This is to certify that the

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IN LOGISTICS: A CONTINGENCY APPROACH

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CONTEXT-STRATEGY-STRUCTURE-PERFORMANCE IN LOGISTICS: A CONTINGENCY APPROACH

By

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ABSTRACT

CONTEXT-STRATEGY-STRUCTURE-PERFORMANCE IN LOGISTICS:
A CONTINGENCY APPROACH

By

Steven Ray Clinton

Contingency-based environment - strategy - structure - performance paradigms have been investigated extensively in the organizational science and strategic management fields. The general premise of such research is that performance is contingent upon a firm's environmental, strategic, structural fit. The purpose of this research was to study such contingent relationships within the context of logistical operations. The objectives were to develop and examine a context-strategy-structure-performance model for logistics based on established constructs. This *Logistics Contingency Model* was then tested for the existence of organizational relationships within logistics operations.

North American *World Class Logistics Research* case firms were examined to test the model. In total, data for fifty-seven firms was available for analysis. In addition, thirty-nine of the firms completed a follow-up questionnaire providing longitudinal strategy and performance data. *T*-tests and regression analysis were used in evaluating selected relationships.

Context was represented by (1) environmental dynamism and hostility and (2) logistics information technology operating systems and planning systems. Strategy was examined using the Bowersox and Daugherty (1987) typology. Structure was

evaluated using established contructs representing formalization, centralization, integration, and span of control. Performance was evaluated using perceived measures of logistics competency relative to competitors. The major findings of the research are:

1. Higher levels of environmental dynamism and hostility resulted in higher levels of formalization. This finding is contrary to long-established empirical results in organizational science.
2. Information technology positively impacts logistics structure. Highly proficient operating and planning systems extend logistical span of control. The former is also associated with greater levels of formalization.
3. Highly dynamic environments stimulate extensive use of integrative committees within logistics organizations.
4. Externally-oriented logistics strategy firms were found to be significantly more likely to use integrative committees in comparison to non-externally-oriented strategy firms.
5. Consistent with the organizational science literature, logistics structure alone did not impact performance. However, the corollary relationship - that structure would mediate contextual and strategic influences on performance - was not supported in this research.

Dedicated to my departed grandmother, Laura Clinton. Her saying, "Self-praise is no endorsement." was never truer.

ACKNOWLEDGMENTS

Throughout my doctoral program I noted the great relief and satisfaction that other students expressed upon finishing the process. Nearly every student uttered something to the effect, "It was all worth it." I always wondered how they could be that certain? I was positive that I would feel differently. After all, the tremendous loss of income, the steadily mounting student loans, the stress and frustration of everything associated with a doctoral program -- none of that could be so easily erased simply by finishing the dissertation and program? Okay - so it appears I was wrong again! Perched on the exit side of this process, I must say, things look different. And I have a number of people to thank for helping me to this point.

First and foremost, I would like to thank Dr. Donald Bowersox. Inclusion in his *World Class Logistics* research was the single most influential part of my doctoral program. It has given me great insight into how one should conduct meaningful research. Participation in the research provided an opportunity to develop my academic career through publications and conference attendance. As co-chair of my dissertation, his frequent admonishments to "get going" provided the necessary "spur-in-my-saddle." I leave Michigan State with nothing but the utmost respect for Dr. Bowersox's professional achievements and dedication to the field of logistics.

My other co-chair, Dr. Cornelia Dröge, assisted me greatly throughout the program. More so than any other faculty member, she witnessed my weaknesses, low points and anger. Through it all she assisted me with well-reasoned assessments of situations and encouragement based upon my strengths. The quality of this dissertation is directly related to her substantial time and effort involved in critiquing draft after draft. Her thoroughness is appreciated and admired.

I also thank my other committee members: Dr. Roger Calantone and Dr. Bixby Cooper. As doctoral program advisor, seminar professor, co-author, and storyteller, Dr. Calantone has had multiple positive influences on me during the program. Dr. Cooper's laid-back style and perceptive comments and questions were appreciated throughout the *World Class Logistics* research and this dissertation process.

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Although the doctoral experience is highly individualized in many respects -- and difficult to explain to outsiders -- the process is shared with other students, all with their own idiosyncrasies and foibles. That sharing, in large measure, makes the experience bearable, stimulating and frequently so absurd it is hilarious. I appreciate the support and humor shared with Judy Schmitz Whipple, Dave Frayer, Matt Myers, and the "mahvelous one," Gary Knight. Stress relief through basketball was also welcome. I thank all those doctoral students who tolerated my limited hardwood skills.

Additionally, I thank my "look-alike," Jeff Schmidt, and his wife, Sue, and my "logistics conference room" cellmate, Robb Frankel, and his wife, Vivienne, for continually opening their homes and dinner tables to the "single guy." They gave far more than I could ever repay in witty conversation. The experiences shared with Robb and Jeff will forever be embedded in my mind and will generally bring a smile to my face if not an outright snort of laughter.

I also thank the departmental staff -- Laurie Fitch, Sharon Baker, Cheryl Lunden, Cindy Seagraves, and Renee Dixon -- for their warm personalities and willingness to always assist me. The fact that they would endure my antics and pranks without losing patience was appreciated.

Finally, in closing, I thank my friends and family. My friends from earlier periods in my life always served as a reminder of where I have come from. Their

collective vows to never address me as "Doctor" helped ground me throughout this process and kept my ego in check.

My parents are owed a huge debt of gratitude as they instilled a love of learning in me at an early age. Their encouragement throughout my life, in both academic and non-academic efforts, is something every child should be fortunate enough to experience. I truly regret that my father, Jim, is not alive to see me cross this final academic hurdle. His passing, seven months prior to my entering the doctoral program, left a huge gap in my life as well as the life of my mother, Caroline. I can never thank her enough for her strength these past five years. In the face of tremendous sadness she rarely asked much of me, preferring instead that I maintained my focus on my program. This dissertation is as much a testament to her resolve as to my own.

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CHAPTER ONE - INTRODUCTION

Behavioral research has gained increasing attention in academic logistics journals. In contrast to the long tradition of logistics study in location theory, transportation economics, inventory modeling, process integration and total cost analysis, etc., behavioral logistics research examines the interplay of human actions and associated work. This "softer" side of logistics research is continually venturing into new areas, attempting to provide both managers and academicians with a better understanding of such diverse topics as strategic alliances, information utilization and customer service. A natural outcome of this research has been the adaptation of concepts and theories from other disciplines. Critics of behavioral logistics research argue that for the field to advance, these concepts must be woven into a broader theoretical structure that serves to illuminate and explain logistics practice.

Mentzer and Kahn's (1995) review of the *Journal of Business Logistics* dramatically illustrates this deficiency. Table 1.1 reproduces their findings concerning research reported in the *Journal of Business Logistics* from its inception through Volume 14, Number 1, 1993.

Table 1.1
Type of Research Performed

Category	% of Articles Published in *JBL*
Normative Literature/Reviews	53.6%
Exploratory Studies	36.2%
Methodology Reviews	6.0%
Hypothesis Testing	4.3%

Nearly 90% of all published articles in the *Journal of Business Logistics*, widely regarded as one of the top logistics journals, have been either normative research, literature reviews or exploratory studies. According to Mentzer and Kahn (1995) this indicated that "... present logistics research has a large degree of substantive justification, but little subsequent theory development and testing." In their view, logistics research -- including behavioral logistics research -- must "... adopt a rigorous research process that manifests theory development."

Similarly, Chow, Heaver and Henriksson (1995) found logistics research lacking a sound theoretical basis. In particular, Chow *et al.* noted that despite a great deal of attention to organizational issues in logistics, comparability among studies is difficult, hampered by the "... variety of ways in which organizational concepts have been defined and measured."

