER 2

# LITERATURE REVIEW

The object of this chapter is to review the body of literature as it relates to performance measurement of logistics in the supply chain. The logistics concept is discussed. The economic significance of logistics to the firm and to the economy is reviewed. Significant conceptual and empirical research on logistics measurement is described. The emerging concept of supply chain management is explored. Research hypotheses are developed.

## The Logistics Concept and Economic Significance

The business function known today as logistics has its roots in transportation and warehousing, which together are known as distribution. While the earliest text to address distribution issues - those relating to farm products - appeared in 1901, most of what we know today about logistics can be traced back to articles and text books on distribution published in the 1950s and 1960s (Kent and Flint 1997). The corporate concern for linking the inbound and outbound flow of goods produced a more integrative perspective, called logistics, which included distribution and other activities associated with product and information flows. Today the business logistics function can include the work of forecasting, procurement, production planning and scheduling,

inventory control, warehousing, transportation, and customer service (Byrne and Markham 1991).

The preeminent professional organization in logistics management is the Council of Logistics Management. It defines logistics as "that part of the supply chain process that plans, implements and controls the efficient flow and storage of goods, services, and related information from the point of origin to the point of consumption in order to meet customers' requirements (Council of Logistics Management 1999). "

Manufacturing, wholesaling, and merchandising firms commit a significant amount of their spending to getting their products to market, or satisfying the "place" utility of their marketing mix. Several studies have found that order processing, transportation, warehousing, and inventory carrying costs of manufacturing and merchandising companies total about 25% of their value-added expenses (Ballou 1992). The end consumer of a product often pays a multiple of the manufacturer's production cost due to the added costs of middlemen in the supply chain. This works only if the end consumers appreciate the value added by these intermediaries. Management and control of the accumulated supply chain logistics costs are essential to the competitiveness of each supply chain participant. In other words, supply chain managers must be mindful that added costs should produce added value for the supply chain's consumer. Otherwise, costs must be reduced within the supply chain to add value for its consumers. Since logistics costs, principally transportation and inventory costs, are a large component of supply chain expense, it is helpful to understand how our U.S. economy has been performing in this area.

The U.S. economy includes several logistics costs: the carrying costs of inventory, (i.e., interest, taxes, depreciation, obsolescence and insurance); warehousing costs; transportation costs; and logistics administration costs. In twenty years, the Gross Domestic Product GDP) increased from $2.03 trillion to $8.51 trillion. Between 1977 and 1993, as a percentage of the GDP, logistics costs declined from 13.7% to 10.2%, reflecting productivity gains in the reduction of relative inventory and lower transportation costs (Delaney 1999) (see Table 1).

While continuous improvement in the cost of logistics as a percentage of the GDP has occurred for many years since 1977, logistics cost productivity veered in the wrong direction in 1994. Higher interest rates, freight costs, and inventory levels were to blame (Bradley 1995). Since the 1992 low of 10.2% of the GDP, logistics costs have ranged upward to 10.8% and flattened out at 10.6% for 1996, 1997 and 1998. The difference between the 10.2% rate and succeeding higher rates represents a cumulative loss of over $16 billion in logistics productivity per year since 1992 (Delaney 1999).

Major reductions in inventory relative to GDP have occurred since 1981, when the prime interest rate was at an all-time high. When we look at the changes in total transportation and inventory costs graphically, it appears that productivity improvements have bottomed out (see Figure 2).

Are further cost reductions possible? A concern could be raised that the economic value of logistics to the macro supply chain is not increasing because total logistics costs relative to the GDP are not declining. But how does the individual firm plan for and evaluate the reductions in its logistics costs? How does the *individual firm*

**Table 1 Trends in Logistics Costs**

| The Cost of the Business Logistics System in Relation to Gross Domestic Product ($ Billions except GDP) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| YEAR | GDP $ Trillion | Values of all Business Inventory | Inventory Carrying Rate | Inventory Carrying Costs | Transportation Costs | Administrative Costs | Total US Logistics Costs | Logistics % of GDP |
| 1977 | 2.03 | 473 | 24.4% | 115 | 151 | 11 | 277 | 13.7 |
| 1978 | 2.29 | 549 | 26.8% | 147 | 173 | 13 | 333 | 14.5 |
| 1979 | 2.56 | 649 | 29.9% | 194 | 193 | 16 | 403 | 15.7 |
| 1980 | 2.78 | 717 | 31.8% | 228 | 241 | 18 | 460 | 16.5 |
| 1981 | 3.12 | 769 | 34.7% | 267 | 228 | 20 | 515 | 16.5 |
| 1982 | 3.24 | 776 | 30.8% | 239 | 222 | 18 | 479 | 14.8 |
| 1983 | 3.51 | 776 | 27.9% | 217 | 243 | 18 | 478 | 13.6 |
| 1984 | 3.90 | 841 | 29.0% | 244 | 268 | 20 | 532 | 13.6 |
| 1985 | 4.18 | 865 | 26.9% | 233 | 274 | 20 | 527 | 12.6 |
| 1986 | 4.42 | 866 | 25.6% | 222 | 281 | 20 | 523 | 11.8 |
| 1987 | 4.69 | 900 | 25.7% | 231 | 294 | 21 | 546 | 11.6 |
| 1988 | 5.05 | 969 | 26.6% | 257 | 313 | 23 | 593 | 11.7 |
| 1989 | 5.44 | 1030 | 28.1% | 289 | 329 | 25 | 643 | 11.8 |
| 1990 | 5.75 | 1071 | 27.2% | 291 | 351 | 26 | 668 | 11.6 |
| 1991 | 5.92 | 1060 | 24.9% | 264 | 355 | 25 | 644 | 10.9 |
| 1992 | 6.24 | 1072 | 22.7% | 243 | 375 | 25 | 643 | 10.3 |
| 1993 | 6.56 | 1106 | 22.2% | 245 | 396 | 26 | 667 | 10.2 |
| 1994 | 6.95 | 1163 | 23.4% | 272 | 420 | 28 | 720 | 10.4 |
| 1995 | 7.27 | 1249 | 24.9% | 311 | 445 | 30 | 786 | 10.8 |
| 1996 | 7.64 | 1280 | 24.4% | 312 | 467 | 31 | 810 | 10.6 |
| 1997 | 8.08 | 1325 | 24.5% | 325 | 504 | 33 | 862 | 10.7 |

Source: 9th Annual *State of Logistics Report* by Cass Information Services, June 1, 1998

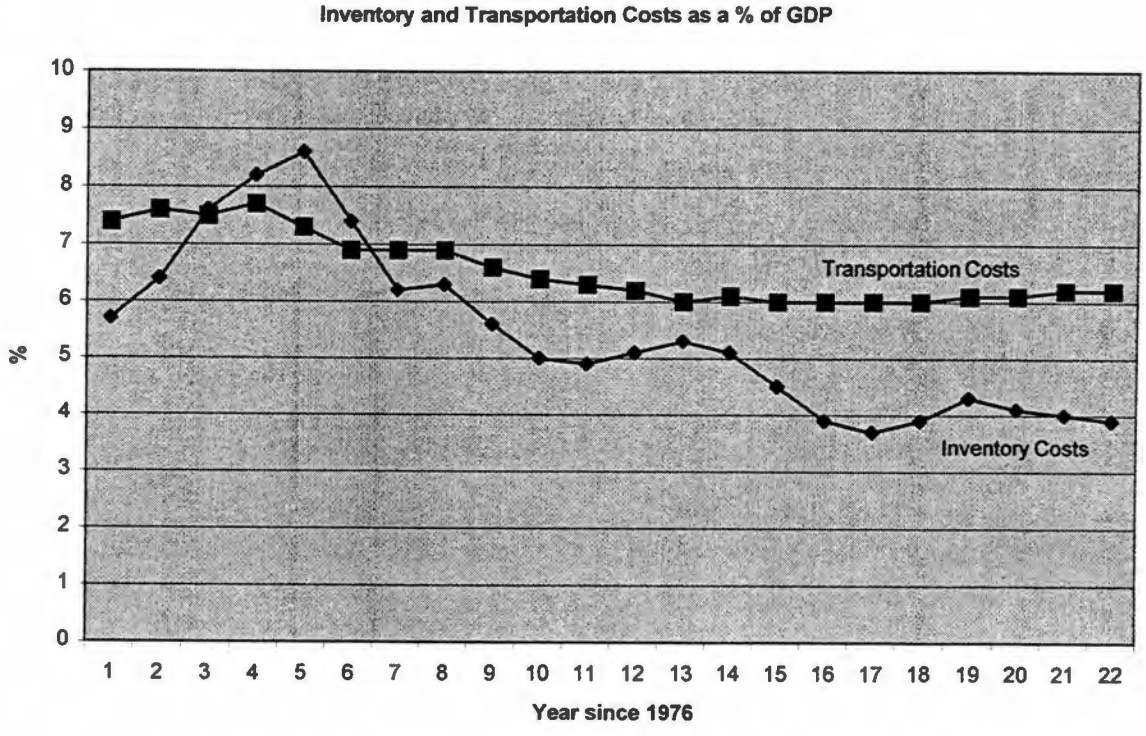



**Figure 2 Changes in Transportation and Inventory Costs**

meet the economic claims of its various constituencies, reduce its logistics costs, and achieve acceptable profitability and returns on investment?

The performance of logistics has a significant impact on the success of the enterprise. We would expect, then, that the measurement and control of logistics activities would be highly refined. This does not appear to be the case. Current research finds that measurement in logistics is not occurring to the degree that is desirable and necessary to affect superior logistics performance in the supply chain.

The literature related to supply chain performance measurement could be grouped under several topics and orientations. They are:

(A) Conceptual articles:
  (1) Performance Definition
  (2) Issues with Measures
  (3) Theoretical Evaluation Criteria

(B) Empirical articles and books:
  (1) Descriptive Studies
  (2) Methods
  (3) Taxonomies
  (4) Prescriptive Performance Improvement Activities.

The conceptual works tend to focus on measurement constructs and prescriptive methodologies. The empirical works tend to focus more on performance *content* than on measurement *process*. Little research has been conducted on multi-firm performance, or measures across a supply chain. The research focus has been on single-firm activity measurement, emphasizing efficiency over effectiveness.

**Conceptual Research on Logistics Performance Measurement**

Logistics efficiency and effectiveness have been two major concerns for logistics scholars. Armitage presented a management accounting technique for measuring and improving efficiency and effectiveness in distribution operations (Armitage 1984). Rhea and Shrock (1987) defined physical distribution effectiveness and presented a framework for the development of measures for distribution customer service programs. They made an important distinction between effectiveness determinants, such as customer satisfaction, and effectiveness dimensions, such as timeliness and accuracy. Harrington, Lambert and Christopher (1991) provided a

formal vendor performance measurement model that used defined criteria and weighted scores to assess the performance of suppliers. The model was tested and successfully implemented.

Mentzer and Konrad (1991) reviewed the construction and use of performance measures from an efficiency and effectiveness perspective, provided an understanding of how performance measures should be constructed, and described the strengths and weaknesses of their use. They also reviewed existing practices in logistics performance measurement and suggested methods of improvement. Problems they cited in establishing performance measures included lack of resources, incomplete information, comparability, measurement error, evaluation and reward systems that encourage dysfunctional behavior, and underdetermination. The variables used in a measure might not *entirely* measure (i.e., they underdetermine) all the aspects of actual inputs and outputs. For example, delaying a truck departure until it is filled with multiple shipments may improve the value of the transportation cost measure, but it does not reflect the customer service damage done by the consequence of a late delivery. Neither the transportation cost measure nor the on-time delivery measure will reveal the ill will of the customer, nor capture the value of a subsequent lost order. Logistics measures are fragmented, and only partially account for the full performance picture. The underdetermination problem produces an inherently flawed measure, especially when the view of performance is a cross-functional one. Thus, it is important to select performance measurement criteria and to establish performance measures carefully. The authors stated that good measurements should:

(1) cover all aspects of the process being measured;

(2) be appropriate for each situation;

(3) minimize measurement error; and

(4) be consistent with the management reward system.

Chow, Heaver and Henriksson (1994) provided a summary of logistics performance literature published in five leading logistics journals between 1982 and 1992. Some of the publications that were reviewed focused on accounting techniques, some on customer service, some on the supplier interface, and some dealt with the variety of operational aspects of logistics performance. Practically all the literature reviewed provided "soft" measures of performance based on mail surveys being used as the data collection method. Only a few references presented "hard" measures, such as net income or accounting measures based on research of archival data. A wide variation existed in the definition of logistics performance. Generally, the literature found that firms tend to focus on their internal performance and they are is especially concerned with efficiency measures. Discussions of supply chain measures are noticeably absent. The variety of performance dimensions suggested by the literature included efficiency, effectiveness, quality, productivity, quality of work life, innovation, profitability, and budgetability. It is generally concluded that defining and measuring performance in logistics is a difficult task for both researchers and practitioners. The authors offered five suggestions:

(1) Researchers need to be more specific about the definitions and limitations of performance measures.

(2) More innovative research designs are needed to complement the "rate-your-own-company" studies.

(3) Contingency models of logistics performance need to be developed to stimulate research on the primacy of various performance dimensions depending on the nature of the industry, company and products involved.

(4) Consideration should be given to assessing the performance of the supply chain, not just that of the individual participants.

(5) More bridge-building between theory and practice is needed.

Their review of the logistics literature revealed a variety of constraints that make it difficult to draw broad inferences about the relationship between a given logistics strategy and performance. With the exception of the mathematical/economic studies, nearly all of the empirical studies utilized soft measures for the outcome variable. Nevertheless, both soft and hard measures are associated with strengths and weaknesses, which limits a researcher's ability to infer the existence of relationships between logistics performance and its antecedents. Conceptually, logistics performance may be viewed as a subset of the larger notion of firm or organizational performance. The latter has attracted a large volume of diverse research over the years. However, increased attention to the development of valid measures is warranted. Researchers might do well to explore contingency models of logistics and supply chain performance.

Caplice and Sheffi (1995) addressed the need for a method by which to evaluate existing logistics metrics. The authors addressed this need by suggesting a set of evaluation criteria for individual logistics performance metrics and by identifying the inherent trade-offs. A classification of logistics performance metrics, organized by process rather than by function, was presented, and the metrics were evaluated using the established criteria. A performance measurement system that is well designed at the

strategic level can be flawed at the individual metric level. The authors advocated a reevaluation of the existing individual metrics rather than developing novel metrics. The "goodness" of a metric can be evaluated along many criteria. The authors presented a synthesis of the prior research to establish eight such criteria: validity, robustness, usefulness, integration, economy, compatibility, level of detail, and behavioral soundness. Definitions and examples for each are presented. The discussion of the trade-offs between criteria, specifically the first four, is enlightening for those converting from functional to cross-functional and process views of performance. The trade-off between validity and robustness implies that as more situation specific aspects of a process are included in the metric, the less comparable, or widely acceptable, it becomes. The trade off between integration and usefulness suggests that the more a metric promotes coordination across different functions (or firms), the less guidance it will provide for the particular function (or firm) manager. The most useful metric for an internal manager is one that focuses on his or her function without any additional exogenous factors. These two major trade-offs for metrics, between the criteria being valid and robust and between the criteria being integrative and useful, are a major dilemma for the design of benchmarkable supply chain metrics.

**Empirical Research on Logistics Performance Measurement**

The Council of Logistics Management (CLM) has done much to advance contributions to the knowledge about measurement in logistics. Research contracted to A.T. Kearney resulted in a publication in 1978 that gave a perspective to the size of productivity improvement and cost reduction opportunities in the U.S. economy related

to distribution (Kearney 1978). A second study, published six years later, described measurement and improvement opportunities, presented criteria for success in improving productivity, and highlighted case studies of successful companies (Kearney 1984). In 1991, a third study was published which described quality and productivity improvement opportunities through logistics measurement (Byrne and Markham 1991). This third publication provided a solid foundation for understanding, developing, and applying appropriate logistics measures *within* the firm. It presented specific measures of productivity, utilization and performance for activities within the various functions of transportation, warehousing, purchasing, materials planning and control, customer service and logistics management. It also presented lists of potential performance improvement actions for each of these functions. This landmark CLM publication provided a detailed taxonomy and suggested improvement actions that should be useful to every logistics manager. It focused the manager on the elements of the task and activities within functions. Companies that seek stability and control would employ the measures described to have command of their internal logistics process. However, it failed to address measurement between firms and across supply chains.

Meanwhile, other Council of Logistics research studies (Bowersox 1989); Global Logistics Research Team at Michigan State University 1995) highlighted the benefits for logistics measurement experienced by both leading edge and world class companies. The 1995 publication (refer to chapter 6, Measurement) reported that the capability to do functional and process assessments and to benchmark best practices is an essential business competency. It also reported that better measurement information availability occurred in the firms surveyed between 1989 and 1995. The study reported

a significant gap in such information availability between the upper third and lower third of firms surveyed. It is notable that the 1995 study found that many key performance areas were not being widely measured. Half of the asset management measures, specifically ROA, ROI, and ABC inventory classification were not available in twelve to nineteen percent of the firms. Seventeen key "cost" measures were reported:

(1) total cost
(2) cost per unit
(3) cost as a percentage of sales
(4) inbound freight
(5) outbound freight
(6) administrative
(7) warehouse order cost
(8) direct labor
(9) comparison of actual versus budget
(10) cost trend analysis
(11) direct product profitability
(12) customer or customer segment profitability
(13) inventory carrying
(14) cost of returned goods
(15) cost of damage
(16) cost of service failures
(17) cost of backorders

Of the seventeen "cost" measures, only five were found to be available in at least 90% of the firms. Availability of key "cost" measures such as "inbound freight" at 75.8% availability, "inventory carrying" at 81.8%, cost of "returned goods" at 70.6%, and cost of a "backorder" at 33.3%, indicated that these measures were absent in twenty percent or more of the firms. Customer service measures such as "fill rate" (79.4% availability), "cycle time" (85.3%), "response time to inquiries" (41.9%), "customer complaints" (69.7%), "sales force complaints" (40.6%), and "overall satisfaction"

(67.7%) indicated some management blindness in this area. Information availability was found in a range of 50-80 % for ten productivity measures. Quality information was not available for accuracy measures – picking, order, and document accuracy – in over 25% of the firms. These findings demonstrate a continuing challenge and opportunity for firms to install adequate performance measurement *within* the enterprise.

Another study (Novack, Langley and Reinhart 1995) surveyed 1,623 logistics managers and, based on the 396 usable responses, concluded the following:

> "Most of these executives indicated that they measure the costs of traditional logistics activities as well as measure the logistics service, such as product availability. They also indicated that a strong relationship exists between logistics service levels and their firms' revenues. Although not as strong, a relationship also exists between logistics costs and firm profits. Even though these relationships were identified to exist, the logistics executive respondents were really not able to quantify these relationships. Even though they believe logistics adds value to their firms' output, these logistics executives said they were not able to quantify this value."

**Conclusions from the Empirical Studies**

These six empirical studies on logistics performance measurement indicate four significant findings:

(1) There is great opportunity for supply chain cost reduction.

(2) There is an insufficiency of collected data, information, and measurement.

(3) There is a widespread inability to articulate the cost-benefit of supply chain management.

(4) Many of the savings cross supply chain corporate boundaries.

These studies demonstrate that logistics performance measurement, even in the best performing companies, has much room for improvement. These studies create a compelling call to action for research on, and application of, improved logistics performance measurement.

To build on and validate this recent empirical research, the first hypothesis to be tested is:

**H1: Key performance measures, as identified by senior supply chain or logistics managers, are not being captured, even though they are perceived to be important to their firm and to their customers.**

## Popular Topics on Logistics Measurement

The most popular subjects of articles written on measurement in logistics include the five major topics of activity-based costing, quality and customer service, benchmarking, reengineering, and financial measures.

### Activity-based Costing

Pohlen and La Londe (1994) traced the evolution of costing approaches beginning from Direct Product Profitability (DPP) to Activity Based Costing (ABC) to Total Cost of Ownership (TCO) to Efficient Consumer Response (ECR) to supply chain costing. These efforts to create accurate and integrated cost measures were undertaken to increase the visibility of logistics costs within the supply chain so that cost reduction opportunities could be identified and pursued. By making use of standard and engineered times and existing rate information, the supply chain costing approach considers activities across the firms in the supply chain. There are two significant

constraints. Firstly, those firms that have not implemented ABC cannot provide logistics or supply chain-related costs at the activity level. Secondly, the detailed level of information about process steps and costs of activities that must be shared by the enterprises require a highly coordinated or integrated partner relationship between them. Such inter-firm relationships are difficult and slow to develop. Ultimately, restructuring the supply chain to exploit efficiencies also requires a mechanism capable of identifying and equitably allocating cost benefits between the partners as changes are implemented.

Direct Product Profitability (DPP) is an accounting system developed specifically for the grocery industry in the 1970s. Its objective was to calculate fully loaded product profitability. An improvement on gross margin costing, DPP determined profitability not only by subtracting the cost of goods from sales, but also by adding direct revenue and subtracting direct product costs. One major weakness of DPP was that it failed to recognize overhead and administrative expenses, therefore, it could not be used for total company costing purposes. DPP required a great deal of supporting data about the physical characteristics of products that continually required updating.

Activity Based Costing (ABC), which emerged in the 1980s, improved on DPP by recognizing both direct and overhead costs. ABC goes a step further by tracing the activity costs to objects consuming those activity costs. ABC analysis allows managers to pinpoint the activities, products, services, or customers consuming overhead resources. By examining current business activities at this level, actual costs can be discovered and inefficient practices can be reengineered. Resources could also be freed up for additional output or eliminated to affect cost savings. One suggestion for how to

start the process to reduce costs and create value for the customer using ABC is to "staple yourself to an order (Shapiro 1992)." This perspective of the order management system, experiencing the total sequence of handlings and internal interfaces of a customer transaction, provides great opportunity for identifying improvement opportunities. Knowing the cost to process an order can be very enlightening.

Product and customer profitability analysis performed by firms using ABC has significantly altered management perceptions. One such study found twenty percent of customers generated 225 percent of the profits, while seventy percent of the customers hovered around the break-even point. The remaining ten percent of customers generated a 125 percent loss (Cooper and Slagmulden 1991). This study demonstrates that profitability analysis using ABC can focus management effort. High cost practices can be targeted for corrective action. By being applied broadly to supply chain management, ABC is helping companies finally understand their total costs (Barr 1996).

A university study involving 100 firms produced some interesting findings (Pohlen and La Londe 1994). At that time, thirty-eight percent of the firms reported implementing ABC, fourteen percent decided against implementing ABC, and nineteen percent had not considered ABC. The proposal to implement ABC was originated by Finance in forty-eight percent of the companies, and by Logistics in only four percent. A later study reported that "most firms have not implemented ABC and cannot provide logistics or supply chain related costs at the activity level (La Londe and Pohlen 1996)."

To test the status of ABC implementation and its importance, the following hypothesis to be tested is:

**H2: Firms that have implemented ABC have a higher perceived competitive advantage over those firms that have not implemented ABC.**

Activity-based costing can take many forms. ABC systems span a continuum from the traditional cost model with a single cost driver to a very elaborate cost system with activities for every conceivable type of work and corresponding activity drivers. The level of ABC sophistication will vary by the proportion of overhead costs and the amount of diversity experienced within the firm. Other articles covering activity-based costing (Koota 1998; Walton 1996; Pirttila and Hautaniemi 1995) also emphasized the importance of ABC in effecting supply chain performance improvements. Nonetheless, implementation of ABC seems to lag.

Additional articles address other aspects: financial measures of logistics (Pegels 1991; Eccles and Pyburn 1992; Speh and Novack 1995); problems with accounting measures (Kaplan 1984); cost and effect (Kaplan and Cooper 1997); balanced scorecard (Kaplan and Norton 1992); economic value added (Cooke 1995); shareholder value (Birchard 1994; Glassman and Stern & Stewart 1997); total cost/value model (Cavinato 1992); linkages to the financial statements (Cavinato 1989); stakeholder approach (Atkinson, Waterhouse and Wells 1997); transaction cost analysis (Rindfleisch and Heide 1997); and the economics of lead-time reduction (Wouters 1991).

Quality and Customer Service

Quality measures in logistics are a second major area covered by the literature. Topics range from continuous improvement measures (Fortuin 1988), quality control systems (Hillman, Mathews, and Huston 1990), process controls (Novack 1989), and quality programs in logistics (Read and Miller 1991). Logistics measurement for strategic planning (Fawcett and Clinton 1996), strategic performance (Chakravarthy 1986), outsourcing (Foster 1998, Aertsen 1993), design (Stevens 1989, Perry 1991), and flow analysis (Scott and Westbrook 1991, Farris 1996) are quality-related topics of research.

Customer service measurement has also been researched (La Londe and Cooper 1988). Customer service has become a crucial measure of competitiveness in markets throughout the world. As competition has become more intense, service quality has become a primary determinant for creating overall customer satisfaction. The necessity to achieve service excellence in markets characterized by shrinking margins and tight budgets has created a powerful challenge for supply chain management. The challenge is to balance these operational realities with the need for quality customer service. Service quality can be effectively managed, even when market conditions are difficult and resources are limited, if the organization can focus on a limited number of high priority logistics service features. One study presents a technique for the evaluation and management of customer service quality (Harding 1998). Another study presents a customer's perspective of product and information flows (Rhea and Shrock 1987).

Customer satisfaction has been shown to depend directly on measurement of effective order fulfillment (Davis 1988).

Benchmarking

Benchmarking topics are abundant, especially in the trade press. This is primarily due to two reasons. Firstly, most logistics managers want a guide on *what* to measure, and to compare their own operational performance to that of their competitors or to a "best-in-class" model. Secondly, the majority of articles on benchmarking are written by consulting firms who, with but a few industry associations, are able to generate the benchmarks and use this platform to recruit clients. Most benchmarking articles are concerned with the *values* of measures and not the numerators and denominators that comprise them, leaving the comparability and validity of the values at question. One notable exception to the emphasis on content rather than process benchmarking is found in the efforts of the Supply Chain Council (Pittiglio, Rabin, Todd and McGrath 1994). A consulting firm that formed a consortium of many major manufacturers in 1994 began the development of a standard process model, called the Supply Chain Operations Reference Model, or SCOR (Shoshanah 1996). The model identified four top-level processes - Plan, Source, Make, and Deliver - and decomposed these into multiple levels of categories and elements. Companies participating in this initiative must further decompose the model into the activities and tasks particular to their operations. There has been no published evidence of the value of this approach to generating good measurement. The approach has been faulted on the basis that there is

no *one* set of governing standards that will define a business model, especially since differentiation is implicit in competitiveness (Mesher 1997).

Reengineering

Finally, the reengineering movement beset the logistics infrastructure in 1990 with an article that focused attention on process mapping, process improvement, process owners, and process customers (Hammer 1990). Unfortunately, the same need for an orientation toward *measures* having owners and customers has not been well represented in the literature. One way to challenge the need for the mountains of measures found in many companies, and the time and expense to produce and communicate them, is to systematically challenge and eliminate all measures that cannot claim an interested customer and owner. This orientation is necessary for internally focused measures. It will be even more difficult to adopt measures *across* firms in the supply chain, unless customers and owners are formally established.

Financial Measures

The subject area of linking logistics performance to financial statements has recently reemerged as a necessary skill set of business managers, given the amount of business press devoted to various financial measures. Return on assets (ROA) is a fundamental financial measure of the overall productivity of the firm in the use of assets that are employed in the generation of revenues. Return on investment (ROI) is an indicator to investors of the firm's performance in generating required rates of return, given the related risk the investors assumed. There is a threshold ROI that the firm

must achieve for investors to continue taking risk with the firm. Another higher ROI threshold must be attained to attract additional investments. Economic value added (EVA) is the difference in after-tax rate of return less the firm's cost of capital. A positive EVA means that the firm is increasing the wealth of its investors. Market value added (MVA) is the total market value of the firm's stock minus total invested capital. MVA is the difference in what investors put into the firm and what they could take out of the firm. The increasing expectations for improvement year after year in EVA and MVA are driving the stock market to new highs and putting increasing pressure on firms to outperform last year's records. The top twenty corporate "wealth providers" have seen their MVAs grow from $1.1 trillion in 1997 to $2.7 trillion in 1999. At the same time, their combined MVA is racing ahead of their EVA, growing from forty-seven times EVA in 1997 to seventy-nine times EVA in 1999 (Tully 1999). Supply chain managers must be competent in using financial tools and measures to help their firms to continue creating wealth for investors.

The du Pont Model

F. Donaldson Brown created a useful tool for today's supply chain executive, known as the du Pont Model or the Strategic Profit Model, while he was working for E. I. du Pont de Nemours & Co.'s Treasurer's Department in 1914 (Chandler 1962). The financial analysis technique Brown used involved tying together the Profit and Loss Statement and the Balance Sheet so that changes in working capital could be associated with changes in sales (see Figure 3).

Brown's creation provided du Pont executives with a consistent methodology by which to evaluate each operating unit's performance, to locate sources of deficiencies, and to prepare and adjust budgets and forecasts.

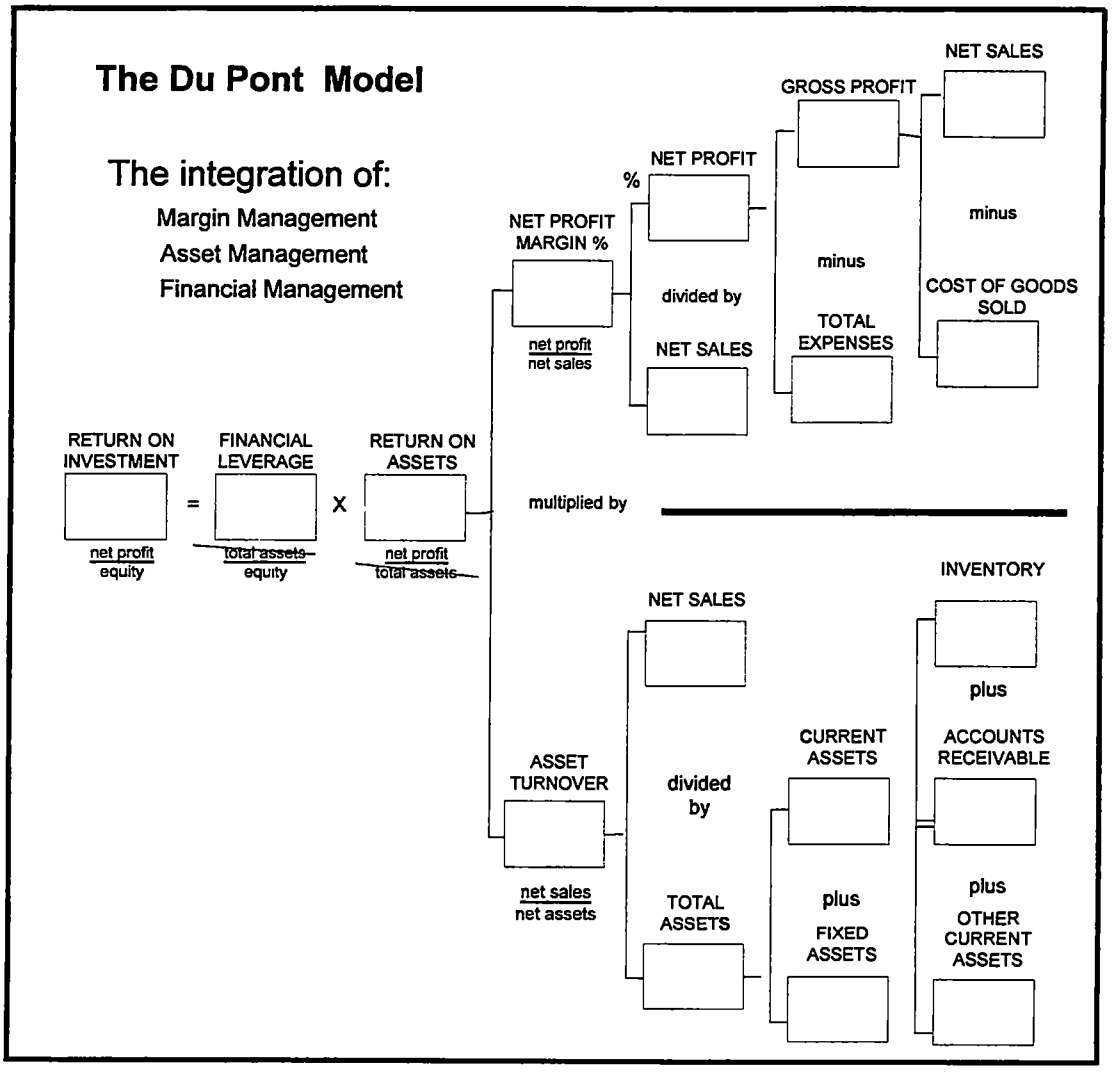



**Figure 3 The du Pont Model**

The du Pont Model is a reliable tool to aid supply chain managers in determining the outcome of project ideas (Cavinato 1989). Using this model, financial simulations are easy to construct that reveal the impact of possible supply chain decisions on the firm's financial performance.

Supply chain executives often have responsibility for a significant portion of the costs of goods sold and operating expenses and, therefore, have a major impact on Margin Management. Decisions and expenditures associated with procurement, inbound transportation, production planning, and materials management are directly related to the net profits of the firm. Supply chain executives have responsibility for a sizable array of assets – inventories, facilities, handling equipment, transportation equipment, and computer and communications systems – used in the operation of the business. Their decisions on asset acquisition, utilization, replacement, and disposal impact the rate of asset turnover.

The ability of the supply chain executive to perform financial analysis affecting supply chain decisions is critical. The supply chain executive must be able to implement the often-competing strategies of cost minimization, value-added maximization, and control/adaptability enhancement (Speh and Novack 1995). This requires the use of financial tools and an understanding of financial measures.

## An Illustration of the Use of the du Pont Model

Using an example, the du Pont model can easily illustrate the impact of supply chain management decisions on the profitability and market value of the firm. A

hypothetical company has net sales of $100 million and a gross margin of $40 million. We can identify the costs of carrying inventory to be $4 million within the total fixed and variable expenses of the business. The firm produces a net profit margin of 3%. This company holds an inventory worth $16 million and carries accounts receivable averaging $8 million. Net current and fixed assets total $44 million, producing an asset turnover ratio of 2.27. Because return on assets are only 6.8%, the company chooses to risk a high amount of debt financing relative to equity so it can generate a stockholder required 15% return on equity (see Figure 4).

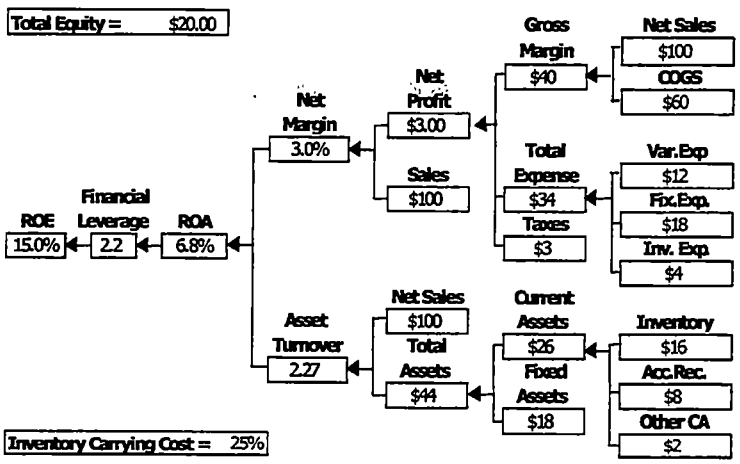



**Figure 4 Illustration of the du Pont Model - Base Case**

Good things happen when the firm reduces the average inventory levels and accounts receivable by 25%. The resulting elimination of $6 million in current assets on the balance sheet improves the asset turnover ratio to 2.63. Since inventory-carrying cost is 25%, these actions also reduce the inventory expense by $1 million on the income statement. At a 50% tax rate, an additional $500,000 net profit is realized, improving the net profit margin to 3.5%. Taken together, this supply chain manager has improved the firm's return on assets from 6.8% to 9.2%. The firm's return on equity then jumps to 20.3% (see Figure 5).

More than likely, however, the chief financial officer recognizes the opportunity to restructure the balance sheet and to reduce the level of risk to stockholders. He or she applies the $6 million in cash freed by the supply chain manager to debt reduction, reducing the leverage factor from 2.2 to 1.9. Still, the return on equity jumps from 15% to 17.5%, a very desirable appreciation. Risk to the stockholders goes down and returns on investment go up (see Figure 6).

The du Pont Model is a useful planning and diagnostic tool for understanding the impact of logistics decisions on the financial health of the firm. Logistics decisions affect the firm's capital structure, risk level, cost structure, profitability and, ultimately, market value. As a major component of supply chain management, logistics management is a key capability of the successful enterprise. Supply chain management should have boardroom attention.

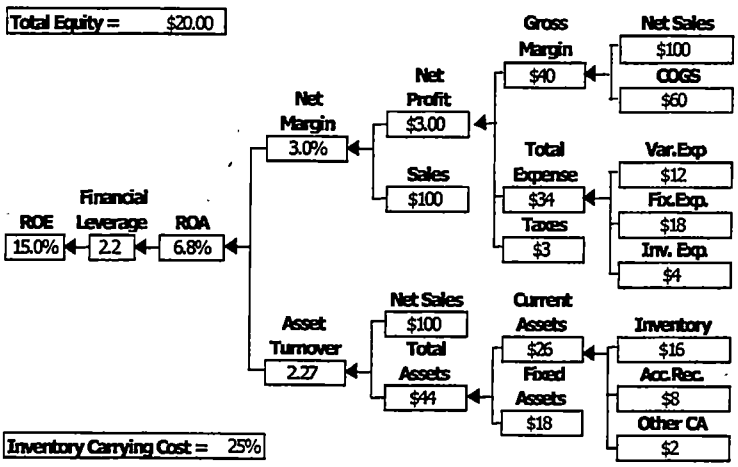



**Figure 5 Reduce Inventory and Receivables and Maintain Debt**

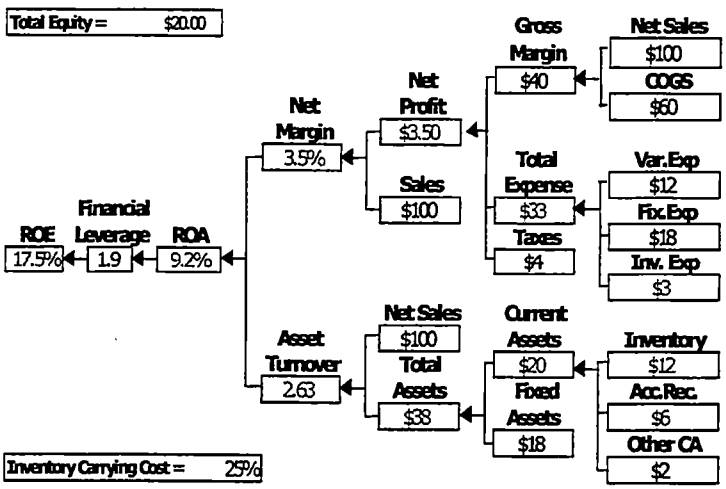



**Figure 6 Reduce Inventory and Receivables and Lower Debt**

The Financial Focus of the Logistics Executive

It was not long ago that operations performance was measured in strictly negative terms, such as costs over budget, damaged goods and shortages, late or missed shipments, and out of stocks (Barks 1989). Increasingly, firms have begun to appreciate how improved supply chain performance produces increases in sales, productivity, and profits. No longer is supply chain management focused only on internal operational activities and measures. Economic measures, both internal *and* external, are increasingly used to justify, judge, and reward the supply chain organization (Koota and Takala 1998). There are three areas of financial focus in which the supply chain executive must demonstrate competency: expense control, capital budgeting, and cash flow generation.

Expense control goes beyond merely managing expenses to the constraints of the budget. Expense control requires a deliberate and continuous search for more efficient ways of getting value-added work performed while eliminating non-value-added activities. Some companies naively install computers and other technologies to automate and speed out dated business practices. The power of computers and technology should be used to "reengineer" the work, to abandon inferior yet institutionalized ways of working, and to create better practices and processes that more closely align with customer needs (Hammer 1990).

Supply chain executives must understand capital budgeting techniques, including their advantages and disadvantages, in order to contribute effectively to investment decision-making. They must speak the language of finance. They must

know which acceptable methods of investment evaluation will best sell their proposals. Several capital budgeting techniques can be simultaneously used on a single investment proposal (Byrne 1992). Decision-makers must consider the amount and timing of cash outflows and cash inflows, as well as the cost of capital or some internal hurdle rate of return. Some firms use the simple payback method of evaluation or the benefit-cost ratio (Pegels 1991). More, sophisticated techniques, such as the internal rate of return method or net present value method, consider the time-value of money in the analysis. These discounted cash flow methods are more accurate and practical than the payback or benefit-cost techniques, and they should be used for supply chain investment decisions (Cavinato 1990). Evidence indicates that the financial community prefers the net present value method (Brealey and Meyers 1991). It should also be the preferred method of investment valuation for the supply chain manager.

Based on an extensive survey of logistics professionals, several focus areas were developed that are central to successful logistics performance (Perry 1991). The number one focus area was found to be "asset productivity," which requires good capital budgeting. Supply chain managers should remember that only cash flow, not accounts payable or receivable, is relevant in capital budgeting. Using the net present value formula can become routine, but forecasting cash flows can be a hazardous occupation. Perhaps this is why capital budgeting has been left to the financial managers, and also why supply chain managers must understand cash flow issues.

Cash flow of the firm can be improved as a result of many business practices. Historically, accounting departments attempted to improve working capital by aggressively collecting accounts receivable from customers while simultaneously

delaying payments to suppliers. Such behavior rarely produces any net benefit across the supply chain (Rafuse 1996).

Today, companies are evaluating managers on their ability to turn products into cash faster, i.e., "turbo cash flow" (Cavinato 1990). The use of cash in the supply chain that is tied up in inventories is competing with a chief financial officer's opportunity to invest that money elsewhere. A key to the notion of a cash cycle is to view the entire logistics, manufacturing, and sales process across the supply chain with regard to what it means for cash flow. Upper management wants to speed up the cash flow cycle in the areas of purchasing, materials management, production, distribution, and sales. Because of this more attention is paid to inventories, processing times, transportation costs, terms of sale, and credit terms.

An effective cash flow strategy reduces the level of inventory and frees the cash committed to those assets throughout the supply chain. A significant generator of positive cash flow has been the system-wide reduction in inventory levels caused by compression in cycle times. An asset, like inventory, is a use of funds. A "permanent" reduction in the level of inventory frees cash and improves asset productivity. When costs are fixed and cash-flow changes do not accompany changes in production scheduling, savings from inventory reductions are often overestimated (Chikara and Weiss 1995).

There is evidence that cash flows are being improved by the use of electronic data interchange (EDI). Also referred to as electronic commerce (e-commerce), this paperless form of computer-to-computer exchange, much of which is transacted via the Internet, can be used in conjunction with buyers' and sellers' banks to transfer funds.

Edibank was formed in 1994 to accomplish this (Orr 1996). Automated freight payment software is available to preaudit, summarize, batch, and pay carriers by electronic check on a scheduled basis (Cooke 1996). To offset the faster cash outflow, shippers receive discounts from carriers in exchange for fast payment. This practice reinforces the "partnering" relationship between the parties in the supply chain.

Cash flow is impacted by terms of sale. Time and place of payment are factored into FOB negotiations. Trading firms agree on who should arrange inland freight, ports, ocean/air, duties and clearances, and final deliveries. As with the cost of inventory, dollars tied up in a shipment represent either a lost opportunity for those funds or an interest cost. Buying and selling companies often have different capital costs. That raises the possibility of improving supply chain performance by having the company with the lowest cost of capital own the goods for as long a period as possible.

Lead-time reductions affect cash flows. Many firms systematically work on controlling and reducing lead-times and have achieved impressive results. An economic evaluation of lead-time reduction should examine the impact on future cash flows across all business functions or at the organizational level, not just the product level (Wouters 1991).

Interest in Finance Has Waned

A study exploring strategic planning issues reported an interesting finding regarding cross-functional interfaces during the planning process. The greatest amount of interface by the marketing department was found to be with the finance department during the planning process. The same condition was found for the manufacturing

function – its greatest amount of interface was also with the finance function. However, logistics *staffs* were found to interface with Marketing, MIS, Manufacturing, and then Finance, in that order, during the planning process. Logistics *operational units* reported most interfaces with Marketing, MIS, Finance, and then Manufacturing (Cooper, Innis, and Dickson 1992). These findings suggest inadequate integration directly between the logistics and financial functions for strategic planning purposes.

For many years, the annual survey of CLM members conducted by The Ohio State University reported that logistics managers, if given the opportunity to return to college for 90 days, would select a curriculum topic in Finance. In recent years, the survey shows the preference for additional knowledge of Finance slipped out of first position. In 1997 only 14% of the respondents selected Finance as their preference (La Londe and Masters 1997). This suggests that managers of the supply chain process are not as interested as they used to be and, perhaps, should be in developing financial skills.

Implications for Supply Chain Partners

Meanwhile, it is necessary that the supply chain executive understand the impact of capital structure and sources of funds on the firm *and the supply chain* in order to sell appropriate investment proposals. These investment decisions can help facilitate the quality of exchange between the firm and its supply chain partners. One obvious outcome of a change in cost structure for the firm is a change in the price it charges for its outputs. Financing a capital investment in supply chain productivity through the use of low cost monies might allow the firm to pass along savings in the form of lower

prices. However, previous research has shown that executives do not believe that external customers react to improvements in operations productivity or operations cost decreases (Speh and Novack 1995). The rationale for this might be that operations cost reductions are not passed on in the form of price reductions to external customers but used, instead, to satisfy the needs of internal customers.

There is the view that profits generated by operations improvements are typically contained within the firm. A counter argument can be found in the growth of "gainsharing" between companies and third-party logistics providers to which they outsource their logistics operations (Richardson 1997). Under gainsharing, as the business partners implement improvements that result in lower costs, both share the savings in an equitable manner. This changes the behaviors between the partners, from a customer trying to bargain down price and a supplier focused on cost reductions to collaborative, supply chain behaviors where gains from productivity and cost improvements are shared. An accurate understanding of activity and process costs is a requisite for implementing gainsharing programs. It is not clear what benefits pass to the customer from the shipper and third party provider's gainsharing. A case could be made to include the customer in these gainsharing agreements between the supplier and third party provider, especially since they impact the nature of services provided.