In response, Chow *et al.* proposed a contingency-based environment, strategy, structure, and performance (ESSP) framework for behavioral logistics research. While others have previously advocated the use of contingency theory (Persson 1982; Pfohl and Zöllner 1987), Chow *et al.* contend that their framework could be used in "... research on the organization of logistics." A graphical representation of the Chow *et al.* framework is reproduced in Figure 1.1.

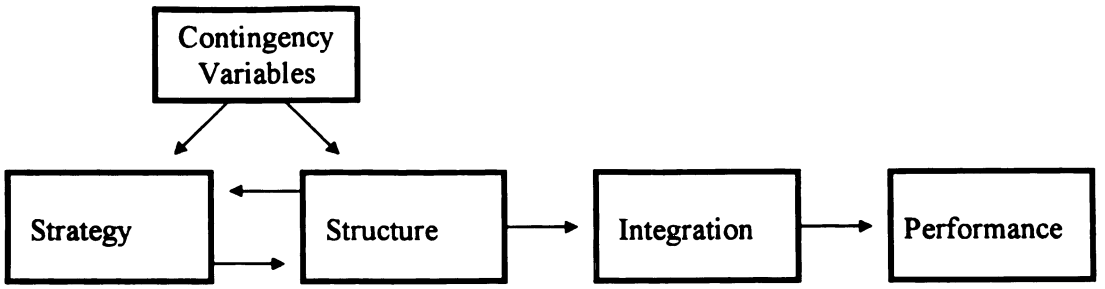

Figure 1.1
Logistics Organization and Performance
Source: *Logistics and Transportation Review* (1995, Number 4)

The framework of Chow *et al.* is, however, an example of the general deficiency identified by Mentzer and Kahn (1995). Chow *et al.* put forth a conceptual framework but leave "... the theory testing to others." Nonetheless, the framework is conceptually rich, with links to organization, management and marketing literature, is theory-driven, and potentially could initiate a coherent and focused stream of behavioral logistical research.

Such behavioral research would be of interest to both academics and practitioners. As organizations strive to compete in a global economy, managers are increasingly viewing logistics as a competitive core competency. Although logistics has been widely described -- and its work practices well documented -- the current state of behavioral logistics research is inadequate to more fully explain the role and value of logistics within the firm. Research leading to a clearer understanding of the relationship between environment, strategy, structure, and performance at the logistics level would be welcome by both academicians and practitioners.

Bearing the challenge of Mentzer and Kahn (1995) in mind, it was the goal of this research to use the Chow *et al.* framework as the basis for developing an alternative logistics contingency model. The alternative conceptualization supplements the strengths of the Chow *et al.* framework. Figure 1.2 presents the alternative model. It is fully discussed in Chapter 2.

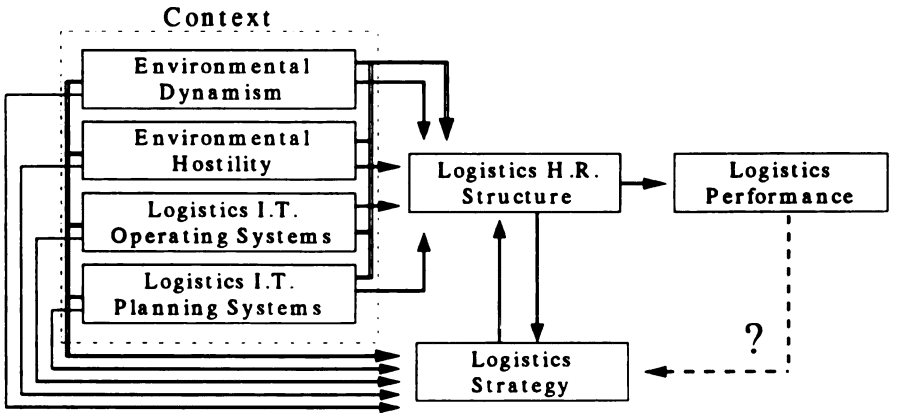

Figure 1.2
Logistics Contingency Model

The application of a contingency approach facilitated the testing of different variables interactive in the environment-strategy-structure relationship and their subsequent impact on logistics performance. The focus of this research was logistics at the strategic business unit level. This level of analysis permitted investigation of logistics on a task level basis and avoided the more complex interrelations of corporate-level processes. Examination of the ESSP framework within a logistics perspective advances logistical theory, establishes a fruitful research stream while simultaneously offering practical insight to practitioners.

GENERAL STATUS OF ENVIRONMENT-STRATEGY-STRUCTURE-PERFORMANCE (ESSP) RESEARCH

The ESSP paradigm is well-established in the organizational science literature. It is concisely defined as follows (Galunic and Eisenhardt 1994, p.216):

> This paradigm maintains that congruency exists between strategy and structure. Moreover, where there is alignment between an organization's strategy and structure, better performance is likely.

Galunic and Eisenhardt's review article (1994) indicates that within the organizational science literature, the ESSP paradigm has been dominated by structural contingency research and theory. Despite this dominance, Galunic and Eisenhardt conclude the structural contingency approach suffers from two primary deficiencies: (1) contradictory findings based on different definitions and interpretations of strategic orientations, structural configurations and performance measures, and (2) empirical shortcomings caused by "... reliance on bivariate models and single contingencies." To overcome these problems, Galunic and Eisenhardt recommend (1994, p.217):

> The current paradigm draws an incomplete picture of the fast-paced change and complex global reality of organizations today. In contrast, a renewed strategy-structure-performance paradigm embraces systems thinking, multiple contingencies, more accurate conceptualization of strategy, structure, and performance and dynamic models. To achieve this renewal, we suggest future research that is multivariate, multilevel, inductive, and longitudinal.

Thus, within the organizational science discipline a structural contingency approach to ESSP is still generally accepted, albeit in need of updating.

Outside the organizational science literature one finds the ESSP paradigm, or significant components of it, used in such diverse areas as strategic management (Habib and Victor 1991; McWilliams and Smart 1993), new product development (Cusumano

and Nobeoka 1992), management information systems (Jarvenpaa and Ives 1994; Kambil and Short 1994), and marketing channels (Ruekert, Walker and Roering 1985; Mohr and Nevin 1990).

In logistics research, Chow *et al.* (1995) note that relatively few studies have utilized an ESSP framework (Persson 1982; Pfohl and Zöllner 1987). They further note that the logistics literature contains few empirical studies linking, in any manner, the areas of strategy, structure, and performance. The work of Dröge and Germain (1989); Germain (1989), Germain, Dröge and Daugherty (1994) has, however, examined various facets of these areas within logistics.

GENERAL CONTINGENCY THEORY

Although Chandler (1962) and Woodward (1965) are recognized as the earliest researchers to investigate contingent relationships between strategy, structure and performance, the development of general contingency theory in organizational science is typically attributed to the work of Lawrence and Lorsch (1967) and Thompson (1967). Building upon this foundation, Lorsch and Morse (1974) and Luthans (1976) further refined the application of contingency theory in organizational studies. Luthans and Stewart (1977, p. 183) define contingency theory as follows:

> The contingency approach is generically situational in orientation, but much more exacting and rigorous. The contingency approach is defined as identifying and developing functional relationships between environmental, management, and performance variables.

In their opinion, contingency theory maintains theoretical validity via an open system while providing a more structured framework consistent with a closed system.

When applied to research, contingency theory is used to identify the different responses to common environmental situations. The different responses are attributed to the differing structures and strategies associated with individual firms. As a result, "The contingency approach suggests, therefore, that we can observe wide variations in effectiveness, but that these variations are not random" (Zeithaml, Varadarajan and Zeithaml 1987).

These non-random variations can be explained by equifinality. As used within the organizational science literature, equifinality is defined as "... *multiple* organizational configurations that result in the effective operation of the firm" (Galunic and Eisenhardt 1994). Firms can and do choose paths based on firm-specific considerations.

According to Luthans and Stewart (1977), these considerations can be grouped into primary, secondary, and tertiary system variables. Primary system variables are grouped into three broad categories: environmental, resource, and management. Secondary system variables include situation, organization and performance. Tertiary system variables represent the interactions between primary and secondary system variables.

Within the Luthans/Stewart framework of primary system variables, environmental factors are largely beyond the control of the firm (e.g., federal legislation). Resource variables typically are characterized as within the control of the firm (e.g., human resources, raw materials). Management variables comprise the operating mechanisms used by managers (e.g., written company policies) to make decisions.

At the secondary system level, situation variables are "... defined by the interaction of environmental and resource variables" (Luthans and Stewart 1977). The interaction of managerial and resource variables comprises the secondary system organizational variables. Environmental and management variables interact to create performance criteria variables. The conceptualization of Luthans and Stewart's (1977) contingency model is reproduced in Figure 1.3.

The interaction of all the variables produces a total system performance, which "... represents the actual performance output of the organization as measured by relevant performance criteria variables" (Luthans and Stewart 1977). From Figure 1.3, it is apparent that numerous relationships are evident, creating a complex model. In order to utilize the model, researchers have sought to simplify or reduce the number of relationships examined within any given study.

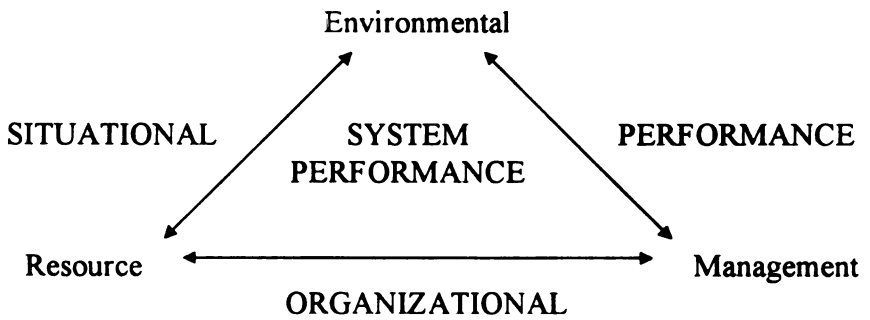

Figure 1.3
Relationships in a Contingency Model

RESEARCH PURPOSE

As increasing attention is focused on logistics, the need exists to better understand how logistics strategy and structure contends with contingencies in order to achieve a satisfactory level of performance. To date, academics working in the logistics field have barely examined the complex relationships of the ESSP paradigm. Consequently, the purpose of this research was to extend the investigation of whether logistics structure and performance are contingent upon specified logistics context[1] and strategic orientation and to what extent, if any, subsequent performance evaluation impacts strategy.

The specific objectives of this research were:

(1) Test empirically if context variables directly or indirectly affected strategy, structure and performance.

(2) Test if a relationship, possibly reciprocal, existed between structure and strategy.

(3) Test if there was any support for a feedback mechanism whereby performance influenced strategy.

(4) Suggest refinements to the proposed CSSP model in an effort to develop additional hypotheses and directions for future logistics research.

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[1] "Context" is increasingly being used in place of "environment." Context signifies inclusion of a wider scope of variables, not just traditional environmental variables. Nonetheless, historically, "environment" appears in the literature. Thus, in Chapters One, Two and Three, "environment" and "ESSP" are used. Once the discussion shifts to the *Logistics Contingency Model*, the more appropriate terms, "context" or "CSSP," are used.

RESEARCH SCOPE

The research scope examined the ESSP paradigm from a logistics perspective at the strategic business unit level. This research was based on the expectation that organizational science concepts could be integrated into logistics research, yielding insights into how contingency variables interact with logistics' organizational structure to achieve or obstruct desired performance levels. This expectation was based on the numerous studies previously mentioned that have successfully used the ESSP approach within general management research. It appeared logical that the paradigm could be used productively in logistics research.

No particular industry, firm size or channel positioning restrictions were imposed. Previous logistics research (Bowersox, Daugherty, Dröge, Rogers, and Wardlow 1989; Council of Logistics Management 1995) indicated that logistics performance was not affected by industry type, firm size or position in channel of distribution. This study was limited, however, to manufacturers and merchandisers. No third party service providers were considered in this research.

The relative lack of ESSP research within logistics created an interesting paradox. From a logistics perspective, the Chow *et al.* framework and the alternative model were untested, suggesting an exploratory approach. At the same time, some of the constructs and scales had been used in logistics ESSP research. Fortunately, the existence of the *World Class Logistics* database offered the potential for initial investigation of the model through a statistical approach. A follow-up survey, tightly focused on pertinent constructs in strategy and performance, supplemented the existing database.

ORGANIZATION

The remainder of this dissertation consists of four chapters. Chapter Two reviews ESSP literature. Particular emphasis is given to the literature cited by Chow *et al.* as some definitional and operational issues exist. Support is provided for the transference of organizational science concepts into the logistics discipline.

Chapter Three details the methodology and research design. The chapter also includes the specific research questions and hypotheses investigated in this research. Chapter Four presents the results derived from the statistical investigation using the North American *World Class Logistics* database.

Chapter Five presents the conclusions in terms of theoretical and pragmatic contributions. Research implications for academics and practitioners are presented. Future research directions, considerations and hypotheses are also suggested.

CHAPTER TWO - SURVEY OF THE LITERATURE

The following is a selected review of pertinent literature covering contingency theory, specific contingency variables identified by Chow *et al.* (1995), and individual and integrated areas of strategy, structure and performance. Given the nature of this dissertation, the discussion of the strategy, structure and performance areas will begin with definitions and constructs as proposed by Chow *et al.* However, additional material will be drawn upon to support the development of an alternative model of context-strategy-structure-performance.

CONTINGENCY THEORY

Contingency theory is rooted in organizational science. It is generally acknowledged that the works of Burns and Stalker (1961), Chandler (1962), and Cyert and March (1963) laid the foundation of contingency theory through discussion of general and open systems theory. Soon thereafter, Lawrence and Lorsch (1967) and Thompson (1967) introduced the formal contingency approach. As defined by Lawrence and Lorsch, contingency theory states that organizations should be viewed as open systems interacting with and affected by the surrounding environment.

In a later and expanded view of contingency theory, Kast and Rosenweig (1973) state:

> The contingency view seeks to understand the interrelationships within and among subsystems as well as between the organization and its environment and to define patterns of relationships or configurations of variables. It emphasizes the multivariate nature of organizations and attempts to understand how organizations operate under varying conditions and in specific circumstances (page ix).

THE CONCEPT OF "FIT"

Inherent in these relationships is the idea of "fit" -- a central theme of contingency theory. Fit is generally characterized as the alignment of a firm's strategy, structure and process with its context or environment. Firms experiencing better fit are expected to have better effectiveness or performance than "misfit" firms (Drazin and Van de Ven 1985). Discussion of the concept of fit is important as researchers believe that the mixed results of the contingency approach are attributable to poor definition and operationalizations of fit (Drazin and Van de Ven 1985; Van de Ven and Drazin 1985; Venkatraman 1989). For the purposes of this research, two perspectives of fit are important. The first perspective is fit as a general concept in organizational science research. The second perspective is fit in terms of an evaluative testing scheme being appropriately matched to a theoretical position.

Three primary types of fit are prevalent in organization science research (Van de Ven and Drazin 1985). These are (1) selection, (2) interaction and (3) systems fit. Each fit "significantly alters the essential meaning of a contingency theory" (Drazin and Van de Ven 1985, p. 515).