Technologies Enabling Financial Improvements

Technology improvements in computers and telecommunications provide firms with increased capability for standardization and automation of data capture, storage, and transmission. Accessibility to data within a company, particularly in those

environments where systems are integrated or operate on a single enterprise-wide resource planning system (ERP), is a critical requirement of decision-makers. The implementation of electronic data interchange (EDI) between companies over the last fifteen years has greatly reduced cycle times and enabled the acceleration of cash flows.

A study reporting supply chain savings potential in the North American automobile industry through the use of EDI concluded the savings could be $1 billion annually (Anonymous 1996). The Automotive Industry Action Group based this estimate on an 18-month project with Ford, General Motors, and Chrysler and their second and third tier suppliers. Order error rates were cut seventy-two percent. Lead-times were reduced fifty-eight percent. Inventory turns improved 20%. Cycle time compression is one of the major emerging logistics strategies that have significant financial impact on supply chain performance (La Londe and Masters 1994).

Decision support systems provide a capability to model present and alternative business practices in order to evaluate their financial implications. They include simple input-output models (Van der Meulen and Spriverman 1985), fourth generation language simulation models (Harrington, Lambert, and Sterling 1992), data envelopment analysis models (Kleinsorge, Schary, and Tanner 1989), and total cost/value models (Cavinato 1992). One of the major issues highlighted in almost every financially oriented logistics model is the reliance on standard costing techniques and the deficiencies of the traditional accounting systems.

Outdated cost accounting and management control systems are a major obstacle in the collection and relevance of logistics financial measures. They can distort

measures of performance and fail to give complete and accurate information for decision-making (Kaplan 1984).

Perceived competitive advantage can be defined from a number of different perspectives such as market share, proprietary technology or practices, and profitability, to name just three. To test the emphasis given to the use of financial measures, the next three hypotheses are:

**H3a: Primary financial measures that drive decision-making in firms are more likely to be related to margin management rather than to asset management.**

**H3b: Primary financial measures that drive decision-making in firms are more likely to be related to margin management rather than to financial measures that integrate the income statement and balance sheet.**

**H3c: Cash flow measures are not often used as a primary financial measure for decision-making.**

## Measurement Within the Firm

There is a need to improve our understanding of the antecedents of measurements and the relationships of the basic types of measurements to the key logistics processes in the supply chain. Such a model could help inform the academic and practitioner of the inter-relationships of processes and performance.

### Start with Strategy

Environment is important to strategy formation. Some scholars believe that strategies must be constrained by, and must react to, ever-changing environmental conditions (Ackhoff 1981). Other scholars maintain that strategy can enact the

environment, and that the deliberate selection from available strategic choices will shape the emergent environment (Miles and Snow 1978). In either case, there is universal agreement that strategy selection and articulation are fundamental to setting the direction and objectives for the firm (see Figure 7).

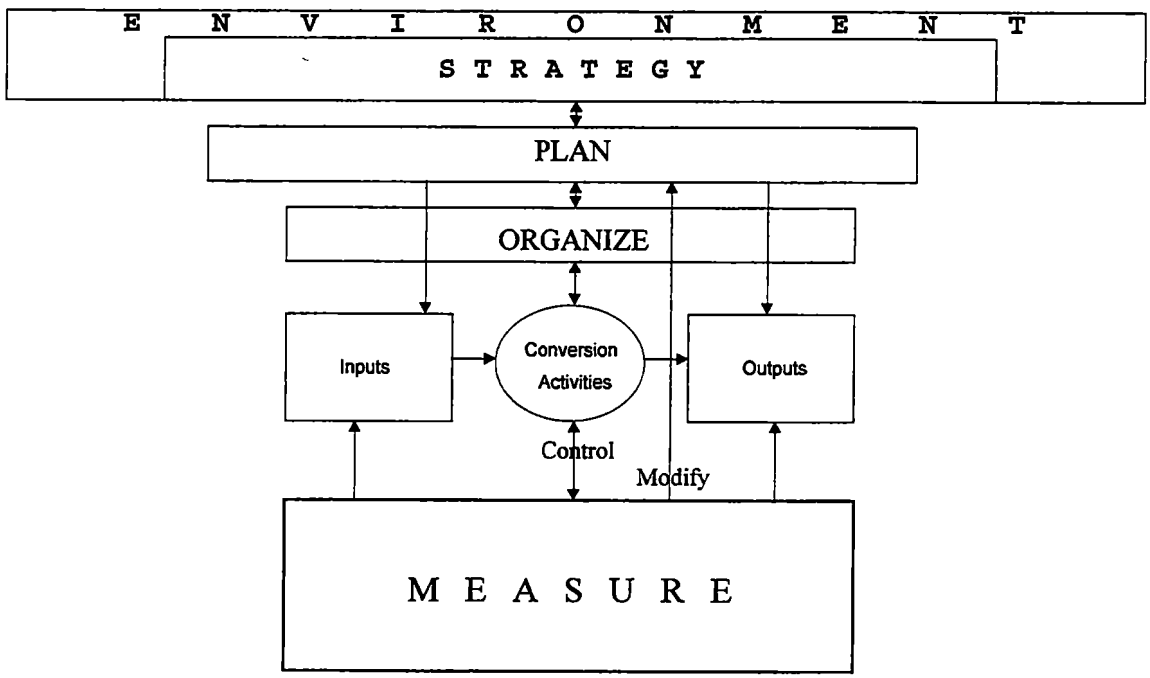



**Figure 7 Environment and Strategy Provide Direction**

Porter (1980) presented a classical approach to strategy, combined with a tool-kit for practitioners. He described five forces that drive industry competition: potential entrants, suppliers, buyers, industry competitors, and substitutes. He reported entry barriers to be: scale, differentiation, capacity requirements, switching costs, distribution

channel access, raw material access, government policy and retaliations. He described exit barriers as being economic, strategic and emotional. All these factors should be considered in evaluating strategic choices. He imparted three generic strategies for competition: low cost strategy, differentiation strategy, and focus strategy. He warned firms about getting "stuck in the middle" with a half-hearted mix of options, not emphasizing one of the three strategies. He stated that the strategic choices cannot be pursued simultaneously but can be pursued sequentially, as opportunities dictate. Porter described four diagnostic components to developing strategy: future goals that drive it, current strategy (or what the firm is doing and can do), assumptions about itself and the industry, and capabilities. Porter recommended a strategy to seek the most favorable buyer, build up buyer switching costs, and reduce costs to switch from suppliers. This last recommended strategy is no longer consistent with the orientation of strategic sourcing and procurement relationships necessary to sustain integrated supply chains.

A modernized version of Porter's strategic competitive choices uses slightly different terms. These terms are operational excellence, product leadership, and customer intimacy (Treacy and Wiersema 1995). The choice of strategy should drive the measurement emphasis placed on its various activities. A firm deciding to be operationally excellent will focus on cost reduction. A firm deciding to be a product leader will emphasize speed to market its new product offerings. A firm emphasizing a customer intimate strategy will value flexibility and responsiveness in its logistics activities, especially customer service. The key logistics measures for these organizations might be the same, but emphasis on them will vary with the choice of strategy.

*Competing for the Future* (Hamel and Prahalad 1994) is a handbook on how to think strategically. The book is focused on leadership, strategy and the changing market environment. Hamel and Prahalad stated that strategy is both a process of understanding and shaping competitive forces, and a process of open-ended discovery and purposeful incrementalism. Firms need to exercise leadership and create their futures, to enact them by being better and, especially, different. Hamel and Prahalad believe that firms should change the rules of the game, reduce boundaries, create new industries, and influence their futures. They should control their firm's destiny by influencing change in the industry. Hamel and Prahalad believe path breaking to be more important than benchmarking. The authors' view of strategy is to unlearn the past, have foresight, and leverage core competencies. Stable value chains do not exist. Companies need to build new profit engines, forge alliances, experiment and learn. Strategy is now more about competing for position in tomorrow's industry than competing within today's industry. An important implication for logistics is that business strategies are evolving and changing, making it important to constantly monitor and adjust logistics strategies, plans *and measurements* to insure alignment to evolving corporate strategies. Segmentation and differentiation often require companies to support multiple strategies, which can be confusing and confounding to logistics managers. Logisticians must pay increased attention to being effective, not just efficient.

**H4: Firms that have alignment in their logistics and business strategy will have a better-perceived competitive advantage than firms that do not.**

**H5: Different business strategies will be associated with different logistics measures.**

Conduct Iterative Planning

Planning follows the articulation of strategy. Planning has been defined as "a formalized procedure to produce systematically, an articulated result based on an integrated system of decisions" (Mintzberg 1994). Planning helps us prepare for the inevitable, pre-empt the undesirable, and manage uncontrollable events. Planning involves objective setting, that is, predetermination of the intended outcomes. It also includes extensive and on-going audits of the external and internal environments. Planning involves analyses and decision-making, including changing decisions previously made based upon newly acquired knowledge. Planning contemplates the implications of current decisions and future possible decisions. Planning involves forecasting and scheduling. It contemplates and directs measurement of actual performance and emergent outcomes to allow for their comparison to planned performance and intended outcomes. Planning is an essential antecedent to measurement. A performance goal must be predetermined before it makes sense to measure the performance. The value of a measure can only inform a decision if it can be compared to a stated goal. Otherwise it is non-actionable and not worth calculating. The calculation of performance always requires comparison of actual output to planned output (see Figure 8).

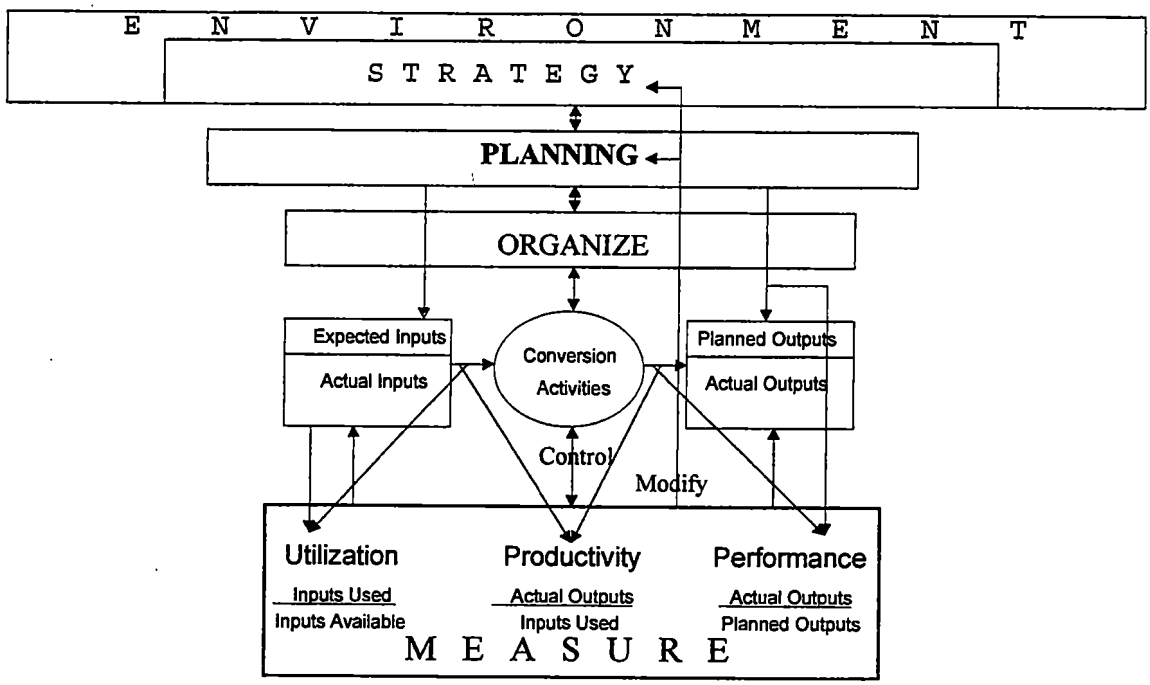



**Figure 8 Planning Precedes Measurement**

Planning the design of the logistical system historically focused on inventory policy, facility location, and transport selection/routing (Ballou 1993). Today, supply chain planners are also concerned with sourcing, outsourcing, and integrated information systems that extend beyond the direct, or unilateral, control of the firm. These planning activities include tasks *and* relationships. Segmentation and mass customization strategies have added complexity. Cycle time compression and customer-mandated quality in execution have created a need for urgency and precision in planning. Several major initiatives confront the planners: asset productivity, horizontal management, information substitution, integrated planning, and system flexibility (Perry 1991). With increasing integration of business activities within and

between businesses, supply chain success calls for connectivity, collaboration, interdependency, and influence, not for unilateral command and control.

**H6a: Firms that have a coordinated or integrated planning process are more likely to measure key logistics processes within the firm.**

**H6b: Firms that have a coordinated or integrated planning process are more likely to measure key logistics processes between it and trading partners.**

**H6c: Firms that have a coordinated or integrated planning process have a better-perceived competitive advantage than firms that do not.**

Organize Resources and Direct Action

No literature was found that suggested a prescribed or model organizational form for the logistics or supply chain organizational structure. However, there have been empirical studies inquiring into the spans of control for logistics units. Generally, a company pursuing a low cost strategy would opt for a centralized, wide span of control logistics organization, while a more customer intimate firm would prefer smaller, more focused and flexible logistics organizations. There is no research to support the implication that the wider the span, the greater the control and integration. Perhaps increasing complexity associated with larger logistics organizations gets in the way of coordinating and integrating its activities. Operationalization of span of control will be based on a set of approximately 15 activities, or functions, that can be found in logistics organizations. Logistics organizations with wide spans of control will be compared to organizations with narrow spans of control. These two grouping will be determined by statistically identifying the median number of functions claimed to be reporting to the Supply Chain or Logistics organization by respondents to a mailed

questionnaire. Respondents claiming above the median number of functions will be classified as having a wide span of control. Respondents claiming below the median number of functions will be classified as having a narrow span of control.

**H7a: Firms with a wide span of logistics control are more likely to follow a low-cost business strategy.**

**H7b: Firms with a narrow span of control are more likely to follow a differentiation or service strategy.**

Identification of the key logistics processes in the supply chain requires the inclusion of supplier and customer interfaces in the planning and organizing of logistics activities. Understanding specifically what customers want and expect is fundamental to achieving customer satisfaction. Similarly, as a customer of its supplier, the firm must articulate its specific needs and expectations to the supplier. Only then can a measure of supplier performance be gauged (see Figure 9).

Due to the absence of findings or equivocal nature of literature in this area, the following three exploratory hypotheses will be tested:

**H8: The size of firm will be related to the type of business strategy, larger firms will tend to follow low-cost strategies and smaller firms will tend to follow service, or differentiation, strategies.**

**H9: The firms with wide spans of control are more likely to demonstrate greater coordination and integration of logistics processes.**

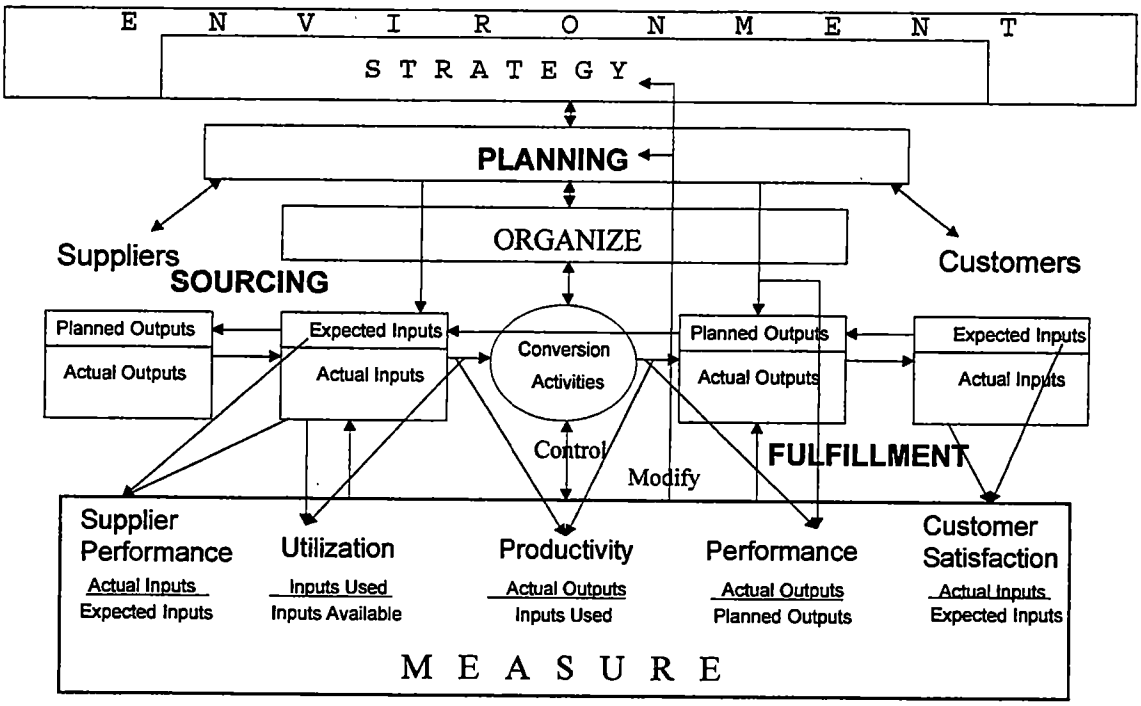



**Figure 9 Supplier and Customer Interfaces**

Measure and Control

In controlling the work of people and technologies, there are only two phenomena that can be observed, counted and monitored: behavior and the outputs that result from the behavior (Ouchi 1977). Control can be conceptualized as an evaluation process that is based on the monitoring and evaluation of behavior or outputs. It is a process of monitoring something, comparing it to some standard, and then providing some selective rewards or adjustments.

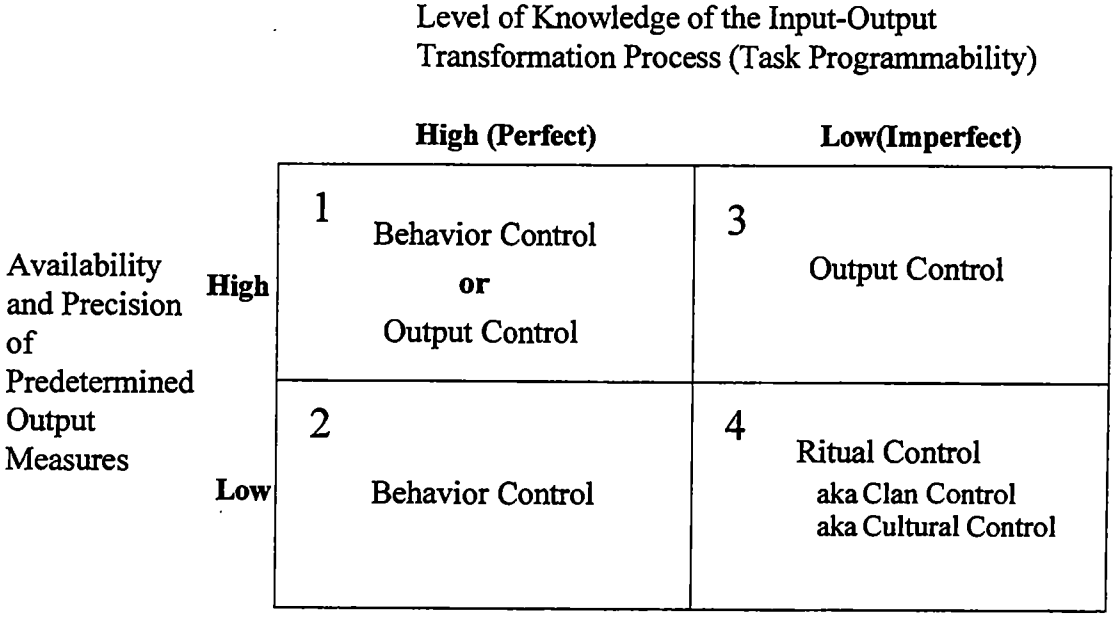
Ouchi reported that an antecedent condition was necessary to apply either form of control. To apply behavior control, the organization must have at least agreement, if not true knowledge, about means-ends relationships.

> "The process by which inputs are transformed into outputs must be felt to be known before supervisors can rationally achieve control by watching and guiding the behavior of their subordinates. Except at the extremes, the dean of a school of business cannot control his faculty research by observing the behavior of faculty members. At best, he can control the quantity of output, but certainly not the quality through these means. On the other hand, the manager of a tin can plant (with engineered, standardized production processes) can observe the behavior of his employees, and if they behave as he knows they should, he can be certain that the expected tin cans are being produced" (Ouchi 1977, p. 97).

In the case of output control, the transformation process does not need to be known. The requisite antecedent to apply output control is a reliable, valid, agreed-upon measure of the desired outputs. The manager of the tin can plant can merely sample the output of his organization and ignore the behavior of his employees. The supply chain manager can count the number of deliveries made on time, assuming agreement has been reached with customers on how to measure on-time delivery, without regard to the behavior of the drivers.

These two parts of the control process - the antecedent conditions and the forms of control (i.e., behavior or output) can be combined into a matrix (see Figure 10).

Accordingly, either behavioral control or output control (cell 1) can be applied when the supervisor has a high degree of knowledge about the value-added transformation process and the output measures are predetermined, available and precise (Ouchi 1979). Where there is low task programmability and the absence of output measures (cell 4), neither control form is appropriate. The organization must then exercise a form of ritual control, also known as cultural or clan control.




This model is adapted from Ouchi (1979), and Govindarajan and Fisher (1990)

**Figure 10 Control Types and Antecedent Conditions**

(Govindarajan and Fisher 1990). Examples might be the management of a Foreign Service officer or supervision of a relationship manager of a third party provider. In these cases, correct behaviors and outputs cannot be identified ahead of time. The selection process might be the only means of controlling in these cases.

As Porter pointed out (1980 p. 35), the primary focus of a Strategic Business Unit (SBU) with a low-cost strategy is cost control. Businesses pursuing low-cost strategies have similar characteristics. They:

- vigorously pursue cost reduction;
- have employees with high levels of experience;
- practice all possible economies of scale;
- acquire process engineering skills;
- routinize the task environment; and
- produce standard, undifferentiated products.

A standard product with a routine task environment implies that the knowledge of ends and means is relatively high, indicating high task programmability. Low-cost strategy businesses can apply the control forms of cells 1 and 3. Only in the case of first line supervisors, who can constantly observe behavior of employees in this context can the conditions of cell 1 apply. Middle and top managers removed from the transformation process must rely on output measures (cell 2) to control their functions. The primary form of control for low-cost producers is output control.

Firms pursuing a differentiation strategy attempt to produce a product that is unique. The task of producing, marketing, and distributing a unique product implies low task programmability (cell 4). Creativity, basic research, product engineering, or long-term relationship building can defy short-term output measurement associated with monthly, quarterly and annual periods, limiting the use of output controls. Consequently, differentiators are left with cells 2 and 4 as control forms, that is, behavior or ritual control. Both forms are subjective.

Output control is not appropriate if:

- the goals of an organization are not understood or agreed upon; and
- outputs are unobservable or unreliable, and thus not good predictors of behavior.

The selection of measures of the management control system depend on the strategy chosen, the knowledge of the transformation process, the level of precision in determining goals and measures of outputs, and trained, observable behaviors of employees.

**H10a: Firms with a low-cost strategy will focus internally and emphasize cost measures relative to other measures of logistics performance.**

**H10b: Firms with a differentiation or service strategy will focus externally and emphasize measures other than cost.**

Differences in Accounting and Operational Measures

The capability to measure actual performance-to-plan is critical to effective management and control. In the accounting and control system, the plan (budget) can be integrated up and down the organization. Top and low level managers understand it and the implications for measured deviations from plan. They share a common language. Each has a specific goal. There is alignment.

The operational measurement and control system, where physical measurement takes place, does not share this alignment characteristic with the financial control system. It is not possible for the warehouse manager's measure of cases picked per labor hour, or for the fleet manager's measure of deliveries per hour, to be integrated into a CEO's interest in revenue dollars billed today. This poses a dilemma. What should be measured and how? How can the physical measure be integrated with others to provide insight, value and direction to different levels of management? This is an area for future research. However, an interim solution could be pursued in the form of activity-based costing (ABC) and activity-based management (ABM). Many articles have been published to demonstrate the technique and value of clothing physical measures in economic terms. Unfortunately, this methodology is difficult and time-consuming to install. Once engaged in ABC, practitioners are made aware of opportunities to reengineer processes and design improved performance into the

operational activities. These managers are then confronted with the questions: Who are the customers and who are the owners of these processes and measures? What do these customers require? How well are the processes performing against those requirements? What must the owners do, based upon the values of the measures and the goals of the firm, to meet or reset those customer expectations?

**H11a: Firms are more focused on internal measures of efficiency (i.e. productivity and utilization) than on measures of effectiveness (i.e. planned performance and outcomes).**

**H11b: Firms are more focused on measurement of activities or processes within the firm than on activities or processes between firms.**

Problems with Measures

The literature suggests many problems with measurement dealing with capability, timeliness, adequacy, actionability and integration. From a managerial perspective the best measure would accomplish four things (Mentzer and Konrad 1991; Caplice and Scheffi 1995):

(1) capture specific aspects of the activity measured;

(2) provide actionable guidance for management intervention;

(3) allow comparability between it and other measures; and

(4) promote coordination between managers of interdependent upstream and downstream flows of activities.

Unfortunately, these four measurement criteria cannot be *simultaneously* satisfied. At the operational level, where measures can both capture specific aspects of the activity and provide actionable guidance, the degree of validity and usefulness of the

measure is highest. As measures are consolidated into higher or more strategic levels of reporting, their validity and usefulness diminishes. The reverse is true for the criteria of comparability and coordination. The degree of robustness (generalizability) and integrativeness is greatest at the consolidated or strategic level and lowest at the operational level (see Figure 11).

This perspective calls for testing how practitioners evaluate the quality of measures they use in logistics and supply chain management.

**H12a: Managers perceive that the logistics measures used accurately capture specific aspects of the activities measured.**

**H12b: Managers perceive that the logistics measures used provide actionable guidance for management.**

**H12c: Managers perceive that the logistics measures used allow for comparability between it and other measures.**

**H12d: Managers perceive that the logistics measures used promote coordination between managers of interdependent upstream and downstream flows.**

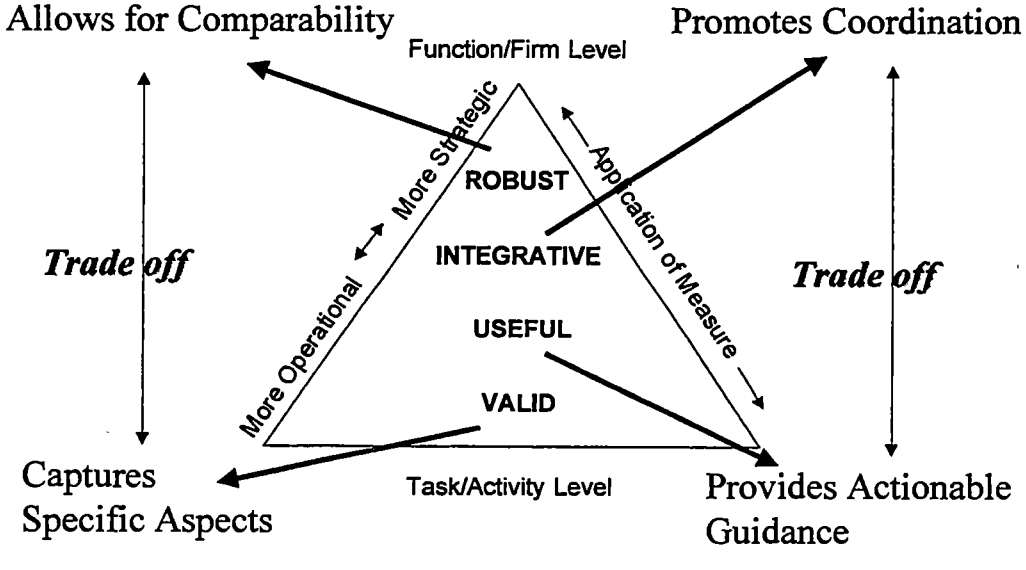



**Figure 11 Trade-Offs Between Criteria**

## The Concept of a Supply Chain

Much has been written about the concept of the supply chain, but there has been little agreement among scholars about the explication of this construct. There has also been little progress by practitioners in operationalizing the practice of supply chain management.

### Creating Value for Customers

Providing customer value and satisfaction are requisites for business success. No single business function can create superior value for customers. All functions must work together in this important task. Each company department can be thought of as a link in the company's value chain (Porter 1985). Each department carries out value creating activities to design, produce, market, deliver, and support the firm's products. Marketing managers pay attention to understanding customer needs, understanding the firm's ability to meet and satisfy those needs, and creating revenues to sustain future growth and profitability. Logistics managers have historically focused their time and attention on three core functions of business operations: inventory policy and practice, facility location and design, and transportation of materials and products (Ballou 1993). Financial managers strive to obtain borrowed funds at the lowest cost, to select projects that offer the best returns, to balance the financial risks taken with investor expectations of returns, and to keep the business liquid. The firm's success depends not only on how well each department performs its work, but also on how well the activities of various departments are coordinated.

Getting Products to Market

Channels of distribution and vertical marketing systems are the traditional terms used to describe supply chains, the former characterized as loose collections of independent companies showing little concern for overall channel performance, and the latter characterizing channel members acting in a unified manner (Armstrong and Porter 1999). Manufacturers, distributors and retailers work together through a system of exchanges to move products from original raw material sources to ultimate consumers. The business functions of warehousing and transportation, important for making a market for goods, were historically the major components of product distribution, which has evolved into what is commonly referred to as business logistics.

We would expect that the logistics strategy of the firm would be well formulated and implemented. This is not the case. Current research finds that (1) the planning and control of logistics and supply chain activities is not occurring to the degree desirable and necessary to effect superior performance of the supply chain; and (2) the logistics linkages between trading partners, especially fulfillment and procurement, are not being effectively planned, scheduled or executed (Kearney 1984,; Bowersox, et al 1989; Byrne and Markham 1991; Global Logistics Research Team at Michigan State University 1995).

Today, the successful supply chain organization is shifting from a *single-firm cost focus* on inventories, facilities, and transportation to a *multi-enterprise focus* on cycle time compression, system-wide cost reduction, and improved value for end-customers (Langley and Holcomb 1992). Having satisfactory or even excellent

products and services no longer guarantees a competitive advantage in today's marketplace. Successful companies find that they must also establish supply chain partnerships to reduce costs and complement their product portfolios with value-adding relationships (Battaglia 1994). The shift in focus and emphasis on relationships is found to be a slowly emerging trend (Cooper and Elram 1997).

Supply Chain Management Schools

Dozens of articles on supply chains and supply chain management (SCM) have appeared in the academic press in the last ten years. Common to all articles on SCM is the recognition of a need for some level of coordination of activities and processes within and between organizations in the supply chain that extend beyond logistics to produce improved pipeline effectiveness and efficiency. According to Cooper, Lambert and Pagh (1997), common themes include: (1) planning and control; (2) work structure; (3) organization structure; (4) product flow facility structure; (5) information flow structure; (6) product structure; (7) management methods; (8) power and leadership structure; (9) risk and reward structure; and (10) culture and attitude. Differences can be seen based on the differences in perceptions of the authors, namely a contrast between a supply chain management perspective (Houlihan 1985; Stevens 1989; Cooper and Ellram 1993); and a business process reengineering perspective (Hammer and Champy 1993; Andrews and Stalick 1993; Hewitt 1994; and Towers 1994). Significantly, the literature has failed to discuss supply chain strategy or supply chain strategy formation.

Obviously, there are multiple components of supply chain management that need to be better understood. As any holistic or integrative perspective might require, we need to understand how each of the components interacts with others. These have been characterized as (1) management components, (2) business process components and (3) structural components. Each scholar has dealt with one or more of these components and some "schools" of SCM thought can be defined.

Bechtel and Jayaran (1997) presented a comprehensive table of definitions associated with authors identified with these various schools (see Figure 12). Significantly, no scholars have yet been identified with a supply chain *strategy* school.

Major issues exist among these scholars. There is the need for agreement on a common definition of a supply chain, the business processes and components which constitute it, and the design of three critical structures: (1) the information flows; (2) decision, authority and governance; and (3) the specific work structure or determination of what work gets done where in the supply chain. The governance structure issues appear to be the most difficult to understand, design and operate. There exist no mechanism to govern multiple firms other than governmental regulation or cooperative agreements among them. Some scholars, (Langley and Holcomb 1992; Lambert, Emmelhainz, and Gardner 1996; and Cooper and Ellram 1997) have made contributions to the understanding of supply chain alliances and partnerships, considering only buyer and seller interactions.

| Author(s) | Definition |
|---|---|
| **Chain Awareness School** | |
| Jones and Riley (1985) | "Supply chain management deals with the total flow of materials from suppliers through end users (p.19). " |
| Houlihan (1988) | "Supply chain management covers the flow of goods from supplier through manufacturer and distributor to the end user (p. 14)." |
| Langley and Holcomb (1992) | "Supply chain management focuses attention on the interactions of channel members to produce an end product/service that will provide best comparative value for the end user (p. 14)." |
| Cavinato (1991) | "...the entire sourcing, value-added, and marketing activities o the overall link of firm up to final customer (p.32)." |
| Novack and Simco (1991) | "Supply chain management covers the flow of goods from the supplier through the manufacturer and distributor to the end user (p. 32)." |
| Stevens (1990) | "Control the flow of material from suppliers, through the value adding (production) processes and distribution channels, to customers." |
| Lee and Billington (1992) | "Networks of manufacturing and distribution sites that procure raw materials, transform them into intermediate and finished products, and distribute the finished products to customers." (p. 65)." |
| **Linkage/Logistics School** | |
| Scott and Westbrook (1992) | "...supply chain is used to refer to the chain linking each element of production and supply process from raw materials through to the end customer (p. 23)." |
| Turner (1993) | "...technique that looks at all the links in the chain from raw materials suppliers through various levels of manufacturing to warehousing and distribution to the final customer (p. 52)." |
| **Information School** | |
| Johannson (1994) | "SCM is really an operations approach to procurement. It requires all participants of the supply chain to be properly informed. With SCM, the linkage and information flow between various members of the supply chain are critical to overall performance." |
| Towill, Naim and Wikner (1992) | "A supply chain is a system, the constituent parts of which include material suppliers, production facilities, distribution services, customers linked together via the feed forward of materials and the feedback flow of information (p. 3)." |
| **Integration School** | |
| Cooper and Ellram (1993) | "An integrative philosophy to manage the total flow of a distribution channel from the supplier to the ultimate user (p. 1)." |
| Ellram and Cooper (1990) | "Supply chain management is an approach whereby the entire network from which suppliers through the ultimate customer, is analyzed and managed in order to achieve the 'best' outcome for the whole system (p. 1)." |
| Hewitt (1992) | "Supply chain integration is only a natural result of redesigned business processes not realignment of existing functional organizations (p. 340)." |

**Figure 12 Supply Chain Schools of Thought**

The relationships of supply chain members are complicated, difficult to manage, and subject to constant change. Supply chain management could easily be characterized as the search for compatible, mutual, and rewarding business relationships simultaneously with customers and suppliers.

Until recently, most definitions of a supply chain focused on the exchanges between sellers and buyers, or dyadic relationships. A supply chain is now more often understood as consisting of *three or more* firms directly linked by one or more of the upstream and downstream flows of products, services, finances, and information from a source to a customer (Mentzer, et al 1999). At a minimum, a supply chain consists of a focal firm and its downstream customer and upstream supplier. The marketing and logistics functions of channel members are largely responsible for supply chain activities. Managers of these functions must have a supply chain *orientation* to effectively pursue supply chain integration and management. A supply chain orientation is the recognition by an organization of the systemic, strategic implications of the activities involved in managing the various flows in a channel of distribution (Mentzer, et al 1999). Supply chain management would then be the implementation of a supply chain orientation across multiple suppliers and customers (Mentzer, et al 1999).

Supply Chain Processes

Until recently, key supply chain processes had not been defined. Departing from a persistent focus on tasks and activities within the firm, management is just beginning to understand the nature and importance of business-spanning processes that

have both an identified customer and owner (Hammer 1990; Lambert, Emmelhainz, and Gardner 1996; Bechtel and Jayaram 1997). The significance of this is that, without understanding who the customers of processes are and their specific requirements or expectations, owners and managers of processes are unable to measure and produce results consistent with those expectations. The key supply chain processes need to be identified and jointly managed by suppliers and customers.

**Accomplishments and Gaps in the Literature**

Excellent conceptual work has been offered on the definition of a good measure. Several books published by the Council of Logistics Management have described the need for, benefits of, and barriers to implementation of logistics measurement programs. The academic and practitioner presses have created awareness of activity-based costing and reported on the success of firms that have employed it.

Gaps in the literature exist in several areas important to logistics measurement. The literature has not adequately addressed the need to designate or identify both *owners* of measures and *customers* of measures, the importance being that customers of measures be involved in predetermining the expected or required performance. Joint determination between owners and customers of measures is crucial to producing the right outcome.

The issue of evaluating marketing and logistics accountability for process performance cannot be resolved until key processes are identified and ownership is established. This step will create better balance between efficiency and effectiveness efforts of supply

chain managers. Firms, separately and in combination, could then expand their focus beyond just input and output measures and toward more important outcome and impact measures.

Moreover, the focus of measurement has been restricted largely to single firm performance. The focus has been on measurement of the firm's inputs and outputs (see Figure 13).

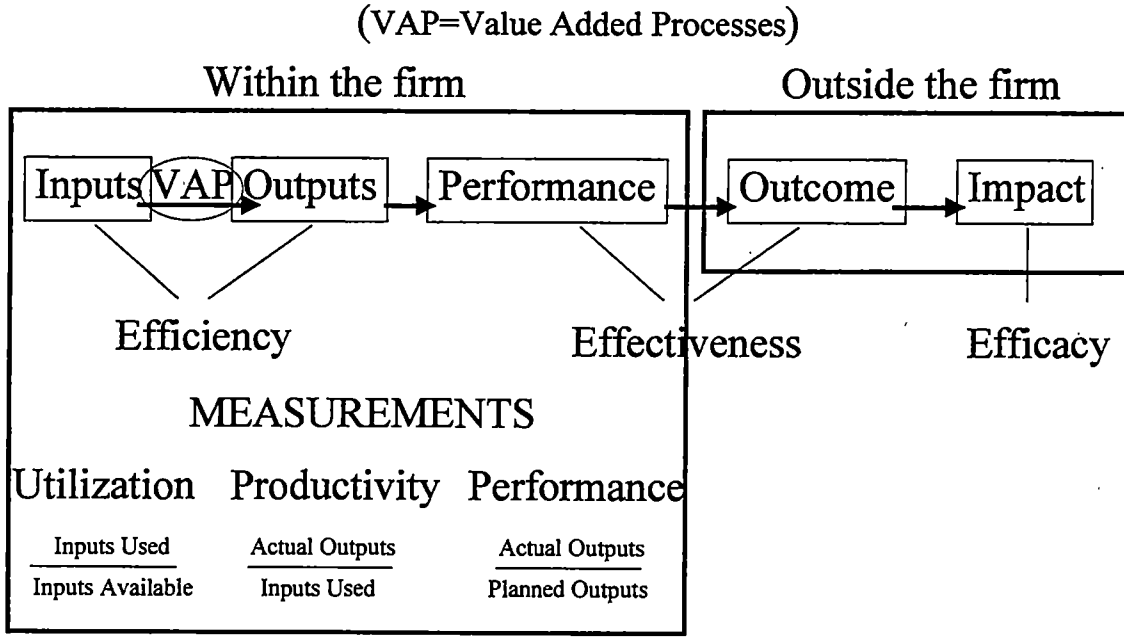
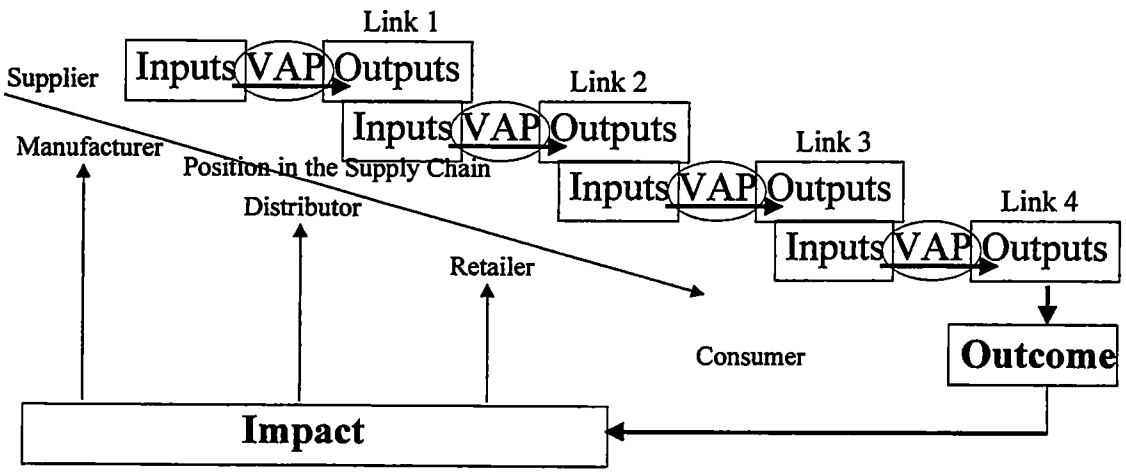



**Figure 13 Measurement Has Been Focused Within the Firm**

Measurement research has been confined to antecedents and behaviors. It has not extended to evaluate consequences or outcomes. Outcomes are results that fall outside the domain of single company managers. A full measure of firm effectiveness should include an evaluation of the *consequences* of firm performance or outcomes and, moreover, the impacts of those outcomes on the various members of the distribution channel or supply chain (see Figure 14). Outcome and consequence measurement is an area for future research for supply chain scholars.




How do we plan and *measure* the Outcome at the Consumer Level and the resulting Impact on this and competing Supply Chains?

**Figure 14 Supply Chain Performance Measurement: Outcome and Impact View**

Also absent in the literature is theory or data on the differences in logistics measurement based upon the firm's position in the supply chain.

**H13a: The emphasis on logistics processes and logistics measurement varies according to the position of the firm in the supply chain relative to the number of steps removed from the consumer.**

**H13b: Manufacturers emphasize downstream measurement more than in upstream measurement.**

**H13c: Retailers emphasize upstream measurement more than downstream measurement.**

**H13d: Distributors tend to balance their emphasis on upstream and downstream measurement.**

While there are publications of documented associations of the degree of use of technology with performance, particularly in the technology trade journals, the research to date has not explained a relationship between technology use and performance measurement activity.

**H14a: The use of technology is positively associated with the degree of performance measurement.**

**H14b: The use of technology is positively associated with a perceived competitive advantage.**

Another gap in the literature is the near-absence of a process orientation to measurement. Historically, physical measurement discussions have been at the task, activity and functional level within the firm. The requisite supply chain orientation calls for a process view of performance spanning multiple firms. Combined with this need to be concerned with interfirm process measures is the need to expand research into measures of *relationships*. Economic, physical *and* psychological measures are

equally important in planning and controlling the utilization, productivity and performance of logistics resources across the supply chain.

Corporate managers should be aware of two recent trends in performance measurement. Firstly, the government has set guidelines for strategic planning and performance measurement across the federal government through the Government Performance and Results Act of 1993 (GPRA). Congress has mandated that the Department of Defense respond with a plan and strategy demonstrating top management commitment to implement the GPRA, with priorities for performance measures and management controls, migrations of systems, data standards, and process improvements (National Academy of Public Administration for the Department of Defense 1996).

This activity will have an impact on the private, supplier sector.

Secondly, a new measure, called Return on Management (ROM) has been suggested to account for management's time and energy (Simons and Davila 1998). Designed specifically to reflect how well a company implements its strategy, this new measure is based on these five questions:

(1) Do employees know which opportunities do not contribute to the organization's strategic mission?

(2) Do managers know what it would take for the organization to fail?

(3) Can managers recall their key diagnostic measures with relative ease?

(4) Is the organization free from drowning in a sea of paperwork and processes?

(5) Do all employees watch the same performance measures that their bosses watch?

It appears that clarity of strategy and alignment of related performance measurement is growing in importance.

**Summary**

Here is a summary list of problems found in the literature associated with measures and the implementation of a measurement program:

Problem with the *purpose* of the measure:
- Lack of a customer of the measure

Problems with the *capture* of the measure:
- Unavailable information
- Lack of resources to collect data
- Might not be collected economically

Problems with the *quality* of the measure:
- Incomplete/inaccurate information
- Measurement error
- May not be jointly defined or similarly interpreted
- Undertermination
- May not be quantitative – soft versus hard
- Efficiency versus effectiveness measures

Problems with *usefulness* of measure:
- Comparability
- Might not facilitate trust
- Conflicting goals/conflicting measures
- Misdirected evaluation and reward systems
- Might not encourage appropriate behaviors
- May be accurate but not useful
- Strategic level measures may not be actionable
- Operational level measures may not roll-up
- Trade off between validity and robustness
- Trade off between integration and usefulness
- Benchmark measures may not be comparable
- May not be easy to understand
- Measures are always backwards looking

Problems with the *administration* of the measure:
- Lack of an owner of the measure

Too many versus not enough measures
Measurement takes time, and is hard work.

These are some of the many issues practitioners must deal with when designing measurement systems for their own departments, functions and firms. A supply chain orientation is necessary to construct supply chain goals, strategies, planning and governance structures. The multi-firm dimensionality of supply chain management adds greater complexity and challenge to performance measurement.

# CHAPTER 3

# RESEARCH METHODOLOGY

The research design and methodology are described in this chapter. This research used multiple methods to acquire data relevant to the research questions and the hypotheses formulated. The principal data collection methods used were:

(1) an extensive review of the literature, which was described in Chapter 2;

(2) a survey of selected logistics thought and practice leaders using the Delphi technique;

(3) in-person and telephone interviews of logistics practitioners from several representative companies conveniently selected to target certain industry supply chains; and

(4) a mail questionnaire completed by senior logistics and supply chain executives.

The research methodology is illustrated by Figure 15.