Selection fit is the most familiar. It is sometimes referred to as congruency fit, a reference to earlier literature when the terms fit and congruency were used (Tosi and

Slocum 1984; Drazin and Van de Ven 1985). Typically, selection fit does not test the relationship of context and/or environment and strategy and/or structure to performance. Selection fit can be described and defined as follows (Selto, Renner and Young 1995, p. 669):

> In the selection approach, organizational context drives organizational design. Fit is defined in terms of predictable correlations between pairs of organizational variables. *Natural selection* predicts that all structure and control variables are correlated with context since anything less would lead to *extinction* in a competitive environment. *Managerial selection* predicts correlations between context and only those control and structural characteristics managed by the organization.

Although widely criticized, selection fit continues to be used in contingency theory. Drazin and Van de Ven (1985) suggest the selection approach may be most appropriate in identifying macro-level relations (e.g., formalization and technology) which can provide insights into micro-level relations (e.g., routinization between departments).

Interaction fit is also quite familiar to contingency theorists. This fit focuses on the effect of the interaction of context and/or environment and strategy and/or structure on performance. Selto *et al.* (1995, p. 669) describe interaction fit as follows:

> The basic concept is that none of context, structure, or control alone should affect performance; it is the fit among them that affects performance. In a regression explaining performance, therefore, an interaction term of context and workgroup structure (and control) should be significant while main effects should not. Statistically, main effects may be significant, of course, but such results detract from the theory.

Schoonhoven (1981) described the drawbacks of interaction fit but also demonstrated its potential. Hers remains a minority in terms of success as most

researchers in the organizational science area have not been successful in supporting interaction effects (Drazin and Van de Ven 1985).

Whereas selection and interaction fit are reductionist approaches, systems fit is holistic (Miller, Gilmour and Van Dierdonck 1981; Drazin and Van de Ven 1985).

> Advocates of this approach assert that the understanding of context-structure performance relationships can only advance by addressing simultaneously the many contingencies, structural alternatives, and performance criteria that must be considered holistically to understand organization design (Drazin and Van de Ven 1985, p.519).

In order to assess fit in the systems approach, pattern-matching has been recommended and employed (Drazin and Van der Ven 1985; Selto, Renner and Young 1995). Pattern-matching requires identification of a high performing subgroup within the data. Then, using summary measures of Euclidean distance, other groups are compared to the high performing group. The further the distance between the high performing group and the subject group, the greater the misfit (i.e., groups plotted closest to the high group are assumed to have better fit and subsequently it can be tested whether they also have better performance or effectiveness).

Due to the overall difficulty in demonstrating fit in organization studies, Drazin and Van de Ven (1985) recommend a "triangulation" approach of all three types of fit. To date, two studies that have applied this approach have had different results. Drazin and Van de Ven (1985) were able to support the selection and systems approaches but not the interaction approach. Selto *et al.* (1995) were only able to support the selection approach. These results, ironically, lead to the conclusion that within contingency approaches there is no one "best fit" measure at this time.

The often contradictory results of contingency theory can be disconcerting. However, Venkatraman (1989) argues that much of the difficulty in investigating fit can be attributed to "a lack of correspondence between the concept and its mathematical formulation ..." (p. 423). As a result, he offers a second perspective of the concept of fit.

In Venkatraman's view, six conceptualizations of fit are available to researchers. These are: (1) fit as moderation, (2) fit as mediation, (3) fit as profile deviation, (4) fit as matching, (5) fit as covariation, and (6) fit as gestalts. None is superior to the others per se but each is appropriate in different research designs. Venkatraman's classificatory framework is reproduced in Figure 2.1.

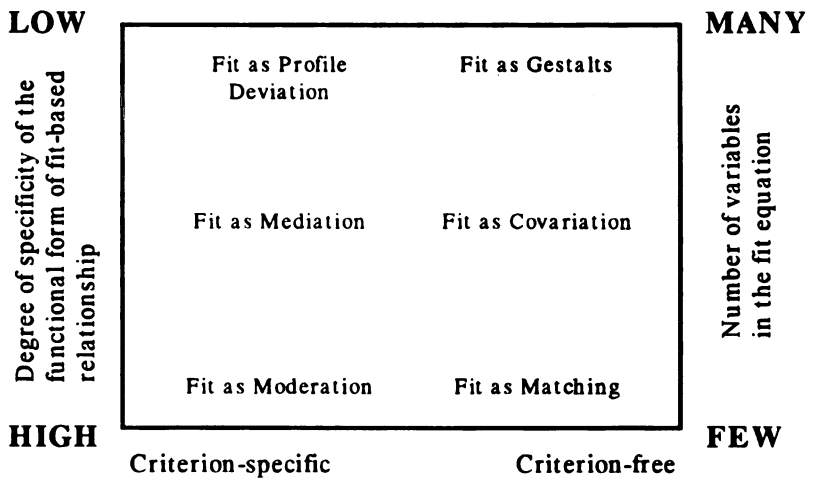

Figure 2.1
Six Perspectives of Fit
Source: Venkatraman (1989) *Academy of Management Review*

The three dimensions indicated in Figure 2.1 serve to guide researchers in determining what type of fit is appropriate for their theoretical discussion. Each fit is further tied to appropriate statistical techniques. It is anticipated that within this research, fit will be assessed using a limited number of variables tied to specific criterion variables. Thus, using Venkatraman's framework, fit as mediation will be most important. Mediation, with its causal relationships, is generally examined within a path-analytic approach.

THE USE OF CONTINGENCY THEORY

The incorporation of different variables, conditions and circumstances, permits the use of the contingency approach in a wide range of research settings. Within organizational science, the contingency approach has been used in research involving savings and loans (Jennings and Seaman 1994), manufacturing firms (Miller 1988), and surgical operating rooms (Schoonhoven 1981). In each case, the contingency approach was used to test relationships within the general sphere of environment, strategy, structure, and performance.

Use of the contingency approach has expanded beyond organizational science. It is frequently applied in organizational behavior and strategic management research. In the mid-1980s, Ruekert, Walker and Roering (1985) employed the contingency approach in their study of marketing activities. Since then, Zeithaml, Varadarajan and Zeithaml (1988) have advocated the use of contingency theory in marketing research and theory-building. Just as the marketing literature has witnessed the growing use of this approach, so too has the area of logistics (Pfohl and Zöllner 1987; Dröge and

Germain 1989; Germain 1989; Kohn, McGinnis and Kesava 1990; Germain, Dröge and Daugherty 1994; Germain and Dröge 1995; Germain 1996).

Despite this widespread use across different disciplines and research settings, contingency theory is not without critics. Even a reduced number of contingency variables can produce a dizzying array of possible combinations (Hofer 1975). Therefore, contingency theorists have typically used a severely reduced number of contingency variables. As a result, much of the work within the contingency approach has used bivariate analysis (e.g., low/high uncertainty versus mechanistic/organic structure). With the advent of more sophisticated analysis tools, most researchers agree that contingency approaches need to consider multivariate levels of analysis (Galunic and Eisenhardt 1994). However, as indicated in the preceding section, Venkatraman (1989) would argue that contingency theorists need to pay greater attention to correspondence between theoretical conceptualization and actual empirical testing.

Child (1972) criticized contingency determinism as an inherently weak type of theoretical construction and not suitable in the contingency approach. This point has been reiterated in the work of Donaldson (1982; 1987) who argued that the problem is much more complex. In Donaldson's view, the change in the environment eventually leads to "substandard performance which comes from the mismatch of structure and contingency." As the firm strives to eliminate the mismatch, it may try to indirectly influence the environment or seek to realign itself in a different environmental context. The resulting structure need only exceed a minimum threshold in terms of economic performance.