**Literature Review**

An extensive search of both academic and practitioner press databases was conducted to identify literature pertaining to logistics performance measurement in the supply chain. Over 700 articles and books were identified using ABI-Inform and Lexus-Nexus data base searches on combinations of approximately 30 key words relating to logistics performance measurement in the supply chain. These references were compiled in a Lotus Notes database. They represent over 500 authors and 200

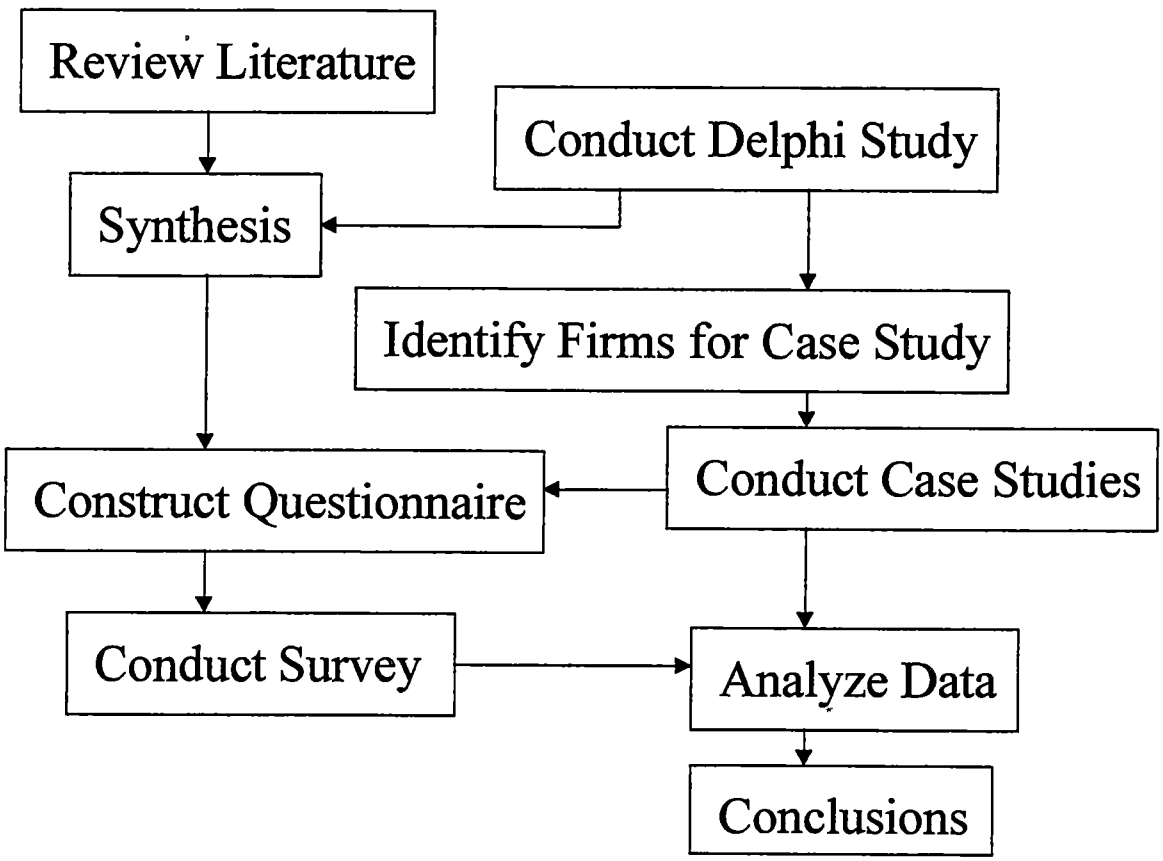



**Figure 15 Research Methodology**

different publications. This literature was reviewed, categorized and synthesized to determine what research has been done and to identify gaps in the literature. This relevant body of knowledge, discussed in Chapter 2, provides antecedent justification for theory building or theory-extension on the subject of logistics performance measurement in the supply chain.

**Delphi Study**

Named after the Greek oracle at Delphi whom the Greeks visited to obtain information about their future, the Delphi is the best known qualitative, structured, and indirect interaction futures method in use today (Woudenberg 1991). Created by Olaf Helmer and Norman Dalkey in 1953 at the RAND Corporation to address a future military issue, the technique became popular when it was applied a decade later to large scale technological forecasting and corporate planning (Helmer 1983). Essentially, Delphi is the name given to a set of procedures for eliciting and refining a set of opinions of a group, usually a panel of experts (Dalkey 1967; Brown 1968). It is a way to extract a consensus position of a group of experts and relies on the "informed intuitive opinions of specialists (Helmer 1983, pg. 134)." As Linstone and Turoff (1975, pg. 3) write, "Delphi may be characterized as a method for structuring a group communication process, so that the process is effective in allowing a group of individuals, as a whole, to deal with a complex problem."

The Delphi research method was helpful in understanding this research area and for setting goals and priorities for further exploration. Subject matter experts, practitioners, and other professionals, identified in the literature and through references of known experts, were surveyed. The questions were open-ended, allowing respondents to fully discuss the area without significant parameters. Results were summarized, and areas of consensus and disagreement were provided to the group. A second survey, building on the knowledge gained during the first iteration, was developed, administered, evaluated, and summarized. The Delphi methodology helped ensure that the researcher did not overlook key areas for future investigation. The

learning from this inquiry of a heterogeneous group of thought and practice leaders helped guide the case studies and construction of the survey questionnaire.

The first survey was mailed in mid-July 1998 to 103 industry professionals, consultants, and educators. A list of individuals included in this mailing is found in Appendix A as Exhibit A1, the cover letter as Exhibit A2, and the survey form as Exhibit A3. Responses were received in late July and early August. The results of the first survey were complied and were sent with the second survey to 101 individuals on August 10, 1998. Responses from the second survey were received in late August. For the first survey, telephone calls were made to interviewees who had not responded by the requested date. For the second round, a fax was sent to each interviewee who had not responded by the requested date. In total, twenty-five responses to the first survey and twenty-seven responses to the second were received. Of the twenty-seven people who responded to the second survey, fourteen had responded to the first round, eleven were new participants, and two responded with letters and comments but not directly to the questions asked. In the first survey, fifteen respondents were from industry, eight were consultants, and two were academicians. In the second survey, twelve respondents were from industry, two were from government and military, seven were consultants, and four were academicians (See Figure 16).

**Case Studies**

The list of candidate companies for case studies was started based on the literature review. They included those firms considered to be the leaders in measuring logistics in their industry that might be willing to share their understanding and

| | Survey | |
|---|---|---|
| | 1st | 2nd |
| Respondents | 25 | 27 |
| New Respondents | 25 | 11 |
| Responded to Previous Survey | NA | 16 |
| Industry Expert | 15 | 14 |
| Government/Military Expert | 0 | 2 |
| Consulting Expert | 8 | 7 |
| Academic Expert | 2 | 4 |

**Figure 16 Delphi Survey Respondents**

experience in this area. Nominations for additional candidates were solicited from a variety of sources, including:

- the Council of Logistics Management (CLM) Research Committee;
- the Logistics faculty of University of Tennessee;
- the Supply Chain practice of Computer Science Corporation; and
- the participants in the Delphi surveys.

The list of candidates included over sixty firms. Based on the composition of the list, the research was geared to focus on four industries:

(1) High Technology;

(2) Health Care;

(3) Automotive; and

(4) Consumer Package Goods.

The list of candidate companies is presented in Appendix B as Exhibit B1.

Initially, the researcher intended to locate and interview groupings of three companies that represented a complete local supply chain (supplier, focal firm, and customer) and that were measuring and sharing information on measurements across all three companies. Efforts to locate such companies were unsuccessful. The research focus was shifted to identify companies for study that were jointly measuring with at least one trading partner. The candidate companies were contacted and given an introductory background on the study. The discussion went as follows:

"The purpose of the case studies was threefold:

(1) to identify process measures being used between companies, and potentially across the supply chain;

(2) to understand barriers and benefits associated with developing and implementing these measures; and

(3) to discover activities that companies undertake to assess and improve process based performance.

The focus of the study is on the interaction between a firm and a significant supplier and customer. We want to interview individuals who can further our understanding. These individuals should have some understanding of how the firms interact, probably at a functional level. We would like to interview individuals knowledgeable in purchasing, order fulfillment, logistics, supply chain management, information technology (as it relates to logistics) and finance. We would like to spend about one to one and one half-hours with each person."

A research colleague from the University of Tennessee and research associates from Computer Science Corporation (CSC) assisted the researcher in setting up appointments and completing the interviews with the companies. In all but three cases, the interview team consisted of at least one participant from CSC and one from the University of Tennessee. The actual format of the interviews varied widely, according to the time and availability of the people interviewed. The ideal session lasted a full day, began with a kick-off meeting for all participants, and then proceeded to interviews with individuals from the various functional areas noted above. In some cases, the primary contact from logistics or supply chain management was able to stay with the team the entire day, and provide continuity across sessions. Due to time constraints, four case studies were conducted through telephone interviews.

An interview guide was distributed to all participants, usually in advance, to help them prepare and/or gather support materials, if available. A copy of the interview guide is presented as Exhibit B2 in Appendix B. Charts, graphs, and lists of measures were solicited, with the strict agreement that only the measures would be used and not their numerical values. Whenever possible, the interviews were taped and later transcribed. If requested, copies of the transcripts were sent to the key contact in the company interviewed.

Case studies were conducted between August and November of 1998. The majority of the sixty firms contacted declined to participate. A total of twenty-two companies agreed to on-site visits and/or telephone interviews to provide data on current practices in logistics performance measurement from senior management in logistics, supply chain, and other functions. Care was given to include a variety of

industries, represented by manufacturing, wholesaling and retailing firms. "Pockets of excellence" were identified to serve as models of best practice in performance measurement of supply chain processes. The case studies permitted the development of a research tool that was used in the questionnaire to systematically collect data from a wider sampling of businesses.

**Mailed Survey**

The heart of the data collection effort was the six-page mail questionnaire. A copy is included in Appendix C as Exhibit C1. A pretest of the questionnaire was completed to minimize instrumentation threats to validity or reliability. The mailing list was created primarily from the membership list of the Council of Logistics Management. The CLM list was edited so the each company received only one questionnaire, mailed to the highest ranked logistics or supply chain member of CLM. CLM members identified as consultants, educators and recruiters were deleted from the list. The list was merged with a listing of the companies included on the current *Fortune* 500 list and with the top 150 companies listed in the article "America's Greatest Wealth Creators," from the November 9, 1998 issue of *Fortune*. Eighty-three companies that were likely to have significant logistics functions were added from these latter two lists to the edited CLM list. The final mailing list included 3,185 logistics professionals in the United States and 179 abroad. The firms they represented included manufacturers, distributors, retailers, transportation firms, public warehouse companies, and third-party logistics providers. Excluded were companies in the financial, insurance, government, software and consulting sectors.

The surveys were mailed on December 1, 1998 with a requested return date of December 18th. A follow-up post card was mailed on December 8th. In all, 355 useable surveys were returned by January 29, 1999. Twenty-eight surveys were returned due to either incorrect addresses or addressees no longer with those companies. The effective response rate was nearly 11%. Both the length of the survey (1184 variables) and the time of the year (year-end business and Christmas priorities) worked against a higher return rate.

**Recap of Hypotheses**

H1: Key performance measures, as identified by senior supply chain or logistics managers, are not being captured, even though they are perceived to be important to their firm and to their customers.

H2: Firms that have implemented ABC have a higher perceived competitive advantage over those firms that have not implemented ABC.

H3a: Primary financial measures that drive decision-making in firms are more likely to be related to margin management rather than to asset management.

H3b: Primary financial measures that drive decision-making in firms are more likely to be related to margin management rather than to financial measures that integrate the income statement and balance sheet.

H3c: Cash flow measures are not often used as a primary financial measure for decision-making.

H4: Firms that have alignment in their logistics and business strategy will have a better-perceived competitive advantage than firms that do not.

H5: Different business strategies will be associated with different logistics measures.

H6a: Firms that have a coordinated or integrated planning process are more likely to measure key logistics processes within the firm.

H6b: Firms that have a coordinated or integrated planning process are more likely to measure key logistics processes between it and trading partners.

H6c: Firms that have a coordinated or integrated planning process have a better-perceived competitive advantage than firms that do not.

H7a: Firms with a wide span of control are more likely to follow a low-cost business strategy.

H7b: Firms with a narrow span of control are more likely to follow a differentiation or service strategy.

H8: The size of firm will be related to the type of business strategy, larger firms will tend to follow low-cost strategies and smaller firms will tend to follow service, or differentiation, strategies.

H9: The firms with wide spans of control are more likely to demonstrate greater coordination and integration of logistics processes.

H10a: Firms with a low-cost strategy will focus internally and emphasize cost measures relative to other measures of logistics performance.

H10b: Firms with a differentiation or service strategy will focus externally and emphasize measures other than cost.

H11a: Firms are more focused on internal measures of efficiency (i.e., productivity and utilization) than on measures of effectiveness (i.e., planned performance and outcomes).

H11b: Firms are more focused on measurement of activities or processes within the firm than on activities or processes between firms.

H12a: Managers perceive that the logistics measures used accurately capture specific aspects of the activities measured.

H12b: Managers perceive that the logistics measures used provide actionable guidance for management.

H12c: Managers perceive that the logistics measures used allow for comparability between it and other measures.

H12d: Managers perceive that the logistics measures used promote coordination between managers of interdependent upstream and downstream flows.

H13a: The emphasis on logistics processes and logistics measurement varies according to the position of the firm in the supply chain relative to the steps removed from the consumer.

H13b: Manufacturers emphasize downstream measurement more than upstream measurement.

H13c: Retailers emphasize upstream measurement more than downstream measurement.

H13d: Distributors tend to balance their emphasis on upstream and downstream measurement.

H14a: The use of technology is positively associated with the degree of performance measurement.

H14b: The use of technology is positively associated with a perceived competitive advantage.

**Relationship of the Hypotheses to the Research Model**

The twenty-eight hypotheses that were tested related to the research model introduced in Chapter 1. In addition, post hoc analyses (PHA) was conducted on the data collected by the mail survey to add additional insights not provided by analysis of the hypothesis. The additional post hoc analyses were necessary to provide a more comprehensive understanding of the various antecedents and moderators that affected the state of logistics measurement and respondent perceptions of their firm's competitive advantage. These relationships of hypotheses and post hoc analyses to the research model are depicted in the figure below (see Figure 17).

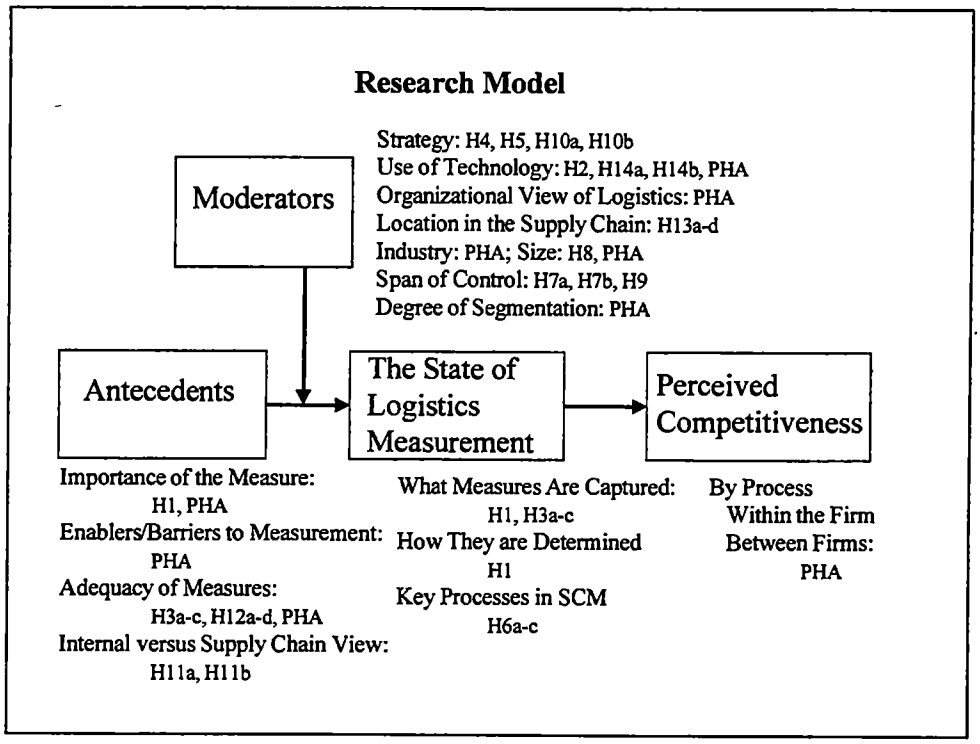



**Figure 17 Relationship of Hypotheses to Research Model**

## Strengths and Limitations of the Methodology

The use of multiple methods of data gathering is considered a strength of the research methodology. The literature review revealed the theoretical issues associated with measurement, as well as issues having to do with the understanding of supply chain management. The Delphi study tapped into the diverse experience and thinking of multiple contemporary researchers and practitioners to help set the direction of the study and framed the areas and questions to be investigated. The case studies provided topical relevance on a great number of issues involved in creating and maintaining a performance measurement system, both for the firm and between it and trading partners.

The mail survey provided a database from which the evaluation of the hypotheses could be made using various statistical techniques. This methodological approach combined both qualitative and quantitative data to support an examination of the research questions and hypotheses.

There are several threats to the validity of the findings based on this methodology. One limitation involves the instrumentation bias of the Delphi study survey form and the researcher's potential bias in analysis and synthesis of the responses. The questionnaire contained many constructs that were not explicitly defined, so respondent understanding of questions asked might be based on multiple interpretations. For example, terms such as "Activity Based Costing" and "Best Value Product/Service" could have been interpreted differently by the respondents. Significantly, the questionnaire itself required extensive subjective ratings by the respondents, requiring the researcher to rely on what is hoped to be informed and honest answers.

Although the number of useable responses (355) was satisfactory, the response rate of eleven percent was considered low. As mentioned previously, the time of the year, the complexity of the questionnaire, the short amount of time given for response, and lack of a monetary incentive were four factors which worked against a higher response rate. Six previous studies that similarly used the Council of Logistics Management membership list for mailings also had low response rates. *Leading Edge Logistics* (Bowersox et. al. 1989) used the CLM membership list and generated 695 responses, of which it identified 117 firms as leading edge. It failed to state a response rate. *Partnerships in Providing Customer Service: A Third Party Perspective* (LaLonde

and Cooper 1989) used the CLM mailing list. For that study, 1230 surveys were mailed and a 29.9% response rate was claimed. *Putting Expert Systems to Work in Logistics* (Allen and Helferich 1990) used the CLM mailing list. That study received only 139 responses and failed to specify the response rate.

*Improving Quality and Productivity in the Logistics Process* (Byrne and Markham 1991) used the CLM mailing list. That study received only 309 responses and failed to specify the response rate. *Creating Logistics Value* (Novack, Langley and Rinehart 1995) used the CLM mailing list. That study claimed a response rate of 25.1%. *World Class Logistics* (Global Logistics Research Team at Michigan State University 1995) used the CLM mailing list. That study claimed a response rate of 19.6%.

Three major publications of logistics research - International Journal of Physical Distribution & Materials Management (IJPD&MM), the Journal of Business Logistics (JBL), and the Transportation Journal (TJ) - have been used previously as sources of information for understanding response rates for mail surveys in logistics research (Novack 1987 and Holcomb 1992). The following response rates were found:

IJPD&MM - 26.0%

JBL - 33.8%

TJ - 14.6%.

Techniques for inducing higher response rates to mail surveys have been published. It has been established that prenotification, follow-ups, and first-class outgoing postage increase the response rate (Fox, Crask, and Kim 1989). A monetary incentive was found to increase response rates (Gajraj, Faria, and Dickinson 1990). The

color of paper used was found to produce no significant difference in response rates (Buttle and Thomas 1997). Length of the questionnaire was found to affect response rates (Roth and BeVier 1998), with shorter, simpler survey instruments producing higher response rates.

This study also failed to test for non-response bias. This is a potentially serious flaw in the methodology that threatens the validity of the findings and conclusions. However, this is somewhat mitigated by the fact that this study was exploratory in nature and not intended to test theory.

Notwithstanding threats to validity, the findings are considered to be reliable. They support findings of previous research of this nature. The analyses of the data follows in Chapter 4.

# CHAPTER 4

# FINDINGS

The purpose of this chapter is to analyze the data collected via the Delphi study, the case studies, and the survey questionnaire. The hypotheses that were developed in Chapter 2 and summarized in Chapter 3 are tested in this chapter.

## Delphi Study

The first survey generated twenty-five responses. The second survey generated twenty-seven responses. The findings of each survey are presented below.

### Key Findings from the First Delphi Study

The survey questions are listed below in bold typeface. The syntheses of responses are listed immediately below the questions, in order of frequency of mention.

**1. What business and market factors are stimulating companies to move toward a supply chain process orientation and away from functional silos?**

The answer was increasing competition. More specific comments were:

- Lower margins and competitive pressures to reduce costs
- Customer service, customer focus
- Cycle time pressures / demands
- Seeking competitive advantage / regain competitive position
- Continued consolidation of the supplier and customer base

**2. What are the barriers companies face in moving toward a supply chain process orientation?**

Status quo tendencies and deficient information capability were cited. More specific comments were:

- Organizational structure and related issues such as resistance to change, lack of infrastructure, lack of leadership commitment, and the lack of trust among partners
- I/T infrastructure: outdated/obsolete, lacking, no funding, Y2K/ERP priorities
- Lack of metrics to measure improvement
- Performance metrics that reward functional / geographical behaviors
- Retaining cost savings *within* individual corporations
- Absence of new performance measures and objectives that are process spanning rather than functional
- Lack of data

**3. What are the key activity or process measures being used <u>inside</u> companies today?**

Traditional internal metrics were referenced, including:

- Specific functional measurements (case fill, inventory turns, cycle time, inventory levels, days sales outstanding, costs versus budget)
- Performance to expectation / requirement (on time delivery, over/short/damaged)

- Broader measures / process measures not being widely used (cash to cash, EVA)

**4. What are the supply chain measures being used <u>between</u> companies today?**

**Are there generic performance measurements that transcend different industries? What are they?**

**Are there generic performance measurements that transcend different linkages in the supply chain? What are they?**

These questions and answers are grouped, as most responses were similar across the three questions. They included:

- Quantitative measures
  - On time delivery, fill rate, "perfect order", order cycle time
- Qualitative measures
  - Customer satisfaction surveys
  - Process improvement opportunities
- General dissatisfaction among respondents about what is being measured / how well / how frequently / to what effect.
- Confusion around definition of the measures, and the lack of standardization for the measures themselves.
  - Example: On-time delivery could be measured against the customer's original request, the initial commitment date, or the last revised commitment date.

**5. What are the key business-to-business linkages that should be measured (if not referenced above)?**

Forecasts, costs and financial consequences were cited. Specifics included:

- Forecast accuracy
- Performance against collaborative planning and goals
- Customer service / satisfaction
- Total supply chain costs (including total channel inventory) / impact on EVA or Shareholder Value/ other economic measures

**6. Please comment on the evolution of the process of measuring activities across firms. What is the current stage? How fast is it evolving? How much progress will occur in the next five years?**

Respondents recognized measurement was deficient today but expected dramatic improvement. Specific comments included:

- The current stage is an awareness that it is necessary, but there is a lack of knowledge regarding how to do it or implement it.
- Many organizations, even today, do not have cross-functional performance measures in place within their own companies.
- Evolution will be based on collaboration among firms
- Expect the next five years to yield dramatic changes; which will likely become cost of doing business with Tier 1, maybe Tier 2, companies

**7. What will be the effect of electronic commerce on business-to-business performance measurement?**

Respondents had mixed thoughts on the value of e-commerce to measurement:

- Major enabling tool: real time information availability, common language for data exchange, encourages standardized measurements, Not a panacea! Will not change anything in and of itself – managers must initiate the changes, and use e-commerce as a tool to facilitate

**8. What companies do you perceive as leaders in performance measurement?**

The popular press favorites were identified:

- Proctor & Gamble, Wal-Mart, Dell, Hewlett-Packard, FedEx, Johnson & Johnson, Nabisco and Pillsbury were mentioned.

**9. What individuals within these companies are responsible for performance measurement, especially in the area of Product/Service Flows, Financial Flows, and Information Flows?**

(The researcher was looking for names of individuals, but received mostly titles.)

**10. What comments or guidance do you have on where research in this area should be focused?**

Respondents were clearly thinking about the evolution of logistics thought and the need for a supply chain orientation. Specific comments included:

- Be very clear in defining "supply chain".
- Build on what has already been accomplished (previous CLM studies, Supply Chain Council, etc.).

- Focus on end-to-end metrics, and tie them to economic measures and executive decision support techniques.

Utilize case studies of "best in class" companies / focus groups made up of individuals from "best in class" companies.

Overall Value of the First Delphi Survey

The first Delphi survey provided justification and direction for this research. Logistics thought and practice leaders said there was a need for this exploratory research. They pointed out the need for a paradigm shift from single-firm measurement to measurement of supply chain processes linking multiple firms. They indicated that supply chain thinking and supply chain measurement were in the developmental stage and were critically relevant to the future success of business. They pointed out that the general lack of knowledge of how to implement supply chain measurement and management was hindering progress. Respondents also identified specific firms that they felt were leaders in logistics performance measurement that were later asked to be case studies.

Objective of the Second Delphi Survey

In the second survey, participants were asked to comment on the findings of the first round of questions, to define the differences between supply chain management and logistics management, and to identify the key processes for each. The cover letter and survey form for this second round of inquiry are included as Exhibits A4 and A5 in Appendix A.

Respondents felt that the findings from the first round were comprehensive. Only Question 1 from the first survey was augmented with additional comments from the review of the second round. Question 1 of the first survey is restated with the additional comments from reviewers:

**1. What business and market factors are stimulating companies to move toward a supply chain process orientation and away from functional silos?**

– *Increasing complexity of the supply chain due to globalization, slower growth in developed markets, and increased expansion to developing markets.*

It is interesting to note that in the first round, the respondents had overlooked the implications of the global economy. As reviewers, many individuals detected this glaring omission.

Results of the Second Delphi Study

The questions from the second survey are listed in boldface type below with a synthesis of the responses.

**1. Much has been written regarding the definition of a supply chain. One such definition states that: "Supply chain management is the integration of business processes from end user through original suppliers that provides products, services, and information that add value for customers." How would you define the difference(s) between Logistics Management and Supply Chain Management?**

– Supply chain management is broader in scope and encompasses logistics management activities.

– Logistics management is functionally oriented, and within a company, whereas supply chain management focuses on the processes and linkages up and down the channels.

– Logistics management is tactical and execution-oriented. It focuses on the physical handling and flow of goods and on the associated information flows. Supply chain management is more strategic in nature and involves collaboration among companies. It is focused more on the "conversion processes" and on customer and supplier relationships.

**2. What key processes or activities are included in "logistics"?**

– General consensus as logistics activities:

– Transportation and warehousing (flow and storage of goods and services)

– Order fulfillment/order entry/order processing

– Inventory control and management

– Approximately 75% defined as logistics/25% as supply chain:

– Customer service

– Approximately 50% defined as logistics/50% as supply chain:

– Sourcing/procurement/purchasing

– Planning and scheduling

– Forecasting

– Information flows directly related to all of the above processes

**3. What key processes or activities are included in "Supply Chain" that are not included in "Logistics"?**

– General consensus:

– Manufacturing/production

– Demand management/customer management/sales

– Product development and commercialization

**4. For discussion purposes, we have hypothesized that many companies are following a path of development from functional measures and benchmarks through process measures to intercompany measures, as further defined below. Please agree or disagree with our premise, comment if you wish, and indicate where you feel your company is on this continuum.** (Consultants and academics were asked to skip the rating, but were asked to make comments on the premises.)

**Stage I – Awareness of logistics functions and the benefits of supply chain management**

**Stage II – Measuring functional activities within logistics or transportation, and comparing to average and/or best-in-class benchmarks**

**Stage III – Identifying the underlying factors for performance against Stage II measures, estimating costs and benefits to improve performance, and implementing initiatives**

**Stage IV – Measuring intracompany cross-functional processes using measures that are both functional and financial in nature/ Estimating costs/benefits and implementing initiatives**

**Stage V – Measuring intercompany logistics activities with a customer or supplier**

**Stage VI – Structuring a formal or informal relationship with a customer or supplier to measure intercompany activities, how these activities impact intracompany activities and costs, and estimating costs/benefits and implementing initiatives**

**Stage VII – Extending Stage VI through more than one link of the supply chain (to customer's customer, supplier's supplier, or supplier to customer)**

**Based on the above criteria, I estimate that my company is now predominantly in Stage:**

**I II III IV V VI VII**

– Of 13 respondents, two rated their companies in Stage II, one in Stage III, eight in Stage IV, and two in Stage VI.

**Based on the same criteria, I estimate that my department/division is now in Stage:**

**I II III IV V VI VII**

– Of 12 respondents, one rated their department in Stage II, one in Stage III, seven in Stage IV, and three in Stage VI (see Figure 18).

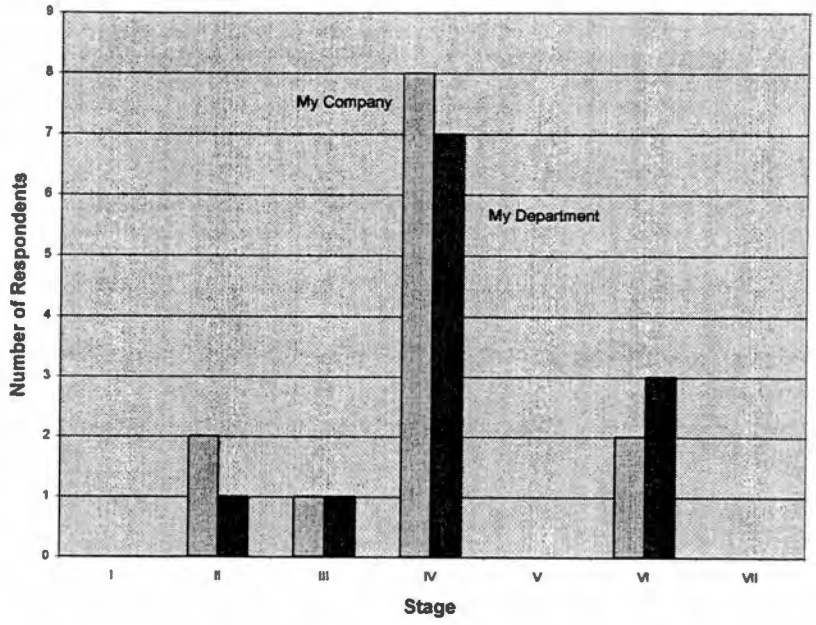



**Figure 18 Measurement Sophistication of Delphi Respondents**

It is interesting to note that a majority of practice leaders claimed that their company and department were predominately in Stage IV (focused on intracompany measurement). Other general comments by respondents on the ratings and criteria include:

– Two of the 14 practitioners had specific comments on the rating criteria and urged additional emphasis on *using* the information gained versus just measuring.

– Four of the seven consultants objected to the ratings criteria.

– Many said it was very difficult to rate an entire company, or even a department or division, because different functions or processes were at different stages. In many cases, the ratings reflected "pockets of excellence" rather than overall performance.

– Some respondents said that additional information and guidance in helping managers integrate their initiatives with those of their customers and suppliers would be valuable in helping them identify the costs and benefits of the initiatives to which they are applying the measurements.

Key Findings from the Second Delphi Study

Despite all of the literature on the subject and the definitions offered by key organizations (including the Council of Logistics Management), there was a wide disparity of understanding as to what logistics and supply chain included. Some individuals offered narrow definitions of logistics processes, defining them as a sub-set of supply chain processes. Others included many more processes as logistics processes, but maintained the sub-set relationship. One individual indicated that there was no difference between the two. This individual also felt that the term "supply chain" was misleading. as it implies sequential processes, when in reality the supply chain is closer to a complex integrated network of processes. Measurement initiatives across companies were very much the exception rather than the rule. Among the twelve respondents from the second survey, only *two* indicated that their firm had relationships with key customers or suppliers that included *shared measurements* and initiatives to

improve those measurements. Several comments were made such as to "pockets of excellence," "relatively few but very effective relationships," etc.

Both surveys indicated that a key barrier to measurement may be a perceived lack of alignment around key measures, multiple definitions and interpretations of those measures, and the difficulty of comparing measurements of different companies (or even different departments or divisions of a single company). This confirmed the researcher's belief that this research would be valuable to the logistics profession. One respondent also offered that "there is too much emphasis on 'measuring' versus 'doing'..." and that "measuring is important, but we are doing some (things) that we don't yet have good measures for."

Considering that the Delphi survey represented the understanding and practices of individuals and companies thought to be among the leaders in supply chain measurement, the overall findings were both humbling and discouraging. There is great confusion over the definition of the logistics management and supply chain management constructs. More formalized explication and dissemination of these terms is required. A majority of respondents claim that their department and company are in Stage IV or focused on *internal* measurement issues. However, most have no shared measures with customers or suppliers. The transition from a logistics orientation to a supply chain orientation appears to require a fundamental shift of focus. Logistics management is thought to focus on accounting measures of functional performance and engineering measures of activities internal to the firm. Supply chain management is thought to focus on processes that interface with trading partners, on investments in developing relationships, and an ability to collaborate on mutual adjustments of

activities in the larger system of multiple firms. Generally, there appears to be great confusion on how to implement supply chain management.

## Case Studies

### Participating Companies

Fifty-five in-depth interviews were conducted with twenty companies and a government agency. Initial telephone interviews with several other companies did not result in complete interviews. The companies that declined did so due to limited time availability of key staff or a belief that they were not leaders in the area of measurement. Participating organizations represented several industries and positions in the supply chain (see Table 2).

### Key Findings from the Case Studies

The purpose of the case studies was threefold: (1) to determine what logistics activities and processes were being measured; (2) to identify barriers and enablers of their measurement efforts; and (3) to discover any methods or tools used to achieve success in this area that could be considered by other companies. Key findings for the case studies are highlighted in Appendix B.

**Table 2 Case Study Participants by Business Category**

| | |
|---|---|
| Consumer Electronics | Government Agency |
| Compaq Computer | Defense Logistics Agency |
| Greybar Electric Company | Medical Supplies Distribution |
| Modus Media International | Owens & Minor, Inc. |
| Motorola, Inc. | Industrial Supplies Distribution |
| Paging Network, Inc. | W. W. Grainger, Inc. |
| Texas Instruments | Office Products |
| Sun Microsystems | 3M |
| Food Distribution | Avery Dennison |
| Martin Brower | Paper Goods Manufacturing |
| Food Manufacturing | International Paper Company |
| Nabisco Foods | Service Provider, Automotive |
| Tyson Foods | Caliber Logistics, Inc. |
| Welch Foods | Speciality Products Retailer |
| Food Retailing | Service Merchandise Company |
| H. E. Butt | |
| Loblaw Companies | |

Lessons Learned from the Case Studies

The case studies showed the importance of key antecedents, moderators, and tools for the implementation of effective logistics and supply chain measurement systems. Several companies flow-charted their workflow and used process mapping and process reengineering to achieve more efficient and effective practices. The use of activity-based costing allowed companies to determine costs to serve customers and to perform customized customer profitability analyses. Data warehousing, providing accurate, comprehensive, timely, and accessible information, was a key enabler of

measurement and performance improvement, as was top management support of measurement initiatives. Sharing databases via the internet with customers and suppliers improved communication and coordination of activities measured. Providing performance scorecards to customers and top management was considered essential. Tying operational measures to the financial statements received top-management attention. Tying individual employee incentives to key performance measures created ownership and responsibility for performance throughout the organization. Elimination of outdated and inappropriate measures and incentives that produced counter-productive behaviors was essential.

Collaboration with customers and suppliers on the key interface processes (such as planning, forecasting, scheduling, order fulfillment and procurement) is a first step in building relationships of trust based on jointly defined and shared measures. Questions to be discussed with trading partners include:

- What constitutes our mutual success?
- How will the factors for success be measured?
- What is the current level of performance, and what is the expected level?
- Who is responsible for gathering the data?
- Who will review the data and approve or disapprove of the progress against the goal?

Being willing to negotiate changes in business practices, so long as there is a benefit to one of the trading partners, is a new but promising orientation for many companies. Bringing key customers or suppliers into the company to mobilize internal functions to address changes required can be more successful than trying to change an organization

from the inside. Attention to cultural compatibility and understanding the trading partner's business strategy can also facilitate supply chain improvements. Finally, successful logistics measurement initiatives and programs rely heavily on top management support

**Mail Survey**

The respondents represented more than twenty-five industries, with food and beverage (21%), chemicals and plastics (9%), automotive related (7%), pharmaceuticals (6%), and paper and related products (6%) being the most represented. Manufacturing was the most predominant business type (56%), followed by distribution/wholesaling (11%), and retailing (10%). Third party logistics providers (7%), carriers (5%), and public warehousing (3%) were also represented. Of the 355 useable responses, 51% were from executives with titles of vice president or senior vice president of logistics, operations, distribution, or supply chain management, suggesting the importance of this function to the firm. These firms represented a wide range in annual sales volume: 31% were under $250 million in sales, 21% were between $250-$500 million, 17% were between $500 million-$1 billion, 21% were between $1-$5 billion, 6% were between $5-$10 billion, and 4% over $10 billion in annual sales.

The balance of this chapter will discuss the findings of the research hypotheses and additional post hoc findings of interest from the mail survey.

Hypothesis 1: Key performance measures, as identified by senior supply chain or logistics managers, are not being captured, even though they are perceived to be important to their firm and to their customers.

Respondents were asked to indicate the degree of importance of various measures to their trading partners, to their own function, and to their company. On a scale of 1 to 5, with 1 being "very important" and 5 being "not important," the means were calculated to compare ratings and rankings for the twelve measures perceived to be most important to partners (i.e., customers, unless the respondents were retailers - then suppliers). On time delivery and order fill were equally ranked as the two most important measures for customers. Freight cost was considerably more important to the function than to partners (see Table 3).

**Table 3 Importance of Measures**

| Measurement | Importance To | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Partner | | | Function | | | Company | | |
| | N | Mean | Rank | N | Mean | Rank | N | Mean | Rank |
| On Time Delivery | 274 | 1.51 | 1 | 275 | 1.49 | 1 | 266 | 1.59 | 1 |
| Order Fill | 233 | 1.62 | 2 | 269 | 1.61 | 2 | 266 | 1.71 | 2 |
| Line Item Fill | 172 | 1.65 | 3 | 235 | 1.79 | 4 | 227 | 1.93 | 4 |
| Back Order | 189 | 1.79 | 4 | 222 | 2.01 | 6 | 217 | 2.10 | 7 |
| Order Cycle Time | 202 | 1.87 | 5 | 218 | 1.97 | 5 | 213 | 2.04 | 6 |
| Invoice Accuracy | 216 | 1.88 | 6 | 187 | 2.04 | 8 | 180 | 1.88 | 3 |
| Case Fill | 112 | 1.92 | 7 | 148 | 2.06 | 9 | 140 | 2.11 | 8 |
| Over/Short/Damage | 194 | 2.02 | 8 | 249 | 2.06 | 10 | 240 | 2.52 | 12 |
| Freight Cost | 144 | 2.19 | 9 | 293 | 1.66 | 3 | 282 | 2.03 | 5 |
| Returns and Allowances | 148 | 2.24 | 10 | 241 | 2.56 | 12 | 231 | 2.43 | 11 |
| Inquiry Response Time | 122 | 2.27 | 11 | 121 | 2.23 | 11 | 120 | 2.36 | 10 |
| Forecasting Accuracy | 75 | 2.53 | 12 | 197 | 2.03 | 7 | 192 | 2.33 | 9 |

Scale: 1 to 5: (1 = Very Important, 5 = Not Important.)

Moreover, respondents indicated that trading partners used many of these measures to quantify their firm's performance, implying that the partners had the measure. Even so, many respondents admitted to not capturing these important measures. For example, the measure of invoice accuracy, the third most important of these measures to the company, was captured by only fifty-two percent of the respondents. Exacerbating this measurement issue was the fact that at least 40% of these measures were not defined, either by the partner or jointly with the partner (See Table 4).

**Table 4 Capture of Measures**

| Measurement | Partner Importance Rank | Partner Uses It? ( Yes %) | Company Captures It? (No %) | Defined by Partner or Jointly Defined (Yes %) |
|---|---|---|---|---|
| On Time Delivery | 1 | 86 | **21** | 60 |
| Order Fill | 2 | 75 | **19** | 58 |
| Line Item Fill | 3 | 55 | **31** | 58 |
| Back Order | 4 | 62 | **36** | 55 |
| Order Cycle Time | 5 | 63 | **38** | 50 |
| Invoice Accuracy | 6 | 69 | **48** | 58 |
| Case Fill | 7 | 32 | **61** | 53 |
| Over/Short/Damage | 8 | 61 | **28** | 57 |
| Freight Cost | 9 | 44 | **13** | 52 |
| Returns and Allowances | 10 | 44 | **31** | 50 |
| Inquiry Response Time | 11 | 36 | **60** | 52 |
| Forecasting Accuracy | 12 | 16 | **46** | 43 |

A separate measure, "overall customer satisfaction," was regarded as important or very important by 90% of the respondents. With a mean of 1.48 on a five-point scale, this was the most important of all measures rated. Yet, only 61% of the respondents said they captured this measure.

To evaluate the differences in responses to the importance of the measures between those firms that captured these measures (the yes group) and those that did not (the "no" group), an independent-samples t-test was performed. This was done for each of the twelve logistics measures for the three importance ratings (Partner, Function, and Firm). Levene's Test for equality of variances produced significance levels that required rejecting the null hypothesis that the variances were equal. Consequently, equal variances were not assumed. Differences in means between the "yes" and "no" groups were found to be statistically significant for ten of the twelve measures (see Table 5). For example, the twenty-one respondents who did *not* capture the measure for "invoice accuracy" generated a mean of 2.80 (less important) for the function. The 161 respondents who *did* capture this measure generated a mean of 1.96 (more important) to the function. The t-test for equality of means found a two-tailed significance level of 0.009 for this comparison of means. In all cases for the twelve (measures) by three (importance dimensions) matrix of comparisons, the "no" group considered the measure less important to partners. However, these differences in means were statistically significant for only two of the twelve measures - "line item fill" and "case fill." Otherwise, there was no difference in perceived importance of the measure to the partner and whether the measure was captured or not.

## Table 5 Comparison of Importance of Measure and Whether It Is Captured

| Measurement | Captured ? | Importance To: Partner N | Partner Mean | Function N | Function Mean | Company N | Company Mean |
|---|---|---|---|---|---|---|---|
| On Time Delivery | No | 50 | 1.70 | 13 | 2.15 | 14 | 2.29 |
| | Yes | 217 | 1.47 | 258 | 1.46 | 251 | 1.56 |
| Order Fill | No | 26 | 1.96 | 10 | 3.00* | 9 | 2.89 |
| | Yes | 201 | 1.57 | 257 | 1.56* | 255 | 1.60 |
| Line Item Fill | No | 28 | 2.18* | 14 | 3.21* | 13 | 2.85 |
| | Yes | 137 | 1.53* | 218 | 1.71* | 212 | 1.88 |
| Back Order | No | 35 | 1.91 | 10 | 4.01* | 9 | 3.89* |
| | Yes | 151 | 1.75 | 224 | 1.68* | 219 | 1.74* |
| Order Cycle Time | No | 57 | 2.04 | 18 | 2.78* | 16 | 2.63* |
| | Yes | 136 | 1.78 | 195 | 1.91* | 192 | 1.99* |
| Invoice Accuracy | No | 85 | 2.00 | 21 | 2.80* | 19 | 2.42* |
| | Yes | 120 | 1.78 | 161 | 1.96* | 157 | 1.82* |
| Case Fill | No | 34 | 2.59* | 26 | 3.85* | 23 | 3.65* |
| | Yes | 74 | 1.60* | 118 | 1.65* | 113 | 1.70* |
| Over/Short/Damage | No | 31 | 2.35 | 11 | 2.82* | 13 | 2.85 |
| | Yes | 158 | 1.95 | 234 | 2.03* | 223 | 2.50 |
| Freight Cost | No | 18 | 2.50 | 9 | 2.57 | 5 | 2.60 |
| | Yes | 119 | 1.63 | 283 | 1.63 | 274 | 2.02 |
| Returns and Allowances | No | 27 | 2.56 | 16 | 3.88* | 15 | 3.40* |
| | Yes | 116 | 2.18 | 219 | 2.47* | 212 | 2.36* |
| Inquiry Response Time | No | 58 | 2.41 | 27 | 2.96* | 26 | 3.00* |
| | Yes | 55 | 2.20 | 90 | 2.01* | 88 | 2.17* |
| Forecasting Accuracy | No | 26 | 2.77 | 20 | 2.75* | 20 | 3.10* |
| | Yes | 48 | 2.38 | 176 | 1.95* | 172 | 2.24* |

Scale: 1 to 5: 1 = Very Important, 5 = Not Important.

* indicates t-test significance (2-sided) at below .05 level

Chi square tests were conducted to understand differences between the group of respondents who rated these twelve measures as a 1 or 2 (important) and the group of respondents who rated these twelve measures as 3, 4 or 5 (less important to not important). The chi square tests supported the results of the t-tests for the two measures of "line item fill" (Pearson chi square value of 10.118 and asymptotic significance of 0.001) and "case fill" (Pearson chi square value of 15.947 and asymptotic significance of 0.000). For only these two measures was statistical significance found to indicate a difference between the rating of importance and whether the measure was captured. For the remaining ten measures, the chi square test found no significant association between perceived importance and whether the measure was captured or not. Key performance measures, known to be important to trading partners and the company, are not being captured by roughly 20-50% of the respondents. The single exception is freight costs, lower on the importance ranking to customers, where 13% do not capture the measure. The data support accepting Hypothesis 1.

Hypothesis 2: Firms that have implemented ABC have a higher perceived competitive advantage over those firms that have not implemented ABC.

Respondents indicated whether they perceived to have an advantage or disadvantage (on a five point scale) compared to their primary competitor for seven processes or capabilities: Customer Service, Order Fulfillment, Sourcing/Procurement, Transportation/Distribution, Warehousing/Handling/Storage, Information Capability, and Planning/Forecasting/Scheduling (See Question II C on page 4 of the questionnaire,

Exhibit X in Appendix Y). They also indicated whether various technologies, including activity-based costing (ABC), were implemented, being implemented, planned for implementation, or not planned for implementation. Crosstabulations were performed comparing responses based on degree of advantage/disadvantage and degree of implementation of ABC. This was done with three grouping variations of degree of advantage/disadvantage and degree of implementation. In no case did the chi square test find any significant associations. Expected counts and actual counts were not statistically different. The findings indicated that perceived competitive advantage for the seven processes/capabilities is not associated with having ABC implemented. Hypothesis 2 is not supported.

Hypothesis 3a: Primary financial measures that drive decision-making in firms are more likely to be related to margin management rather than to asset management.

Respondents selected from a list of thirteen financial measures a primary financial measure that drives decision making in their organizations. For Hypotheses 3a, 3b and 3c, the nonparametric chi-square test was appropriate to test for significance. This goodness of fit test compared the observed and expected frequencies of choice of primary financial measure to determine if the selections contained the same proportion of values. The chi-square value produced was 153.847, with twelve degrees of freedom and asymptotic significance of 0.000. The choices of primary financial measures are significantly different (see Table 6).

**Table 6 Chi Square Test for Primary Financial Measure**

| | Primary Financial Measure | | |
|---|---|---|---|
| | Observed N | Expected N | Residual |
| Cash Flow | 24 | 26.2 | -2.2 |
| Contribution Margin | 20 | 26.2 | -6.2 |
| EPS | 22 | 26.2 | -4.2 |
| EBIT/EBITDA | 46 | 26.2 | 19.8 |
| EVA | 27 | 26.2 | 0.8 |
| Gross Profit Margin | 47 | 26.2 | 20.8 |
| Market Share | 8 | 26.2 | -18.2 |
| Net Profit Margin | 66 | 26.2 | 39.8 |
| ROA | 13 | 26.2 | -13.2 |
| ROCE | 17 | 26.2 | -9.2 |
| ROE | 4 | 26.2 | -22.2 |
| ROI | 38 | 26.2 | 11.8 |
| RONA | 8 | 26.2 | -18.2 |
| Total | 340 | | |

Net profit margin (19.4%) and gross profit margin (13.8%) were the two most frequently selected financial measures (see Figure 19). This supports the hypothesis that management is especially concerned with margin management.

The thirteen measures were grouped into four categories: Margin Management Measures, Asset Management Measures, Integrative Measures, and Other Measures (see Figure 20). Margin Management Measures accounted for 52.6% of the responses. It is remarkable that *integrative* financial measures were selected by less than one out of five respondents. This suggests a lack of understanding of the impact of asset utilization on the production of wealth by the firm.

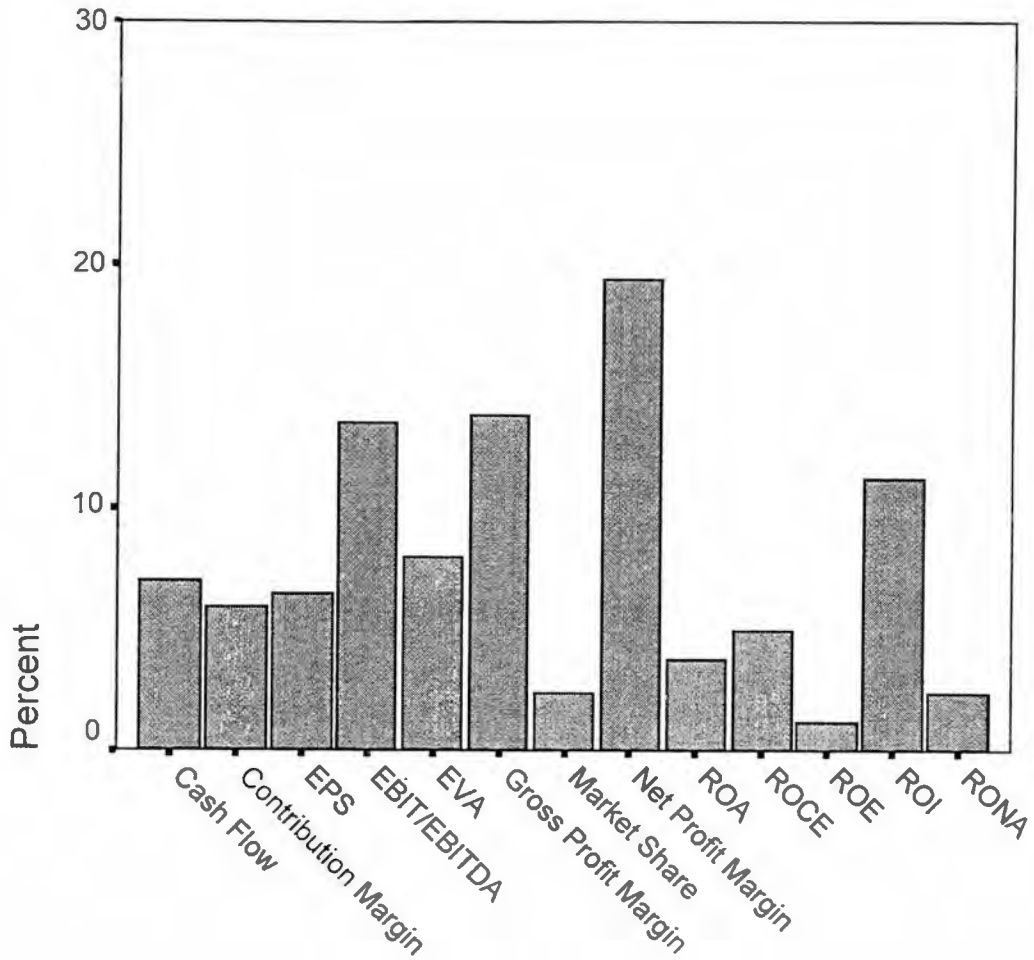



**Figure 19 Primary Financial Measure**

| Categories of Primary Financial Measures | % of Total Respondents<br><br>Valid N=340 |
|---|---|
| Margin Management | |
| Net Profit Margin | 19.4 |
| Gross Profit Margin | 13.8 |
| EBIT | 13.5 |
| Contribution Margin | 5.9 |
| Subtotal | 52.6 |
| Asset Management | |
| ROA | 3.7 |
| RONA | 2.4 |
| Subtotal | 6.1 |
| Integrative Measures | |
| ROI | 11.2 |
| ROCE | 4.8 |
| ROE | 1.1 |
| Subtotal | 17.1 |
| Other Measures | |
| EVA | 7.9 |
| Cash Flow | 7.1 |
| EPS | 6.5 |
| Market Share | 2.3 |
| Subtotal | 23.8 |

**Figure 20 Categories of Primary Financial Measures**

Respondents selected one of eight choices for primary business strategy. These were:

- Differentiated Customer Service
- Best Value Product/Service
- Low Cost Provider/Cost Leader
- All Things to All People
- Focus On a Product/Market Niche
- Differentiation or Innovation in Product/Services
- Differentiation Supply Chain Management
- Tailored Personalized Service to Customers

Margin management was the primary financial measure regardless of business strategy (see Figure 21).

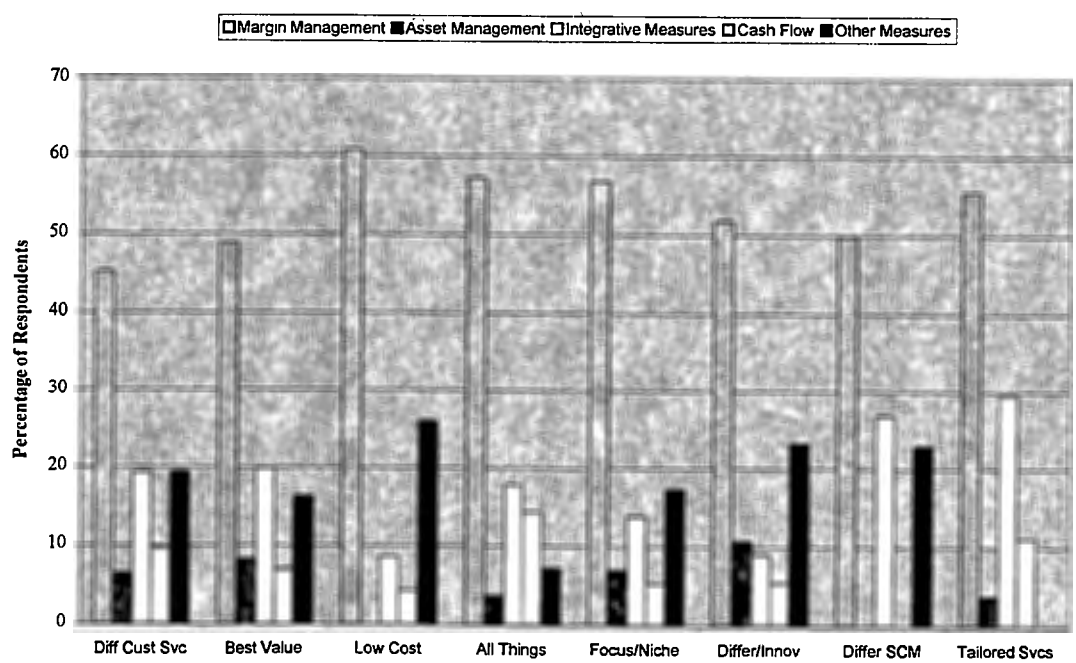



**Figure 21 Primary Financial Measure by Business Strategy**

Respondents selected one of five choices for their primary logistics strategy. They were:

- Minimize Supply Chain Costs
- Increase Corporate Revenue
- Maintain or Improve Customer Service
- Provide Best Value Added Services/Capabilities for Our Customers
- Provide Tailored, Personalized Service to Specific Customer Segments

Margin management measures were the primary financial measures regardless of logistics strategy (see Figure 22).

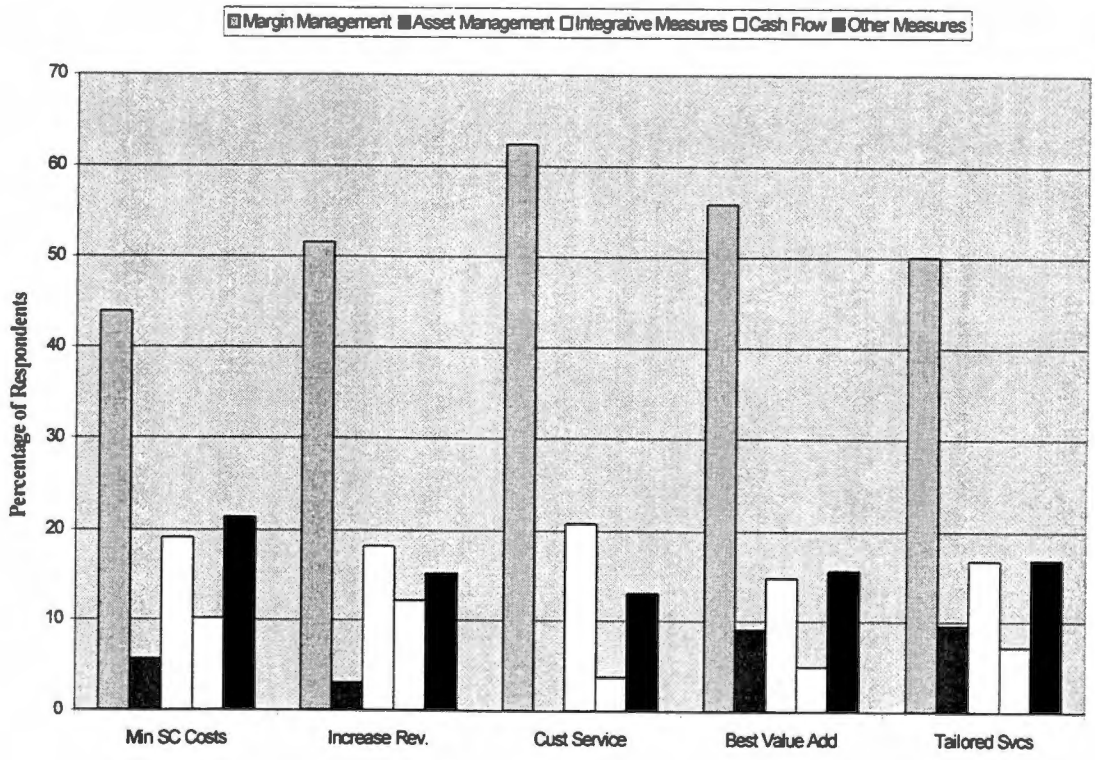



**Figure 22 Primary Financial Measure by Logistics Strategy**

Respondents indicated their company's position in its primary supply chain. Their five choices were:

- Sells Directly to the End Consumer,

- is One Step Removed from the end consumer,

- is Two Steps Removed from the end consumer,

- is Three Steps Removed from the end consumer,

- is primarily a Service Organization, acting as a Subcontractor to other businesses, and occupies multiple locations in the supply chain.

Margin management measures were the primary financial measure regardless of the company's position in the supply chain (see Figure 23). Hypothesis 3a is supported by the data.

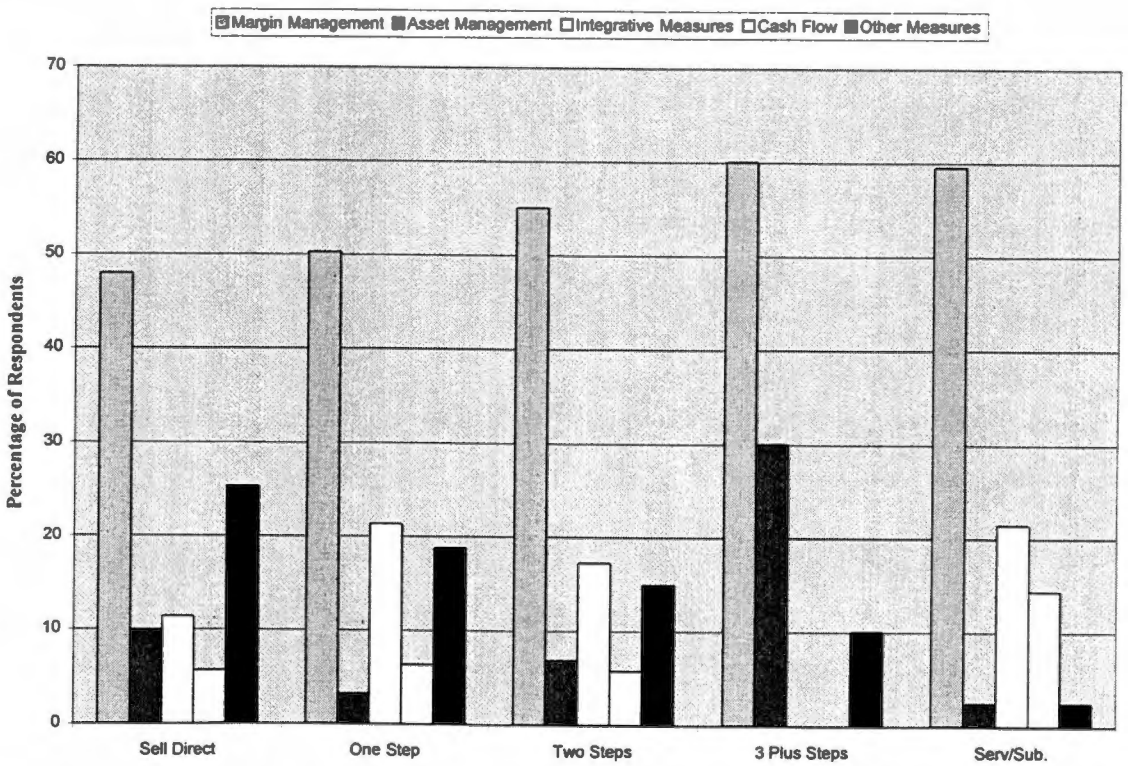



**Figure 23 Primary Financial Measure by Position in the Supply Chain**

Hypothesis 3b: Primary financial measures that drive decision making in firms are more likely to be related to margin management rather than to financial measures that integrate the income statement and balance sheet.

The measures that integrate the income statement and the balance sheet, namely ROI, ROCE, and ROE, were selected by only 17.1% of the respondents as their primary financial measure. More than three times as many respondents selected margin management measures as their primary financial measure. A chi-square test found significance in these results, as described in Table 6, above. The data support Hypothesis 3b.

Hypothesis 3c: Cash flow measures are not often used as a primary financial measure for decision-making.

Cash flow was selected by only 7.1% of the respondents as their primary financial measure. By business strategy, it was selected zero to 14% of the time. By logistics strategy, it was selected 3 to 12% of the time. By position in the supply chain, it was selected zero to 14% of the time. A chi-square test found significance in these results, as described in Table 6, above. Hypothesis 3c is supported by the data (see Table 7).

**Table 7 Cash Flow as a Primary Financial Measure**

| "Cash Flow is the Primary Financial Measure in My Organization." | |
|---|---|
| Total Respondents Valid N=340 | 7.1% |
| **By Business Strategy** | |
| Diff Cust Svc Valid N=31 | 9.7% |
| Best Value Valid N=86 | 7.0% |
| Low Cost Valid N=23 | 4.3% |
| All Things Valid N=28 | 14.3% |
| Focus/Niche Valid N=58 | 5.2% |
| Differ/Innov Valid N=56 | 5.4% |
| Differ SCM Valid N=26 | 0.0% |
| Tailored Svcs Valid N=27 | 11.1% |
| **By Logistics Strategy** | |
| Minimize SC Costs Valid N=89 | 10.1% |
| Increase Revenue Valid N=33 | 12.1% |
| Customer Service Valid N=53 | 3.7% |
| Best Value Added Valid N=122 | 4.9% |
| Tailored Svcs Valid N=42 | 7.1% |
| **By Position in the Supply Chain** | |
| Sell Direct Valid N=71 | 5.6% |
| One Step Valid N=127 | 6.3% |
| Two Steps Valid N=87 | 5.7% |
| 3 Plus Steps Valid N=10 | 0.0% |
| Serv/Sub. Valid N=42 | 14.3% |

Hypothesis 4: Firms that have alignment in their logistics and business strategy will have a better-perceived competitive advantage than firms that do not.

Respondents selected their primary business strategy from a list of eight choices and their primary logistics strategy from a list of five choices. The most often selected business strategy was "Best Value Products/Services" (25.8%); the least often was "Low Cost Provider" (6.9%) (see Figure 24). A nonparametric chi square test found

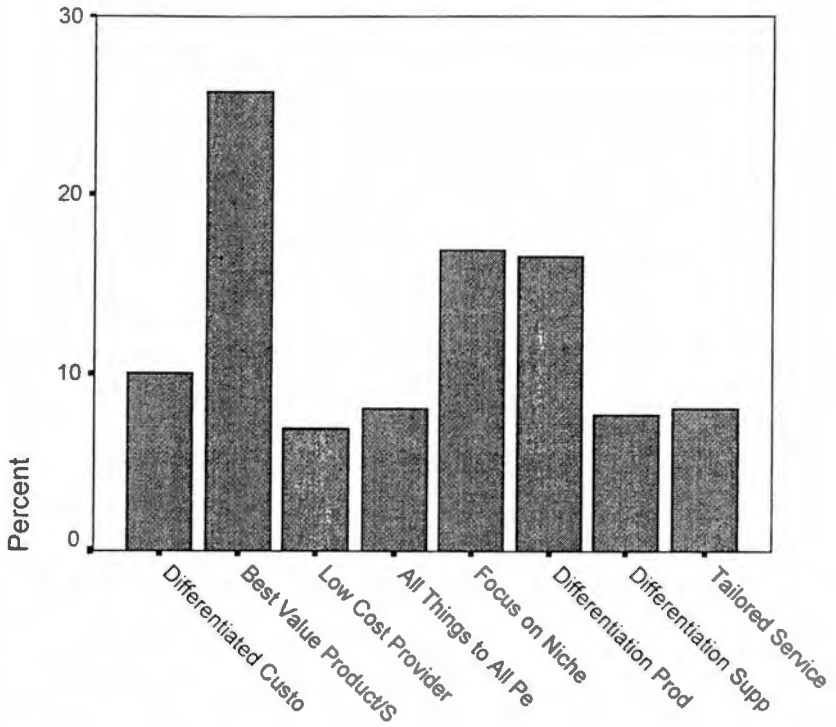



**Figure 24 Describe Business Strategy**

significance in the differences in the choices of business strategy (chi-square value of 87.516, seven degrees of freedom, and asymptotic significance of 0.000).

The most often selected logistics strategy was "Provide Best Value Services/Capabilities for Our Customer" (37.8%) and the least selected was "Increase Corporate Revenue" (9.4%) (see Figure 25). A nonparametric chi square test found significance in the differences in the choices of logistics strategy (chi-square value of 96.267, four degrees of freedom, and asymptotic significance of 0.000).

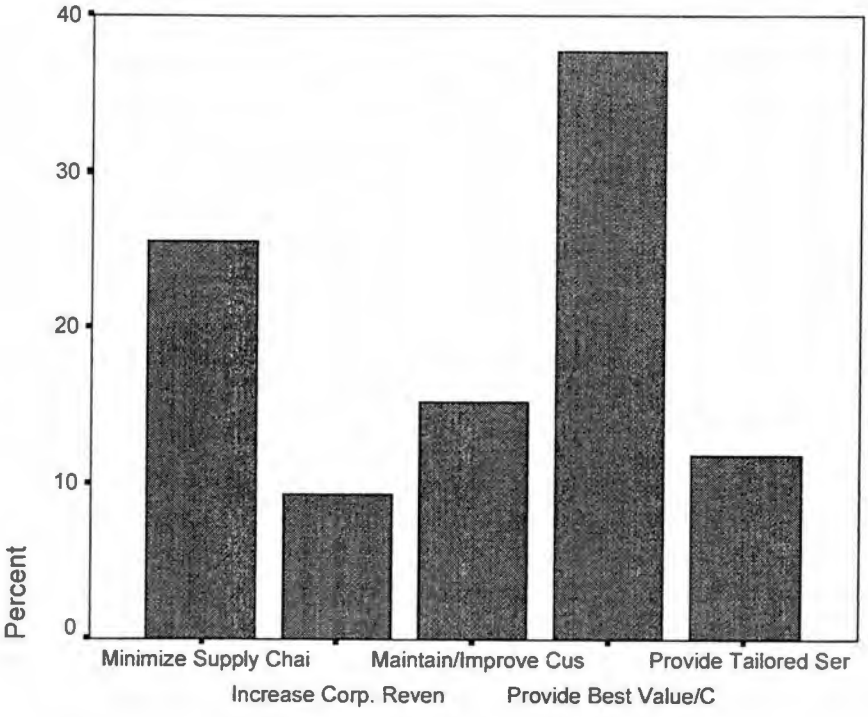



**Figure 25 Describe Logistics Strategy**

The selection of a logistics strategy was compared to the business strategy selected.

The comparison of matched selections of business and logistics strategies reveals an array of possible strategy pairs (see Table 8).

**Table 8 Business Strategy Alignment with Logistics Strategy**

| | Logistics Strategies | | | | | |
|---|---|---|---|---|---|---|
| Business Strategies | Minimize supply chain costs | Increase corporate revenue | Maintain or improve customer service | Provide best value-added services for customers | Provide tailored, personalized services | Total |
| Differentiated customer service | 7 | 3 | 5 | 17 | 3 | 35 |
| Best value product/service | 23 | 11 | 11 | 36 | 9 | 90 |
| Low cost provider | 15 | 1 | 5 | 3 | 0 | 24 |
| All things to all people | 8 | 1 | 10 | 7 | 1 | 27 |
| Focus on niche | 15 | 9 | 12 | 19 | 4 | 59 |
| Differentiation/innovation in products/services | 9 | 4 | 8 | 29 | 7 | 57 |
| Differentiation through supply chain management | 10 | 1 | 1 | 11 | 4 | 27 |
| Tailored, personalized service to customers | 1 | 2 | 1 | 11 | 13 | 28 |
| Total | 88 | 32 | 53 | 133 | 41 | 347 |

Visual inspection of Table 8 reveals many mismatches between business strategy and logistics strategy. "Best Value" and "All Things" strategies are likely indicative of the presence of no clear strategy, consequently making alignment problematic.

A chi square test was conducted to determine if there were any significant associations between the selection matches of business and logistics strategy. For the 347 valid cases, an asymptotic significance level of 0.000 was determined, indicating

that strong associations were present. Specifically, strong positive associations were found between two matches: (1) "Low Cost Provider" business strategy and the logistics strategy of "Minimize Supply Chain Costs;" and (2) "Tailored, Personalized Service to Customers" business strategy and "Tailored, Personalized Service" logistics strategy. A strong negative association was found between one match: "Tailored, Personalized Service to Customers" business strategy and the logistics strategy of "Minimize Supply Chain Costs." The "Best Value" matches of business and logistics strategy did not produce a statistically significant association.

An attempt was made to find an association between those respondents who reported "aligned" business and logistic strategies of (1) Low Cost or (2) Tailored Service based upon their claim of a competitive advantage or disadvantage. Cell counts were below the minimum required to produce results using the chi square test (see Table 9).

A visual inspection of the data in Table 9 reveals that no respondents with strategies out of alignment claimed a disadvantage in the order fulfillment, transportation, or warehousing activities. Perhaps this supports the theory that ignorance is bliss. However the data are inconclusive to either support or reject Hypothesis 4.

**Table 9 Alignment of Strategies and Competitive Advantage**

| Counts of Strategy based on Perceived Competitive Advantage | Low Cost- Aligned | | Low Cost - Not Aligned | |
|---|---|---|---|---|
| | Claimed Advantage | Claimed Disadvantage | Claimed Advantage | Claimed Disadvantage |
| Process/Capability | | | | |
| Customer Service | 6 | 3 | 3 | 1 |
| Order Fulfillment | 5 | 2 | 3 | 0 |
| Sourcing/Procurement | 8 | 1 | 5 | 2 |
| Transportation | 8 | 0 | 7 | 0 |
| Warehousing | 4 | 3 | 6 | 0 |
| Information Capability | 5 | 8 | 3 | 3 |
| Planning/Forecasting/Scheduling | 4 | 5 | 3 | 4 |

| Counts of Strategy based on Perceived Competitive Advantage | Tailored-Aligned | | Tailored - Not Aligned | |
|---|---|---|---|---|
| | Claimed Advantage | Claimed Disadvantage | Claimed Advantage | Claimed Disadvantage |
| Process/Capability | | | | |
| Customer Service | 8 | 1 | 7 | 0 |
| Order Fulfillment | 9 | 1 | 6 | 0 |
| Sourcing/Procurement | 4 | 1 | 5 | 1 |
| Transportation | 7 | 3 | 9 | 0 |
| Warehousing | 8 | 1 | 8 | 0 |
| Information Capability | 11 | 1 | 9 | 2 |
| Planning/Forecasting/Scheduling | 4 | 0 | 3 | 4 |

Hypothesis 5: Different business strategies will be associated with different logistics measures.

The thirty-seven logistics measures explored on the questionnaire were crosstabulated with the eight business strategy choices to determine if there were any associations between the business strategy pursued and whether or not specific logistics measures were captured. Overall, a statistically significant association with business strategy was found for only four of the thirty-seven logistics measures (see Table 10).

**Table 10 Significant Associations of Measures and Business Strategy**

| Significant Associations of Measures and Business Strategy | | | |
|---|---|---|---|
| Measure | Pearson Chi Square Value | Degrees of Freedom | Asymptotic Significance |
| Cost to serve | 19.496 | 7 | 0.007 |
| Returns and allowances | 20.454 | 7 | 0.005 |
| Inventory obsolescence | 16.463 | 7 | 0.021 |
| Incoming material quality | 14.356 | 7 | 0.045 |

Based on the comparisons of expected counts to actual counts, the following interpretations can be made: Tailored service business strategies are more likely to capture the cost to serve measure, while low cost provider strategies are less likely to do so. Tailored service business strategies are more likely to capture the returns and allowances measure. Measures of obsolete inventory are significantly less likely to be captured by companies with either an "All Things to All People" or a Tailored Service strategy.

Since no association between business strategy and logistics measures captured was found for thirty-three of the thirty-seven measures, Hypothesis 5 can not be supported.

Although Hypothesis 5 was not supported by the data, post hoc exploratory analysis produced some interesting associations. Twice as many statistically significant

**Table 11 Significant Associations of Measures and Logistics Strategy**

| Significant Associations of Measures and Logistics Strategy | | | |
|---|---|---|---|
| Measure | Pearson Chi Square Value | Degrees of Freedom | Asymptotic Significance |
| Line item fill | 10.677 | 4 | 0.03 |
| Out of stock | 11.896 | 4 | 0.018 |
| Cost to serve | 15.208 | 4 | 0.004 |
| Inquiry response time | 11.762 | 4 | 0.019 |
| Finished goods inventory turns | 10.453 | 4 | 0.009 |
| Product units processed per warehouse labor unit | 10.366 | 4 | 0.035 |
| Processing accuracy | 10.984 | 4 | 0.027 |
| Space utilization vs capacity | 10.73 | 4 | 0.03 |

associations were found between *logistics strategy* and the capture of measures (see Table 11). Based on the comparisons of expected counts to actual counts, the logistics strategy of "Tailored Service" is more likely to capture several logistics measures (see Table 12).

Location in the supply chain accounts for more statistically significant associations with the measures captured than logistics strategy does. Seventeen of the thirty-seven measures produced associations with position of the firm in the supply chain (see Table 13).

**Table 12 Implications of Associations of Measures and Logistics Strategy**

| Significant Associations of Measures and Logistics Strategy | | |
|---|---|---|
| Measure | Strategy More Likely to Capture Measure | Strategy Less Likely to Capture Measure |
| Line item fill | Increase corp. revenue | Provide best value |
| Out of stock | Tailored service | Min. supply chain costs |
| Cost to serve | Tailored service | Maintain/improve cust svc |
| Inquiry response time | Min. supply chain costs<br>Maintain/improve cust svc | Tailored service |
| Finished goods inventory turns | Min. supply chain costs | Increase corp. revenue |
| Product units processed per warehouse labor unit | Tailored service | Increase corp. revenue |
| Processing accuracy | Tailored service | Min. supply chain costs |
| Space utilization vs capacity | Tailored service | Increase corp. revenue |

**Table 13 Significant Associations of Measures and Position in the Supply Chain**

| Significant Associations of Measures and Position in the Supply Chain | | | |
|---|---|---|---|
| Measure | Pearson Chi Square Value | Degrees of Freedom | Asymptotic Significance |
| Order fill | 11.922 | 4 | 0.018 |
| Line item fill | 10.17 | 4 | 0.038 |
| Out of stock | 9.497 | 4 | 0.050 |
| Back orders | 11.374 | 4 | 0.023 |
| Perfect order fulfillment | 10.118 | 4 | 0.038 |
| Cost to serve | 19.928 | 4 | 0.001 |
| Returns and allowances | 23.17 | 4 | 0.000 |
| Inquiry response time | 16.181 | 4 | 0.003 |
| Inventory count accuracy | 13.373 | 4 | 0.010 |
| Forecast accuracy | 13.636 | 4 | 0.009 |
| Inventory carrying costs | 19.696 | 4 | 0.001 |
| Inventory obsolescence | 11.335 | 4 | 0.023 |
| Outbound freight costs | 16.14 | 4 | 0.003 |
| Processing accuracy | 14.431 | 4 | 0.006 |
| Space utilization vs capacity | 9.711 | 4 | 0.046 |
| Labor utilization vs capacity | 11.487 | 4 | 0.022 |
| Equipment utilization vs capacity | 11.922 | 4 | 0.018 |

Based on the comparisons of expected counts to actual counts, those companies that sell directly to the end consumer are often *more likely* to capture logistics measures. Companies two steps removed, typically manufacturers, are only more likely to capture measures of inventory accuracy and less likely to capture cost to serve and perfect order fulfillment (see Table 14).

**Table 14 Differences in Emphasis on Measures based on Supply Chain Position**

| Significant Associations of Measures and Position in the Supply Chain | | |
|---|---|---|
| Measure | Position More Likely to Capture Measure | Position Less Likely to Capture Measure |
| | (Steps Removed from Consumer) | |
| Order fill | Service org/subcontractor | Three or more steps |
| Line item fill | Sell direct | Service org/subcontractor |
| Out of stock | Sell direct | Service org/subcontractor |
| Back orders | (none) | Service org/subcontractor |
| Perfect order fulfillment | Sell direct<br>Service org/subcontractor | Two steps |
| Cost to serve | Sell direct<br>Service org/subcontractor | Two steps |
| Returns and allowances | One step | Service org/subcontractor |
| Inquiry response time | Sell direct | One step |
| Inventory count accuracy | Two steps | Service org/subcontractor |
| Forecast accuracy | One step | Service org/subcontractor<br>Sell direct |
| Inventory carrying costs | One step | Service org/subcontractor |
| Inventory obsolescence | One step | Service org/subcontractor |
| Outbound freight costs | One step | Service org/subcontractor |
| Processing accuracy | Sell direct | Two steps |
| Space utilization vs capacity | Sell direct | Two steps |
| Labor utilization vs capacity | Sell direct | One step |
| Equipment utilization vs capacity | Sell direct | Two steps |

Hypothesis 6a: Firms that have a coordinated or integrated planning process are more likely to measure key logistics processes within the firm.

Respondents described the current state of logistics measurement for seven logistics processes/capabilities by indicating one of five states: (1) they were *unaware* of the process performance and did not measure it; (2) they were *aware* of the process performance and did not measure it; (3) they *measure* activities of the process but did not take action to change the value of the measure; (4) they *coordinate* functional activities and estimate costs and benefits of implementing improvements based upon the measures captured; and (5) they *integrate* activities with other functions or firms based upon functional and financial measures captured and implement improvements in the process. These ratings were made for both within the company and between it and trading partners. The planning process was one of the seven evaluated by the respondents.

A chi square test was conducted to determine the association of having a coordinated or integrated planning process with the likelihood of at least measuring other logistics processes and capabilities within the firm. In all cases, a significant positive association was found (see Table 15). The data strongly support Hypothesis 6a. Measurement is more often found in firms that have a formal planning function.

**Table 15 Firms that Plan Internally Also Measure and Improve Internally**

| Having a Coordinated or Integrated Planning Process is Significantly Associated with Measurement of Logistics processes and capabilities Within the Firm | | | |
|---|---|---|---|
| Processes/Capabilities | Pearson Chi Square Value | Degrees of Freedom | Asymptotic Significance |
| Customer Service | 12.210 | 1 | 0.000 |
| Order Fulfillment | 14.606 | 1 | 0.000 |
| Sourcing/Procurement | 18.652 | 1 | 0.000 |
| Transportation/Distribution | 13.401 | 1 | 0.000 |
| Warehousing/Storage | 12.044 | 1 | 0.001 |
| Information Capability | 33.691 | 1 | 0.000 |
| Planning/Forecasting/Scheduling | 121.935 | 1 | 0.000 |

Hypothesis 6b: Firms that have a coordinated or integrated planning process are more likely to measure key logistics processes between it and trading partners.

A chi square test was conducted to determine the association of having a coordinated or integrated planning process with the likelihood of at least measuring other logistics processes and capabilities between the firm and its trading partners. In all cases, a significant positive association was found (see Table 16). The data strongly support Hypothesis 6b.

**Table 16 Firms that Plan Are More Likely to Measure**

| Having a Coordinated or Integrated Planning Process is Significantly Associated with Measurement of Logistics processes and capabilities Between the Firm and its Trading Partner | | | |
|---|---|---|---|
| Processes/Capabilities | Pearson Chi Square Value | Degrees of Freedom | Asymptotic Significance |
| Customer Service | 17.111 | 1 | 0.000 |
| Order Fulfillment | 16.947 | 1 | 0.000 |
| Sourcing/Procurement | 10.018 | 1 | 0.002 |
| Transportation/Distribution | 14.886 | 1 | 0.000 |
| Warehousing/Storage | 20.938 | 1 | 0.000 |
| Information Capability | 40.961 | 1 | 0.000 |
| Planning/Forecasting/Scheduling | 93.068 | 1 | 0.000 |

Hypothesis 6c: Firms that have a coordinated or integrated planning process have a better-perceived competitive advantage than firms that do not.

A chi square test was conducted to determine the association of having a coordinated or integrated planning process with the likelihood of having a perceived competitive advantage in logistics processes and capabilities, for both within the firm and between the firm and its trading partners. No significant associations were found for Customer Service, Transportation, Warehousing, or Information Capability. A significant positive association was found for Order Fulfillment and Planning/

**Table 17 Advanced Planning Pays Off Competitively**

| Having a Coordinated or Integrated Planning Process is Significantly Associated with a Competitive Advantage in some Logistics processes and capabilities | | | |
|---|---|---|---|
| Processes/Capabilities | Pearson Chi Square Value | Degrees of Freedom | Asymptotic Significance |
| Order Fulfillment, Within the Firm | 6.625 | 1 | 0.010 |
| Order Fulfillment, Between Firms | 4.330 | 1 | 0.037 |
| Sourcing/Procurement, Within the Firm | 4.290 | 1 | 0.038 |
| Planning/Forecasting/Scheduling, Within | 27.187 | 1 | 0.000 |
| Planning/Forecasting/Scheduling, Between | 12.605 | 1 | 0.000 |

Forecasting/Scheduling. A significant association for Sourcing/Procurement was found only within the firm and not between firms (see Table 17). The data only partially support Hypothesis 6c.

Hypothesis 7a: Firms with a wide span of control are more likely to follow a low-cost business strategy.

Respondents indicated whether any of fifteen activities associated with logistics and supply chain management reported within their function. The Supply Chain/Logistics function claimed primary control over thirteen of the fifteen activities. Operation/Manufacturing was the primary controlling function for two activities, Purchasing and Production Planning (see Table 18).

## Table 18 Supply Chain/ Logistics Function and Span of Control

| Functional Responsibility for Various Activities | | | |
|---|---|---|---|
| Activities | Supply Chain / Logistics Function % | Other Largest Function % | Other Function |
| Logistics Network Design/Strategy | 77.6 | 14.1 | Operations/Manufacturing |
| Transportation Planning | 75.5 | 17.8 | Operations/Manufacturing |
| Outbound Transportation | 75.3 | 17.2 | Operations/Manufacturing |
| Inbound Transportation | 68.4 | 22.9 | Operations/Manufacturing |
| Warehousing | 62.7 | 28.9 | Operations/Manufacturing |
| Order Fulfillment | 58.5 | 27.1 | Operations/Manufacturing |
| Inventory Management/Planning | 52.8 | 29.4 | Operations/Manufacturing |
| Order Processing | 48.7 | 24.9 | Sales/Marketing/Merchandising |
| Demand Forecasting | 40.0 | 37.9 | Sales/Marketing/Merchandising |
| Order Entry | 39.1 | 35.6 | Sales/Marketing/Merchandising |
| Procurement/Sourcing | 38.6 | 37.2 | Operations/Manufacturing |
| Customer Service | 37.8 | 33.8 | Sales/Marketing/Merchandising |
| Inventory Accounting/Control | 37.6 | 37.0 | Finance |
| Purchasing | 34.3 | 38.0 | Operations/Manufacturing |
| Production Planning | 33.6 | 52.6 | Operations/Manufacturing |

New variables were established to examine the differences in responses from companies with wide and narrow spans of control. Only manufacturers, distributors, and retailers (267 out of 355 respondents) were considered in the span of control comparison, since service providers often do not manage all the traditional, or core activities, associated with product distribution. Core logistics activities were defined to include these six:

(1) Logistics Network Design/Strategy,

(2) Transportation Planning,

(3) Outbound Transportation,

(4) Inbound Transportation,

(5) Warehousing, and

(6) Inventory Management/Planning.

The narrow span of control group would include at least four of the six core logistics activities. Sixty-five of the manufacturer, distributor, ands retailer respondents claimed that less than four of the core logistics activities reported to the supply chain or logistics function. They were excluded from the analysis for span of control, leaving 202 cases. The completed questionnaires for these remaining 202 respondents were sorted into fifteen groups. The groups represented the different frequencies for which the fifteen activities were claimed to report to the Supply Chain/Logistics organization. Only 5.4 percent of respondents claimed primary responsibility for all fifteen activities. Another 8.4 percent of respondents claimed primary responsibility for fourteen activities. Another 4.5 percent of respondents claimed primary responsibility for thirteen activities. The median of activities claimed to report to the Supply Chain/Logistics organization was between nine and ten activities. Fifty-six percent of respondents claimed ten or more of the activities. Forty-four percent of respondents claimed nine or fewer activities. Consequently, wide span of control was defined as having primary responsibility for ten or more of the fifteen activities. Those claiming nine or fewer of the activities reporting to Supply Chain/Logistics were classified in the narrow span of control group. There were 113 respondents (56%) claiming wide spans of control (see Table 19).

A chi-square test was used to test for significance between span of control and choice of business strategy. The Pearson chi-square value of 4.276, with seven degrees

**Table 19 Span of Control and Choice of Business Strategy**

| Business Strategy | Span of Control | |
|---|---|---|
| | Narrow % | Wide % |
| | N=89 | N=113 |
| Differentiated Customer Service | 10.2 | 10.7 |
| Best Value Product/Service | 33.0 | 25.0 |
| Low Cost Provider/Cost Leader | 10.2 | 8.0 |
| All Things To All People | 5.7 | 10.7 |
| Focus on a Product/Market Niche | 18.2 | 16.1 |
| Differentiation or Innovation in Products/Services | 15.9 | 17.9 |
| Differentiation Through Supply Chain Management | 4.5 | 8.0 |
| Tailored, Personalized Service to Customers | 2.3 | 3.6 |
| Total | 100.0 | 100.0 |

of freedom, produced an asymptotic significance of 0.747. Statistical significance was not established. The data indicate that Low Cost Provider was the *sixth* choice of companies with a wide span of control, providing no support for Hypothesis 7a. Only six percent of the 202 manufacturer, distributor, ands retailer respondents chose Low Cost Provider as the company's primary business strategy from the eight possible selections.

Had the hypothesis been stated as: "Firms with a low cost business strategy are more likely to have a wide span of control," the data would have been supportive. However, the data do *not* support Hypothesis 7a that firms with a wide span of control in their supply chain/logistics function are more likely to follow a low cost strategy.

Hypothesis 7b: Firms with a narrow span of control are more likely to follow a differentiation or service strategy.

As previously mentioned, statistical significance was not established between span of control and choice of business strategy. As shown in Table 19, above, the narrow span group selected the tailored service and differentiation strategies less often than did the wide span group. The analysis of the data does *not* support Hypothesis 7b.

Hypothesis 8: The size of firm will be related to the type of business strategy; larger firms will tend to follow low-cost strategies and smaller firms will tend to follow service, or differentiation, strategies.

There were 104 respondents in the smaller firm category and 106 in the larger group category. Size of firm and choice of business strategy were crosstabulated to determine if there was a statistically significant association between these two variables. The Pearson chi-square value was 21.349, with seven degrees of freedom. The asymptotic significance was 0.003, indicating a very strong association. An examination of the actual versus expected counts found that smaller companies are much more likely to have a tailored service strategy or focus on a niche than larger firms are. Larger firms are more likely to claim the Best Value or Low Cost business strategy than smaller firms are (see Table 20).

**Table 20 Size of Firm and Business Strategy**

| Business Strategy | Size of Firm | |
|---|---|---|
| | Smaller N=104 % | Larger N=106 % |
| Differentiated Customer Service | 4.8 | 5.7 |
| Best Value Product/Service | 11.0 | 17.1 |
| Low Cost Provider/Cost Leader | 1.9 | 4.8 |
| All Things To All People | 3.8 | 3.3 |
| Focus on a Product/Market Niche | 9.5 | 4.3 |
| Differentiation or Innovation in Products/Services | 8.1 | 8.6 |
| Differentiation Through Supply Chain Management | 1.9 | 4.8 |
| Tailored. Personalized Service to Customers | 8.6 | 1.9 |
| Total | 49.5 | 50.5 |

However, the data do not support Hypothesis 8. Combining the three differentiation strategies reveals that 14.8 percent are smaller firms and 19.1 percent are larger firms. Smaller firms do not tend to follow differentiation strategies, even though they are significantly associated with tailored service strategies.

Recognizing that this hypothesis considered only the lowest third and the highest third sales volume groups, an additional post hoc classification and analysis was conducted to include *all* cases. Using an univariate analysis of variance test and the six sales volume choices as a continuous scale where

1 = <US$250M;

2 = US$250-$500M;

3 = US$500M-$1B;

4 = US$1B-$5B;

5 = US$5B-$10B; and

6 = >US$10B,

mean scores of sales volume for each of the eight business strategies were calculated (see Table 21).

**Table 21 Mean Score of Sales Volume By Business Strategy**

| Dependent Variable: Total Sales Volume | Univariate Analysis of Variance | | |
|---|---|---|---|
| Business Strategy | Mean | Std. Dev. | Valid N |
| Low Cost Provider/ Cost Leader | 2.96 | 1.37 | 24 |
| Best Value Product/Service | 2.92 | 1.59 | 85 |
| Differentiation Through Supply Chain Management | 2.89 | 1.31 | 27 |
| Differentiated Customer Service | 2.76 | 1.5 | 34 |
| Be All Things to All People | 2.71 | 1.54 | 28 |
| Differentiation or Innovation in Products/Services | 2.67 | 1.47 | 55 |
| Focus on a Product/ Market Niche | 2.25 | 1.23 | 57 |
| Tailored, Personalized Service to Customers | 1.68 | 1.09 | 28 |
| Total | 2.63 | 1.46 | 338 |

The Type III sum of squares method was used to test for significance (alpha = 0.05) in the differences between means. The test of between-subjects effects revealed significance of 0.002. To determine which means differ significantly the Tukey's honestly significant difference (HSD) test was used. Tukey's HSD test uses the Studentized range statistic to make all pairwise comparisons between groups and sets the experimentwise error rate to the error rate of the collection for all pairwise comparisons. When testing a large number of pairs of means, Tukey's HSD test is more powerful than the Bonferroni test (SPSS 1998). The Tukey HSD multiple comparison analysis identified three significant mean differences and all were associated with the Tailored, Personalized Service strategy (see Table 22).