A long-standing tenet of contingency theory, and its rejection of the universalist approach, is that there is no one "best way" for firms to organize - even when facing identical environments. This basic belief is currently captured in the concepts of adaptation and equifinality. Adaptation "asserts that the elements within the system adapt to one another to preserve the basic character of the system" while equifinality "holds that a system can reach the same final state from differing initial conditions and by a variety of paths" (Zeithaml, Varadarajan and Zeithaml 1988).

Schoonhoven (1981) identified five problems with contingency theory: (1) lack of clarity; (2) contingency relations as interactions; (3) functional forms of interaction; (4) the analytic model used; and (5) assumptions about contingency relationships. The first problem, lack of clarity, has lead to calls for greater refinement of variables and constructs as a remedy (Schoonhoven 1981; Tosi and Slocum 1984). The second problem, contingency relations as interactions, also stems from incomplete specification. In Schoonhoven's (1981) words, "Explicit recognition should be given to the fact that contingency arguments produce interactive propositions." Her results (Schoonhoven 1981) indicate that contingency theory can accommodate interactions but it is the responsibility of the researcher to specify such relationships.

The third problem, functional forms of interaction, concerns the mathematical function of implied interactions. Schoonhoven argued that a lack of clarity permitted researchers to use mathematical or statistical techniques that represented different interactions than described by researchers. Consequently, conflicting findings among researchers could potentially be traced to this problem. Again, Schoonhoven suggested several solutions to the problem and demonstrated results supporting her suggestions.

Schoonhoven's position coincides with Venkatramen's (1989) concept of fit.

Schoonhoven's fourth criticism, the analytic model used, attacks an underlying assumption of most contingency research -- linear relationships. This problem can be addressed to some extent by the use of more sophisticated quantitative methods and less reliance on bivariate correlations (Gupta 1987; Galunic and Eisenhardt 1994).

Finally, the problem concerning assumptions about contingency relationships suggests that contingency theory makes an assumption of symmetrical effects (i.e., an increase in one variable must result in the same increase in the affected variable). Tosi and Slocum (1984) acknowledge this problem and suggest that it is incumbent upon each researcher to clearly specify proposed contingency relationships. From their perspective, this problem is surmountable but it requires a thorough review and analysis of concepts and methodological procedures each time contingency relationships are proposed.

CONTINGENCY VARIABLES

Lawrence and Lorsch (1967) originally envisioned contingency variables to come from "outside" the organization - typically from the environment or contextual domain of the firm. As such, these exogenous variables were considered to be subject to little control or influence by firms. Although environmental variables and their contingent relationships with strategy, structure and performance continue to be investigated, a second set of contingency variables has emerged. These variables represent aspects of a firm's strategic position (e.g., vertical integration) and are directly under a firm's control (Hambrick and Lei 1985). Similarly, Ginsberg and

Venkatraman (1985) argue that strategy and performance can be important contingency variables.

This more expansive view of contingent relationships is reflected by the five contingency variables identified by Chow *et al.*: (1) environmental uncertainty, (2) environmental heterogeneity, (3) the importance of logistics, (4) information technology, and (5) strategy. The first four will be discussed in this section. Strategy will be discussed in the next section covering the strategy-structure-performance paradigm.

ENVIRONMENTAL UNCERTAINTY

Within the contingency approach, environmental uncertainty can be traced to the work of Lawrence and Lorsch (1967) and Duncan (1972). Lawrence and Lorsch investigated the subenvironments of marketing, manufacturing and research. In each of these subenvironments three questions were asked concerning: (1) lack of clarity of information, (2) general uncertainty of causal relations, and (3) long time span of feedback about results (Lawrence and Lorsch 1967). Duncan (1972) investigated two dimensions of the environment, simple-complex and static-dynamic.

Subsequent application and testing of these two approaches to environmental uncertainty indicated reliability and replication problems (Tosi, Aldag and Storey 1973; Downey, Hellriegel and Slocum 1975). Consequently, subenvironment-centered approaches have generally not been used although aspects of information continue to be of interest. Additionally, Duncan's static-dynamic dimension has evolved into a commonly cited measure of environmental uncertainty.

Environmental uncertainty is defined by Chow *et al.* as "the extent to which outcomes are unpredictable" (p.300). In their view, environmental uncertainty has two important dimensions: (1) the ability of the decision-maker to predict the behavior and expectations of constituent groups, and (2) the range of these behaviors and expectations. This definition is fairly consistent with the use of environmental uncertainty in various disciplines.

A representative example is Miller and Friesen's (1978) use of dynamism and hostility as part of their environment construct. The respective definitions capture the dimensions favored by Chow *et al.*

> Dynamism in the environment is manifested by the amount and unpredictability of change in customer tastes, production or service technologies, and the modes of competition in the firm's principal industries.
>
> Hostility in the environment is evidenced by price, product, technological, and distribution competition, severe regulatory restrictions, shortages of labor or raw materials, and unfavourable demographic trends (e.g., the drying up of markets).

The definitions underscore an important point. Items designed to measure the respective variables can be drawn from numerous areas (i.e., customer tastes, technologies, price competition, etc.), thereby making it difficult to assemble a standard list of items applicable to every research design. Table 2.1 further illustrates this point by indicating the wide range of items used to measure environmental uncertainty in various organizational and marketing studies.

TABLE 2.1
Items Used to Portray Environmental Uncertainty

Source	Measure of Environmental Uncertainty	Relationship Studied
Woodward (1965)	Technology Type: - custom - mass production - continuous process	Structure
Hofer (1975)	Stage of Product Life Cycle	Bus. Strategy
Nonaka & Nicosia (1979)	Certainty-Uncertainty of Environmental Information	Marketing Organization Structure
Day (1986)	Market Growth Rate (high versus low) Firm's Competitive Position (leader versus follower)	Strategic Choice

Source: Adapted from Zeithaml, Varadarajan and Zeithaml (1988)

Given this flexibility, environmental uncertainty remains a frequently employed contingency variable as it is predicted to both directly and indirectly affect elements of organization strategy and structure. Its use has spread to the areas of strategic management (e.g., Miller 1988), marketing (e.g., Ruekert, Walker and Roering 1985) and logistics (e.g., Kohn, McGinnis and Kesava 1990).

The basic premise is that as environmental uncertainty increases, organizational structure must adapt to process information related to an unstable environment. A common proposal reflecting this relationship is that a low level of environmental uncertainty leads to mechanistic structures. These structures are generally considered to be highly centralized and focused on efficiency. Conversely, high levels of environmental uncertainty lead to organic structures. Organic structures are typically characterized as decentralized and emphasizing flexible, nonroutine thinking and solutions (Burns and Stalker 1961).

A complete review of environmental uncertainty and its hypothesized impact on the components of the strategy, structure and performance framework is difficult. As mentioned previously, and illustrated by Table 2.1, items measuring these relationships are many and varied. Fortunately, contingency approaches used in logistics research provide a much narrower scope of relevant work. The remainder of the discussion of environmental uncertainty focuses on this research. Table 2.2 summarizes the use of environmental uncertainty items in logistics research.