**Table 22 Tailored Service Strategies Are Associated with Smaller Firms**

| Multiple Comparisons of Means (Tukey HSD) Dependent Variable: Total Sales Volume | | | | |
|---|---|---|---|---|
| (A) Business Strategy | (B) Business Strategy | Mean Difference (A-B) | Std. Error | Sig. |
| Tailored, Personalized Service to Customers | Low Cost Provider/ Cost Leader | -1.28 | 0.40 | **0.027** |
| | Best Value Product/Service | -1.24 | 0.31 | **0.002** |
| | Differentiation Through Supply Chain Management | -1.21 | 0.38 | **0.035** |
| | Differentiated Customer Service | -1.09 | 0.36 | 0.057 |
| | Be All Things to All People | -1.04 | 0.38 | 0.117 |
| | Differentiation or Innovation in Products/Services | -0.99 | 0.33 | 0.054 |
| | Focus on a Product/ Market Niche | -0.57 | 0.33 | 0.672 |

This additional post hoc testing of Hypothesis 8 using all cases and all sales levels does not provide support as the hypothesis is stated. If the hypothesis had been restricted to the single strategy of Tailored, Personalized Service, it could be demonstrated that such a strategy is more likely to be associated with smaller firms than with larger firms.

Hypothesis 9: The firms with wide spans of control are more likely to demonstrate greater coordination and integration of logistics processes.

Supply chain/logistics functions in manufacturing, didtributing, and retailing firms with control of ten or more of the fifteen activities described earlier under Hypothesis 7a are considered to have wide spans of control. This group was compared with the narrow span of control group to determine if there were any significant associations with greater coordination and integration of the seven processes/capabilities discussed in Hypotheses 6a, 6b, and 6c. A chi-square test showed no significant associations for any of the processes/capabilities within the company but did determine that there were three significant associations on the "between firms" basis (see Table 23).

However, an examination of the actual to expected counts demonstrated that there was a significant *negative* association with wide spans of control and these three processes/capabilities between trading partners. The data show that supply chain/logistics functions with *narrow* spans of control are more likely to be coordinated

**Table 23 Wide Span of Control and Intercompany Significance**

| Having a Wide Span of Control is Significantly Associated with Coordination or Integration of Three Logistics Processes and Capabilities Between the Firm and Its Trading Partners | | | |
|---|---|---|---|
| Processes/Capabilities | Pearson Chi Square Value | Degrees of Freedom | Asymptotic Significance |
| Transportation/Distribution | 13.401 | 1 | 0.000 |
| Warehousing/Storage | 12.044 | 1 | 0.001 |
| Information Capability | 33.691 | 1 | 0.000 |

or integrated with trading partners in these areas. Hypothesis 9, therefore, must be rejected.

Hypothesis 10a: Firms with a low-cost strategy will focus internally and emphasize cost measures relative to other measures of logistics performance.

Six of the thirty-seven logistics measures explored for degree of importance and capture by the respondents were associated with cost. They were:

- cost to serve,
- inbound freight cost,
- 3rd party storage cost,
- inventory carrying costs,
- outbound freight cost, and

- logistics cost per unit versus budget.

A crosstabulation was performed between these six cost measures and the eight business strategies. Only one significant association was found, which was with cost to serve. The Pearson chi-square value was 19.496, with seven degrees of freedom, and produced an asymptotic significance of 0.007. In that case, a comparison of actual versus expected counts revealed that low cost provider strategies were *less likely* to capture the cost to serve measure.

Another crosstabulation was performed between these six cost measures and the five logistics strategies. Only one significant association was found, which was also for cost to serve. The Pearson chi-square value was 15.208, with four degrees of freedom, and produced an asymptotic significance of 0.004. In that case, a comparison of actual versus expected counts revealed that "minimize supply chain cost" strategies were, again, *less likely* to capture the cost to serve measure.

The data do not support Hypothesis 10a. Firms with low cost strategies do not emphasize cost measures over other measures of performance.

Hypothesis 10b: Firms with a differentiation or service strategy will focus externally and emphasize measures other than cost.

The respondents claiming the three differentiations strategies and the tailored service business strategy were grouped and compared for association with the five cost measures. It was anticipated that a significant negative association would support this hypothesis, especially if Hypothesis 10a had been supported. The Pearson chi-square

test found significance only for the cost to serve measure. An evaluation of the actual counts to expected counts revealed that significantly more respondents in this group (63) did actually capture this cost to serve measure than would normally be expected (49). The data do not support Hypothesis 10b.

Hypothesis 11a: Firms are more focused on internal measures of efficiency (i.e. productivity and utilization) than on measures of effectiveness (i.e., planned performance and outcomes).

The thirty-seven logistics measures included on the questionnaire were grouped into two categories: those that were related to efficiency and those that were related to effectiveness. On a scale of 1=No and 2=Yes for the question, "Do you capture this measure?" the effectiveness measures produced a higher mean overall than the efficiency measures (see Table 24). This indicates that respondents capture a greater percentage of effectiveness measures than efficiency measures.

A paired samples t-test was conducted on the Efficiency and Effectiveness measures to determined if there were statistical significances between the means for each group of measures. The test produced a correlation of 0.541 and two-tailed significance of 0.000, indicating significant difference. The data do not support Hypothesis 11a that firms are more focused on internal efficiency measures.

## Table 24 Efficiency versus Effectiveness Measures

| Effectiveness Measures | Mean | % Capture | Efficiency Measures | Mean | % Capture |
|---|---|---|---|---|---|
| Inventory count accuracy | 1.86 | 85.8 | Outbound freight cost | 1.87 | 87.3 |
| Customer complaints | 1.83 | 76.6 | Finished goods inventory turns | 1.86 | 80.2 |
| Order fill | 1.81 | 80.8 | Inbound freight cost | 1.69 | 68.9 |
| On-time delivery | 1.79 | 78.6 | 3rd party storage cost | 1.62 | 58.6 |
| Over/short/damaged | 1.72 | 72.3 | Inventory carrying cost | 1.60 | 60.4 |
| Out of stocks | 1.71 | 70.5 | Logistics cost per unit vs budget | 1.52 | 52.4 |
| Returns and allowances | 1.69 | 69.1 | Orders processed/labor unit | 1.49 | 43.3 |
| Line item fill | 1.68 | 68.5 | Product units processed per warehouse labor unit | 1.48 | 47.6 |
| Order cycle time | 1.68 | 62.3 | Space utilization vs capacity | 1.46 | 46.5 |
| Back orders | 1.64 | 64.4 | Equipment downtime | 1.46 | 46.0 |
| Inventory obsolescense | 1.63 | 62.7 | Equipment utilization vs capacity | 1.40 | 40.4 |
| Incoming material quality | 1.62 | 61.6 | Cost to serve | 1.37 | 37.4 |
| Overall customer satisfaction | 1.61 | 60.8 | Units processed per time unit | 1.37 | 37.2 |
| Days sales outstanding | 1.59 | 58.7 | Orders processed per time unit | 1.36 | 36.1 |
| Forecast accuracy | 1.54 | 54.4 | Labor utilization vs capacity | 1.36 | 35.8 |
| Invoice accuracy | 1.52 | 52.1 | Product units processed per transportation unit | 1.25 | 21.8 |
| Processing accuracy | 1.45 | 45.0 | | | |
| Case fill | 1.39 | 39.1 | | | |
| Perfect order fulfillment | 1.39 | 39.5 | | | |
| Cash/cash cycle time | 1.32 | 32.2 | | | |
| Inquiry response time | 1.30 | 29.6 | | | |
| Average | 1.61 | 60.2 | Average | 1.51 | 50.0 |

Hypothesis 11b: Firms are more focused on measurement of activities or processes within the firm than on activities or processes between firms.

A measurement integration matrix was included in the questionnaire to help respondents identify their level of measurement sophistication for seven logistics processes/capabilities, for both *within* their company (intracompany) and *between* their firm and trading partners (intercompany). Respondents could select their state of measurement from five choices. They could be (1) unaware; (2) aware but not measuring; (3) measuring and comparing to benchmarks; (4) coordinating activities based on the measurement to improve performance; or, (5) integrating measures and improvements cross-functionally or across businesses.

Customer service activities are the primary interfaces with customers and would seem to be a quite important area to measure, coordinate and integrate activities to insure effective performance. The data suggest that 35% of the respondents (those who are Unaware or Aware) do not capture measures for customer service. Only 22% of respondents (those who are Coordinating or Integrating) are acting on intercompany measures of customer service (see Table 25).

**Table 25 Measurement of Customer Service**

| Process/Capability: | **Customer Service** | |
|---|---|---|
| Level of Sophistication | Within the Firm % | With Trading Partner % |
| Integration | 18 | 5 |
| Coordination | 27 | 17 |
| Measuring | 27 | 28 |
| Aware | 29 | 38 |
| Unaware | 6 | 12 |

One of the major processes in a supply chain is order fulfillment, as it captures and satisfies customer demand. Thirty percent of respondents (those who are Unaware or Aware) do not measure this internally, and 41% do not capture the intercompany measure (see Table 26).

**Table 26 Measurement of Order Fulfillment**

| Process/Capability: | **Order Fulfillment** | |
|---|---|---|
| Level of Sophistication | Within the Firm % | With Trading Partner % |
| Integration | 12 | 4 |
| Coordination | 25 | 18 |
| Measuring | 34 | 37 |
| Aware | 24 | 29 |
| Unaware | 6 | 12 |

**Table 27 Measurement of Sourcing/Procurement**

| Process/Capability: | **Sourcing/Procurement** | |
|---|---|---|
| | Within the Firm | With Trading Partner |
| Level of Sophistication | % | % |
| Integration | 90 | 5 |
| Coordination | 23 | 16 |
| Measuring | 27 | 21 |
| Aware | 28 | 32 |
| Unaware | 13 | 27 |

The data show that companies are paying less attention to sourcing/procurement activities than to their customer interfaces. The sourcing process is the least integrated of the seven (see Table 27).

As might be expected, given the importance of transportation in logistics, this was the most measured and best integrated of the seven processes/capabilities. It is notable that more than a third still do not measure transportation internally, and nearly half (Unaware of 17% and Aware of 32%) do not capture intercompany measures of transportation (see Table 28).

**Table 28 Measurement of Transportation/Distribution**

| Process/Capability: | **Transportation/Distribution** | |
|---|---|---|
| Level of Sophistication | Within the Firm % | With Trading Partner % |
| Integration | 17 | 8 |
| Coordination | 30 | 19 |
| Measuring | 22 | 25 |
| Aware | 26 | 32 |
| Unaware | 5 | 17 |

Warehousing was the second most measured activity of the seven. However, the focus has been internally oriented. Sixty percent of respondents (Those who are Unaware or Unaware) have not yet begun to measure intercompany warehousing activities (see Table 29).

**Table 29 Measurement of Warehousing/Storage**

| Process/Capability: | **Warehousing/Storage** | |
|---|---|---|
| Level of Sophistication | Within the Firm % | With Trading Partner % |
| Integration | 16 | 6 |
| Coordination | 29 | 16 |
| Measuring | 25 | 19 |
| Aware | 23 | 41 |
| Unaware | 8 | 19 |

It is clear from earlier studies and findings that information technology is a concern and increasing focus of firms. The benefit of these information technologies has not been greatly realized within the firm and between companies (see Table 30).

**Table 30 Measurement of Information Capability**

| Process/Capability: | **Information Capability** | |
|---|---|---|
| | Within the Firm | With Trading Partner |
| Level of Sophistication | % | % |
| Integration | 12 | 4 |
| Coordination | 27 | 17 |
| Measuring | 22 | 25 |
| Aware | 30 | 38 |
| Unaware | 9 | 17 |

It could be argued that planning/forecasting/scheduling is the most critical process, with the capability of transcending multiple firms. Firms that demonstrate sophistication in this process have demonstrated a higher perceived competitive advantage. Still, many firms have not yet realized a capability in this important dimension of supply chain management (see Table 31).

**Table 31 Measurement of Planning/Forecasting/Scheduling**

| Process/Capability: | **Planning/Forecasting/Scheduling** | |
|---|---|---|
| | Within the Firm | With Trading Partner |
| Level of Sophistication | % | % |
| Integration | 9 | 4 |
| Coordination | 27 | 14 |
| Measuring | 24 | 24 |
| Aware | 30 | 39 |
| Unaware | 10 | 19 |

For every process/capability, it is obvious that sophistication in measurement has an internal focus. A paired samples t-test was conducted to determine if the level of measurement sophistication within the firm was significantly different from measurement between firms. For each of the seven pairs of within and between processes/capabilities a significance of 0.000 was calculated (see Table 32). Consequently, the data consistently support Hypothesis 11b, that firms are more focused on measurement of activities within the firm than between firms.

**Table 32 Internal Focus is Significantly Greater Than Intercompany Focus**

| | | Paired Samples T-Test | | | |
|---|---|---|---|---|---|
| Pair | Process/Capability | Valid N | Mean | Correlation | Sig. |
| 1 | Customer Service, Within & Customer Service, Between | 317 | 3.10<br>2.64 | 0.553 | 0.000 |
| 2 | Order Fulfillment, Within & Order Fulfillment, Between | 301 | 3.15<br>2.71 | 0.481 | 0.000 |
| 3 | Sourcing/Procurement, Within & Sourcing/Procurement, Between | 313 | 2.88<br>2.41 | 0.56 | 0.000 |
| 4 | Transportation/Distribution, Within & Transportation/Distribution, Between | 315 | 3.30<br>2.68 | 0.464 | 0.000 |
| 5 | Warehousing/Storage, Within & Warehousing/Storage, Between | 309 | 3.23<br>2.48 | 0.481 | 0.000 |
| 6 | Information Capability, Within & Information Capability, Between | 310 | 3.03<br>2.51 | 0.574 | 0.000 |
| 7 | Planning/Forecasting, Within & Planning/Forecasting, Between | 307 | 2.98<br>2.45 | 0.522 | 0.000 |

Hypothesis 12a: Managers perceive that the logistics measures used accurately capture specific aspects of the activities measured.

Respondents were asked to react to the statement: "The logistics measures we use currently accurately capture the events and activities being measured." The respondents indicated their degree of agreement or disagreement by use of a five-point scale, where 1 equaled "strongly agree" and 5 equaled "strongly disagree." For 344 valid responses, 69.5% were in agreement. Only 23% disagreed (see Figure 26).

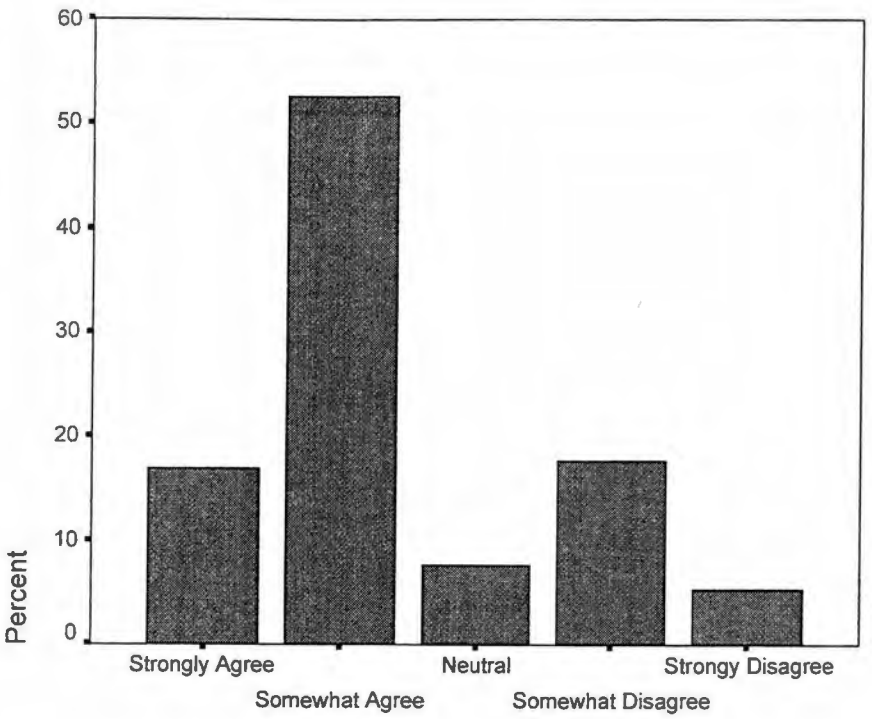



**Figure 26 Measures Accurately Capture Events**

A nonparametric chi-square test (chi-square value of 249.692, with four degrees of freedom, and asymptotic significance of 0.000) demonstrated that these differences were significant. The data support Hypothesis 12a.

Hypothesis 12b: Managers perceive that the logistics measures used provide actionable guidance for management.

Respondents were asked to react to the statement: "The logistics measures we use currently are understandable by the decision-makers in our company and provide a guide for action to be taken." The respondents indicated their degree of agreement or

disagreement by use of a five-point scale, where 1 equaled "strongly agree" and 5 equaled "strongly disagree." For 343 valid responses, 64.7% were in agreement. Only 21.6% of the respondents disagreed (see Figure 27). A nonparametric chi-square test (chi-square value of 193.574, with four degrees of freedom, and asymptotic significance of 0.000) demonstrated that these differences were significant. The data support Hypothesis 12b.

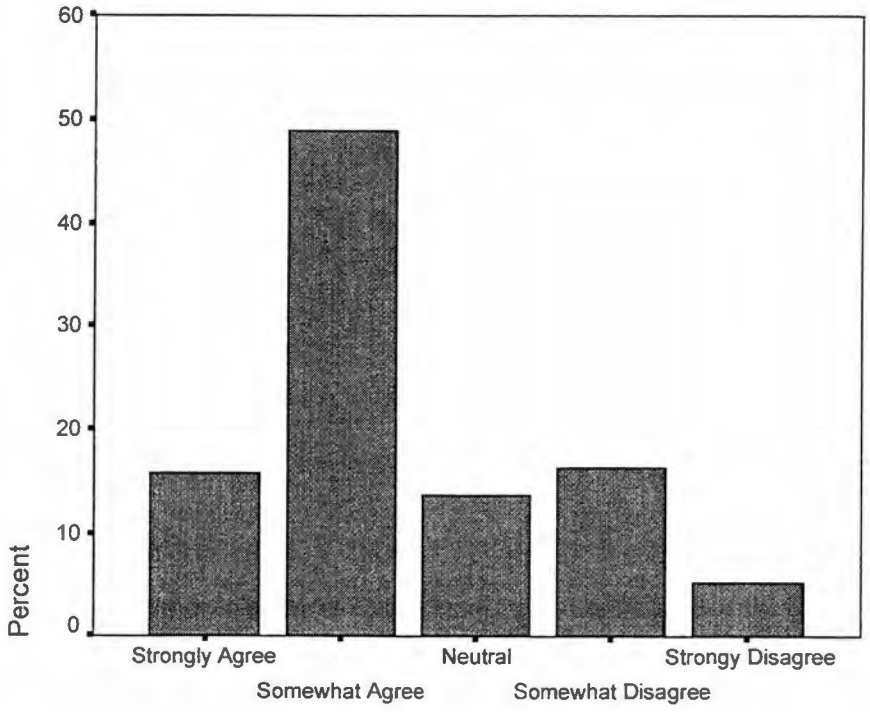



**Figure 27 Measures Are Understood By Decision Makers**

H12c: Managers perceive that the logistics measures used allow for comparability between it and other measures.

Respondents were asked to react to the statement: "The logistics measures we use currently are interpreted similarly by *internal* users, are repeatable, and are comparable across time, location and divisions." The respondents indicated their degree of agreement or disagreement by use of a five-point scale, where 1 equaled "strongly agree" and 5 equaled "strongly disagree." For 340 valid responses, 66.8% were in agreement. Only 23.5% of respondents disagreed with the statement (see Figure 28).

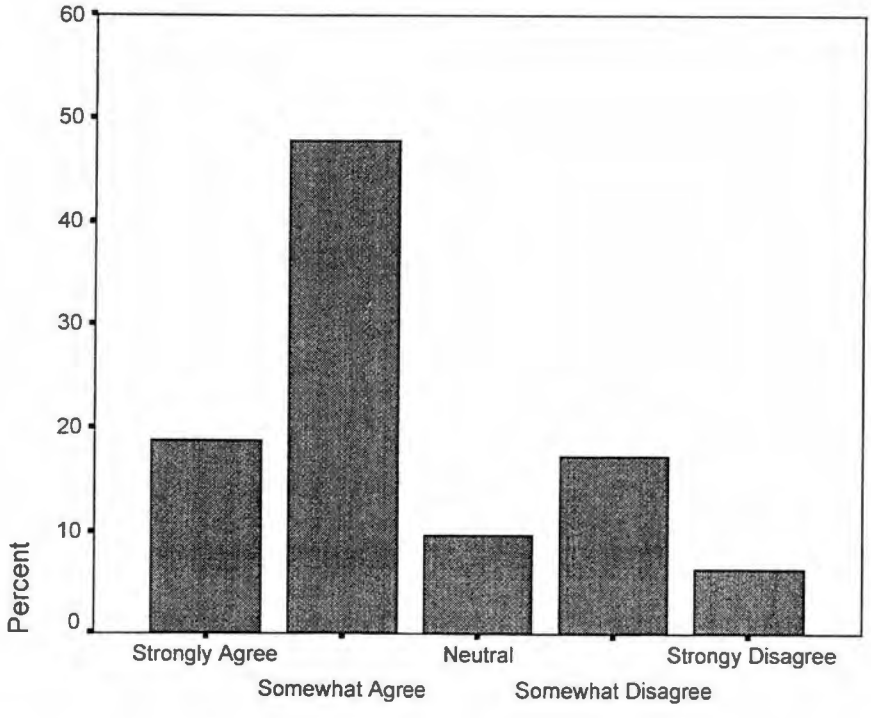



**Figure 28 Measures Are Interpreted Similarly By Internal Users**

A nonparametric chi-square test (chi-square value of 184.647, with four degrees of freedom, and asymptotic significance of 0.000) demonstrated that these differences were significant. It would appear that there is strong support for Hypothesis 12c. However, responses were different when external users were considered. Respondents were asked to react to the statement: "The logistics measures we use currently are interpreted similarly by *external* users, are repeatable, and are comparable across time, location and divisions." The respondents indicated their degree of agreement or disagreement by use of a five-point scale, where 1 equaled "strongly agree" and 5 equaled "strongly disagree." For 342 valid responses, only 34.2% were in agreement. There was a large neutral group of 31%. There were 34.8% who disagreed (see Figure 29).

A nonparametric chi-square test (chi-square value of 75.749, with four degrees of freedom, and asymptotic significance of 0.000) demonstrated that these differences were significant. While support for Hypothesis 12c can be found when considering users of measures *internal* to the firm, there is not strong agreement for interpretation and comparability of the firms measures with *external* entities. There is only partial, qualified support for Hypothesis 12c.

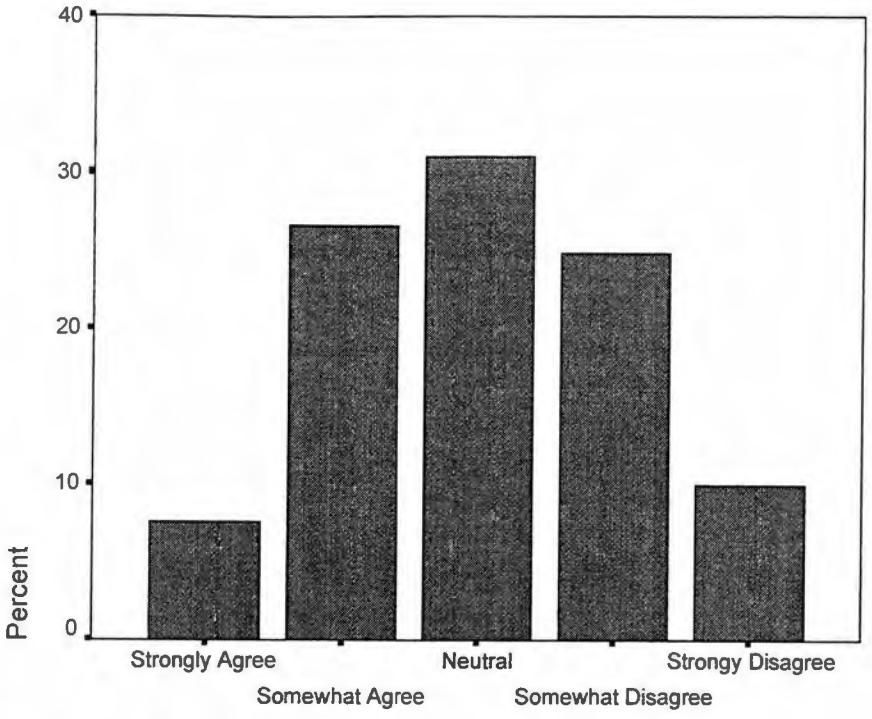



**Figure 29 Measures Are Interpreted Similarly By External Users**

Hypothesis 12d: Managers perceive that the logistics measures used promote coordination between managers of interdependent upstream and downstream flows.

Respondents were asked to react to the statement: "The logistics measures we use currently include all relevant aspects of the processes and promote coordination across functions and divisions." The respondents indicated their degree of agreement or disagreement by use of a five-point scale, where 1 equaled "strongly agree" and 5 equaled "strongly disagree." For 342 valid responses, only 33.9% were in agreement. There were 46.2% who disagreed (see Figure 30).

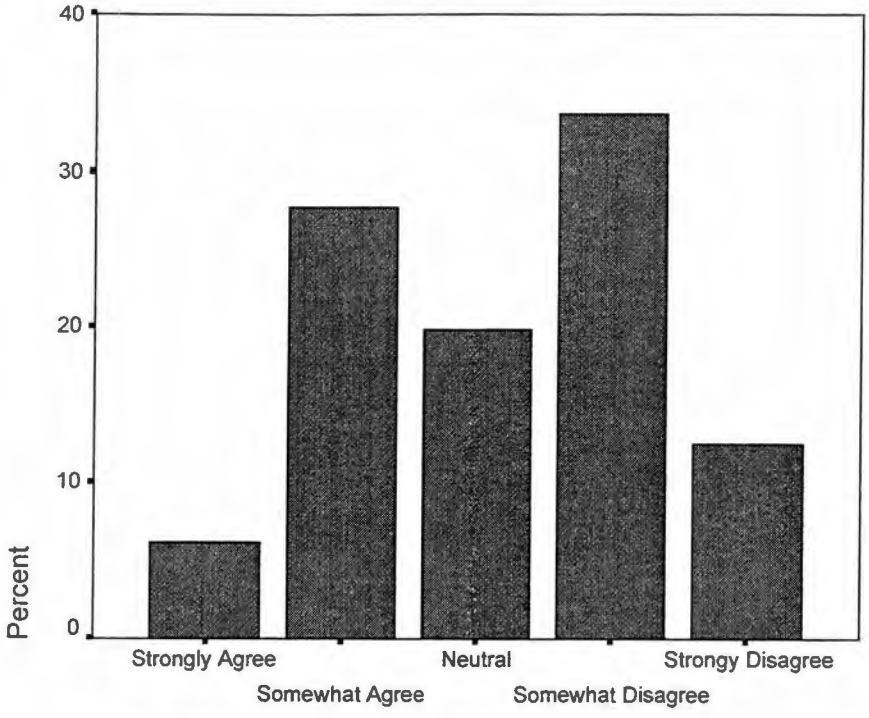



**Figure 30 Measures Include Relevant Aspects**

A nonparametric chi-square test (chi-square value of 84.374, with four degrees of freedom, and asymptotic significance of 0.000) demonstrated that these differences were significant. These findings do not support Hypothesis 12d. However, three other questions related to promotion of upstream and downstream coordination were asked, having to do with compatibility of the measures and whether they discouraged counter-productive behaviors.

Respondents were asked to react to the statement: "The logistics measures we use currently are compatible with existing *internal* information and systems in the organization." The respondents indicated their degree of agreement or disagreement by use of a five-point scale, where 1 equaled "strongly agree" and 5 equaled "strongly

disagree." For 340 valid responses, 59.7% were in agreement. Only 24.4% disagreed with the statement (see Figure 31). A nonparametric chi-square test (chi-square value of 182.618, with four degrees of freedom, and asymptotic significance of 0.000) demonstrated that these differences were significant.

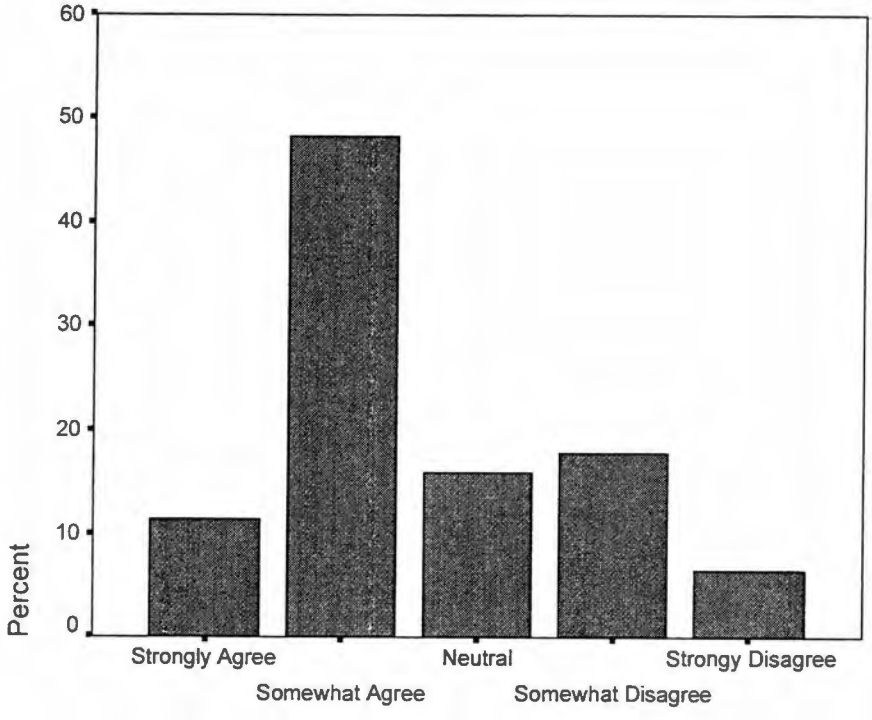



**Figure 31 Measures Are Compatible With Internal Information**

It would appear that there is some support for Hypothesis 12d. However, responses were different when external users were considered. Respondents were asked to react to the statement: " The logistics measures we use currently are compatible with existing *external* information and systems in the organization." The respondents

indicated their level of agreement or disagreement by use of a five-point scale, where 1 equaled "strongly agree" and 5 equaled "strongly disagree." For 341 valid responses, only 33.7% were in agreement. There was a large neutral group of 32%. There were 34.3% who disagreed (see Figure 32). A nonparametric chi-square test (chi-square value of 127.666, with four degrees of freedom, and asymptotic significance of 0.000) demonstrated that these differences were significant.

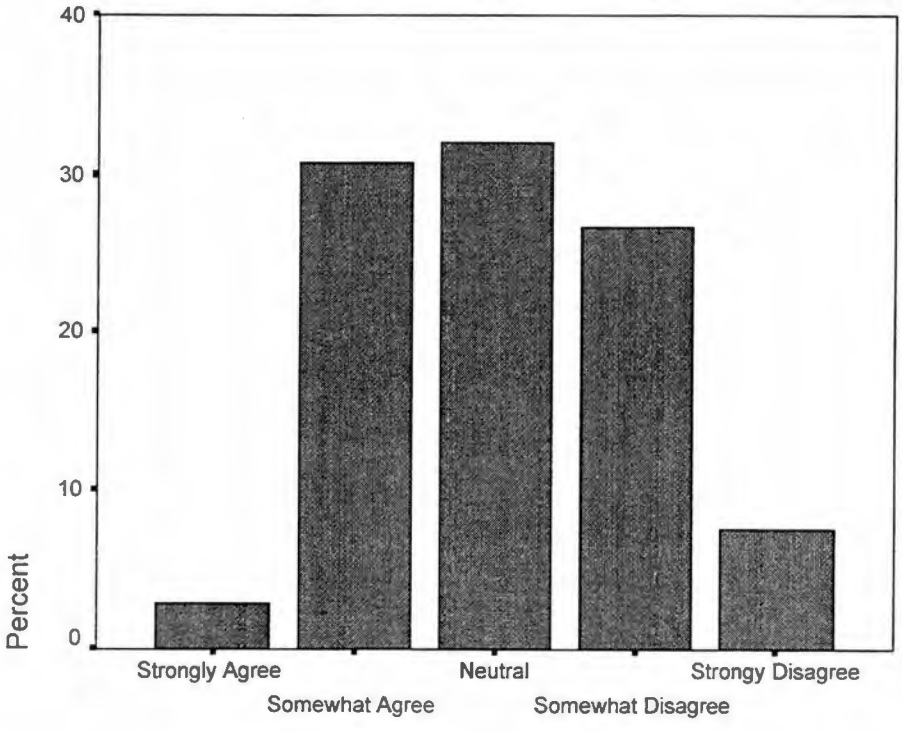



**Figure 32 Measures Are Compatible With External Information**

A final question related to the promotion of coordination was posed. Respondents were asked to react to the statement: "The logistics measures we use currently minimize incentives for counterproductive acts or game playing and are presented in a useful form." The respondents indicated their degree of agreement or disagreement by use of a five-point scale, where 1 equaled "strongly agree" and 5 equaled "strongly disagree." For 342 valid responses, 46.3% were in agreement. Only 27.6% disagreed with the statement (see Figure 33). A nonparametric chi-square test (chi-square value of 122.837, with four degrees of freedom, and asymptotic significance of 0.000) demonstrated that these differences were significant.

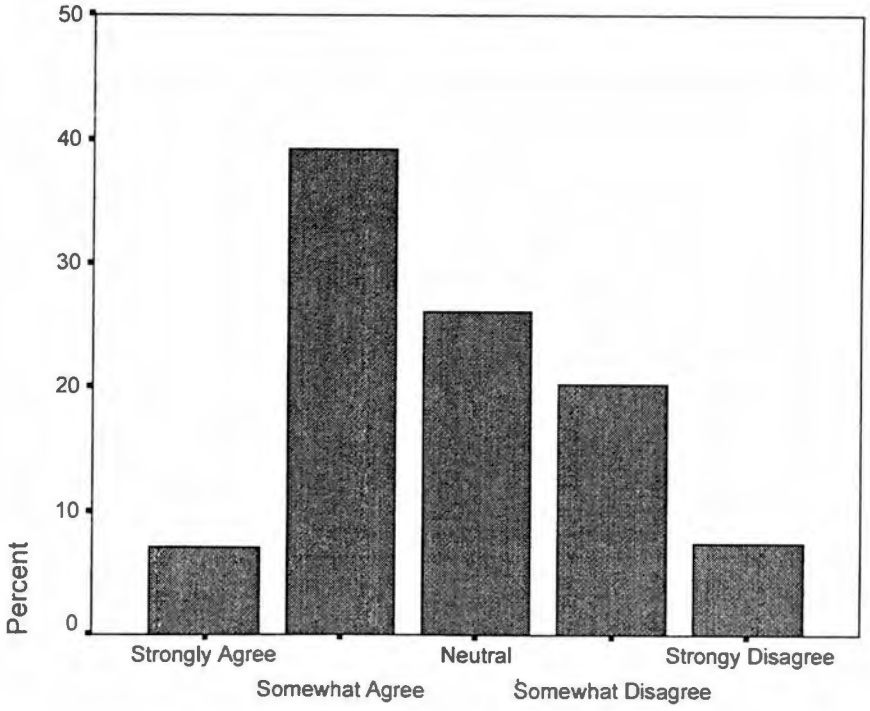



**Figure 33 Measures Minimize Incentives for Counterproductive Acts**

There is evidence that current measures are compatible internally and tend to minimize game playing. However, current measures do not succeed in promoting coordination with upstream and downstream flows, likely due to their incompatibility with external measurement systems. Hypothesis 12d is not supported.

Hypothesis 13a: The emphasis on logistics processes and logistics measurement varies according to the position of the firm in the supply chain relative to the steps removed from the consumer.

Respondents were given a choice of five selections to indicate their company's location in the extended supply chain for the majority of its goods or services. These were:

- Sells directly to the end consumer;
- Is one step removed from the end consumer;
- Is two steps removed from the end consumer;
- Is three steps removed from the end consumer; and
- Is primarily a service organization acting as a subcontractor to other businesses, and occupies multiple locations in multiple supply chains.

To determine if there were any statistically significant associations between a firm's location in the supply chain and the degree of measurement sophistication or emphasis, chi-square tests were conducted for each of the seven processes/capabilities.

Significant associations between supply chain position and logistics measurement sophistication occurred in six cases out of the fourteen possibilities (see Table 33).

The number of valid responses for five supply chain positions varied from 311 to 335. The supply chain position most represented was one step removed from the consumer. All positions were well represented except for that defined as three steps removed from the consumer, for which only nine valid responses were obtained. Interpretation of the chi-square analyses for this one group must be ignored due to inadequate numbers. Otherwise, associations can be interpreted.

**Table 33 Associations Between Measurement and Position in the Supply Chain**

| Significant Associations Between Position in the Supply Chain and the Sophistication of Measurement of Logistics Processes and Capabilities | | | |
|---|---|---|---|
| Processes/Capabilities | Pearson Chi Square Value | Degrees of Freedom | Asymptotic Significance |
| Sourcing/Procurement, Intracompany | 26.618 | 16 | 0.046 |
| Transportation/Distribution, Intracompany | 29.235 | 16 | 0.022 |
| Information Capability, Intracompany | 27.184 | 16 | 0.038 |
| Transportation/Distribution, Intercompany | 34.430 | 16 | 0.005 |
| Warehousing/Storage, Intercompany | 26.786 | 16 | 0.044 |
| Information Capability, Intercompany | 34.757 | 16 | 0.004 |

Results of the associations for supply chain positions and the internal sourcing/procurement process indicated that the location of the firm relative to the location of the end consumer does influence the level of measurement (see Table 34). This exploratory finding sheds new light on why some firms measure some activities more than other firms.

**Table 34 Measurement By Position for Intracompany Sourcing/Procurement**

| Sophistication of Measurement for Company Location within the Supply Chain | | | | | | |
|---|---|---|---|---|---|---|
| | **Sourcing/Procurement, Intracompany** | | | | | |
| Measurement Sophistication Level | Sell Directly to Consumer | One Step Removed from Consumer | 2 Steps Removed from Consumer | 3 Steps Removed from Consumer | Service Org/ Subcontractor | Total |
| | N= 70 % | N=123 % | N=88 % | N=9 % | N=41 % | N=331 % |
| Unaware | 14.3 | 6.5* | 14.8 | 11.1 | 24.4* | 12.7 |
| Aware | 31.4 | 29.3 | 22.7 | 22.2 | 31.7 | 28.1 |
| Measuring | 22.9 | 33.3* | 26.1 | 0.0 | 22.0 | 26.9 |
| Coordinating | 24.3 | 21.1 | 23.9 | 66.7 | 17.1 | 23.3 |
| Integrating | 7.1 | 9.8 | 12.5 | 0.0 | 4.9 | 9.1 |
| Total | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |
| * = significant | | | | | | |

Firms one step removed from the consumer are more likely to be measuring this process and less likely to be unaware of these activities for sourcing/procurement within the firm. Service organizations/subcontractors are more likely to be unaware of the activities.

Results of the associations for supply chain positions and the internal transportation/distribution process are as follows (see Table 35):

**Table 35 Measurement by Position for Intracompany Transportation**

| Sophistication of Measurement for Company Location within the Supply Chain | | | | | | |
|---|---|---|---|---|---|---|
| | **Transportation/Distribution, Intracompany** | | | | | |
| Measurement Sophistication Level | Sell Directly to Consumer | One Step Removed from Consumer | 2 Steps Removed from Consumer | 3 Steps Removed from Consumer | Service Org/ Subcontractor | Total |
| | N= 70 % | N=123 % | N=87 % | N=9 % | N=43 % | N=332 % |
| Unaware | 4.3 | 2.4* | 6.9 | 22.2 | 9.3 | 5.4 |
| Aware | 24.3 | 27.6 | 21.8 | 33.3 | 27.9 | 25.6 |
| Measuring | 21.4 | 22.8 | 25.3 | 11.1 | 16.3 | 22.0 |
| Coordinating | 21.4 | 37.4* | 31.0 | 33.3 | 20.9 | 30.1 |
| Integrating | 28.6* | 9.8 | 14.9 | 0.0 | 25.6* | 16.9 |
| Total | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |
| * = significant | | | | | | |

Firms one step removed from the consumer are more likely to be coordinating this process and less likely to be unaware of these activities for transportation/distribution within the firm. Companies that sell directly to the consumer and service organizations/subcontractors are more likely to be integrating transportation/distribution activities.

Results of the crosstabulation to determine associations for supply chain positions and internal information capabilities are as follows (see Table 36):

**Table 36 Measurement by Position for Intracompany Information Capability**

| Sophistication of Measurement for Company Location within the Supply Chain | | | | | | |
|---|---|---|---|---|---|---|
| | **Information Capability, Intracompany** | | | | | |
| Measurement Sophistication Level | Sell Directly to Consumer | One Step Removed from Consumer | 2 Steps Removed from Consumer | 3 Steps Removed from Consumer | Service Org/ Subcontractor | Total |
| | N= 70 % | N=121 % | N=85 % | N=9 % | N=44 % | N=329 % |
| Unaware | 14.3* | 5.0* | 11.8 | 22.2 | 4.5 | 9.1 |
| Aware | 18.6* | 38.0* | 28.2 | 11.1 | 31.8 | 29.8 |
| Measuring | 22.9 | 27.3 | 20.0 | 22.2 | 13.6 | 22.5 |
| Coordinating | 32.9 | 23.1 | 28.2 | 22.2 | 27.3 | 27.1 |
| Integrating | 11.4 | 6.6 | 11.8 | 22.2 | 22.7 | 11.6 |
| Total | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |
| * = significant | | | | | | |

Companies that sell directly to the consumer are more likely to be unaware and less likely to be aware, of these internal information capabilities. Firms one step removed from the consumer demonstrate the reverse. They are more likely to be aware and less likely to be unaware of these information capabilities within the firm.

Results of the associations for supply chain positions and the external transportation/distribution process are as follows (see Table 37):

**Table 37 Measurement by Position for Intercompany Transportation**

| Sophistication of Measurement for Company Location within the Supply Chain | | | | | | |
|---|---|---|---|---|---|---|
| | **Transportation/Distribution, Intercompany** | | | | | |
| Measurement Sophistication Level | Sell Directly to Consumer | One Step Removed from Consumer | 2 Steps Removed from Consumer | 3 Steps Removed from Consumer | Service Org/ Subcontractor | Total |
| | N= 66 % | N=120 % | N=84 % | N=9 % | N=39 % | N=318 % |
| Unaware | 18.2 | 19.2 | 15.5 | 11.1 | 12.8 | 17.0 |
| Aware | 27.3 | 35.8 | 34.5 | 22.2 | 23.1* | 31.8 |
| Measuring | 25.8 | 25.0 | 29.8 | 22.2 | 15.4 | 25.2 |
| Coordinating | 13.6 | 18.3 | 16.7 | 44.4 | 28.2 | 18.9 |
| Integrating | 15.2* | 1.7* | 3.6* | 0.0 | 20.5* | 7.2 |
| Total | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |
| * = significant | | | | | | |

Companies that sell directly to the consumer and service organizations/ subcontractors are more likely to be integrating intercompany transportation/ distribution. Interestingly, firms that are one step removed and two steps removed from the consumer demonstrate the reverse. They are less likely to be integrating transportation/distribution between firms.

Results of the crosstabulation to determine associations for supply chain positions and intercompany warehouse/storage activities are as follows (see Table 38):

**Table 38 Measurement by Position for Intercompany Warehousing**

| Sophistication of Measurement for Company Location within the Supply Chain | | | | | | |
|---|---|---|---|---|---|---|
| | **Warehousing/Storage, Intercompany** | | | | | |
| Measurement Sophistication Level | Sell Directly to Consumer | One Step Removed from Consumer | 2 Steps Removed from Consumer | 3 Steps Removed from Consumer | Service Org/ Subcontractor | Total |
| | N= 65 % | N=118 % | N=82 % | N=9 % | N=38 % | N=312 % |
| Unaware | 21.5 | 15.3 | 19.5 | 22.2 | 21.1 | 18.6 |
| Aware | 43.1 | 49.2* | 37.8 | 22.2 | 26.3* | 41.3 |
| Measuring | 23.1 | 17.8 | 20.7 | 11.1 | 13.2 | 18.9 |
| Coordinating | 7.7* | 15.3 | 15.9 | 44.4 | 23.7 | 15.7 |
| Integrating | 4.6 | 2.5* | 6.1 | 0.0 | 15.8 | 5.4 |
| Total | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |
| * = significant | | | | | | |

Companies that sell directly to the consumer less likely to be coordinating intercompany warehousing/storage. Companies that are one step removed are more likely to be aware of and less likely to be integrating warehousing/storage between companies. Service organizations/subcontractors are less likely to be aware of intercompany warehousing/storage issues.

Results of the chi-square test to determine associations for supply chain positions and internal information capabilities are as follows (see Table 39):

**Table 39 Measurement by Position for Intercompany Information Capability**

| Sophistication of Measurement for Company Location within the Supply Chain | | | | | | |
|---|---|---|---|---|---|---|
| | **Information Capability, Intercompany** | | | | | |
| Measurement Sophistication Level | Sell Directly to Consumer | One Step Removed from Consumer | 2 Steps Removed from Consumer | 3 Steps Removed from Consumer | Service Org/ Subcontractor | Total |
| | N= 66 % | N=119 % | N=82 % | N=8 % | N=40 % | N=315 % |
| Unaware | 22.7 | 15.1 | 18.3 | 12.5 | 10.0 | 16.8 |
| Aware | 36.4 | 44.5* | 31.7 | 12.5 | 37.5 | 37.8 |
| Measuring | 19.7 | 30.3 | 28.0 | 25.0 | 12.5* | 25.1 |
| Coordinating | 18.2 | 7.6* | 20.7 | 37.5 | 27.5* | 16.5 |
| Integrating | 3.0 | 2.5 | 1.2 | 12.5 | 12.5 | 3.8 |
| Total | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |
| * = significant | | | | | | |

Firms one step removed from the consumer are more likely to be aware of intercompany information capability, and less likely to be coordinating it. Service organizations/subcontractors are less likely to be measuring interfirm information capability but more likely to be integrating it. Based upon these findings, emphasis on logistics *processes* can vary depending on the firm's position in the supply chain. Therefore, Hypothesis 13a is supported.