Table 2.2
Environmental Uncertainty in Logistics Research

Research	Measure of Environmental Uncertainty	Relationship Studied
Germain (1989)	Percentage of Manufacturing to Customer Order: - Standardized - Customized - Hybrid	Organizational Structure, Strategic Planning, Flexibility
Kohn, McGinnis and Kesava (1990)	Based on Miller and Friesen's (1978) dynamism and hostility constructs	Logistics Strategy
Fawcett and Closs (1993)	Perceived Globalization Impact: 5-item measure of opportunities/threats created by economic globalization	Logistics, Manufacturing, Competitive Position
Germain, Dröge and Daugherty (1994)	Miller and Dröge (1986) Environmental Uncertainty Scale	JIT
World Class Logistics Research Survey - MSU (1994/95)	Miller and Dröge (1986) Environmental Uncertainty Scale	Unpublished-to-date.
Germain and Dröge (1995)	Miller and Dröge (1986) Environmental Uncertainty Scale	EDI/Technology/ JIT
Germain (1996)	Miller and Dröge (1986) Environmental Uncertainty Scale	Logistics Innovation Adoption

Germain's (1989) research supported the hypothesis that environmental uncertainty (i.e., defined as environmental market uncertainty according to percentage

of manufacturing to customer order) is related to organizational structuring of logistics. He found that "manufacturers within the standardized context were found to consolidate more logistics activities in a single department than customized context manufacturers" (p.27). This follows the mechanistic/organic rationale of the organizational science literature.

Using flexibility as a proxy for performance, Germain (1989) obtained mixed results. His findings generally support the hypothesis that manufacturers in a customized context will exhibit greater logistics flexibility. However, certain measures such as product phase-out and product introduction did not support "the contingency view that organizations facing environmental uncertainty attempt to remain flexible and adaptive" (p.23).

The research of Kohn, McGinnis and Kesava (1990) found that logistics strategy was independent of "dynamism" but not "hostility." In this study, dynamism was defined as "the unpredictability of change in customer taste, technology and modes of competition;" hostility was defined as "level of competition, severity of regulatory restrictions, shortages and unfavorable demographic trends" (p.27). Thus, if viewed in terms of the Chow *et al.* definition, range of behaviors affects logistics strategy but the decision-maker is able to adequately predict constituent groups' actions, thereby minimizing the impact of those actions.

Fawcett and Closs (1993) found that Perceived Globalization Impact did influence performance, logistics and manufacturing. However, as firms move to global manufacturing, the increased uncertainty has a greater impact on logistics than manufacturing. The authors believe this is due in large part to the "additional attention

required to design an effective and flexible logistics system" (p.18).

The remaining studies in Table 2.2 use the Miller and Dröge (1986) environmental uncertainty scale. Given the relative importance of this scale, each of the items is reproduced below:

Our firm must rarely change its marketing practices to keep up with the market and competitors.	Our firm must change its marketing practices extremely frequently.
The rate at which products/ services are getting obsolete in the industry is very slow (e.g., basic metal like copper).	The rate of obsolescence is very high as in some fashion goods.
Actions of competitors are quite easy to predict (as in some primary industries).	Actions of competitors are unpredictable.
Demand and consumer tastes are fairly easy to forecast (e.g., for milk companies).	Demand and tastes are almost unpredictable (e.g., high-fashion goods).
The production/service technology is not subject to very much change and is well established (e.g., in steel production).	The modes of production/ service change often and in a major way (e.g., advanced electronic components).

The collective results of the three reported studies support the use of environmental uncertainty in contingency approaches to logistics research. Environmental uncertainty predicts JIT selling, integration, performance control and operations decentralization but not specialization or scheduling decentralization (Germain, Dröge and Daugherty 1994). Germain and Dröge (1995) again found support for the positive association between JIT strategy and environmental uncertainty. They also identified a significant relationship between environmental uncertainty and production complexity but not between environmental uncertainty and EDI technology.

Finally, environmental uncertainty is a significant predictor of radical logistics innovation, manufacturing operations decentralization and integration, but not specialization or innovation adaptation decentralization (Germain 1996).

ENVIRONMENTAL HETEROGENEITY

Environmental heterogeneity is closely related to environmental uncertainty. Chow *et al.* have chosen to define it as "the degree of complexity in the firm's environment" (p.301). The degree of complexity is typically reflected in number of products, customers, suppliers, locations, etc. It is noteworthy that Chow *et al.* would use the term "complexity" in their definition as it is a term that appears synonymous with environmental heterogeneity in the literature.

Duncan's (1972) work in perceived environmental uncertainty used a simple-complex dimension in addition to the static-dynamic dimension discussed in the preceding section. He conceptualized the simple-complex dimension as follows:

> The simple part of the simple-complex dimension deals with the degree to which the factors in the decision unit's environment are few in number and are similar to one another in that they are located in a few components. The complex phase indicates that the factors in the decision unit's environment are large in number (p.315).

At the same time, Child (1972) described "environmental complexity" as "the heterogeneity of and range of an organization's activities." Hage and Dewar (1973) employed the term "complexity" to mean "the number of different organizational specialties." The general premise underlying all of these definitions is that a more heterogeneous environment causes greater perceived uncertainty, leading to greater information-processing requirements (Duncan 1972; Pennings 1975; Tung 1979; Dess

and Davis 1984).

Although this premise is intuitively appealing, Duncan (1972) found the static-dynamic dimension to be considerably more important than the simple-complex dimension. Researchers working in strategic management have also had similar findings, resulting in considerably less usage of environmental heterogeneity as a contingency variable (Bourgeois 1980, 1985; Lindsay and Rue 1980).

In other studies that have employed environmental heterogeneity, results have been mixed. Keats and Hitt (1988), writing on the environment-organization interface, posited a positive relationship between "complexity" and organizational divisionalization. Their findings did not support the relationship, although it was determined that complexity's primary influence was on size of firms. Hambrick and Lei (1985), working in the area of strategy, attempted to prioritize contingency variables relevant to business strategy. Among the ten variables selected for analysis was rate of concentration in an industry. Even though it does not fully represent the environmental heterogeneity construct, industry concentration can be considered an element. Hambrick and Lei's results offered some support for the importance of firm concentration. However, of the ten variables, it was classified in the "secondary importance group," the least important variables in Hambrick and Lei's study.

Miller and Friesen (1978) used "heterogeneity" in their research of strategy types. They defined it as "the differences in competitive tactics, customer tastes, product lines, channels of distribution, etc." (p.922). In this study, heterogeneity was characterized as an aspect of an overall environment construct. Of the ten archetypes identified, heterogeneity is the most important environmental factor in only one and it

is the least important in five.

Within the logistics literature there is little evidence of previous use of environmental heterogeneity. Kohn, McGinnis and Kesava (1990) did use it in examining organizational environment and logistics strategy. They used two different definitions in their study. The first definition is based on Miller and Friesen's (1978) work. Kohn *et al.* found that when using this definition, the result was that logistics strategy is independent of environmental heterogeneity. The second definition was based on Dess and Beard's (1984) use of complexity: "Complexity is defined as the heterogeneity and range of an organization's activities." The same result was obtained. Logistics strategy was independent of complexity. This finding led Kohn *et al.* to conclude that in terms of logistics research, environmental heterogeneity as defined by Miller and Friesen and complexity as defined by Dess and Beard have similar meanings but no significant relationship to logistics strategy.

IMPORTANCE OF LOGISTICS

The third contingency variable advocated by Chow *et al.* is the importance of logistics. They define the importance of logistics as "the extent to which logistics activities constitute an important portion of the firm's value-adding activities" (p.301). The underlying justification for inclusion of this variable is the relative cost of logistics within a given firm. Citing Christopher (1986) and Davis and Brown (1974), Chow *et al.* contend that if the ratio of logistics costs to total costs is high, logistics will merit closer attention. Positioning logistics closer to top management may be one way of ensuring attention and emphasis.

There is no prior use of this exact variable in logistics research. Perceptual measures of the importance of logistics have been obtained in Michigan State University's *Leading Edge* and *World Class Logistics* research. Bowersox *et al.* (1989) concluded that "reporting to top-level executives is indicative of greater visibility and recognition" (p.87).