To examine if there are statistically significant associations between supply chain position and thirty-seven specific logistics *measures*, a chi-square test was conducted. Significant associations with supply chain position were found for over half of the measures, largely due to inclusion of service organizations/subcontractors, who often do not deal with physical products the same way manufacturers, distributors and retailers do. Excluding that position category, as well as the small-numbered group three steps removed from the consumer, the chi-square tests revealed seven significance relationships between measurement and position in the supply chain (see Table 40).

Interpretations of significance, using only the three supply chain positions, are as follows:

- Cost to Serve
    - Direct sellers are more likely to capture this measure (N=69)
    - Firms two steps removed are less likely to capture this measure (N=87)
- Inquiry Response Time
    - Direct sellers are more likely to capture this measure (N=67)
    - Firms one step removed are less likely to capture this measure (N=129)

**Table 40 Associations Between Position and Capture of Measure**

| Chi-Square Tests - Statistically Significant Associations between Position in the Supply Chain and Capture of Measure | | |
|---|---|---|
| Measures | Asymptotic Significance | |
| | All Positions Considered | Only Direct, One and Two Steps Removed Considered |
| Returns and allowances | 0.000 | 0.602 |
| Inventory carrying cost | 0.001 | 0.717 |
| **Cost to serve** | 0.001 | 0.013 |
| **Inquiry response time** | 0.003 | 0.001 |
| Outbound freight cost | 0.003 | 0.686 |
| **Processing accuracy** | 0.006 | 0.001 |
| **Forecast accuracy** | 0.009 | 0.043 |
| Inventory count accuracy | 0.010 | 0.398 |
| Order fill | 0.018 | 0.879 |
| **Equipment utilization vs capacity** | 0.018 | 0.041 |
| **Labor utilization vs capacity** | 0.022 | 0.012 |
| Back orders | 0.023 | 0.695 |
| Inventory obsolescense | 0.023 | 0.799 |
| Finished goods inventory turns | 0.032 | 0.278 |
| Line item fill | 0.038 | 0.065 |
| Perfect order fulfillment | 0.038 | 0.116 |
| **Space utilization vs capacity** | 0.046 | 0.038 |
| Out of stocks | 0.050 | 0.225 |

- Forecast Accuracy

    - Direct sellers are less likely to capture this measure (N=68)

    - Firms one step removed are more likely to capture this measure (N=129)

- Processing Accuracy

    - Direct sellers are more likely to capture this measure (N=67)

    - Firms two steps removed are less likely to capture this measure (N=87)

- Space Utilization

    - Direct sellers are more likely to capture this measure (N=66)

    - Firms two steps removed are less likely to capture this measure (N=88)

-Labor Utilization

    - Direct sellers are more likely to capture this measure (N=68)

    - Firms one step removed are less likely to capture this measure (N=127)

- Equipment Utilization

    - Direct sellers are more likely to capture this measure (N=68)

    - Firms two steps removed are less likely to capture this measure (N=86)

This analysis demonstrates that the position of firms in the supply chain does affect the importance of specific logistics measures to them. This conclusion lends additional support for Hypothesis 13a.

Hypothesis 13b: Manufacturers emphasize downstream measurement more than upstream measurement.

One way to determine if manufacturers emphasize downstream measurement more than upstream measurement is to compare their levels of measurement sophistication for the order fulfillment process to that of the sourcing/procurement process. The data indicate that 76.7% of manufacturers measure and take action on measures for order fulfillment within the firm (i.e., they measure, coordinate or integrate) and 59.5% do so on an intercompany basis (see Table 41).

**Table 41 Manufacturers and Order Fulfillment**

| Business: **Manufacturing** Downstream Level of Sophistication | **Order Fulfillment** Within the Firm N=185 % | With Trading Partner N=180 % |
|---|---|---|
| Integration | 13.5 | 1.7 |
| Coordination | 28.6 | 16.1 |
| Measuring | 34.6 | 41.7 |
| Aware | 18.9 | 28.9 |
| Unaware | 4.3 | 11.7 |

The data indicate that 62.8% of these manufacturers measure and take action on measures for sourcing/fulfillment within the firm and 40.4% do so on an intercompany basis (see Table 42).

There was approximately fifty percent more measurement activity with trading partners by manufacturers in the fulfillment process (downstream) versus the

**Table 42 Manufacturers and Sourcing/Procurement**

| Business: **Manufacturing** Upstream Level of Sophistication | **Sourcing/Procurement** | |
|---|---|---|
| | Within the Firm N=188 % | With Trading Partner N=181 % |
| Integration | 7.4 | 2.8 |
| Coordination | 26.1 | 17.7 |
| Measuring | 29.3 | 19.9 |
| Aware | 27.7 | 32 |
| Unaware | 9.6 | 27.6 |

sourcing/procurement process (upstream), i.e., 59.5% versus 40.4%.

To determine if the proportions were significantly different, a paired samples t-test was performed comparing order fulfillment and sourcing /procurement mean scores for manufacturers. Three pairs were compared. Significant differences were found for each pair (see Table 43). This method of comparison supports Hypothesis 13b.

**Table 43 Paired Sample T-Test for Manufacturers**

| | | Paired Samples T-Test for Manufacturers | | | |
|---|---|---|---|---|---|
| Pair | Process/Capability | Valid N | Mean | Correlation | Sig. |
| 1 | Order Fulfillment, Within & | 179 | 3.27 | 0.492 | 0.000 |
| | Order Fulfillment, Between | | 2.67 | | |
| 2 | Sourcing/Procurement, Within & | 181 | 2.94 | 0.476 | 0.000 |
| | Sourcing/Procurement, Between | | 2.36 | | |
| 3 | Order Fulfillment, Between | 177 | 2.68 | 0.309 | 0.000 |
| | Sourcing/Procurement, Between | | 2.36 | | |

Hypothesis 13c: Retailers emphasize upstream measurement more than downstream measurement.

A way to determine if retailers emphasize upstream measurement more than downstream measurement is to compare their levels of measurement sophistication for the order fulfillment process to that of the sourcing/procurement process. The data indicate that 75.8% of retailers measure and take action on measures for order fulfillment within the firm and 58.1% do so on an intercompany basis (see Table 44).

The data indicate that 51.6% of these retailers measure and take action on measures for sourcing/fulfillment within the firm and 41.9% do so on an intercompany basis (see Table 45).

**Table 44 Retailers and Order Fulfillment**

| Business: **Retail/Merchandising** Downstream Level of Sophistication | **Order Fulfillment** Within the Firm N=33 % | With Trading Partner N=31 % |
|---|---|---|
| Integration | 6.1 | 9.7 |
| Coordination | 21.2 | 12.9 |
| Measuring | 48.5 | 35.5 |
| Aware | 21.2 | 32.3 |
| Unaware | 3 | 9.7 |

**Table 45 Retailers and Sourcing/Procurement**

| Business: **Retail/Merchandising** Upstream Level of Sophistication | **Sourcing/Procurement** Within the Firm N=33 % | With Trading Partner N=31 % |
|---|---|---|
| Integration | 6.1 | 3.2 |
| Coordination | 27.3 | 12.9 |
| Measuring | 18.2 | 25.8 |
| Aware | 36.4 | 35.5 |
| Unaware | 12.1 | 22.6 |

To determine if the proportions were significantly different, a paired samples t-test was performed comparing order fulfillment and sourcing /procurement mean scores for retailers. Three pairs were compared. A significant difference was found for only the sourcing/procurement process (see Table 46). Since no significant difference was found comparing retailer measurement with trading partners upstream (sourcing/procurement) versus downstream (order fulfillment), Hypothesis 13c is not supported.

**Table 46 Paired Sample T-Test for Retailers**

| | | Paired Samples T-Test for Retailers | | | |
|---|---|---|---|---|---|
| Pair | Process/Capability | Valid N | Mean | Correlation | Sig. |
| 1 | Order Fulfillment, Within & | 31 | 3.06 | 0.304 | 0.244 |
| | Order Fulfillment, Between | | 2.81 | | |
| 2 | Sourcing/Procurement, Within & | 31 | 2.77 | 0.646 | 0.031 |
| | Sourcing/Procurement, Between | | 2.39 | | |
| 3 | Order Fulfillment, Between | 31 | 2.81 | 0.369 | 0.068 |
| | Sourcing/Procurement, Between | | 2.39 | | |

Hypothesis 13d: Distributors tend to balance their emphasis on upstream and downstream measurement.

To determine if distributors tend to balance their emphasis on upstream and downstream measurement, levels of measurement sophistication for the order fulfillment process were compared to that of the sourcing/procurement process. The data indicate that 54.5% of distributors measure and take action on measures for order fulfillment within the firm and 48.4% do so on an intercompany basis (see Table 47).

**Table 47 Distributors and Order Fulfillment**

| Business: **Distributor/Wholesaler** Downstream Level of Sophistication | **Order Fulfillment** Within the Firm N=33 % | With Trading Partner N=31 % |
|---|---|---|
| Integration | 12.1 | 3.2 |
| Coordination | 18.2 | 12.9 |
| Measuring | 24.2 | 32.3 |
| Aware | 42.4 | 35.5 |
| Unaware | 3 | 16.1 |

The data indicate that 69.7% of these distributors measure and take action on measures for sourcing/fulfillment within the firm (add the percentage that measure, coordinate, and integrate) and 37.6% do so on an intercompany basis (see Table 48). In other words, seventy percent of respondents have an active measurement program internally on sourcing and procurement issues but less than forty percent do so on sourcing and procurement issues with their suppliers.

**Table 48 Distributors and Sourcing/Procurement**

| Business: **Distributor/Wholesaler** Upstream Level of Sophistication | **Sourcing/Procurement** Within the Firm N=33 % | With Trading Partner N=32 % |
|---|---|---|
| Integration | 18.2 | 6.3 |
| Coordination | 30.3 | 12.5 |
| Measuring | 21.2 | 18.8 |
| Aware | 24.2 | 31.3 |
| Unaware | 6.1 | 31.3 |

To determine if the proportions were significantly different, a paired samples t-test was performed comparing order fulfillment and sourcing /procurement mean scores for distributors. Three pairs were compared. Significant difference was found for the within and between mean scores for the upstream and downstream processes. However, since no significant difference was found comparing measurement emphasis on fulfillment versus sourcing, the data tend to support Hypothesis 13d (see Table 49).

**Table 49 Paired Sample T-Test for Distributors**

| | | Paired Samples T-Test for Distributors | | | |
|---|---|---|---|---|---|
| Pair | Process/Capability | Valid N | Mean | Correlation | Sig. |
| 1 | Order Fulfillment, Within & | 31 | 3.00 | 0.237 | 0.049 |
| | Order Fulfillment, Between | | 2.52 | | |
| 2 | Sourcing/Procurement, Within & | 32 | 3.34 | 0.468 | 0.000 |
| | Sourcing/Procurement, Between | | 2.31 | | |
| 3 | Order Fulfillment, Between | 31 | 2.52 | 0.246 | 0.524 |
| | Sourcing/Procurement, Between | | 2.35 | | |

Hypothesis 14a: The use of technology is positively associated with the degree of performance measurement.

Respondents who said they were implementing or had completed implementation of any of ten supply chain technologies were grouped and compared with those who were not using these technologies. The ten technologies are:

- ERP (Enterprise Resource Planning)
- TMS (Transportation Management System)
- WMS (Warehouse Management System)
- MRP/DRP (Material/Distribution Requirements Planning)
- APS (Advanced Planning and Scheduling)
- ABC/ABM (Activity Based Costing/Management)

- EDI (Electronic Data Interchange)

- Use of Internet with customers/suppliers

- Use of Internet for Business-to-Business transactions

- Scanner/Bar Coding/POS (Point of Sale Systems

These ten technologies were crosstabulated with the levels of sophistication of measurement of the seven logistics processes/capabilities for both groups, i.e., implemented versus not implemented. Twenty-two statistically significant associations were found (see Table 50).

There were three significant associations involving ERP technology. Firms that use ERP are more sophisticated in measurements involving order fulfillment, information capabilities, and planning within the firm. ERP technology appears not to be significant for intercompany process measurement.

There were two significant associations involving TMS technology. Firms that use TMS are more sophisticated in measurements involving order fulfillment and information capabilities within the firm. It is notable that TMS technology does not affect the level of measurement sophistication for the transportation/distribution process. TMS technology appears not to be significant for intercompany process measurement.

There were four significant associations involving WMS technology. Firms that use WMS are more sophisticated in measurements involving order fulfillment, transportation/distribution, and warehousing/storage activities within the firm. WMS technology is also associated with enhanced sophistication of intercompany warehousing/storage measurement.

## Table 50 Technology and Measurement Sophistication

| Significant Associations Between Technology Use and Sophistication of Measurement | | | | | | | |
|---|---|---|---|---|---|---|---|
| Technology | Customer Service | Order Fulfillment | Sourcing/ Procurement | Transportation/Distribution | Warehousing/ Storage | Information Capability | Planning /Forecasting/ Scheduling |
| Intracompany | | | | | | | |
| ERP | No | YES | No | No | No | YES | YES |
| TMS | No | YES | No | No | No | YES | No |
| WMS | No | YES | No | YES | YES | No | No |
| MRP/ DRP | No | No | No | No | No | No | No |
| APS | No | No | No | No | YES | No | YES |
| ABC/ ABM | No | No | No | No | No | No | No |
| EDI | No | No | No | No | No | No | No |
| Internet | No | No | No | No | No | No | No |
| Internet B To B | No | YES | YES | No | No | No | No |
| Scanner POS | YES | No | No | No | YES | No | No |
| Intercompany | | | | | | | |
| ERP | No | No | No | No | No | No | No |
| TMS | No | No | No | No | No | No | No |
| WMS | No | No | No | No | YES | No | No |
| MRP/ DRP | No | No | No | No | No | No | No |
| APS | No | No | YES | No | No | No | YES |
| ABC/ ABM | YES | YES | No | No | YES | YES | No |
| EDI | No | No | No | No | No | No | No |
| Internet | No | No | No | No | No | No | No |
| Internet B To B | No | No | No | No | No | No | YES |
| Scanner POS | No | No | No | No | No | No | No |

MRP/DRP technology is not associated with any difference in measurement sophistication within or between firms.

There were four significant associations involving APS technology. Firms that use APS are more sophisticated in measurements involving warehousing and planning within the firm and sourcing/procurement and planning between firms.

There were four significant associations involving ABC/ABM technology, notably all on an intercompany basis. Firms that use ABC/ABM are more sophisticated in measurements involving customer service, order fulfillment, warehousing and information capability between firms.

EDI technology is not associated with any difference in measurement sophistication within or between firms. Using Internet technology to exchange information with customers or suppliers is also not associated with any difference in measurement sophistication within or between firms. However, using Internet Business-to-Business transaction technology is associated with more sophisticated measurement internally, with order fulfillment and sourcing/procurement, and externally, with planning, forecasting and scheduling.

There were two significant associations involving Scanner/POS technology. Firms that use Scanner/POS technology are more sophisticated in measurements involving customer service and warehousing/storage within the firm.

Because only 22 of the 140 chi-square tests of associations revealed significance, there is only weak support for Hypothesis 14a. Only in the case of ABC/ABM, on an intercompany basis, is there limited support of this hypothesis.

Hypothesis 14b: The use of technology is positively associated with a perceived competitive advantage.

Respondents were placed into two groups. Those who had implemented or were in the process of implementing the particular technology were in one group. Those who were not implementing the technology were placed into a second group. The ten technologies were crosstabulated with the seven logistics processes/capabilities to determine associations with claimed advantage or disadvantage (see Table 51).

**Table 51 Technology and Competitive Advantage**

| Significant Associations Between Technology Use and Perceived Competitive Advantage | | | | | | | |
|---|---|---|---|---|---|---|---|
| Technology | Customer Service | Order Fulfillment | Sourcing/ Procurement | Transportation/Distribution | Warehousing/ Storage | Information Capability | Planning /Forecasting/ Scheduling |
| ERP | No | No | No | No | No | No | No |
| TMS | No | No | No | No | No | No | No |
| WMS | No | No | YES | No | YES | No | No |
| MRP/ DRP | No | No | No | No | No | No | No |
| APS | No | No | No | No | No | No | No |
| ABC/ ABM | No | No | No | No | No | No | No |
| EDI | No | No | No | No | No | No | No |
| Internet | No | No | No | No | No | No | No |
| Internet B To B | No | No | No | No | No | No | No |
| Scanner POS | No | No | No | No | No | No | No |

There were only two significant associations, both involving Warehouse Management Systems (WMS) technology. Firms that are implementing or have implemented WMS are *less* likely to have a perceived advantage in sourcing/ procurement and *more* likely to have an advantage in warehousing/storage. Otherwise, having technology has no effect on the firm's perceived competitiveness internal information capability. Hypothesis 14b is not supported.

**Recap of Hypotheses and Findings**

H1: Key performance measures, as identified by senior supply chain or logistics managers, are not being captured, even though they are perceived to be important to their firm and to their customers.

Supported.

H2: Firms that have implemented ABC have a higher perceived competitive advantage over those firms that have not implemented ABC.

Not supported.

H3a: Primary financial measures that drive decision-making in firms are more likely to be related to margin management rather than to asset management.

Supported.

H3b: Primary financial measures that drive decision-making in firms are more likely to be related to margin management rather than to financial measures that integrate the income statement and balance sheet.

Supported.

H3c: Cash flow measures are not often used as a primary financial measure for decision-making.

Supported.

H4: Firms that have alignment in their logistics and business strategy will have a better-perceived competitive advantage than firms that do not.

Inconclusive.

H5: Different business strategies will be associated with different logistics measures.

Not supported.

H6a: Firms that have a coordinated or integrated planning process are more likely to measure key logistics processes within the firm.

Supported.

H6b: Firms that have a coordinated or integrated planning process are more likely to measure key logistics processes between it and trading partners.

Supported.

H6c: Firms that have a coordinated or integrated planning process have a better-perceived competitive advantage than firms that do not.

Partially supported.

H7a: Firms with a wide span of control are more likely to follow a low-cost business strategy.

Not supported.

H7b: Firms with a narrow span of control are more likely to follow a differentiation or service strategy.

Not supported.

H8: The size of firm will be related to the type of business strategy, larger firms will tend to follow low-cost strategies and smaller firms will tend to follow service, or differentiation, strategies.

Not supported.

H9: The firms with wide spans of control are more likely to demonstrate greater coordination and integration of logistics processes.

Not supported.

H10a: Firms with a low-cost strategy will focus internally and emphasize cost measures relative to other measures of logistics performance.

Not supported.

H10b: Firms with a differentiation or service strategy will focus externally and emphasize measures other than cost.

Not supported.

H11a: Firms are more focused on internal measures of efficiency (i.e., productivity and utilization) than on measures of effectiveness (i.e., planned performance and outcomes).

Not supported.

H11b: Firms are more focused on measurement of activities or processes within the firm than on activities or processes between firms.

Supported.

H12a: Managers perceive that the logistics measures used accurately capture specific aspects of the activities measured.

Supported.

H12b: Managers perceive that the logistics measures used provide actionable guidance for management.

Supported.

H12c: Managers perceive that the logistics measures used allow for comparability between it and other measures.

Partially supported.

H12d: Managers perceive that the logistics measures used promote coordination between managers of interdependent upstream and downstream flows.

Not supported.

H13a: The emphasis on logistics processes and logistics measurement varies according to the position of the firm in the supply chain relative to the steps removed from the consumer.

Supported.

H13b: Manufacturers emphasize downstream measurement more than upstream measurement.

Supported

H13c: Retailers emphasize upstream measurement more than downstream measurement.

Not supported.

H13d: Distributors tend to balance their emphasis on upstream and downstream measurement.

Supported.

H14a: The use of technology is positively associated with the degree of performance measurement.

Partially supported.

H14b: The use of technology is positively associated with a perceived competitive advantage.

Not supported.

**Additional Findings from the Mail Survey**

The mail survey provided data not directly related to the many hypotheses tested in this chapter. Many interesting questions were generated that were addressed by a post hoc analysis. These interesting findings are not associated with a specific hypothesis. They are descriptive and exploratory. They provide a better understanding of the impact of various antecedents and moderators of the state of logistics measurement. They have to do with differences in measurement based upon:

(1) three different views of the logistics organization;

(2) the relative importance of measurement as a management issue;

(3) the degree of use of available technologies that could support logistics measurement;

(4) the degree of advantage or disadvantage claimed in key logistics capabilities;

(5) the perception of enablers and barriers to logistics measurement;

(6) the amount of business segmentation done by logistics organizations;

(7) the quality of measures captured; and

(8) the size of firm and perceived competitive advantage.

Different Views of Logistics by Business Type

Most manufacturing firms view their logistics function as a cost center. Only 3% of manufacturers view the logistics function as a profit center (see Table 52).

**Table 52 How Logistics Is Viewed By the Organization**

| How is Logistics Viewed? | Manufacturers | Distributors | Retailers |
|---|---|---|---|
| | % | % | % |
| Cost Center | 55 | 31 | 54 |
| Profit Center | 3 | 36 | 11 |
| Service Center | 40 | 31 | 31 |
| Other | 4 | 1 | 3 |

Distributors, on the other hand, view their logistics function more often as a profit center. In fact, while the percentages in Table 43 show a balanced distribution across cost, profit and service centers, a chi-square test showed that Distributors are significantly more likely to view logistics as a profit center.

Crosstabulations of how logistics is viewed by the organization with measurement of the seven logistics processes produced no significant associations.

Crosstabulations of how logistics is viewed by the organization with the claim of competitive advantage in the seven logistics processes did produce significant associations. In five of the processes/capabilities - customer service, order fulfillment, warehousing/storage, information capability, and planning/forecasting/scheduling - Profit Centers are more likely to claim a perceived advantage than Cost Centers or Service Centers. No significant differences were found for sourcing/procurement or transportation/distribution processes.

The Importance of Measurement as a Management Issue

Logistics measurement was not considered a top management issue facing the organization by most of the respondents. Only sixteen percent said logistics measurement within the company was in their top three issues (see Table 53).

**Table 53 Measurement as a Top Management Issue**

| Important Logistics Issues Facing the Organization (Selected as One of Three Most Important Issues) | | |
|---|---|---|
| | | Ranked in Top Three by |
| 1 | Cost control/cost reduction | 55% |
| 2 | Information technology utilization | 48% |
| 3 | Improving customer service processes | 38% |
| 4 | Cycle time reduction | 28% |
| 5 | Strategic alliances with customers/suppliers | 28% |
| 6 | Changing organizational structure | 17% |
| **7** | **Logistics measurement within the company** | 16% |
| 8 | Expanding distribution into new channels/markets | 15% |
| 9 | Quality improvement | 12% |
| **10** | **Logistics measurement between company and customers/suppliers** | 11% |
| 11 | Outsourcing | 10% |
| 12 | Integrating with internet-based customer ordering systems | 9% |
| 13 | Logistics support for global market expansion | 8% |

Given the need for emphasis on the processes that interface with customers and suppliers, it is remarkable that only 11% of the respondents placed this capability it their top three priorities. Supply chain management requires interfirm measurement.

The Use of Technology

Respondents indicated the degree to which they have planned or implemented various technologies that could facilitate logistics measurement. Most firms were not considering the use of enabling technologies such as Advanced Planning and Scheduling or Activity Based Costing (see Table 54).

**Table 54 Use of Technology**

| Technology | No Planned Implementation % | Planning Implementation % | Implementation Underway % | Implementation Completed % |
|---|---|---|---|---|
| ERP | 52 | 16 | 23 | 10 |
| TMS | 42 | 25 | 17 | 16 |
| WMS | 28 | 25 | 19 | 28 |
| MRP/ DRP | 33 | 15 | 19 | 33 |
| APS | 56 | 27 | 9 | 9 |
| ABC/ ABM | 56 | 24 | 9 | 11 |
| EDI | 9 | 14 | 29 | 49 |
| Internet | 13 | 33 | 31 | 23 |
| Internet B To B | 27 | 37 | 22 | 34 |
| Scanner POS | 22 | 22 | 21 | 12 |

Competitive Advantage by Key Logistics Capability

Respondents indicated their perception of their company's level of performance compared to its primary competitor in seven logistics capabilities. Five selection choices were available, from "major advantage" to "major disadvantage." Those

percentage of respondents claiming either a "major advantage" or "advantage" were compared to the percentage claiming "disadvantage" or "major disadvantage" (see Table 55).

Respondents most often claimed an advantage in Customer Service and Transportation/Distribution. Planning/Forecasting/Scheduling and Information Capability were least often claimed as competitive advantages and most often claimed as competitive disadvantages.

**Table 55 Performance Compared to Competitor**

| Comparison of Performance to Primary Competitor | | |
|---|---|---|
| Process/Capability | "Advantage" % | "Disadvantage" % |
| Customer Service | 59 | 8 |
| Order Fulfillment | 49 | 10 |
| Sourcing/Procurement | 37 | 11 |
| Transportation/Distribution | 54 | 8 |
| Warehousing/Storage | 43 | 12 |
| Information Capability | 44 | 27 |
| Planning/Forecasting/Scheduling | 28 | 23 |

Enablers and Barriers to Logistics Measurement

Respondents were asked to rate several factors as being neutral, a barrier, or an enabler of their ability to develop and use logistics measures *within* their company. Interestingly, only a few factors stood out as primarily one or the other (see Table 56).

**Table 56 Enablers and Barriers Within the Firm**

| Factor | % Said Enabler | % Said Barrier |
|---|---|---|
| Upper Management Support | 74 | 11 |
| Resourse Availability in My Function/Department | 60 | 24 |
| Skill Set of Employees | 50 | 24 |
| Ability to Obtain Priority for Logistics Projects | 46 | 29 |
| Resourse Availability in I.T. Function | 43 | 46 |
| Accuracy of Information Available | 43 | 39 |
| Timliness of Information | 42 | 29 |
| Acceptance/Resistance to Change | 40 | 34 |
| Organizational Culture | 39 | 33 |
| Availability of Information | 37 | 43 |
| Budget | 32 | 33 |
| Other Departments | 27 | 27 |

Respondents were asked to rate several factors as being neutral, a barrier, or an enabler of their ability to develop and use logistics measures *between* their company and trading partners. Again, only a few factors stood out as primarily one or the other (see Table 57)

**Table 57 Enablers and Barriers Between Firms**

| Factor | % Said Enabler | % Said Barrier |
|---|---|---|
| Upper Management Support | 57 | 16 |
| Trust | 45 | 27 |
| Availability of Information | 44 | 45 |
| Accuracy of Information Exchanged | 38 | 34 |
| Timliness of Information | 36 | 36 |
| Resourse Availability to Maintain Measures | 31 | 50 |
| Industry Standards | 31 | 15 |
| Organizational Cultures | 28 | 36 |
| Compatibility of I.T. Systems | 26 | 52 |
| Acceptance/Resistance to Change | 26 | 39 |
| Trade Associations | 25 | 5 |
| Multiple Definitions Among Customers | 17 | 51 |

Having multiple definitions for such things as "on-time delivery" is a major barrier to measurement that facilitates performance improvement. Measures should have identifiable owners and customers, so that agreement can be reached on (1) what should be measured, (2) how it should be measured, and (3) a standard of expected performance.

Business Segmentation Done by Logistics Organizations

Respondents were asked if their firm segmented four components of its business transactions, i. e., differentiated services and costs associated with different (1)

customers; (2) finished goods products; (3) suppliers; or (4) purchased materials. Sixty-five percent said they segmented based on customers and sixty-three percent said they segmented on finished goods products. Less segmentation was done for procurement than for fulfillment. Fifty-three percent said they segmented based on suppliers and fifty-five said they segmented based on purchased items.

Crosstabulations for segmentation and measurement were performed. Twelve significant associations were found (see Table 58).

No associations were produced for segmentation by customer. Whether a firm differentiates among customers does not affect the likelihood that logistics measures are captured. Four associations were found for segmentation by finished goods stock keeping units (SKUs), three for segmentation by suppliers, and five for segmentation by purchased items. In every case of association, those firms that segmented were more likely to measure the logistics processes/capabilities indicated.

No associations were found for segmentation and likelihood of claiming a competitive advantage except in two cases. Firms that segmented suppliers were more likely to claim an advantage in Information Capability and Planning/Forecasting/ Scheduling.

**Table 58 Association Between Segmentation and Measurement**

| Significant Associations Between Segmentation and Measurement | | | | |
|---|---|---|---|---|
| Process/Capability | Segmentation | | | |
| | Customers | Finished Goods SKUs | Suppliers | Purchased Items /Materials |
| Intracompany | | | | |
| Customer Service | No | No | No | YES |
| Order Fulfillment | No | YES | No | YES |
| Sourcing/ Procurement | No | YES | YES | YES |
| Transportation/Distribution | No | No | No | No |
| Warehousing/ Storage | No | YES | No | No |
| Information Capability | No | No | No | No |
| Planning/ Forecasting/Scheduling | No | No | YES | YES |
| Intercompany | | | | |
| Customer Service | No | No | No | YES |
| Order Fulfillment | No | YES | No | No |
| Sourcing/ Procurement | No | No | No | No |
| Transportation/Distribution | No | No | No | No |
| Warehousing/ Storage | No | No | No | No |
| Information Capability | No | No | No | No |
| Planning /Forecasting/Scheduling | No | No | YES | No |

The Quality of Logistics Measures

The research findings indicated that a large percent of firms capturing measures fail to take action on them. Could this be due to a lack of confidence in the quality of measures captured? Survey respondents commented on twelve statements about the quality of logistics measurements. Using a five-point scale, with 1 equal to "strong agreement" and 5 equal to "strong disagreement," the results provide the following observations:

(1) one-quarter of measures captured are not accurate;

(2) one-fifth of measures captured are not interpreted similarly within the firm;

(3) one-third of measures captured are not interpreted similarly between firms;

(4) one-fifth of measures captured are not readily understandable to guide actions;

(5) two-fifths of measures captured are not comprehensive;

(6) one-fifth of measures captured are not cost effective;

(7) one-quarter of measures captured are not compatible internally;

(8) one-third of measures captured are not compatible between firms;

(9) one-quarter of measures captured are not compatible with cash flow measures; and

(10) one-quarter of measures captured encourage counter-productive behaviors.

Size of the Firm and Perceived Competitive Advantage

Perhaps due to greater resources or the demands of greater complexity, firms larger than $500 million in annual revenue are significantly more likely to measure key logistics processes/capabilities than smaller firms (see Table 59).

**Table 59 Company Size and Capture of Measure**

| Chi-Square Tests - Statistically Significant Associations between Size of Firm and Capture of Measure (Smaller Firms < $500 million Sales > Larger Firms) | | |
|---|---|---|
| Process/Capability | Asymptotic Significance | Firm Size More Likely to Capture Measure |
| Intracompany | | |
| Customer Service | 0.019 | Larger |
| Order Fulfillment | 0.005 | Larger |
| Sourcing/Procurement | 0.000 | Larger |
| Transportation/Distribution | 0.002 | Larger |
| Warehousing/Storage | 0.001 | Larger |
| Information Capability | 0.014 | Larger |
| Planning/Forecasting/Scheduling | 0.000 | Larger |
| Intercompany | | |
| Customer Service | 0.026 | Larger |
| Order Fulfillment | 0.004 | Larger |
| Sourcing/Procurement | 0.026 | Larger |
| Transportation/Distribution | 0.002 | Larger |
| Warehousing/Storage | 0.023 | Larger |
| Information Capability | Not | Neither |
| Planning/Forecasting/Scheduling | 0.010 | Larger |

There were no significant associations found between the size of the firm and perceived competitive advantage for any of the seven logistics processes/capabilities. Larger firms have no perceived competitive advantage over smaller firms, even though they are more likely to capture logistics measures.

**Summary of Findings**

In this chapter the testing of all hypotheses was reviewed. Post hoc analyses produced additional relevant findings. Major findings supported by these analyses are:

(1) Logistics measurement is generally not considered to be one of the important issues facing the organization.

(2) Key logistics performance measures are not captured by a large percentage of firms, even though they are perceived to be important to the firm and to its customers.

(3) Even though a logistics performance measure is captured, organizations often fail to take action based upon the value of the measure.

(4) The quality of measures captured is often perceived to be deficient.

(5) Firms are more focused on measurement of activities or processes within the firm than on activities or processes between firms.

(6) The position of the firm in its dominant supply chain influences what it measures.

(7) Technologies that would facilitate measurement are not being considered for implementation by a large percentage of companies.

(8) Logistics organizations viewed as Profit Centers are more likely to claim a competitive advantage in logistics processes/capabilities than Cost Centers or Service Centers.

(9) Firms that have a coordinated or integrated Planning/Forecasting/ Scheduling process are more likely to measure logistics performance than other firms.

(10) Larger firms are more likely to measure logistics processes/capabilities than smaller firms.

(11) Smaller companies are more likely to pursue a business strategy of Tailored, Personalized Service than larger companies.

(12) Firms with a Low Cost business strategy are more likely to have wide spans of control in Logistics than narrow spans of control.

(13) Firms with a narrow span of control in Logistics are more likely to coordinate Transportation, Warehousing and Information processes with trading partners than firms with wide spans of control in Logistics.

(14) Top management support is seen as the greatest enabler of logistics performance measurement.

(15) The primary financial measures that drive decision making in organizations are related to Margin Management.

What does all this mean? The conclusions and implications of this research are discussed in Chapter 5. Contributions of this research and areas for future research are also covered in the next, and concluding, chapter.

# CHAPTER 5

# CONCLUSIONS

This chapter presents (1) conclusions based on the research findings; (2) implications for researchers and practitioners; (3) major contributions of this research to developing and testing theory in logistics performance; (4) strengths and limitations of the research methodology; and (5) areas for future research.

The framework of the research model that is described in Chapter 1 is used to guide this discussion. Conclusions are made about (1) the state of logistics measurement; (2) the antecedent measurement orientation; (3) the moderating contextual factors; and (4) associations with perceived competitiveness (see Figure 34).

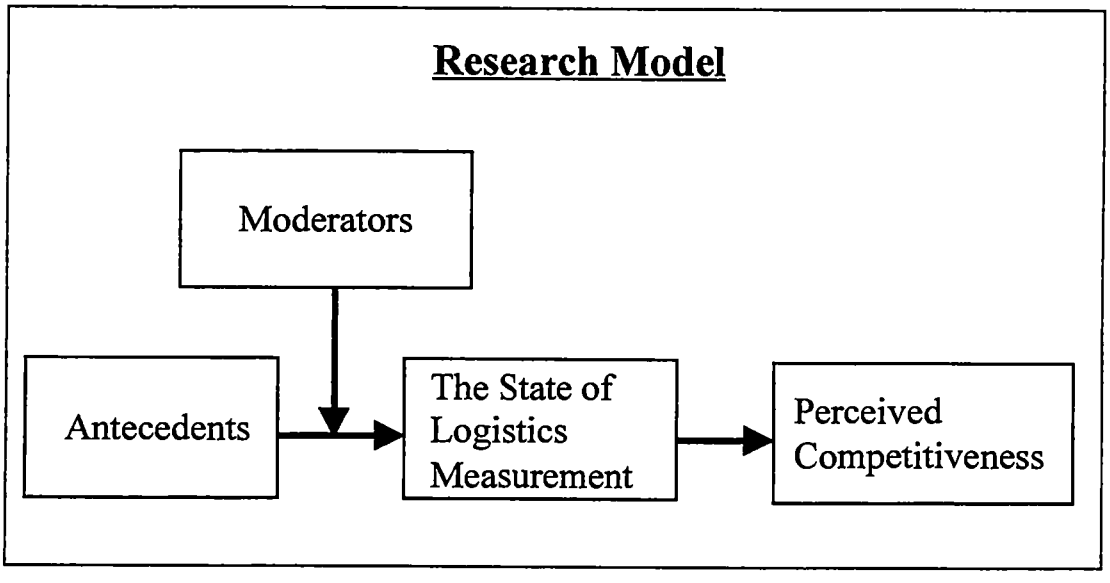



**Figure 34 Research Model**

**The State of Logistics Measurement**

The state of logistics measurement construct described in Chapter 1 can be understood by answering these three questions:

(1) What logistics measures are actually being captured?

(2) How are these logistics measures determined?

(3) To what degree are the logistics measures acted upon?

The questionnaire used in this study provided thirty-seven choices of logistics measures frequently found in the literature. Respondents indicated if their firm captured these measures (see Table 60).

A much higher level of logistics measurement was expected, especially for some of the more common measures in logistics such as on-time delivery, fill rates, and freight costs. The conclusion is that a large percentage of firms are not capturing important measures of logistics performance. This sets up the observation: If firms don't *measure*, they probably don't *plan* performance and don't take corrective action when appropriate. It must be concluded that, if firms do not measure performance, they lack control over important activities.

Even more remarkable is the lack of definition of the four measures that were claimed as being *most important* to customers.

| Measure | % Jointly Defined | % Customer Defined | % neither |
|---|---|---|---|
| On-time Delivery | 31 | 29 | 40 |
| Order Fill | 25 | 33 | 42 |
| Invoice Accuracy | 28 | 30 | 42 |
| Order Cycle Time | 25 | 25 | 50 |

**Table 60 Measures Captured**

| Effectiveness Measures | % Capture | Efficiency Measures | % Capture |
|---|---|---|---|
| **Involve Trading Partner** | | **Cost** | |
| Customer complaints | 76.6 | Outbound freight cost | 87.3 |
| On-time delivery | 78.6 | Inbound freight cost | 68.9 |
| Over/short/damaged | 72.3 | 3rd party storage cost | 58.6 |
| Returns and allowances | 69.1 | Inventory carrying cost | 60.4 |
| Order cycle time | 62.3 | Logistics cost per unit vs budget | 52.4 |
| Overall customer satisfaction | 60.8 | Cost to serve | 37.4 |
| Days sales outstanding | 58.7 | Average | 60.8 |
| Forecast accuracy | 54.4 | | |
| Invoice accuracy | 52.1 | **Productivity** | |
| Perfect order fulfillment | 39.5 | Finished goods inventory turns | 80.2 |
| Inquiry response time | 29.6 | Orders processed/labor unit | 43.3 |
| Average | 59.5 | Product units processed per warehouse labor unit | 47.6 |
| | | Units processed per time unit | 37.2 |
| | | Orders processed per time unit | 36.1 |
| **Internal Focus** | | Product units processed per transportation unit | 21.8 |
| Inventory count accuracy | 85.8 | Average | 44.4 |
| Order fill | 80.8 | | |
| Out of stocks | 70.5 | **Utilization** | |
| Line item fill | 68.5 | Space utilization vs capacity | 46.5 |
| Back orders | 64.4 | Equipment downtime | 46.0 |
| Inventory obsolescence | 62.7 | Equipment utilization vs capacity | 40.4 |
| Incoming material quality | 61.6 | Labor utilization vs capacity | 35.8 |
| Processing accuracy | 45.0 | Average | 42.2 |
| Case fill | 39.1 | | |
| Cash/cash cycle time | 32.2 | | |
| Average | 61.1 | | |

Suppliers can not satisfy their customers' expectations if there is no agreement with the customers' definition of performance. Without recognized customers and owners of measures, the evaluation and improvement of logistics and supply chain performance are problematic. It can be concluded that a great amount of measurement activity is non-productive.

This study identified the three key logistics processes in the supply chain to be (1) Fulfillment; (2) Sourcing/Procurement; and (3) Planning/Forecasting/Scheduling. These processes exist within firms as well as extend between them and their supply chain trading partners. The level of measurement of these processes varied both within the firm and between firms, but intercompany measures are less often captured in all cases. For Fulfillment, fifty-nine percent of companies measure, but only 22% take action on an intercompany basis. For Sourcing/Procurement, only 21% take action on an intercompany basis. For Planning/Forecasting/Scheduling, only 18% take action on an intercompany basis.

Only about 20% of the time, according to the survey, do practitioners *take action* to coordinate or integrate activities with trading partners that improve performance for the three key logistics processes in the supply chain. The conclusion is a disappointing one: not much effort is given to performance improvement. Even when a measure is captured, action to improve performance is not often taken, and control is not assured. Organizations can have information but fail to act on it. Perhaps this outcome is due to the lack of predetermined performance objectives or the inadequacies

of the measures themselves, as was discovered in exploring the antecedents of logistics performance measurement.

**Antecedents of the State of Logistics Measurement**

Antecedents to measurement, or the measurement orientation construct, can best be understood by answering these four questions:

(1) Does the importance of a logistics measure influence its capture?

(2) What are the barriers and enablers of logistics measurement?

(3) How adequate are current logistics measures?

(4) Does the logistics organization have an internal viewpoint or has it developed a supply chain orientation?

The Importance of Logistics Measures

Analyses demonstrated that respondents who considered specific measures important were more likely to capture those measures than were respondents who considered them to be less important. Causal relationships between consideration of importance and capture of measure were not explored. However, statistically significant associations between consideration of importance and capture of measure were explored and *not* found. As previously indicated in Tables 3 and 4, even though a measure is considered important, it is often not captured. The reason that a specific measure is not captured does not relate to its degree of perceived importance. The ranking of perceived importance for Invoice Accuracy illustrates such a conclusion. Invoice Accuracy was reported to be third in importance for the company, sixth in

importance for the customer, and eighth in importance for the logistics function. Even then, forty-eight percent of respondents said this measure was not captured.

Barriers and Enablers of Logistics Measurement

Upper management support was found to be the most significant enabler of the development and use of performance measures with and between firms. Resource availability, skill set of employees, and the ability to obtain priority for logistics projects were also seen as enablers for logistics measurement within the company. Several of the case studies supported these findings, underscoring the importance of a senior management individual or team that "champions" logistics measurement initiatives. A conclusion is that measurement efforts require leadership.

Interestingly, acceptance of change was perceived as an enabler of logistics measurement within the firm, but resistance to change was perceived as a barrier for logistics measurement between firms. Incompatibility of information technology systems, multiple definitions of measures, and resource availability to maintain measures emerged as barriers to inter-firm logistics measurement. Trust between trading partners was seen as an enabler of inter-firm measurement. These finding support the conclusion that building collaborative relationships with customers and suppliers requires a sustained commitment of resources.

An effective planning capability, which requires leadership and sustained commitment of resources, is likely to be the strongest enabler of the development and use of logistics measures within and between firms. Firms that fail to plan activities or outcomes have little use of measures of those activities or outcomes. Supply chain

integration requires collaborative planning with trading partners. Based on the low level of intercompany measurement and performance improvement revealed by the research, it is concluded that not much collaborative planning is occurring.

The Adequacy of Current Logistics Measures

Several hypotheses were related to the adequacy of current performance measures. Margin Management was found to be the primary financial measure that drives decision-making in organizations, regardless of business strategy, logistics strategy, or position in the supply chain. One might expect that informed executives would overwhelmingly favor a primary financial measure that integrates the income statement and balance sheet. Failure to do so ignores the value or cost of assets and the sources and uses of funds (i.e., cash flows). Reliance on Gross Margin or Net Margin measures overlooks the impact of logistics and supply chain management on the business. A conclusion is that logistics practitioners do not understand or are unable to educate management on the full financial impact of logistics performance. Balanced sets of measures of business performance are recommended. As one of the case studies described, "cockpit measures" that reflect a balanced scorecard for management are associated with better control.

The quality of measures was tested for perceived accuracy, actionability, and internal comparability and compatibility. In these cases, 65-70% of respondents agreed that current logistics measures demonstrated these qualities. This leaves about one-third of respondents who do not believe their current measures have these attributes. Only about one-third *agreed* that current measures are *externally* comparable, compatible,

and promote intercompany coordination. It can be concluded that logistics practitioners who perceived their logistics measures to be inadequate will be disposed not to take action on them. A better job must be done in defining and designing logistics measures.

The Internal Focus of the Logistics Function

The measurement integration matrices for the seven logistics processes/ capabilities clearly demonstrate that companies are more focused on internal activities. Intercompany measurement was only about one-half as developed as intracompany measurement in every analysis. Supply chain management requires logistics managers to shift their focus of measurement to the external interfaces with customers and suppliers. Overcoming the current internal orientation will require different behaviors and different measures. More attention needs to be given to the fulfillment and sourcing/procurement processes and the supportive planning/forecasting/scheduling process that can integrate them. The ability to establish lasting cooperative relationships governed by mutual adjustments between trading parties is becoming increasingly more important. This could well be the greatest challenge for logistics practitioners and provide the ultimate sustainable competitive advantage for their firms.

**Moderators of the State of Logistics Measurement**

The moderators of logistics measurement, or the contextual factors construct, can be best understood by answering these eight questions:

(1) How does the state of measurement vary by industry?

(2) How does the state of measurement vary by size of company?

(3) How does the state of measurement vary by business strategy?

(4) How does the organization's view of the logistics function affect its state of measurement?

(5) How does the degree of business segmentation influence the state of logistics measurement?

(6) What effect does the logistics organization's span of control have on logistics measurement?

(7) What impact does the use of technology have on logistics measurement?

(8) How does the location of the firm in its dominant supply chain affect the state of logistics measurement?

Differences in Industry and the State of Logistics Measurement

No significant associations were found between industry and logistics measurement using a paired samples t-test. Every industry apparently has its leaders and itslaggards. No one industry appears to differ from others with regard to the state of logistics measurement. It can be concluded that there are no "leading" industries with regard to logistics measurement.

Differences in Company Size and the State of Logistics Measurement

Large companies are more likely to capture measures than small companies. Using the criteria of $500 million in annual sales as the "break point" between large and small firms, large firms are almost always more likely to capture logistics measures. The one exception found was in intercompany information capability, where the size of

firm had no association with the capture of measures. Moreover, no associations were found between company size and the likelihood of perceived competitive advantage. The conclusion is that small firms that do not capture logistics measures are just as likely to claim competitive advantages as large firms that do capture logistics measures. The capture of the measure is not necessarily associated with a perceived competitive advantage.

A final association found regarding the size of firm was the association with a specific business strategy. Large firms were more likely to claim low cost or best value business strategies than small firms were. Small firms were more likely to claim a tailored service strategy or focus on a market niche than large firms were. While more measurement will be found in large firms, no conclusion was drawn about the appropriateness of the measures captured for supply chain management.

Differences in Business Strategy and the State of Logistics Measurement

No single business strategy was found to be more associated with logistics performance measurement than any other strategy. Significance was found for "aligned" pairs of business and logistics strategies, i.e., low cost provider with minimize supply chain costs, and tailored services with tailored services, respectively.