INFORMATION TECHNOLOGY

Information technology has been widely introduced to the field of logistics as evidenced by geo-positioning satellite communications, optical scanner links between retailers and suppliers, bar coding of packages, computerized picking systems, etc. The general belief is that information technology facilitates efficient and effective logistics operations. But from a logistics research perspective, what is information technology? Unfortunately, Chow *et al.* do not define it.

Two studies have examined the impact of adoption of incremental and radical logistics technology (Germain 1996; Germain, Dröge and Daugherty 1994). With the exception of robotics, their examples of logistics technology are all information-based applications (e.g., AS/AR systems, handheld data entry devices, order entry software, freight consolidation software, etc.). The 1994 study identified three logistics technology clusters: (1) high cost, revolutionary technology, (2) medium cost, medium revolutionary technology, and (3) low cost, incremental technology. Additionally, adoption of the three logistics technology types were significantly correlated with a formalization of measurement construct but not with decentralization. Integration was related to medium cost, medium revolutionary logistics technology and to span of

control.

Germain (1996) defined the three clusters as radical, intermediate and incremental. His findings generally support the earlier study. Of special interest to this research is his work with environmental uncertainty and its relationship to the two extreme technology clusters. Germain found that environmental uncertainty is significantly related to radical but not incremental innovation. His conclusion is that a more dynamic environment creates a "future-oriented organization aware of external change and hence more receptive to original solutions" (p.124). In an EDI-specific research, Williams (1994) found that logistics channel EDI-adoption was not significantly related to environmental uncertainty. This is consistent with Germain, Dröge and Daugherty (1994). Germain (1996) did not specifically test the EDI-uncertainty relationship as EDI was classified as an intermediate technology.

In terms of interorganizational relations, Williams (1994) found that channel power played a significant role in EDI-adoption in a logistics channel. She notes that in many cases EDI-implementation is mandated by the stronger channel partner. This supports the work of Clemons and Row (1993) who found that interfirm coordination through information technology frequently faces significant resistance.

> Improving coordination within the distribution channel requires investment in IT, but it also requires significant changes in the organizational mechanisms used to manage the interactions, which we term *coordination structure*. Conceptually, improved coordination must be viewed not just in terms of players changing their strategies within an existing game, but in terms of changing the structure of the game. Changes in coordination structure can improve overall channel efficiency, but can also affect the bargaining power of the parties. In some cases, one party can find him or herself actually worse off under improved coordination, due to a loss of bargaining power, thus leading him

> to resist the change; this can be true even if coordination yields a net economic surplus to the channel (p.75).

Such resistance can perhaps be explained within logistics by the microsocial view that posits that technologies first alter tasks and skills, only later does organizational structure modification take place (Barley 1990). If so, it is possible that the impact of information technology has been felt most at the lower levels or "front lines" of the organization. Given the fact that most logistics tasks are low to medium-skilled jobs it is entirely possible that resistance is encountered. The electronic integration view holds that impacts are felt beyond the firm's boundaries and subsequently affect employees of other firms (Kambil and Short 1994). This interlocking relationship created by information technology and its effects on lower-level personnel has not been examined in the logistics literature.

Closs, Goldsby and Clinton (1997) have recently examined information technology and its influence on logistics capability. They define information technology as the operating and planning systems used by logistics personnel. In each of these systems they evaluate reliability, timeliness, accuracy, connectivity, availability, flexibility, and format. Their findings support the idea that a firm's logistics capability is primarily influenced by logistics operating timeliness, usage driven formatting and flexibility.

STRATEGY, STRUCTURE, INTEGRATION, AND PERFORMANCE: INDIVIDUAL DEFINITIONS UNDER THE CHOW *ET AL.* FRAMEWORK

This section reviews the definitions and literature pertaining to four constructs: strategy, structure, integration and performance. The following section examines the relationships of these variables.

STRATEGY

A fundamental problem in researching logistics strategy is that most "grand strategies" (Miles and Snow 1978; Porter 1980) have been developed in relation to overall corporate or divisional strategy. The richness of such strategies is usually lost at the functional level. Consider, for example, Porter's typology of cost leadership/differentiation/focus. This is usually applied in logistics research in the form of a low cost <---> customer service continuum (e.g., *World Class Logistics Research*, Michigan State University 1992-1995). While this can provide insights into a firm's logistics orientation, it falls far short of the descriptions and explanations offered at the corporate level. Furthermore, there is no study that has systematically related logistics strategy to overall corporate strategy.

Chow *et al.* recognize the limitations of corporate strategies in logistics research. While acknowledging the existence of logistics-specific typologies they prefer to use the following definition: "Logistics strategy can be defined as a pattern of action plans designed for the purpose of achieving logistics goals" (p.296). In the words of the authors, this definition "can encompass different typologies" (p.296).

Bowersox *et al.* (1989) proposed the logistics process/market/channel typology. Chow *et al.* discuss this typology, noting its focus on organizational mechanisms. This

emphasis is evident in the definitions provided in Table 2.3.

Table 2.3
Process / Market / Channel Definitions

Process strategy is concerned with managing a broad group of logistics activities as a value-added chain. Emphasis is on achieving efficiency from managing purchasing, manufacturing, scheduling and physical distribution as an integrated system.
Market strategy is concerned with managing a limited group of logistics activities for a multidivision single business unit or across multiple business units. The logistics organization seeks to make joint product shipments to common customers for different product groups and seeks to facilitate sales and logistical coordination by a single-order invoice.
Channel strategy is concerned with managing logistics activities performed jointly with dealers and distributors. The strategic orientation places a great deal of attention on external control. Significant amounts of finished inventories are typically maintained forward or downstream in the distribution channel.

Source: Bowersox *et al.* (1989) *Leading Edge Logistics: Competitive Positioning for the 1990s*, Oak Brook, IL: Council of Logistics Management.

This organizational focus clearly indicates patterns of activities associated with different logistics strategies. Presumably such organization is intended to facilitate the achievement of logistics objectives. In that sense, the Bowersox *et al.* typology is much more specific than Chow *et al.*'s broad definition. In advocating their position, Chow *et al.* argue that the Bowersox *et al.* typology fails to incorporate trade-offs. However, since the release of the Chow *et al.* framework, additional empirical support for the process/market/channel typology has been obtained (Clinton and Closs 1997). Factor analysis has established clear evidence of specific tendencies and practices within each of the individual strategies. The varying intensity of several factors common to all three strategies suggests that trade-offs might be identifiable. Based on

this new development it would seem worthwhile to pursue further research into the typology.

STRUCTURE

Structure is a multidimensional construct. Unlike strategy, however, the dimensions are better defined. Chow *et al.* indicate that five properties of structure are most important in logistics research: centralization, formalization, span of control, scope, and logistics integration. In developing the definitions for each of these properties, Chow *et al.* have relied upon the organizational sciences literature. The first four properties are discussed under structure. Integration will be discussed separately, highlighting its position in the Chow *et al.* framework.

Centralization

In the view of Chow *et al.*, centralization is defined along two dimensions. Centralization is "the extent to which the power to make logistics decisions is concentrated in the organization" and "the hierarchical distance between logistics decision-makers and senior executives who make more 'global' decisions on an organization-wide scale" (p.288). The former dimension is more closely related to organizational science while the latter dimension has been discussed only in the logistics literature in relation to centralization.

> Centralization involves the locus of authority to make decisions in organizations. If, for instance, the power to make decisions is exercised by one or relatively few individuals, the structure is considered centralized. The minimum degree of centralization (decentralization) would exist in an organization if decision-making authority were exercised equally by every member of the organization. Degree of centralization, then, refers to the dispersion of decision-making authority throughout the

> organization (Dalton, Todor, Spendolini, Fielding and Porter 1980 p.58-59).