Remarkably, no respondents with misaligned business and logistics strategies claimed a disadvantage in order fulfillment, transportation, or warehousing. This finding could support the conclusion that perceived competitive advantage does not *appear* to be associated with alignment of strategies. However, sensitivity to covariation between choice of strategy and perceived competitive advantage suggest

two possible explanations. Firstly, the measure for perceived competitive advantage might not have been sufficiently precise to allow a statistical conclusion to be drawn. Secondly, control for background factors was not established, setting up the possibility that other phenomena obfuscated the true relationships between these factors. Several explanations could be offered. Respondents might have been comparing themselves to other equally misaligned competitors. Respondents might have been biased not to admit to a disadvantage in these capabilities. Respondents could be wrong in their perception. Additional research on strategy alignment and perceived competitiveness is suggested.

Choice of business strategy was significantly associated with the capture of only four measures out of thirty-seven. Choice of logistics strategy was associated with eight out of thirty-seven measures. In those cases, logistics organizations with a strategy of tailored service were more likely to capture measures than other organizations were. It can be concluded that choice of strategy does not result in preferences for specific logistics measures.

It could not be shown that low cost strategies were associated with internal measures of efficiency, or that differentiation strategies were associated with external measures other than cost. Overall, it can be concluded that strategies, whether aligned or not, have *little* to do with the state of logistics measurement (i.e., identifying which measures are important, how they are determined, or if they are captured).

Differences in the Organizational View of the Logistics Function and the State of Logistics Measurement

No significant associations were found between how logistics is viewed (i.e., whether a cost, profit, or service center) and the likelihood of capturing any specific logistics measure. However, Profit Centers were found to be more likely to claim an advantage in customer service, order fulfillment, warehousing/storage, information capability, and planning/forecasting/scheduling. This suggests the conclusion that profit accountability and concern for satisfying the customer are positive moderators for logistics competitiveness.

Differences in Business Segmentation and the State of Logistics Measurement

Whether or not a company segments based on *customers* has no bearing on their likelihood to capture logistics measures. Companies that segment based on *suppliers* are more likely to capture measures relating to sourcing/procurement and planning/ forecasting/scheduling. Segmentation by *products* had four significant measurement associations for finished goods and five for purchased materials in the three key supply chain processes. It can be concluded that segmentation by products and suppliers seems to improve the likelihood of measurement.

No associations were found for segmentation and likelihood of claiming a competitive advantage except those firms that segmented *suppliers* were more likely to claim an advantage in Information Capability and Planning/Forecasting/ Scheduling.

Differences in Span of Control and the State of Logistics Measurement

A wide span of control was found to be associated with a *lesser* likelihood of coordination and integration for transportation/distribution, warehousing/storage, and information capability on an intercompany basis. Firms with a narrow span logistics organization are *more* likely to coordinate and integrate these same three processes/capabilities with their trading partners. Crosstabulation of span of control with the capture of measures found that a *narrow* span of control logistics organizations were more likely to capture intercompany measures of planning/forecasting/scheduling and information capability. It can be concluded that a narrow span of control logistics organization can be more focused on trading partners.

No associations were found between span of control and perceived competitive advantage. It can be concluded that the grouping of multiple functions and departments under a single Head of Logistics does not necessarily facilitate capture of logistics measures or perceived competitive advantage. Perhaps the additional management complexity of larger logistics organizations mitigates against this. Additional research in this area is necessary.

Differences in Use of Technology and the State of Logistics Measurement

It was shown that firms that have implemented activity based costing (ABC) do not enjoy an advantage over firms that have not instituted ABC. As previously described (Table 43, Chapter 4) only twenty-two of 140 tests showed significance in associating use of technology with measurement of logistics processes. When considering the implications of having technologies, only two associations with

competitive advantage were found. Both associations were with Warehouse Management Systems (WMS). One WMS association, with sourcing/procurement, was negative. Those firms with WMS technology were *less* likely to have an advantage in sourcing/procurement. The other WMS association was positive. Those firms with WMS technology were more likely to have a perceived competitive advantage in warehousing/storage. This study provides very little evidence that perceived competitive advantage is associated with the use of the ten considered technologies. Since this conclusion is counter-intuitive, either the theory that technology use provides an advantage is flawed or the measure used to test the theory is flawed. Because perceived competitive advantage was entirely *subjective* in this study, it is considered an inappropriate measure to support the conclusion that technology use does not matter. Better measurement designs are necessary.

Differences in the Location of the Firm in Its Dominant Supply Chain and the State of Logistics Measurement

The comparisons of position of the firm in the supply chain to the capture of logistics measures revealed many significant associations. When service organizations/subcontractors and firms three steps removed from the consumer were excluded, several significant associations remained. Many differences were found between what a direct seller measures and what the firms one or two steps removed from the consumer measure. Direct sellers are more likely to capture measures of cost-to-serve, inquiry response time, processing accuracy, and the utilization measures related to space, labor, and equipment. It can be concluded that both manufacturers and

retailers emphasize the sales side of their businesses while distributors balance their emphasis on selling and buying.

**Conclusions of the Research**

This study confirms the observations of previous research about logistics performance measurement:

(1) Most firms represented by the respondents do not comprehensively measure logistics performance.

(2) Even the best performing firms fail to realize their productivity and service potential available from logistics performance measurement.

(3) Logistics competency will increasingly be viewed as a competitive differentiator and a key strategic resource for the firm.

This study contributes additional observations about logistics performance measurement and supply chain management:

(1) Logistics performance measurement is not a top issue for practitioners.

(2) Many companies capturing measures are not taking action based on the information it provides.

(3) Of intercompany measures being captured, less than forty percent are jointly defined or agreed to by both trading partners, indicating a need and opportunity for collaboration.

(4) Enabling technology is not planned for implementation by a large percentage of companies.

(5) Technology use is not associated with a *perceived* competitive advantage.

(6) Activity based costing is not associated with the capture of logistics measures within the firm but is associated with capture of measures on four processes/capabilities between firms. The traditional accounting system takes precedence internally but is not compatible or useful between firms.

(7) Appropriate financial measures are not being used to assess the contributions and importance of logistics in most firms.

(8) Opportunities exist for improving the alignment of business strategies and logistics strategies. However, such alignment does not appear to affect the state of logistics measurement.

(9) A case can be made that wide spans of control are not conducive to coordination with trading partners.

(10) Position of the firm in the supply chain relative to the end consumer influences the emphasis on which logistics measures are important and captured.

(11) Top management support is a key enabler of the development of an effective logistics measurement system.

Logistics interfaces with the Finance function seem to be inadequate. This conclusion is supported in the literature and by the findings of this research. Appropriate financial measures of the value and performance of the logistics function are not being used to guide decision making in the firm.

Lacking measurement of outputs, organizations appear to resort to ritual control of behaviors that may or may not be reinforced by incentive plans. When desired behaviors and outputs are not specified ahead of time, organizations must rely on ritual

control. Often they rely solely on their ability to select or deselect processes, employees, contractors, suppliers, customer, and relationships, either to achieve desired results, or to avoid undesired consequences. The planning process inevitably appears to be the most critical for business success. Management must invest in the planning process.

Low cost business strategies that are typical of mechanistic, internally focused organizations are not good candidates for supply chain partnerships. This strategy does not need activity based costing (ABC). Tailored, personalized service strategies (customer value based strategies) are typical of better supply chain partners. These strategies will benefit from ABC by allowing the comparison, with customers, of cost-to-serve and value of service.

This research revealed that low cost strategies are not as popular as might be expected. Best Value strategies were not defined but seem to be a popular choice for many organizations. The seeming lack of specificity in definition of what constitutes best value appears to give organizations the comfort of flexibility in their behavior. It could be argued that Best Value strategies do not give competitors much information about what the firm might do. It is likely the least "accountable" of the strategic choices given the survey respondents.

The emerging trend toward asset-free (hollow) corporations and virtual corporations suggests that access to measurement information across business boundaries is becoming more important, if not essential. Shared databases, collaborative planning and forecasting are important tools to facilitate this trend.

**Major Contributions of this Research**

In addition to updating the literature on the state of logistics measurement, this descriptive/exploratory research has made several unique contributions. A major contribution of this research is the recognition of the need to shift practitioner focus from measurement of logistics activities *internal* to the firm to a few key business-spanning processes. Such a reorientation is a requisite for supply chain management. This shift requires less reductionistic thinking and microscopic views and more systemic, strategic thinking and telescopic views. The concept of process customers and process owners should be extended to the measures themselves. Identification of the three key processes - fulfillment, sourcing/procurement, and planning/ forecasting/scheduling - should also contribute to helping the practitioner focus efforts on the important performance improvement opportunities. The research model itself has provided a useful framework for thinking about logistics measurement. Appreciating the influence of antecedents and moderators of the state of logistics measurement should help guide the practitioner in selecting appropriate, compatible partners for initiatives in supply chain process improvement.

Practitioners can learn from this research that most companies do not measure much, do not measure well, and often measure the wrong things. At least, they do not always measure the right things. What has been missing is the "orientation" toward processes, the recognition of systems of interdependencies and trade-offs. Taken a step further, the practical supply chain question becomes "What are we trying to accomplish?" not "What are we measuring?" Customers need to be specifically asked

how they want to be treated. Suppliers must be specifically informed of performance expectations. Customers of processes and measures are *always* the correct judges of performance. Today, customers are better informed, more demanding and perhaps more fickle than ever. The astute logistics manager needs to pay more attention to relationship management with key customers and suppliers. Industries are blurring. Boundaries between companies are blurring. Path breaking is becoming more important than benchmarking for growth and change. The firm's goal is not to simply hang on to today's market share. The firm's goal should be to create influence for its role in emerging industries and relationships with trading partners. What should be measured is an important question. What should be *done* is more relevant in today's fast-paced, competitive economy. This research demonstrates that opportunities abound for tomorrow's leaders.

**Implications for Researchers and Practitioners**

This research has referred to the theoretical problems with the adequacy of measures in regard to their quality and usefulness. The multiple criteria of a good measure cannot be simultaneously satisfied. Trade-offs must be made between validity and comparability and between integrativeness and usefulness. Undetermination is particularly serious when using task and activity measures to evaluate processes. Process measures that capture quality and usefulness need to be developed to also capture outcomes and impacts in addition to productivity. The *purpose* of measures can only be understood when customers and owners of measures exist and collaborate. This has been overlooked in the research.

Another very real problem with measures is that they involve people, i.e., workers working. Work is objective, as most measures are designed to be. There is likely a best way to do the work, independent of the worker. This is a mechanistic viewpoint. However, workers are subjective, individualistic, and subject to wide variations in aptitude, interests, and behaviors. Measures need to contemplate that much of what workers do is subjective - creative, innovative, and unique. This is a humanistic viewpoint. Knowledge work is not programmable. The output cannot often be predetermined nor perceived. Consequently, measures of knowledge work do not exist. Moreover, measures of relationships are elusive. Yet, supply chain performance is largely built on knowledge workers building and maintaining relationships. Relationship planning and relationship measurement is an area for future academic research.

**Strengths and Limitations of the Research Methodology**

The multiple methods of data gathering, the use of a combination of qualitative and quantitative data, and the relevant, empirical nature of the research are considered strengths of this study. External validity, realism, and generalizability are enhanced by the research design. The reproducibility component of external validity is considered high, in that this study could easily be reproduced and generate the same results. Generalizability across logistics organizations whose senior logistics executive maintains membership in the Council of Logistics Management can be claimed. Generalizability is also enhanced because the study focused on the measures and not their values, as might have been done in a benchmarking study. Statistical conclusion

validity is considered satisfactory, given the statistical techniques used. No attempt was made to establish internal validity, i.e., whether any of the relationships between variables were causal.

Non-response bias was not tested as part of the survey methodology. This could pose a serious threat to validity. However, because this study was exploratory and not one of theory testing, this threat to validity is somewhat mitigated. The sample size of 355 cases provided statistical conclusion validity. The findings cannot be extrapolated beyond the population of CLM membership.

The extensive analysis of contextual factors suggested that strategy, technology, and industry do not make much difference in whether logistics measures are captured, how they are defined, what action is taken, or the perception of competitive advantage. Some differences in the degree of measurement that were found related to size, span of control, degree of segmentation and whether the logistics organization was viewed as a profit center. However, those associations were explained.

The weakness of this study would be found in its instrumentation and nomological validity. As mentioned in Chapter 3, no validation of shared understanding of terminology and concepts was conducted. Did the respondents interpret the questions in the same way? Did they have a shared understanding of the various technologies? Were they truthful and consistent in their responses? Certainly, there were instrumentation errors and maturation effects in the Delphi study, the case studies, and the questionnaires. Interviewer bias likely played a role in the interpretation of interviews. One nagging question has to do with the identification of enablers and barriers. Often, the same factor was seen equally as both an enabler and a

barrier. Did the respondents who had been successful in some stage or activity of logistics measurement see the same factor as a barrier looking ahead and as an enabler looking back? Maturation of respondents may have influenced their responses.

No major conclusion was made without justification. Rigor was observed in developing the relevant and interesting findings and conclusions. As explained by Mentzer and Flint (1997):

> "Rigor does not imply use of increasingly sophisticated methodologies just to prove we can use them. Rather, rigor implies care in avoiding inadvertently concluding something the research did not actually reveal." (p.200)

**Areas for Future Research**

The temptation was great to look for causality. Determining causality was not a goal of this research. Evidencing internal validity was not a capability of the statistical methods appropriate for the testing of the hypotheses. The question remains. Why do firms not do a better job of logistics measurement? Some reasons were offered based on the strength of associations between antecedents and moderators with the state of logistics measurement. Perhaps there is no compelling event for the firm to improve on its state of logistics measurement. Perhaps there are no dire consequences for failing to improve logistics performance measurement. Perhaps firms achieve control through the use of organized rituals and selection/deselection activities. The transition to supply chain management certainly requires more research into appropriate governance structures that might succeed in affecting ongoing, mutual adjustments in the expectations and work processes of linked companies.

What should be the scorecard for supply chains? What would a generalized, balanced set of metrics look like that incorporate multi-firm objectives? How helpful are external benchmarks in improving the capture of measures or improvement of performance?

Traditional accounting practices seem to adversely impact the capability to produce accurate, actionable logistics measures. Why have firms not dealt with this more effectively? Why do we not see more use of activity based costing to help improve logistics measurement and performance?

The emphasis for logistics measurement seems to still be on expense control, given that margin management measures are primary. Why is there not more emphasis on capital budgeting and asset management in logistics performance measurement?

No research has been found that has looked at the capital structure of multiple supply chain trading partners to determine where inventory should be held, i.e., with the firm with the lowest cost of capital. This will influence terms of sale and cash flow across the supply chain.

What can be done to change cultures and norms to facilitate more effective logistics measurement systems? What is the role of management and employee incentive and reward systems?

Gainsharing practices used by third party providers need to be studied in order to understand how they can be applied to multiple trading partners for improvements in supply chain system performance.

How has cycle time compression been measured for a supply chain? What is the magnitude of cost reduction opportunities among multiple partners? How can integrated supply chain planning/forecasting/scheduling systems be best implemented?

What are possible and desirable forms of governance among and between supply chain partners? The health maintanence organization (HMO) is an example. The HMO does not own hospitals, employ physicians, or operate supply production facilities but does attempt to rationalize the costs of delivery of medical services. The HMO focus has been on cost reduction, not service enhancement or patient value, which seems to have constrained its effectiveness. Is a similar model appropriate for supply chain management? Does this require supra-organizations or multi-company teams?

The role of the university and its faculty in the development and operation of model supply chains would be another area of future research for scholars in the fields of marketing and logistics. Perhaps universities could be objective facilitators of multi-firm governance.

A supply chain unit of analysis is needed. A firm-level unit of analysis is inadequate. Can a *supply chain* decision support system (DSS) capability be developed? Will companies share information and resources to make this happen?

Historically, barriers to entry, such as economies of scale or proprietary technology, have helped insulate firms individually from competitive threats and promoted firm profitability. An investigation of the importance of supply chain relationships as collective barriers to entry for supply chain members would be of interest.

Is supply chain performance ultimately a debate on ends versus means? Can individual, industry-dominant companies succeed in meeting their performance goals without pursuing supply chain management? Under what conditions would firms shift from protecting their independence to actively seeking interdependent relationships?

Are stockholders concerned about the financial health of the firm's customers and suppliers? What measures should be of interest to them? In integrated supply chain environments this will become more important.

The basic question persists in dealing with employees and trading partners: What's in it for me? Knowing how to answer this question will allow change to occur based upon plans and measures. Empirical studies demonstrating how successful supply chain partners addressed this issue would be of interest.

How willing is an organization to experiment and change their logistics measurement practices? What conditions must exist? How can this be measured? Are organizations driven to achieve desirable results, or avoid undesirable consequences? How does that impact the logistics measurement effort?

Measurement seems to be concerned with behavior or output. Is that all? What about measuring outcomes and impacts not associated with the firm's financial statements? Should these be in the balanced scorecard?

Literature does not discuss *supply chain* strategy formation. How could this be done? Should business strategy inform/direct both downstream and upstream supply chain interfaces? Could firms perform better with different business strategies for sourcing (upstream) and fulfillment (downstream) processes?

Accountability and ownership for performance depends on logistics performance measurement. With that in mind, desirable research would attempt to complete the sentence: Supply chain success calls for....

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# APPENDICES

# Appendix A - Delphi Study

| DELPHI MAILING LIST | | | |
|---|---|---|---|
| Name | | Title | Organization |
| Tom | Adelsberger | Director of Logistics | Wegmans Food Markets, Inc. |
| Dave | Anderson | Managing Partner | Andersen Consulting |
| Judith | Anderson | Partner | Anderson and Rust |
| Joe | Andraski | Vice President Customer Marketing | Nabisco |
| Mark | Bachman | Vice President & Controller | National Service Industries, Inc. |
| Rick | Balla | Group Manager - National Materials Management | GTE Supply |
| Mark | Barg | Managing Director | Price Waterhouse |
| Bill | Best | Vice President Asia | AT Kearney |
| Donald | Biggs | Director of Logistics | Welch Foods Inc. |
| Jim | Blaser | Executive Consultant | Mercer Management Consulting |
| James | Borling | Vice President, Logistics | Kraft Foods |
| Donald | Bowersox | Professor, Business Administration | Michigan State University |
| Jack | Busher | Vice President | CSX |
| Bob | Camp | Principal | Robert Camp Inc. |
| Virginia | Carmon | Senior Manager | KPMG Peat Marwick LLP |
| Joe | Casaroll | Director of Transportation | General Motors |
| Martin | Christopher | Professor of Marketing and Logistics | Cranfield School of Management |
| Kevin | Clark | VP Logistics Services | Unisys Corp |
| David | Cloth | Logistics Manager | Mobil Chemical Co |
| Bill | Cook | Vice President Distribution | Lanier Worldwide |
| Martha | Cooper | Professor of Marketing and Logistics | The Ohio State University |
| William | Copacino | Managing Partner Strategic Services | Andersen Consulting |
| Anne | Cosini | Director of EDI | Liz Claiborne |
| Ed | Darnborough | Vice President Logistics Operations and Service | Hunt Wesson |
| Bob | Delaney | Vice President | Cass Information Systems |
| Ralph | Drayer | Vice President ECR | Proctor & Gamble |
| Mike | Duke | Senior Vice President Logistics | Wal*Mart |
| Paul | Dunn | Vice President & Treasurer | IMC Global, Inc. |
| Tom | Escott | President | Caliber Logistics Inc. |
| James | Evans | Professor | Univerisity of Cincinnati |
| Bob | Filipski | Vice President Financial Planning & Systems | Amkor Technology |
| Jean | Fowler | Vice President Information Technology | McNeil Consumer Products Co. |
| Mary Lou | Fox | Senior Vice President | Manugistics |
| Ed | Frazelle | President | Logistics Resources International |
| Lynn | Fritz | Chairman &CEO | Fritz Companies |
| Ron | Gable | VP Global Supply Chain | Campbell Soup |
| Mike | Gardner | Executive Vice President and COO | GATX |
| Jon | Garrity | Manager Logistics | Bic Corporation |
| George | Gecowets | Executive Vice President | Council of Logistics Management |
| Jim | Gilmore | Logistics Director | Strategic Horizons |
| Walter | Golembeski | VP Manufacturing & Technology Asia-Pacific Division | Colgate-Palmolive Company |
| Thomas | Gorey | Vice President of Logistics Integration | Sears Roebuck and Co. |

| | | | |
|---|---|---|---|
| Craig | Gustin | Principal | CGR Management Consultants |
| Bernie | Hale | Senior Vice President | DSC Logistics |
| | | Director Logistical Servives | |
| Nancy | Haslip | Administration | BankBoston Corporation |
| Don | Heide | Senior Vice President Distribution | Target Stores |
| Mary | Hinske | Logistics Manager | Mobil Chemical Co |
| Steve | Ivaska | Vice President | Caterpillar Logistics Systems |
| Michael | Jack | Executive Director of Financial | Cummins Engine Company |
| Herb | Johnson | Senior Vice President Logistics | Consumer Value Stores |
| Roger | Kallock | Deputy Under Secretary of Defense | Secretary of Defense Logistics |
| Bryan | Kelln | Sr VP and General Manger | General Cable Corporation |
| Jaap | Kwist | Director of Distribution | Unilever |
| Nicholas | LaHowchic | President & CEO | Limited Distribution Services |
| Bernard | LaLonde | Professor Emeritus | The Ohio State University |
| Douglas | Lambert | Professor | The Ohio State University |
| Jun-Sheng | Li | President | JB Hunt Logistics Inc |
| Christopher | Lofgren | Chief Technology Officer | Schneider National Inc |
| Cliff | Lynch | President | CF Lynch & Associates |
| Ed | Marien | Professor Emeritus | University of Wisconsin |
| Chuck | Marr | Group Supply Chain Manager | Hewlett-Packard Company |
| Ken | Mason | Vice President Commercial Aerospace | Ryder Integrated Logistics Inc |
| Kathleen | Mazzarella | Vice President - Comm/Data | Graybar Electric |
| John | Mentzer | Professor Marketing and Logistics | University of Tennessee |
| Arthur | Mesher | Executive Vice President | Descartes Systems Group Inc |
| Thomas | Miller | Vice President & Corporate Controller | Avery Dennison |
| J. D. | Milliken | VP Logistics & BPR | J.M. Smucker Company |
| James | Morehouse | Vice President | AT Kearney |
| Gerry | Murphy | Chief Executive Officer | NFC plc |
| Clyde | Nelson | Manager EDI/UPC | Dayton-Hudson |
| Jeffrey | Noddle | Executive Vice President | Super Valu |
| | | Associate Professor of Business | |
| Robert | Novack | Logistics | Pennsylania State University |
| Kevin | O'Laughlin | Partner | Ernst & Young |
| Gus | Pagonis | EVP Logistics | Sears Roebuck and Co. |
| Bill | Perry | Vice President Logistics | i2 Technologies |
| Terrance | Pohlen | Chief Business Analysis Office | Defense Supply Center |
| Richard | Powers | President | Insight, Inc |
| Mary Lou | Quinto | Director of Logistics International | SmithKline Beecham |
| Gary | Ridenhower | Director of Supply Chain Management | 3M |
| Robert | Sabath | Certified Management Consultant | Mercer Managememt Consulting |
| Winston | Scotland, Sr. | VP - Supply Chain | Lipton |
| Gary | Sease | Senior Vice President Logistics | Service Merchandise |
| Ed | Settle | Alliance Partner Manager | Manugistics |
| | | Professor & Dir Center of | |
| Yosef | Sheffi | Transportation Studies | MIT |
| Tom | Speh | Professor of Marketing and Logistics | Miami University |
| | | Assoc Professor of Marketing and | |
| Jay | Sterling | Logistics | University of Alabama |
| James | Stock | Professor of Marketing & Logistics | University of South Florida |

| | | | |
|---|---|---|---|
| Mitch | Stover | SVP Department Store Distribution | Dayton-Hudson |
| Kathleen | Strange | Director of Logistics and Strategic Implementation | Staples, Inc. |
| Doug | Strom | Vice President Operations Finance | UDV North America |
| Joe | Sukola | CFO Business Services | Allied Signal |
| Tim | Sullivan | Supply Chain Operations Manager | Frito-Lay, Inc. |
| John | Thompson | SVP & CIO | Liz Claiborne |
| Stephen | Tibey | Vice President Operations Services | Kraft Foods |
| Kim | Treaster | Vice President. | Logility |
| Gene | Tyndall | Partner | Ernst & Young |
| Pat | Wallace | GM-Process Design | LTV Steel |
| Mike | Wells | Vice President Logistics | Hershey Foods Corporation |
| Scott | Williams | Director of Procurement | PSE&G |
| John | Williford | President & CEO | Menlo Logistics |
| Elaine | Winter | Director of Communications and Research | Council of Logistics Management |
| Jim | Wright | Vice President Distribution | Wal*Mart |
| Thomas | Zavertnik | Director Global Supply Chain Alliance | Ryder Intergrated Logistics |

THE UNIVERSITY OF TENNESSEE
KNOXVILLE

Department of Marketing, Logistics and Transportation
College of Business Administration
310 Stokely Management Center
Knoxville, Tennessee 37996-0530
(423) 974-5311
Fax # (423) 974-1932

July 23, 1998

Mr. Richard Powers
President
Insight, Inc.
19820 Village Office CT
Bend, OR 97702

Dear Mr. Powers:

The **Council of Logistics Management (CLM)**, in conjunction with The University of Tennessee and Computer Sciences Corporation, is embarking on a significant research project titled **"Measuring Logistics Activities in the Supply Chain."** This is a request for your help.

Today's business environment is transitioning from a sequential, independent, transaction-based environment to one comprised of multiple synchronized and process-based logistics environments. The interconnectedness of the partners in the logistics channel, both physical and informational, is becoming crucial. As businesses evolve how they operate, it followsthat standards and measures used to indicate exceptional performance must also change. As the focus of a firm moves outward, the need for more sophisticated and integrated logistics performance measures becomes increasingly critical.

The objective of the CLM research is to reexamine how we measure the logistics process; not just within a firm but also between firms and throughout the supply chain. The research will include an extensive literature review, direction from a group of supply chain experts in the form of a Delphi study, case studies, and a broad survey of logistics professionals. The research will result in a report which includes business-to-business measures of performance as well as a diagnostic tool kit to help firms implement new measurement techniques.

We have identified you as a thought leader with insights and expert knowledge related to the research subject. We invite you to lend guidance to the project through participation in our Delphi study. Delphi study participation requires that you complete two surveys. The first survey is attached. The results of this survey and the second survey will be distributed in mid-August.

**Please complete the attached survey and return it by July 27.** The survey may be returned by fax to Jim Keebler, The University of Tennessee, 423.974.1932 or 423.974.8898. If you would like additional information, please contact Jim at 423.974.5244. This is a significant project for CLM and we need your help. Thanks in advance for your participation.

Sincerely,

C. John Langley, Jr.

C. John Langley, Jr., Ph.D.
John H. "Red" Dove Distinguished Professor
Of Logistics and Transportation
The University of Tennessee

**Council of Logistics Management** *Delphi Study Survey*
**Measuring Logistics Activities in the Supply Chain**

Please complete the following questions and return via fax by July 27, 1998. You will receive a report of the results, and a second survey, in mid-August. Responses will be strictly confidential and individual comments will be masked in summary results.

Attention: Jim Keebler
Associate Director
Office of Corporate Partnerships
The University of Tennessee
Fax no: 423.974.1932 or 423.974.8898

Name: Mr. Richard F. Powers
Company: Insight, Inc.
Phone Number: 541-388-6998
Fax Number: 541-388-9884

Please correct information if missing or inaccurate

1. What business and market factors are stimulating companies to move toward a supply chain process orientation and away from functional silos?

   - What are the barriers companies face in moving toward a supply chain process orientation?

2. What are the key activity or process measures being used inside companies today?

3. What are the supply chain measures being used between companies today?

   - Are there generic performance measurements that transcend different industries? What are they?

- Are there generic performance measurements that transcend different linkages in the supply chain? What are they?

- What are the key business-to-business linkages that should be measured (if not referenced above)?

4. Please comment on the evolution of the process of measuring activities across firms. What is the current stage? How fast is it evolving? How much progress will occur in the next five years?

5. What will be the effect of electronic commerce on business-to-business performance measurement?

6. What companies do you perceive as leaders in performance measurement?

- What individuals within these companies are responsible for performance measurement, especially in the area of Product/Service flows, Financial flows, and Information flows?

7. What comments or guidance do you have on where research in this area should be focused?

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Fax # (423) 974-1932

August 10, 1998

Mr. Bill Best
Vice President Asia
AT Kearney
One Pacific Place 31/F
Queensway Road, Admiralty
Hong Kong

Dear Mr. Best:

As mentioned in our earlier letter, the **Council of Logistics Management (CLM)**, in conjunction with The University of Tennessee and Computer Sciences Corporation, is embarking on a significant research project titled **"Measuring Logistics Activities in the Supply Chain."** The purpose of the study is to reexamine how we measure the logistics process; not just within a firm but also between firms and throughout the supply chain.

Please find attached a summary of the findings from the first Delphi survey. The findings are based on a response rate of approximately 25%. In follow up calls, we found that vacations and travel schedules had reduced the ability of many of you to participate in the survey. Therefore, we are sending the second survey to the entire group rather than only to those who responded to the first round, as is typically done in a Delphi study. We would like to extend special thanks to those who were able to respond to the first effort, and hope that more of you can participate in this second survey.

Please review the results, and provide any general or specific comments that you feel are appropriate. In addition, **please complete the attached second survey and return the comment sheet and the survey by August 24.** The survey may be returned by fax to Jim Keebler, The University of Tennessee, 423.974.1932 or 423.974.8898. If you would like additional information, please contact Jim at 423.974.5244.

If you wish to receive an electronic file of the responses from the surveys, there is a space on the comment sheet where you may indicate this. Please note that these responses do not contain any personal data, and as such no respondent or company can be identified by their comments. Comments that may be unique to a particular company or individual have been removed from the file. The final results of the study will be made available to respondents in September.

Again, this is a significant project for CLM and we appreciate your continued support. Thank you in advance for your participation.

Sincerely,

C. John Langley, Jr., Ph.D.
John H. "Red" Dove Distinguished Professor
Of Logistics and Transportation

**Council of Logistics Management** *Delphi Study Survey – Phase II*
**Measuring Logistics Activities in the Supply Chain**

Please comment on the results from the first survey in the space provided. Please also answer the three additional questions, and return via fax by August 24, 1998 to Jim Keebler (no fax cover sheet is required).

Attention: Jim Keebler
Associate Director
Office of Corporate Partnerships
The University of Tennessee
Fax no: 423.974.1932 or 423.974.8898

Name: Mr. Bill Best
Company: AT Kearney
Phone Number: 852-2501-1401
Fax Number: 852-2530-4295

Please correct information if missing or inaccurate

O Yes, I would like to receive the complete data file from the first round of this survey
Please send it as a file attachment to the following email address:

_____

I would like to make the following comments and/or observations with regard to the reported findings on Phase I of your Delphi Survey on *Measuring Logistics Activities in the Supply Chain*:

(Please add additional sheets if you need more space)

1. Much has been written regarding the definition of a supply chain. One such definition states that: "Supply chain management is the integration of business processes from end user through original suppliers that provides products, services and information that add value for customers."[1] How would you define the difference(s) between Logistics Management and Supply Chain Management?

   - What key processes or activities are included in "Logistics"?

   - What key processes or activities are included in "Supply Chain" that are not included in "Logistics"?

2. For discussion purposes, we have hypothesized that many companies are following a path of development from functional measures and benchmarks through process measures to intercompany measures, as further defined below. Please agree or disagree with our premise, comment if you wish, and indicate where you feel your company is on this continuum. Consultants and academics should skip the rating, but please comment on the premises.

   - Stage I – Awareness of logistics functions and the benefits of supply chain management.
   - Stage II – Measuring functional activities within logistics or transportation, and comparing to average and/or best in class benchmarks.
   - Stage III – Identifying underlying factors for performance against Stage II measures, estimating costs and benefits to improve performance, and implementing initiatives.
   - Stage IV – Measuring intracompany cross-functional processes using measures that are both functional and financial in nature. Estimating costs/benefits and implementing initiatives.
   - Stage V – Measuring intercompany logistics activities with a customer or supplier.
   - Stage VI – Structuring a formal or informal relationship with a customer or supplier to measure intercompany activities, how these activities impact intracompany activities and costs, and estimating costs/benefits and implementing initiatives.
   - Stage VII – Extending Stage VI through more than one link of the supply chain (to customer's customer, supplier's supplier, or supplier to customer).

[1] The International Center for Competitive Excellence, University of North Florida, Douglas M. Lambert, coordinator, 1994. In 1996, this group moved with Lambert to The Ohio State University and changed its name to The Global Supply Chain Forum.

Based on the above criteria, I estimate that my company is now predominantly in Stage:

| I | II | III | IV | V | VI | VII |
|---|---|---|---|---|---|---|

Based on the same criteria, I estimate that my department/division is now in Stage:

| I | II | III | IV | V | VI | VII |
|---|---|---|---|---|---|---|

Comments:

3. As part of this study, we want to conduct Case Studies with supply chains in at least three different businesses/industries utilizing distinctly different distribution channels. These chains will consist of three or four links (such as supplier – manufacturer – (third party provider) – customer, or wholesaler – distributor – customer, etc.). We want to work with companies who are working in Stages V thru VII as defined above. This is not a benchmarking study – we do not want the actual numbers themselves. We want to discuss the process, the barriers, and the benefits that these supply chains have experienced so that others may learn how to follow them.

   What companies (including your own, if appropriate) would you suggest that we approach, and with what person in that company should we initiate the contact?

***Thank you again for your participation in this important study. If you have additional comments that you feel would benefit the team in its research effort, please do not hesitate to call us at your convenience.***

## *Logistics Measurement in the Supply Chain*
## *Findings from the First Delphi Study*

1. **What business and market factors are stimulating companies to move toward a supply chain process orientation and away from functional silos?**
   - Lower margins and competitive pressures to reduce costs
   - Customer service, customer focus
   - Cycle time pressures / demands
   - Seeking competitive advantage / regain competitive position
   - Continued consolidation of the supplier and customer base

   - **What are the barriers companies face in moving toward a supply chain process orientation?**
     - Organizational structure and related issues, such as: resistance to change, lack of infrastructure, lack of leadership commitment, and the lack of trust among partners
     - I/T infrastructure: outdated/obsolete, lacking, no funding, Y2K/ERP priorities
     - Lack of metrics to measure improvement
     - Performance metrics that reward functional / geographical behaviors
     - Retaining cost savings *within* individual corporations
     - Absence of new performance measures and objectives that are process spanning rather than functional
     - Lack of data

2. **What are the key activity or process measures being used <u>inside</u> companies today?**
   - Specific functional measurements (case fill, inventory turns, cycle time, inventory levels, days sales outstanding, costs versus budget)
   - Performance to expectation / requirement (on time delivery, over/short/damaged)
   - Broader measures / process measures are discussed but not being widely used (cash to cash, EVA)

3. **What are the supply chain measures being used <u>between</u> companies today?**
   - **Are there generic performance measurements that transcend different industries? What are they?**
   - **Are there generic performance measurements that transcend different linkages in the supply chain? What are they?**

   *(These are grouped, as most responses were similar across the three questions)*
   - Quantitative measures:
     - On time delivery, fill rate, "perfect order", order cycle time
   - Qualitative measures:
     - Customer satisfaction surveys
     - Process improvement opportunities
   - General dissatisfaction of what was being measured / how well / how frequently / to what effect

   - **What are the key business-to-business linkages that should be measured (if not referenced above)?**
     - Forecast accuracy
     - Performance against collaborative planning and goals
     - Customer service / satisfaction
     - Total supply chain costs / impact on EVA or Shareholder Value/ other economic measures

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4. **Please comment on the evolution of the process of measuring activities across firms. What is the current stage? How fast is it evolving? How much progress will occur in the next five years?**
   - The current stage is an awareness that it is necessary, but there is a lack of knowledge regarding how to do it or implement it
   - Many organizations, even today, do not have cross-functional performance measures in place within their own companies
   - Evolution will be based on collaboration among firms
   - Expect next five years to yield dramatic changes; likely to become cost of doing business with Tier 1, maybe Tier 2 companies

5. **What will be the effect of electronic commerce on business-to-business performance measurement?**
   - Major enabling tool; real time information availability, common language for data exchange, encourage standardized measurements, will provide the infrastructure to support the measurement
   - Not a panacea! Will not change anything in and of itself – managers must initiate the changes, and use e-commerce as a tool to facilitate

6. **What companies do you perceive as leaders in performance measurement?**
   - Proctor & Gamble, Wal-Mart, Dell, Hewlett-Packard, FedEx, Johnson & Johnson, Nabisco and Pillsbury were mentioned more than once

   - **What individuals within these companies are responsible for performance measurement, especially in the area of Product/Service flows, Financial flows, and Information flows?**
     - We were looking for names of individuals, but received mostly titles. We will address this issue separately.

7. **What comments or guidance do you have on where research in this area should be focused?**
   - Be very clear in defining "supply chain"
   - Build on what has already been accomplished (previous CLM studies, Supply Chain Council, etc.)
   - Focus on end-to-end metrics, and tie them to economic measures and executive decision support techniques
   - Utilize case studies of "best in class" companies / focus groups made up of individuals from "best in class" companies

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# Appendix B - Case Studies

B. 1 List of Original Sixty Company Candidates
B. 2 Case Study Interview Guide (Includes Process Definitions)
B. 3 Key Findings from the Case Studies

- 3M
- Modus Media/Sun Microsystems
- PageNet/Motorola
- Greybar/Texas Instruments
- Loblaw/Excel Beef
- Welch's/H.E. Butt
- Nabisco/Wegman's
- Martin Brower/McDonald's
- Tyson Foods/International Paper
- W.W. Granger
- Avery Dennison
- Caliber Logistics/Mopar
- Service Merchandise

| List of Original Sixty Company Candidates | |
|---|---|
| 3M | J.M. Smucker Company |
| AGTE Supply | Kraft Foods |
| Allied Signal | Lanier Worlwide |
| Amkor Technology | Lipton |
| Avery Dennison | Liz Claiborne |
| BankBoston Corporation | Logility |
| BIC Corporation | LTV Steel |
| Caliber Logistics | Manugistics |
| Campbell Soup Company | McNeil Consumer Products |
| Cass Information Systems | Menlo Logistics |
| Caterpillar Logistics Systems | Mobil Chemical Company |
| Colgate-Palmolive | Nabisco |
| Consumer Value Stores | National Service Industries |
| CSX | NFC plc |
| Cunmmins Engine Company | Proctor & Gamble |
| Dayton-Hudson | Ryder International Logistics |
| Descartes Systems Group | Schneider National |
| DSC Logistics | Sears Roebuck and Company |
| Frito-Lay, Inc. | Service Merchandise |
| Fritz Companies | SmithKline Beecham |
| GATX | Staples, Inc. |
| General Cable Corporation | Super Valu |
| General Motors | Target Stores |
| Greybar Electric | The Limited |
| Hershey Foods Corporation | UDV North America |
| Hewlett-Packard | Unilever |
| Hunt Wesson Foods | Unisys Corporation |
| i2 Technologies | Wal*Mart |
| IMC Global, Inc. | Wegmans Food Markets, Inc. |
| J.B. Hunt | Welch Foods |

**Measuring Logistics Activities in the Supply Chain**
**Protocol for Case Studies**
**CLM Research Project**

I. Introductions **10 minutes**

- A. Responsibilities
- B. Title
- C. Time with the company
- D. I/T questions
  1. Type of I/T systems in use
  2. How advanced / integrated are these systems
  3. Have you implemented an ERP solution
     - a) Which one / when
  4. Have you implemented a TMS and/or WMS solution
     - a) Which one / when
  5. Have you implemented a SCM solution
     - a) Which one / when
- E. How would you describe your corporate strategy:
  1. Operational excellence – low cost provider
  2. Customer intimacy – customer service
  3. Product leadership – quality, R&D

II. Purpose of the study **5 minutes**

- A. Two major goals of the research project:
  1. Identify a set of universal logistics measures across the supply chain
  2. Attempt to understand which measures can be used throughout the supply chain
     - a) How well these measures are integrated within your firm
       - (1) How do they impact the internal firm
       - (2) Who has awareness to and/or visibility of the measures
       - (3) Who makes decisions based on the measures
     - b) How well they are integrated with your suppliers or customers
       - (1) What type of visibility is there within your firm to their measurements, and within theirs to yours?
  3. IT IS NOT a benchmarking study:
     - a) We want to understand what you measure, how you measure, and how you define these measures - we do not necessarily want to know the values derived from these measures

B. Purpose of the case studies

1. Understand the barriers and benefits associated with developing and implementing these measures
2. Provide the industry with a broad range of activities that companies can undertake to improve process based performance
3. Based on these findings we will be:
   a) Conducting several more interviews
      (1) Within your supply chain
      (2) Within 3 other supply chains
   b) Mail survey

III. Interactions with your best supplier (or customer) **20 – 30 minutes**

A. What criteria do you use to think of them as "best"?

1. Volume of sales?
2. Unique business value of the supplier (customer)?

B. Can you describe the chronological steps that were taken to move forward together?

1. Was there a specific triggering event that made you choose to become closer to your supplier (customer)? *(such as cost reductions, scarce resources, efficiency initiative, etc.)*
2. What barriers did you have to overcome, and how did you do it?
   a) Information technology
   b) Reward structure
   c) Political, etc.

C. What processes do you feel are most important in linking you with this particular supplier (customer)?

1. See Table 1 below – how would you define each of these processes within your company

## Table 1 Supply Chain Processes

| *Process* | *Partial Definitions – For discussion only* |
|---|---|
| **Customer service** | Provides "one face" to the customer with current information – order status, manufacturing, etc.<br>Information exchange around order status, availability even before placing an order<br>Can include resolution of damages, shortages |
| **Order fulfillment** | From receipt to delivery – timely, accurate delivery of orders meeting customer expectations |
| **Planning, forecasting and scheduling** | Planning within your company<br>Forecasting the demands of your customers<br>Scheduling of production and materials requirements<br>Sharing all of the above with your customers and/or suppliers |
| **Sourcing / procurement** | Decisions on what to buy, and where to buy it<br>Decisions on when to buy, and in what quantities (can include inbound material handling)<br>Vendor management / qualification<br>Total cost, quality |
| **Flow / transportation** | Could be plant to plant or to / from the supplier / customer |
| **Storage – warehousing** | Raw material and finished goods<br>Material handling |
| **Information flows** | Real time data communication<br>Collaborative planning and scheduling<br>Using technology to its fullest capability (ie., fully functional, or cleaning EDI data after receipt) |
| **Demand generation** | Developing the "suction" to pull products through the supply chain<br>Includes Marketing, Sales, R&D |
| **Cash flows** | Days sales outstanding<br>Bad debt / sales uncollected<br>Write-offs / discounts<br>Ratio of payables to receivables |

| | |
|---|---|

For each of the processes:

2. How important are they
3. What impact do they have on the firm
   a) Internal
      (1) Improvements in customer service
      (2) Costs going up / down
   b) External

D. For the most important processes, how would you rank them: **10 – 20 Minutes**

*(Please see Table 2 - )*

1. Which is the most important process to your firm
2. Is it the most important process to your customer / supplier
3. What are the most important measurements used for the most important processes?
   a) How are they defined
   b) How have they changed
      (1) Definition changed?
      (2) Calculating differently?
      (3) Output / value better but measure not changed?
   c) What is the impact of the measures on both of your firms
   d) How well these measures are integrated within your firm
      (1) How do they impact the internal firm
      (2) Who has awareness to and/or visibility of the measures
      (3) Who makes decisions based on the measures
   e) How well they are integrated with your suppliers or customers
      (1) What type of visibility is there within your firm to their measurements, and within theirs to yours?

IV. In an ideal world, how would you change what or how you measure? **10 – 20 minutes**

A. What other variables would you include?
   1. Time?
   2. Cost?
   3. Quality?
   4. Others? Responsiveness? Visibility? Flexibility?

B. What are some of the barriers that keep you from changing or putting in place these measures?
   1. In an ideal world, what would you like to measure, but currently cannot?

V. Describe your worst supplier (customer)

A. What makes them the worst

1. Is it the values – the outcomes – or what can be measured

2. Are you measuring the same processes with them as with your best supplier (customer)?

VI. Summary **5 minutes**

A. What questions regarding measurements or measurement processes should we have asked, but have not

B. What additional information should we know, but have not yet uncovered

## Table 2 Measurement / Integration Matrix

| | *Intracompany* I | *Intercompany* X |
|---|---|---|
| 4 ***Integrate*** | Measuring intracompany cross-functional processes using measures that are both functional and financial in nature. Estimating costs/benefits and implementing initiatives | Measuring intercompany cross-functional processes using measures that are both functional and financial in nature, estimating costs/benefits to improve, reaching agreement, and implementing initiatives that impact both companies |
| 3 ***Coordinate*** | Identifying underlying factors for performance against measures, estimating costs and benefits to improve performance, and implementing initiatives | Identifying underlying factors for performance against measures, estimating costs/benefits to improve, reaching agreement, and implementing initiatives that impact both companies |
| 2 ***Measure*** | Measuring functional activities within the company, and comparing to average and/or best in class benchmarks | Measuring the functional activities occurring between two companies, and comparing to average and/or best in class benchmarks |
| 1 ***Aware*** | Awareness of logistics functions and the potential benefits of logistics management for the company | Awareness of logistics functions and the potential benefits of supply chain management for both companies |

Key Findings from the Case Studies

The purpose of the case studies was threefold: (1) to determine what logistics activities and processes were being measured; (2) to identify barriers and enablers of their measurement efforts; and (3) to discover any methods or tools used to achieve success in this area that could be considered by other companies.

*3M*

3M management expects data-based decisions. This has been ingrained in the culture at 3M for a long time. This has resulted in the development of a comprehensive data warehouse and the extensive use of activity-based costing. This capability has given 3M the ability to quantify cost relationships between products, services and customers. A few of the benefits of this measurement capability are:

- Customized Profitability Analysis – the ability to look at individual customer sales, factory cost, customer service cost, and freight and distribution cost, as well as the cost-to-serve aspects of internal support departments.
- Product / Service Agreements – the ability to establish and measure a unique agreement with any customer, specifying the products and services to be supplied, what aspects will be measured, and the expected level of performance for each. When the customers desired measurements are expressed differently from those generally used by 3M, both measures can be shown, if requested.

- *Info My Way* – 3M has provided access to about 3000 customers, allowing them to check order status and inventory availability across the Internet (user name & password protection). In 1999, that access included a link to carrier status, allowing the customer to locate an order even after it leaves 3M.
- Information accuracy – 3M separately tracks the percentage of transactions actually measured, in addition to the measures themselves. If the actual information is not available for some reason (desired ship date not on customer order, etc.), the system will not estimate the entry. This allows 3M to work to improve information accuracy as well as the service level being measured.

Logistics excellence is one of the three key areas for 3M's business strategy focus. This assures top management support for logistics initiatives. This focus has been repaid with a reduction in the overall cost of logistics, equal to 1.5% of sales over the past five years. Additional improvements in other areas include:

- Improved visibility of information to the people actually performing the work:
  - By giving warehouse personnel increased visibility to the orders, and allowing them to balance their own workloads, on-time delivery in regional distribution centers improved from 85% to 98% without adding additional employees.
  - Cross functional teams have implemented cause analysis, and used it to locate and resolve underlying barriers to improved performance.
- Automated price-matching verification on incoming EDI transactions has drastically reduced charge-backs and discrepancies.
- Future goals include:

- Adding real time simulation to the data warehouse to allow "what if" analysis on trade-offs in cost and service.
- Implementing a program that ties employee satisfaction and customer satisfaction to the incentive plan.

*Modus Media / Sun Microsystems*

Customer (Sun) had a perception that Modus Media (MMI) was not meeting the Sun scorecard requirements for delivery and quality. The Sun scorecard was somewhat subjective, but the customer's perception, right or wrong, is always the key to the business relationship. Therefore, MMI had to create the correct perception of its real performance. To do so, MMI did the following:

- Changed to a business unit organization with a process orientation and "one face to the customer" (Business Unit Manager)
- Tracked and captured objective measures that matched theSun scorecard and shared the information with Sun
- Instituted a Quarterly Business Review (QBR) to go over the Sun scorecard and MMI data before the scorecard was finalized

This was a highly competitive, price-driven business. The MMI culture was heavily disposed toward measuring but had been data rich and information poor. Organizational changes, coupled with information technology tools, allowed MMI to organize the infomation and create sales tools that effectively state:

- This is what we can do for you.
- This is what it will cost.

MMI did not yet have a comprehensive ABC implementation but had been able to evaluate their operations to approximate their cost to serve. Net results were:

- Unprofitable customers were identified, work methods were reengineered or service contracts were renegotiated or terminated
- While revenues went down for a year, their key measure of financial performance, earnings before interest and taxes (EBIT), increased significantly
- Two key competitors have announced within the past 6 months that they are ceasing operations altogether or in the area with which they compete with MMI

The corporate culture was changed from "finger pointing and rock throwing" to cooperative ownership and accountability with the new measurement program called VVA (Validate the Value Added). Key objectives were to:

- Link the process-based measures at the floor level to the customer-based measures (KCRP – Key Customer Related Processes) at the business management level and ultimately, to the financial measures being used by company management.
- Demonstrate to the individual employee the impact that his/her job performance has on overall departmental and corporate goals
- Create a mechanism to determine root causes / barriers for failure in order to achieve goals and form teams to address and remove the barriers

Each work group formulated its three key measures that supported the overall goals for on-time delivery, quality, etc. Results were tracked daily, charts were updated weekly and posted for public view. Weekly team meetings were focused on determining root causes for failure to achieve desired results. The slogan became MUI (moo ee), which stands for Measure It, Understand It, and Improve It. Cultural transition occurred when employees saw that someone was actually doing something about the problems. The culture changed to cooperation among cross-functional teams, with each individual understanding how they could make a difference.

*Paging Network (PageNet)/ Motorola*

Measuring started after contract negotiation with key supplier Motorola who required a 120-day lead time for order fulfillment. PageNet was placing orders 120 days out, yet often changing or canceling orders 30 days before their scheduled ship date. PageNet wanted Motorola to lower prices and improve service (especially stock-outs and back orders). Motorola shared with PageNet what they had been doing to incur extra costs for Motorola:

- High percentage of changes
- High levels of safety stock
- Orders from local units – no centralized buying

PageNet and Motorola agreed to:

- Thirty day lead time with no changes
- A specified number of expedited orders to be delivered in less than 30 days

- On time delivery
- A 6-month rolling forecast to be provided by PageNet
- A monthly review of forecast, schedule and measurements

Jointly-defined measurement was used, resulting in a transition from poor relationships with arguments and finger pointing to fact-based discussions and better relationships.

*Graybar / Texas Instruments*

Texas Instruments (TI) had seventeen stockrooms in thirteen facilities being operated as cost centers. Each stockroom added the cost of overhead to the purchase price of each part, material or component and "sold" it internally to other departments. Cost ranged from 15-18% at best to 32-38% at worst. Graybar was engaged to manage the stockrooms, own the inventory, and have responsibility for all procurement. Over the duration of the relationship, Graybar has reduced the cost factor to approximately 20% of previous levels. This relationship is managed, using the following measures:

- Stock-outs (reduced from 9-10% to less than 3%)
- On time delivery (now 99%)
- Subjective "customer" satisfaction rating level that increased from 54% to current 94%

Key factors cited as enablers for relationship:

- Trust
- Innovative spirit (especially on part of TI)
- Cultural compatibility between the two companies

TI and Graybar have entered into an expanded relationship for the supply of production materials.

*Loblaw/Excel Beef*

Loblaw outsourced their butchering function to Excel Beef (division of Cargill) for the eastern market zone. Some of the drivers for this change were:

- Space requirements and fixed asset cost that prevented Loblaw from having meat departments in all stores, especially smaller, "no frills" stores
- Lack of skilled labor
- Sanitation issues

Benefits to Loblaw:

- Revenue growing by offering fresh meat in "no frills" stores
- Forecasting of "raw material" and production, now performed by Excel Beef
- Stores having the ability to order the quantity needed, pre-cut, avoiding labor costs

Barriers encountered:

- Loblaw not having the "as is" from before outsourcing, having trouble gathering new information early in the new arrangement, and having trouble quantifying the costs and benefits
- Union issues
- Resistance to change and a lack of trust between organizations

- A key to overcoming barriers –responsible visionary for both procurement and merchandising became the project owner (top management support)

Further changes and enhancements since outsourcing:

- Purchasing of raw material taken back by Loblaw, as they found it decreased their overall leverage in the market, especially in those areas not yet serviced by Excel.
- Order system changed from manual to automated – orders now placed by hand held computer, accumulated by Loblaw, and forwarded to Excel four times per day.
- Concurrent evolution in systems at Excel and Loblaw enabled greater visibility into inventory by both companies.

*Welch's/H.E. Butt*

Internal measures have been tied directly to management incentives on a team approach. The various department heads are measured as a unit rather than only on those areas in which they have direct impact. At first, only a small portion of an individual's incentive compensation was tied to team results, but it was increased annually. This has resulted in a collective focus on interdepartmental communications and coordination. Key measurements at Welch's are focused on three areas:

- Service – measuring "perfect order" delivery on a national basis
  - Complete
  - On time
  - Accurate and timely Invoice

- No damage
- Track cases shipped vs ordered and other functional measures to accumulate overall statistics

- Cost goal - overall lowest delivered cost
- Quality – measured in four primary areas
  - Product quality
  - Safety
  - Environmental impact
  - Meeting customer specifications

Welch's has established a program intended to generate profitable revenue growth through supply chain collaboration with their trading partners. For example, H.E. Butt (H-E-B) approached Welch's with a problem on dock congestion. They questioned if it made sense to change racking and pallet configurations to help them alleviate the congestion and avoid investment in additional fixed assets.

- H-E-B opened their warehouse operations to Welch's and shared costs of various components.
- Welch's shared their costs of transportation, pallet "building", etc.
- After investigation of alternatives, the implemented changes had a slight cost increase to Welch's but generated 25% revenue growth through H-E-B in the first year.

*Nabisco/Wegman's*

Nabisco has established an internal logistics training and development program. This helps them to attract good people and helps them develop the leaders and key individuals needed to create and staff their supply chain initiatives. Key components are:

- Defined set of core competencies expected at each level
- Internal university, designed to help individuals attain the competencies required for the next level, with credits for time invested
- System for feedback on progress against goals on a regular basis.

Nabisco has a measurement called ROMI – Return on Management Invested. Included in this is the establishment of the Customer Profitability program and scorecard. This allows them to measure the net profitability of each major customer and to track management time invested against each customer relationship.

Nabisco has been a key participant in the establishment of the Collaborative Planning, Forecasting, and Replenishment (CPFR) initiative and has participated in several pilots. A recent pilot with Wegman's involved the snack nuts area, specifically Nabisco's Planter's® line. Key areas measured included:

- Forecast accuracy
- Case fill from Nabisco DC to Wegman's DC
- Case fill from Wegman's DC to Wegman's stores
- Days of supply in Wegman's DC
- Out-of-stock in Wegman's stores
- Sales growth over same period last year

- Actual cost of receiving

The overall goal of this initiative is to eliminate internal demand forecasting and replace it with collaboration between supplier and customer. Various goals with regard to inventory levels, inventory turns, tolerance for stock-outs, category growth, etc., can be balanced and programmed into the CPFR model. The pilot actually yielded a larger than anticipated growth in sales. Further pilots are planned.

*Martin-Brower/McDonald's*

Martin-Brower is one of the largest of the forty-four distributors responsible for supplying McDonald's restaurants. All distributors for McDonald's are measured on eleven key measures. These include key customer measures such as:

- On time delivery
- Delivery reliability
- Delivery accuracy
- Damage

These measures were defined about twelve years ago and have been enhanced and expanded since. However, following the principle that "success is the greatest enemy of innovation." These measures could become barriers to potential initiatives for lower total supply chain costs, as several are focused on low level functional activities:

- Cases per mile
- Hours utilized per truckload, etc.

To a large extent, the measures are currently used to provide answers to people that ask questions rather than to improve the process. Initiatives are currently underway to look at the overall cost of logistics, from the counter all the way back to the potato farmer, cattle rancher, and lettuce grower. One of the barriers to overcome is that certain functional measures need to be changed in order to facilitate lower overall cost. For example, loads could be palletized to facilitate automated material handling equipment and faster transfer of material from delivery truck into the store. Because this would decrease the labor cost to the store, decrease the time that the delivery truck is blocking space in the store parking lot, it would also decrease the cases per mile of the distributor. Since only the latter is currently measured, establishing the trade-offs to arrive at total cost of logistics is expected to be challenging.

*Tyson Foods / International Paper*

Measurement enables or facilitates trust. International Paper (IP) would like to become the sole supplier of corrugated packaging to Tyson nationally and work as partners to assure the best service and cost while increasing profitability for both parties. For Tyson, cost is the number one driver. The background is:

- Tyson has built its reputation and business by being flexible and responsive. Due to variations in bird weight, decisions on which "product" to make are made "on-the-fly" and often changed several times a day. IP has configured their business to respond to these frequent changes.

- IP supplies corrugated paper from nine facilities to eighty-three Tyson locations nationwide. Many of these locations are recent acquisitions, and not under centralized purchasing control. Each location is a profit center. Therefore, even when centralized purchasing is the norm, each location is still looking to the improve margin and reduce cost.
- In many cases, data is not currently available to support fact-based decisions. SAP has been implemented, and data gathering regarding on-time delivery, quality and condition will begin soon.
- Contract was originally bid in the early 1990s. IP got about 30-35%. Three years later, in a new contract, IP's share was increased. Currently IP is in the middle of the third contract, and has about 65% of the Tyson business.
- IP has placed two employees with Tyson to work on product development and initiatives for cost reduction and service improvement. Gains have been made in rationalizing how to package SKU's, and in the use of engineered fibers to reduce weight and cost of packaging.

IP would like to change the relationship to a cost-plus program. Currently, material cost is 70% of box cost. While there remains room for gain by using engineered fibers, etc., the larger potential is in the 30% cost of conversion, overhead and freight. IP feels that they can work with Tyson to further reduce cost to Tyson while building increased ROI for IP. Tyson agrees in principle but sees the need to further define and measure the relationship in these areas:

- Cost will continue to be the number one driver. With a decentralized P&L, each facility will be "taking shots" at the relationship every time a local supplier comes in with a low price trying to buy into the system. The measurement and justification system will have to reflect the total cost of acquisition and quality and must be bulletproof.
- Other key drivers for the relationship are:
  - Reducing total cost of transportation and material handling through systematic use of routing and back-hauls
  - Engineering of packaging to reduce weight and scrap
  - Improving scheduling and forecasting
  - Implementing electronic invoices that are error-free, and facilitating quick payment

Both parties agree that measurement will be the key to establish trust, and build the relationships necessary to support the partnership at the desired level.

*W. W. Grainger*

In many companies, a relatively low percentage of the number of customers (often 20% or less) make up a relatively large percentage of the total business (often 80% or more). At Grainger, this rule definitely does not apply. Grainger has over 1,500,000 active customers. Customer segmentation was not feasible. Therefore, Grainger chose business segmentation. It divided the different types of services into different business units, analyzed the associated overheads involved with providing the different services, and structured its costs accordingly. The case study focuses on the core business – Grainger Industrial Supply.

Grainger has implemented a series of internal measures, referred to as Cockpit Metrics. The effect is similar to the cockpit of a modern commercial jet, with a large central graph depicting the key measures for a particular area and smaller surrounding graphs showing the components that make up and or effect the central measures.

- Corporate focus is on "economic earnings" (EE), a measure that reflects the cost of capital against retained earnings. Corporate-wide profit sharing ensures that each employee also has a vested interest in this key measure.
- Cockpit Metrics, at the senior officer level, tracks key measures that directly impact EE.
- Cockpit Metrics, at the senior manager level, tracks the key measures that impact the metrics of the next highest level.
- At the operating level, key measures include on time delivery, cycle time, and "first pass yield" (that percentage of instances when the company has what the customer wants, where he wants it, and can satisfy the order as requested).

Benefits realized from the measurement system since conception include:

- Increased EE
- Improved quality of life in the workplace – when data is available, it changes the focus from the people to the information, and it facilitates people working together to find solutions to problems instead of blaming each other for their difficulties.

Concurrently with the Cockpit Metrics, Grainger instituted an organizational structure to facilitate communication and coordinate process improvement initiatives. These teams are actually the "owners" of the Cockpit Metrics at the various levels. Regular review of the measures takes place in the Cross Functional Teams (CFTs) and in the Process Improvement Initiative Teams (PIITs). Root cause analysis helps to identify problem areas, which are then targeted by proposed solution initiatives. Approval for initiatives must come from the Business Leadership Team (BLT). This assures two key elements for success:

- Upper management support for initiatives is assured, as all initiatives must be approved and funded by the BLT.
- Multiple initiatives by different functional areas will not occur – differences in proposed actions must be resolved at the PIIT level before presentation for approval by the BLT

*Avery Dennison*

Avery Dennison (AD) has a program for its customer service representatives called "Knock Your Socks Off." In an area where quantitative measures are often difficult, they have developed five key areas of assessment:

- Accessability – measured by percentage of customer problems resolved on the first call compared against the number of calls that go into voice mail or hang-ups.
- Likeability – measured by service complaints, surveys, and feedback from customers (this is not a totally objective measure, but efforts to make it better continue).
- Knowledge – the level of product and systems knowledge and knowledge of the customer. There are weekly training sessions that include testing and certification.
- Accuracy – measured by PO and invoice change requirements (error codes) and deductions.
- Keeping commitments – similar to likeability but measured by surveys with internal as well as external customers.

The incentive provided for strong performance is paid vacation time.

One of Avery Dennison's retail customers had been attempting to redefine its definition of what constituted on-time delivery. AD maintained that delivery was when the shipment was delivered to the customer's receiving dock. The customer wanted to consider their order delivered when AD products were placed on their retail store shelves, available for purchase by their customers. AD wouldn't agree, claiming they could not control the shipment after it was tendered for unloading. The customer said that was not the issue. Improved packaging, labeling and sequencing of the item in the shipments could facilitate the retailer's ability to avoid rehandling and warehousing and move AD products directly onto the retail shelves. AD's inability to shift their orientation limited their ability to satisfy their customer.

*Caliber Logistics/Mopar*

One of the relationships Caliber has in the automotive arena is with Mopar, the replacement parts division of Chrysler. Caliber's primary responsibility to Mopar is to move the parts from the suppliers to one of the five national Central Distribution Centers (CDCs). The goal of this program, titled Controlled Parts Delivery (CPD), is to maximize dealer order fill levels while reducing inventory by optimizing total logistics (including reduced manufacturing lead times). As a third party logistics provider, it is necessary to measure performance and value added to demonstrate continuing value to the customer. The Mopar example demonstrates ways in which measurements can be used in third party provider relationships.

Measurement is used as a basis for partnership agreements. In order to demonstrate value, the two parties must agree on several things:

- What constitutes success?
- How will the factors for success be measured?
- What is the current level of performance, and what is the expected level?
- Who is responsible for gathering the data?
- Who will review the data and approve or disapprove of the progress against the goal?

These factors are common among all third party providers. They can, and should be, applied to internal cross-functional initiatives and to any intercompany relationship. What is less common, especially in intracompany initiatives, is the alignment of measurements to the business strategy. Caliber's Start-Up team works with the customer to articulate:

- What is the business strategy of the business unit being supported?
- What logistics strategy best supports that business strategy?
- What are the key performance indicators that will indicate if initiatives are supporting the logistics strategy?
- What is the current state of those key performance indicators?
- What is the desired level of performance?

When strategic objectives are clear and performance can be measured, partnerships are much more likely to succeed for both parties.

A third party provider can be an enabler to an integrated supply chain and also enable stronger cross-functional performance within a company. In the Mopar relationship, Caliber works with three segments of Mopar, each of whom has individual goals and objectives:

- Mopar HQ is primarily concerned with the suppliers and the delivery of parts from the suppliers into the CDCs.
- Mopar Corporate Logistics is primarily concerned with traffic and transportation, and managing transportation costs as a percentage of the dollar volume of purchases.
- The CDCs and Regional DCs (RDCs) are measuring "facing fill" – that percentage of the time that the dealer's order can be filled from the right RDC, at the right time, with the right part number.

Caliber effectively operates at the center of the three Mopar entities. They serve as the conduit for information and facilitator for balancing trade-offs in cost and service. To meet the central goal of shortening the pipeline from parts supplier to dealer, Caliber measures two key indicators:

- Absolute hours from supplier notification of part availability to delivery at CDC
- Compliance against standards for the above:

  For each supplier location, Mopar and Caliber have established a standard shipping time that is used by the dealer network as ordering standards. Compliance measures availability against those standards.

Caliber also has visibility into many of Mopar's systems and has used their internal analysis tools to suggest changes for consideration. For example:

- The variability in shipping demand created a problem throughout the system. The peaks required overtime, and the low spots were wasteful of resources.
- Standard purchasing practice was to allow wide shipping windows for inventory placement parts.

- Caliber used their own data to model a system with defined order points and narrower windows staggered throughout the month.
- In addition, they studied the impact of change orders on availability and demand and recommended a program that freezes orders in the time period of seven days before shipment. This has allowed the parts suppliers to balance their own workload and give Caliber better notification as to when parts would be available.
- The net impact of both programs was a smoother curve that allowed improved service at a lower overall cost of logistics.

Third party providers can use measurement to demonstrate their added value and as an added value in and of itself:

- Caliber measures six key areas, specified by Mopar, as part of the contract terms. In addition, they measure three other areas that they feel are key indications of the service level provided. The combined nine measures are reviewed on a monthly basis. Trends are discussed, changes are suggested, and cooperation is facilitated through the use of data based-decision making.
- In addition, Caliber uses their visibility into Mopar systems, in combination with their internal systems, to measure supplier performance and carrier performance and to report that information back to Mopar HQ and Corporate Logistics, respectively. Mopar then uses this information in evaluations and negotiations with suppliers and carriers. Mopar is not able to capture this information on its own.

*Service Merchandise*

The strategic vision for Service Merchandise (SM) is to move from regional centers holding inventories to a central warehouse for inventory. They plan the use of flow-through regional centers to service stores. Corporately, they are moving from the catalogue store concept to a customer-picks-and-takes concept. They are testing a small size, limited line, mall store concept ("Service Select") as well as a superstore (40,000 sq. ft. - 10k in warehouse, 30k in retail) format. Twenty-five percent of sales are jewelry (also 100% of earnings). Their small appliance business is large. SM is among the top five customers of all its appliance suppliers. Home products, accessories, molded and pine furniture are also merchandised. Historically, large, non- and slow-moving inventory positions resulted from the requirement to support expected demand from catalogue items. Using CAPs Toolkit, especially the network optimization module, SM modeled networks consisting of 1 to 5 RDCs. They found four to be optimal. These are located in Nashville, Dallas, Orlando, and near West Point, NY. They have a separate Returns Center in Bowling Green, KY. Now, 82% of the 350 retail stores are within one day of a RDC. The number of SKUs has been reduced 30% over the last two years. This change in corporate business strategy has had a profound effect on their internal supply chain. The previous annual catalogue strategy produced an inefficient and costly logistics system.

About three years ago, Service Merchandise began establishing vendor partnerships. They shifted from infrequent, deal-driven, large orders to small, more

frequent orders. These are tracked manually, with monthly report cards by vendor for fill rate and order cycle by segments. They process-mapped the whole order-receipt cycle with Black and Decker, and made joint decisions (i.e. don't hold shipments for a back order) and joint measures, (i.e., ASN Accuracy, ASN Timeliness, Forecast Accuracy). They automated manual systems, including EDI214 information from carriers. They realized a large benefit of joint flow-charting of order/shipment flow process with suppliers, resulting in shared understanding, joint decisions and alignment of measures. They now meet with vendors quarterly to review performance.

Service Merchandise is now emphasizing planning and inventory management. Out-of-stocks and non-moving items have management attention. They are measuring vendor performance in terms of "first receipts" for on-time performance, within three days for balance of split shipments, and "first fill" rate. They now have an exception report for all delayed (late) receipts. Their procurement system was thirty years old, and the warehouse management system was twenty-two years old. They are now using the internet (and extranet) for transportation load optimization. Their key performance measures today are (1) Sales and Margin by Region, District, and Store; (2) Out of Stocks, Inventory Management measures, such as "turns" versus last year, and versus plan; and, (3) Vendors performance in terms of percent of order for the month received to-date. They used to get most of their deliveries bunched at the end of the month. Now, they are able to smooth these flows.

Top management used to be concerned only with sales measurement. This permitted the bad practice of excessively large backlogs of unloaded trailers at RDCs. Today, they have trailer backlog daily reports. The executive committee now has

visibility to multiple supply chain measures, whereas it used to only have just out of stock data.

# Appendix C - Mail Survey

## C. 1 Eight Page Questionnaire

CSC COUNCIL OF LOGISTICS MANAGEMENT UT

# Measuring Logistics Activities in the Supply Chain

**Logistics Survey**

**WHY YOU SHOULD COMPLETE THIS SURVEY!** You have been selected to represent the viewpoints of your company in a study that is considered essential by the Council of Logistics Management. It is very important that this questionnaire be completed and returned in order that the results will represent the thinking throughout your industry. **In addition,** all respondents whose survey is received by mail or by fax by **December 18, 1998,** will receive a complimentary copy of the book that will result from this study. This is a $70 value ($35 for CLM members). Your copy will be sent to you before the book is available to the general public.

Per the letter of explanation, in addition to this Logistics Survey, you will find one additional survey marked for a colleague. Please ask the appropriate individual in your organization to complete that survey. They will also receive a complimentary advanced copy of the book.

Please take about 30 minutes to fill in the survey, and **return it to us by mail** in the envelope provided. If you prefer, you can **fax your response** to 310.322.3685 by **December 23.** All responses will be kept confidential.

Thank you in advance for your help on this survey. We look forward to sharing the results with you in the near future.

**Important: Completed questionnaires will be scanned for data entry. Please do not fold survey. Please ensure that, when indicating answers, you fill in the appropriate circle(s) completely using either black ink or a #2 pencil. Example:**
**Correct:** ● **Incorrect:** Ø ⊗ ◒

## I. Organization — All responses will be kept confidential

A. How is the supply chain / logistics management function viewed in your organization?

O Cost center O Profit center O Service center O Other (please specify) _____

B. For each of the activities listed below, please mark the circle indicating which organizational function has primary responsibility for that activity:

| | Supply Chain/ Logistics | Operations/ Manufacturing | Store Operations | Finance | Sales/Marketing/ Merchandising | Other (specify) |
|---|---|---|---|---|---|---|
| Customer Service | O | O | O | O | O | O _____ |
| Order Entry | O | O | O | O | O | O _____ |
| Order Processing | O | O | O | O | O | O _____ |
| Order Fulfillment | O | O | O | O | O | O _____ |
| Procurement / Sourcing | O | O | O | O | O | O _____ |
| Purchasing | O | O | O | O | O | O _____ |
| Production Planning | O | O | O | O | O | O _____ |
| Inventory Accounting / Control | O | O | O | O | O | O _____ |
| Inventory Management / Planning | O | O | O | O | O | O _____ |
| Inbound Transportation | O | O | O | O | O | O _____ |
| Outbound Transportation | O | O | O | O | O | O _____ |
| Warehousing | O | O | O | O | O | O _____ |
| Demand Forecasting | O | O | O | O | O | O _____ |
| Transportation Planning | O | O | O | O | O | O _____ |
| Logistics Network Design / Strategy | O | O | O | O | O | O _____ |

**C. Please indicate the three most important logistics issues facing your organization in the coming year.**

- O Cycle time reduction
- O Cost control / cost reduction
- O Improving customer service processes
- O Logistics measurement within the company
- O Changing organizational structure
- O Information technology utilization / optimization
- O Logistics support for global market expansion
- O Quality improvement
- O Outsourcing
- O Strategic alliances with customers / suppliers
- O Logistics measurement between company and customers / suppliers
- O Expanding distribution into new channels / markets
- O Integrating with Internet-based customer ordering systems
- O Other (please specify): _____

**D. Please indicate if implementations of the following technologies / software packages / business practices are planned, in process, or have been completed by your company.**

| | No Implementation Planned | Planning Implementation | Implementation Underway | Implementation Completed |
|---|---|---|---|---|
| ERP (Enterprise Resource Planning) | O | O | O | O |
| TMS (Transportation Management System) | O | O | O | O |
| WMS (Warehouse Management System) | O | O | O | O |
| MRP / DRP (Material / Distribution Requirements Planning) | O | O | O | O |
| APS (Advanced Planning & Scheduling) | O | O | O | O |
| ABC/ABM (Activity Based Costing / Management) | O | O | O | O |
| EDI (Electronic Data Interchange) | O | O | O | O |
| Use of Internet to exchange information with customers/suppliers | O | O | O | O |
| Use of Internet for Business-to-Business Transactions | O | O | O | O |
| Scanner / Bar Coding / Point of Sale Systems | O | O | O | O |
| Other (please specify): _____ | O | O | O | O |

**If you have responsibility for multiple divisions, please keep in mind the *single* largest or most important division when answering all remaining questions on the survey.**

**E. Please indicate the types of relationships your company has with your customers and suppliers in each of the following categories by indicating the approximate number of companies that fall into each category.**

| Type of Relationship | Number of Customers | Number of Suppliers |
|---|---|---|
| **Partnership**<br>Companies have formed *partnerships*, and share significant level of operational integration, each viewing the other as an extension of themselves; no end date planned | | |
| **Integration**<br>*Integration* of activities; longer-term focus, but not indefinite; may have multiple divisions and functions within both companies involved | | |
| **Coordination**<br>On a limited basis, *coordinate* activities and planning; primarily short-term focus; perhaps only one division or functional area from each company involved | | |
| **Transactional**<br>Primarily *transactional.* with no requirement for joint commitment or joint operations beyond some shared information | | |

## II. Logistics Measures & Strategy

**A. Again, if you have responsibility for multiple divisions, please answer these questions with the *single* largest or most important division in mind. Please ensure that it is the same organizational entity for which you answer all other questions.**

For each of the measures listed below, please mark whether it is captured on a regular basis in your company. If you are a retailer, please consider the retail stores as your customer.

For those measures marked "Yes," please indicate how important the measure is to your department and how important the measure is to the overall division / company. Very important measures can be thought of as those that are critical to the management of the department / company and would hinder the ability to effectively manage if the measures were not provided.

| | | | Function / Department | | | | | Division / Company | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Very Important | | | | Not Important | Very Important | | | | Not Important |
| | No | Yes | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| Order Fill | O | O | O | O | O | O | O | O | O | O | O | O |
| Case Fill | O | O | O | O | O | O | O | O | O | O | O | O |
| Line Item Fill | O | O | O | O | O | O | O | O | O | O | O | O |
| Out Of Stocks (Finished Goods) | O | O | O | O | O | O | O | O | O | O | O | O |
| Back Orders | O | O | O | O | O | O | O | O | O | O | O | O |
| On-time Delivery | O | O | O | O | O | O | O | O | O | O | O | O |
| Order Cycle Time | O | O | O | O | O | O | O | O | O | O | O | O |
| Cash-To-Cash Cycle Time | O | O | O | O | O | O | O | O | O | O | O | O |
| Perfect Order Fulfillment | O | O | O | O | O | O | O | O | O | O | O | O |
| Customer Complaints | O | O | O | O | O | O | O | O | O | O | O | O |
| Overall Customer Satisfaction | O | O | O | O | O | O | O | O | O | O | O | O |
| Orders Processed per Labor Unit | O | O | O | O | O | O | O | O | O | O | O | O |
| Cost To Serve | O | O | O | O | O | O | O | O | O | O | O | O |
| Returns and Allowances | O | O | O | O | O | O | O | O | O | O | O | O |
| Days Sales Outstanding | O | O | O | O | O | O | O | O | O | O | O | O |
| Inquiry Response Time | O | O | O | O | O | O | O | O | O | O | O | O |
| Invoice Accuracy | O | O | O | O | O | O | O | O | O | O | O | O |
| Finished Goods Inventory Turns | O | O | O | O | O | O | O | O | O | O | O | O |
| Inbound Freight Cost | O | O | O | O | O | O | O | O | O | O | O | O |
| 3rd Party Storage Cost | O | O | O | O | O | O | O | O | O | O | O | O |
| Inventory Count Accuracy | O | O | O | O | O | O | O | O | O | O | O | O |
| Forecast Accuracy | O | O | O | O | O | O | O | O | O | O | O | O |
| Inventory Carrying Costs | O | O | O | O | O | O | O | O | O | O | O | O |
| Inventory Obsolescence | O | O | O | O | O | O | O | O | O | O | O | O |
| Incoming Material Quality | O | O | O | O | O | O | O | O | O | O | O | O |
| Over / Short / Damaged | O | O | O | O | O | O | O | O | O | O | O | O |
| Outbound Freight Cost | O | O | O | O | O | O | O | O | O | O | O | O |
| Orders Processed per Time Unit | O | O | O | O | O | O | O | O | O | O | O | O |
| Units Processed per Time Unit | O | O | O | O | O | O | O | O | O | O | O | O |
| Logistics Cost per Unit vs Budget | O | O | O | O | O | O | O | O | O | O | O | O |
| Product Units Processed per Warehouse Labor Unit | O | O | O | O | O | O | O | O | O | O | O | O |
| Product Units Processed per Transportation Unit | O | O | O | O | O | O | O | O | O | O | O | O |
| Processing Accuracy | O | O | O | O | O | O | O | O | O | O | O | O |
| Space Utilization vs Capacity | O | O | O | O | O | O | O | O | O | O | O | O |
| Labor Utilization vs Capacity | O | O | O | O | O | O | O | O | O | O | O | O |
| Equipment Utilization vs Capacity | O | O | O | O | O | O | O | O | O | O | O | O |
| Equipment Downtime | O | O | O | O | O | O | O | O | O | O | O | O |
| Other _____ | O | O | O | O | O | O | O | O | O | O | O | O |
| Other _____ | O | O | O | O | O | O | O | O | O | O | O | O |

**B. The following questions relate to measures that your customers / suppliers use.**

| For the list of measures found below, please indicate by marking No or Yes if your *customers* use this measure to quantify *your company's* performance. For retailers, please indicate those measures you use for *supplier's performance*. | For those measures marked Yes, please indicate if the definition that you use to define the measure is similar to the definition used by your trading partner (customers or suppliers), using the following scale: 1 = Jointly Defined 2 = In Process of Jointly Defining 3 = Under Discussion 4 = Customer Defined 5 = Don't Know<br>Then, please indicate how important (or critical) your partners view these measures. | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Definition of the Measure | | | | | Importance of Measure to Partner | | | | |
| | | | Jointly Defined | | | | Don't Know | Very Important | | | | Not Important |
| | No | Yes | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| Order Fill | O | O | O | O | O | O | O | O | O | O | O | O |
| Case Fill | O | O | O | O | O | O | O | O | O | O | O | O |
| Line Item Fill | O | O | O | O | O | O | O | O | O | O | O | O |
| On-time Delivery | O | O | O | O | O | O | O | O | O | O | O | O |
| Order Cycle Time | O | O | O | O | O | O | O | O | O | O | O | O |
| Performance To Request Date | O | O | O | O | O | O | O | O | O | O | O | O |
| Performance To Commit Date | O | O | O | O | O | O | O | O | O | O | O | O |
| Returns and Allowances Handling | O | O | O | O | O | O | O | O | O | O | O | O |
| Inquiry Response Time | O | O | O | O | O | O | O | O | O | O | O | O |
| Customer Service Performance | O | O | O | O | O | O | O | O | O | O | O | O |
| Invoice Accuracy | O | O | O | O | O | O | O | O | O | O | O | O |
| Stock-outs / Backorders | O | O | O | O | O | O | O | O | O | O | O | O |
| Forecast Accuracy | O | O | O | O | O | O | O | O | O | O | O | O |
| Over / Short / Damaged | O | O | O | O | O | O | O | O | O | O | O | O |
| Freight Cost | O | O | O | O | O | O | O | O | O | O | O | O |
| Other: _____ | O | O | O | O | O | O | O | O | O | O | O | O |

**C. With respect to each of the processes listed below, please indicate how you compare to your primary competitor.**

| | Major Advantage | Advantage | Parity With Competitors | Disadvantage | Major Disadvantage | Not A Factor |
|---|---|---|---|---|---|---|
| Customer Service | O | O | O | O | O | O |
| Order Fulfillment | O | O | O | O | O | O |
| Sourcing / Procurement | O | O | O | O | O | O |
| Transportation / Distribution | O | O | O | O | O | O |
| Warehousing / Handling / Storage | O | O | O | O | O | O |
| Information Capability | O | O | O | O | O | O |
| Planning, Forecasting & Scheduling | O | O | O | O | O | O |

**D. Which of the following statements best describes your division's / company's primary business strategy? (mark one only)**

- O Differentiated customer service
- O Best value product / service
- O Low cost provider / cost leader
- O Be all things to all people
- O Focus on a product / market niche
- O Differentiation or innovation in products / services
- O Differentiation through supply chain management
- O Tailored, personalized service to customers

**E. Which of the following best describes your division's / company's location in the extended supply chain? For the majority of our goods/services, our division / company: (mark only one)**

- O Sells directly to the end consumer
- O Is one step removed from the end consumer
- O Is two steps removed from the end consumer
- O Is three steps or more removed from the end consumer
- O Is primarily a service organization acting as a sub-contractor to other businesses, and occupies multiple locations in multiple supply chains

**F. Which one of the following statements best describes your primary logistics strategy? Our primary logistics strategy is to: (mark one only):**

- O Minimize supply chain costs
- O Increase corporate revenue
- O Maintain or improve customer service
- O Provide best value added services / capabilities for our customers
- O Provide tailored, personalized service to specific customer segments

## III. Measurement Issues

**A. How do the following factors affect your ability to develop and use logistics measures *within your company*? For each factor, please mark the appropriate circle:**

| | Very Significant Enabler | Enabler | Neutral, Not Important | Barrier | Very Significant Barrier |
|---|---|---|---|---|---|
| Upper management support | O | O | O | O | O |
| Resource availability within my function/department | O | O | O | O | O |
| Resource availability in I/T function | O | O | O | O | O |
| Acceptance / resistance to change | O | O | O | O | O |
| Budget | O | O | O | O | O |
| Accuracy of information available | O | O | O | O | O |
| Ability to obtain priority for logistics projects | O | O | O | O | O |
| Organizational culture | O | O | O | O | O |
| Skill set of employees | O | O | O | O | O |
| Timeliness of information | O | O | O | O | O |
| Other departments within the company | O | O | O | O | O |
| Availability of information | O | O | O | O | O |
| Other (please specify): _____ | O | O | O | O | O |

**B. How do the following factors affect your ability to measure logistics activities *between your company and your trading partners*? For each factor, please mark the appropriate circle:**

| | Very Significant Enabler | Enabler | Neutral, Not Important | Barrier | Very Significant Barrier |
|---|---|---|---|---|---|
| Availability of information | O | O | O | O | O |
| Resources availability between companies to calculate and maintain measures | O | O | O | O | O |
| Compatibility of I/T systems | O | O | O | O | O |
| Acceptance of / resistance to change | O | O | O | O | O |
| Accuracy of information exchanged | O | O | O | O | O |
| Organizational culture(s) | O | O | O | O | O |
| Trust | O | O | O | O | O |
| Timeliness of information | O | O | O | O | O |
| Upper management support | O | O | O | O | O |
| Multiple definition of measures among customers | O | O | O | O | O |
| Industry standards | O | O | O | O | O |
| Trade Associations | O | O | O | O | O |
| Other (please specify): _____ | O | O | O | O | O |

**C. Does your company actively segment (A, B, C analysis) the following components of its business transactions?**

| | Yes | No | | Yes | No |
|---|---|---|---|---|---|
| Customers | O | O | Suppliers | O | O |
| Finished Goods /SKU's | O | O | Purchased items / materials | O | O |

## IV. Process Integration

**A. Please read the descriptions in the following table. Following the table, you will be asked to indicate the most appropriate description (using the letter in the upper left hand corner of the box) for several processes within your company.**

| | Definitions of Integration Levels | |
|---|---|---|
| | Within our division / company | Between our company and our customer / supplier |
| *Awareness* | **A**<br>Awareness of logistics functions and the potential benefits of logistics management to the company | **W**<br>Awareness of logistics functions and the potential benefits of supply chain management to both companies |
| *Measurement* | **B**<br>Measuring functional activities within the company, reconciling definitions of measures, and comparing to average and/or best-in-class benchmarks | **X**<br>Measuring the functional activities occurring between two companies, reconciling definitions of measures, and comparing to average and/or best-in-class benchmarks |
| *Coordination* | **C**<br>Identifying underlying factors for performance against functional measures, estimating costs and benefits to improve performance, and implementing initiatives | **Y**<br>Identifying underlying factors for performance against functional measures, estimating costs/benefits pertaining to improvement, and reaching agreement to implement initiatives that impact both companies |
| *Integration* | **D**<br>Measuring intracompany cross-functional processes using measures that are both functional and financial in nature. Estimating costs/benefits and implementing initiatives | **Z**<br>Measuring intercompany cross-functional processes using measures that are both functional and financial in nature, estimating costs/benefits pertaining to improvement, reaching agreement, and implementing initiatives that impact both companies |

Based on the descriptions found in the table above, please indicate the *current state* of measurement activities *within* your division / company and *between* your company and your customers / suppliers. Please indicate the level of measurement activities in each of the seven processes listed.

Mark either A, B, C, or D *corresponding to the definitions above* in the "Within our division / company" column first, and then either W, X, Y, or Z in the "Between our company and our customer / supplier" column for each process (total 14 marks). For lack of awareness, please indicate "Unaware."

| Process | Within our division / company | | | | | Between our company and our customers / suppliers | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Customer Service | O Unaware | O A | O B | O C | O D | O Unaware | O W | O X | O Y | O Z |
| Order Fulfillment | O Unaware | O A | O B | O C | O D | O Unaware | O W | O X | O Y | O Z |
| Sourcing / Procurement | O Unaware | O A | O B | O C | O D | O Unaware | O W | O X | O Y | O Z |
| Transportation / Distribution | O Unaware | O A | O B | O C | O D | O Unaware | O W | O X | O Y | O Z |
| Warehousing / Storage | O Unaware | O A | O B | O C | O D | O Unaware | O W | O X | O Y | O Z |
| Information Capability | O Unaware | O A | O B | O C | O D | O Unaware | O W | O X | O Y | O Z |
| Planning, Forecasting & Scheduling | O Unaware | O A | O B | O C | O D | O Unaware | O W | O X | O Y | O Z |

## V. Quality of Measures

**A. Below is a list of statements regarding logistics measurement within your division/company. For each, indicate your level of agreement or disagreement with the statement**

| | Strongly Agree | Somewhat Agree | Neither Agree Nor Disagree | Somewhat Disagree | Strongly Disagree |
|---|---|---|---|---|---|
| The logistics measures we use currently accurately capture the events and activities being measured. | O | O | O | O | O |
| The logistics measures we use currently are interpreted similarly by *internal* users, are repeatable, and are comparable across time, location and divisions. | O | O | O | O | O |
| The logistics measures we use currently are interpreted similarly by *external* users, are repeatable, and are comparable across time, location and divisions. | O | O | O | O | O |
| The logistics measures we use currently are readily understandable by the decision-makers in our company, and provide a guide for action to be taken. | O | O | O | O | O |
| The logistics measures we use currently include all relevant aspects of the processes and promote coordination across functions and divisions. | O | O | O | O | O |
| The *internal* logistics measures we use currently have significant benefits that outweigh the cost of data collection, analysis, and reporting. | O | O | O | O | O |
| The *external* logistics measures we use currently have significant benefits that outweigh the cost of data collection, analysis, and reporting. | O | O | O | O | O |
| The logistics measures we use currently are compatible with existing *internal* information and systems in the organization. | O | O | O | O | O |
| The logistics measures we use currently are compatible with existing *external* information and systems in the organization. | O | O | O | O | O |
| The logistics measures we use currently are compatible with existing cash flow measures in the organization. | O | O | O | O | O |
| The logistics measures we use currently provide a sufficient degree of detail or aggregation for the users. | O | O | O | O | O |
| The logistics measures we use currently minimize incentives for counter-productive acts or game playing and are presented in a useful form. | O | O | O | O | O |

**B. What measures, not currently available to you, would you like to use?**

| |
|---|
| |
| |
| |

## VI. Demographics

All responses will be kept confidential

**A. Which of the following is the *primary* financial measure that drives decision making in your organization (please mark one).**

O 1. Cash Flow
O 2. Contribution Margin
O 3. Earnings per Share (EPS)
O 4. EBIT or EBITDA
O 5. Economic Value Added (EVA)
O 6. Gross Profit Margin
O 7. Market Share
O 8. Market Value Added (MVA)
O 9. Net Profit Margin
O 10. Return on Assets (ROA)
O 11. Return on Capital Employed (ROCE)
O 12. Return on Equity (ROE)
O 13. Return on Investment (ROI)
O 14. Return on Net Assets (RONA)

**B. Please indicate the total sales of your organization:**

O <US$250M O US$250-$500M O US$500M-$1B O US$1B-$5B O US$5B-$10B O >US$10B

**C. Please advise your Zip Code (for US respondents) or your country (for non-US respondents).**

Zip Code ___ ___ ___ ___ ___ Country _____

**D. What is the primary business of your company? (mark only one)**

O 1. Manufacturing
O 2. Retail / Merchandising
O 3. Carrier (all modes, including forwarders)
O 4. Public Warehouse (including warehouse marketing organizations)
O 5. Material Handling Equipment (Manufacturer or Dealer)
O 6. Publishing
O 7. Communications
O 8. Distributor / Wholesaler
O 9. Software / Computer Services
O 10. Service Industry
O 11. Third Party Logistics Provider
O 12. Other: _____

**E. If you marked #1 or #2 above, please mark the primary type of industry of your company (mark only one). If you did not mark #1 or #2, please skip.**

O 1. Appliances
O 2. Automotive and Transport Equipment (including parts and aftermarket)
O 3. Building Materials / Lumber Products
O 4. Chemicals and Plastics
O 5. Clothing and Textiles
O 6. Computer Hardware and Peripheral Equipment
O 7. Construction, Farm and Garden Equipment
O 8. Department Store and/or General Merchandise
O 9. Electronics and Related Instruments
O 10. Electrical Machinery (including parts and supplies)
O 11. Food and Beverage
O 12. Furniture
O 13. Hardware
O 14. Machine Tools and Machinery
O 15. Metal Products (fabricated)
O 16. Mining and Minerals
O 17. Office Equipment and Supplies (excluding paper)
O 18. Paper and Related Products
O 19. Petroleum and Petrochemicals
O 20. Pharmaceuticals, Drugs, and Toilet Preparations
O 21. Primary Metals
O 22. Rubber Products and Related Goods
O 23. Other: _____

**F. Please indicate the title of the senior logistics position within your organization**

O 1. Senior VP or VP of Logistics
O 2. Director of Logistics
O 3. Manager, Logistics
O 4. Senior VP or VP of Supply Chain Management
O 5. Director of Supply Chain Management
O 6. Manager, Supply Chain Management
O 7. Senior VP or VP of Operations
O 8. Senior VP or VP of Distribution
O 9. Director of Transportation
O 10. Director of Warehousing
O 11. Other: _____

**Thank you for your time and participation.**

# VITA

## James S. Keebler

James Steven Keebler was born in La Jolla, California on August 17, 1944. Son of a career United States Army officer, his family of seven moved constantly. Jim lived in California, Japan, Alaska, New Jersey, Indiana, Virginia, and Germany, graduating from high school in Wurzburg in 1962. He earned his bachelor's degree in Business Administration at California State Polytechnic University in 1966. Graduating from Officers Candidate School in 1967, Jim's four-years in the United States Army Transportation Corps provided duty in New Jersey, Alabama, Virginia, Germany, Holland, Viet Nam, where he served as a Captain.

Jim worked for many companies during a twenty-five year corporate career, redesigning their logistics infrastructures and leading growth and change. Those companies included: Hunt-Wesson Foods, Bergen Brunswig Corporation, A.T. Kearney, Inc.,The Pillsbury Company, Digital Equipment Corporation, and Colgate Palmolive.

Graduate study at Boston University, California State University at Northridge, and Claremont Graduate School produced master's degrees in Finance and Management. Jim has lectured at Ohio State University, Penn State University, and M.I.T., in addition to teaching at the University of Tennessee.

Jim's five children range in age from 31 to 8 years. Jim and his wife, Kathy, and sons Nicholas and Devin plan to settle down in Minnesota, where he has accepted a tenure track position in Marketing at St. Cloud State University.