The preceding is a representative definition of centralization/ decentralization in the organizational science literature. The underlying rationale for including centralization in contingency models is that it can result in better overall coordination and control, leading to greater organization performance (Ruekert *et al.* 1985). But this is believed to hold true only in stable environments. Highly volatile, uncertain environments force decentralization as decision-makers are unable to cope with the jumbled or erratic information flow (Pennings 1975; Mintzberg 1979; Tosi and Slocum 1984).

The second dimension, hierarchical distance between logistics and senior executives, is not routinely investigated in organizational theory literature -- even using other functional areas. The "logistical excellence" studies conducted at Michigan State University (i.e., *Leading Edge; World Class Logistics*) have been at the forefront of this dimension. However, there is no evidence that researchers associated with these projects have advanced the idea that hierarchical distance is a distinct dimension of centralization. In any event, Bowersox *et al.* (1989) have found that closer proximity or easier access to top management by logistics managers is "indicative of greater visibility and recognition" (p.83).

There is, however, yet another use of centralization within the logistics literature. Germain (1989) has used the number of activities under logistics departmental line control to indicate centralization. This control "was assumed to represent the extent to which logistics activities were centrally consolidated within a

single department (p. 24)."

This definition presents a dilemma. It is logical to equate the consolidation of activities within a single department as representing centralization. After all, decision-making authority would then be concentrated in one department and not shared across-functional or divisional boundaries. However, measuring the level of centralization based on line control is contrary to the organizational science meaning based on number of people wielding decision-making authority. In the particular study used by Germain, respondents provided an indication of whether the activity was (a) part of the formal control of logistics, and then if it was, (b) did line or staff have responsibility for the activity? Using the organizational science position, one is compelled to think that perhaps staff control (i.e., concentration of decision-making authority in fewer parties) over the activities is more consistent with the concept of centralization. Line personnel are typically more numerous than staff. Thus, if line personnel are entrusted with the responsibility one could perhaps argue that this is consolidation of the activities but decentralization of decision-making authority.

Span of Control and Scope

Chow *et al.* note that span of control has evolved into two closely related meanings - range of *activities* under a manager versus number of *people* under a manager. Based on Van Fleet and Bedeian's (1977) review of the concept, the number of subordinates under a manager is the more traditional measure. Chow *et al.* adopt this position and define span of control as the number of subordinates who report to a single superior.

Span of control has been of interest to researchers primarily because of its relationship to effectiveness. It is generally theorized that supervisors can only effectively manage a limited number of subordinates. Of interest to this research is the finding that information technology can "extend" the span of control within organizations (Germain, Dröge and Daugherty 1994).

The concept of "scope" is defined by Chow *et al.* as "the degree to which logistics activities are grouped together in the same organization or organizational sub-unit" (i.e., see preceding discussion of centralization). This could be of interest as it will illustrate whether firms deploy logistics responsibility from a single, concentrated unit or disperse it across-functional areas such as manufacturing, purchasing or marketing. The latter approach is frequently advocated by proponents of integrated logistics management. The concept itself, however, has little prior application in the literature as it has previously come under the definition of span of functional activity control.

Formalization

Formalization has been extensively studied in the organizational science literature. Its consistent meaning within that body of work has enabled Chow *et al.* to apply a similar meaning in their framework: Formalization is the degree to which goals, rules, policies and procedures for logistics activities are precisely and explicitly formulated (p.289). The general premise is that stable environments promote structures high in formalization whereas dynamic, uncertain environments are associated with lower levels of formalization. When the appropriate matching of environment and formalization occurs, firms tend to be more efficient than under mismatched

circumstances. Researchers have generally found that centralization and high levels of formalization are associated. Dröge and Germain (1994) have evidence of this in logistics.

INTEGRATION

Integration has usually been defined as a structural property in the organizational sciences and logistics literatures (Parsons 1960; Miller and Dröge 1986; Miller 1987; Dröge and Germain 1989). Germain (1996) has succinctly defined integration as "lateral communications that span divisions, functions, or departments" (p.118). Within logistics research, integration is typically depicted as a dimension of organizational structure impacted by environmental uncertainty, context and strategy (Germain, Dröge and Daugherty 1994; Germain 1996).

This view of integration contrasts with the recommendation of Chow *et al.* that integration be considered as an intermediate outcome variable, a product of organization structure. They state:

> Integration is an outcome that can be associated with the state of collaboration at one of three levels: two or more logistics activities within a firm; the logistics process and other corporate activities within the firm (such as marketing); participants in the supply chain. In sum, integration is the degree to which logistics tasks and activities within the firm and across the supply chain are managed in a coordinated fashion (p.291).

Thus, although Chow *et al.* generally define integration in the same manner as previous researchers, they position it as the key variable between structure and performance. Although not explicitly stated, this reflects a belief that the systems approach to logistics thinking (i.e., integrated logistics) requires acknowledged

integration antecedent to successful logistics performance. However, a recent stream of research into the integrated logistics concept and information systems does not support this view of integration as an outcome (Gustin, Stank and Daugherty 1994; Stank, Daugherty and Gustin 1994; Gustin, Daugherty and Stank 1995). The authors note that "the integrated distribution concept creates an organizational structure ..." (Gustin, Daugherty and Stank 1995, p.2).

PERFORMANCE

For the majority of their framework, Chow *et al.* draw upon the organizational theory literature. They feel no compuncture to do so in the area of performance. The logistics literature is overflowing with measures of performance - so many in fact that Chow *et al.* do not even attempt a definition. This omission is defensible when one considers the numerous ways in which logistics performance can be measured. But that is the key. Any measure used should "directly evaluate the performance of the logistics system" (Dröge and Germain 1989, p.85). In that respect, many of the global measures (e.g., market share, corporate profitability) used in the strategy-structure-performance paradigm literature are inappropriate for this research focus. In order to properly assess performance in this study, the performance construct must reflect the task level evaluation consistent with the other model variables. Table 2.4 presents a summary of logistics performance measures used in five leading logistics journals between 1982 and 1992 (Chow, Heaver and Henriksson 1994).

Table 2.4
Logistics Performance Measures: 1982-1992

Source	Measure	Definition of Performance
Rhea & Shrock (1987)	Soft	"Distribution effectiveness": adequacy, consistency, timeliness, initiative, responsiveness
Perry (1988)	Soft	"Operating Performance" of specific logistics dimensions
Bowersox *et al.* (1989)	Soft	Common attributes index
Dröge & Germain (1989)	Soft	Firm's ability to accommodate product introduction, phaseout, recall and customization of service
Gassenheimer, Sterling & Robicheaux (1989)	Soft	Logistical performance: length of order cycle time, meeting delivery dates, fill rate, advance notice on shipping delays, accuracy, etc.
Germain (1989)	Soft	Firm's ability to accommodate supply disruption, production schedule changes, product introduction, phase-out, etc. and customization of service
Yavas, Luqmani & Quraeshi (1989)	Soft	Efficiency measures compared to purchasing sophistication
Cooper, Browne & Peters (1990)	Soft	Performance indicators of logistics efficiency
Fawcett (1990)	Soft	Carrier performance
Read & Miller (1990)	Soft	Quality
Clarke (1991)	Soft	Productivity
Clarke & Gourdin (1991)	Hard	Data envelopment analysis (DEA): efficiency/productivity
Fawcett (1991)	Soft	"Competitive position" of firm/profit center on 5 perceptual measures
Gomes & Mentzer (1991)	Hard	Profitability
Harrington, Lambert & Christopher (1991)	Hard	Vendor performance: lead-time, lead-time variability, fill rate, etc.
Kleinsorge, Schary & Tanner (1991)	Hard	DEA - efficiency
Marr (1991)	Soft	"Distribution service performance"/ 1-item performance measure
Daugherty, Sabath & Rogers (1992)	Soft	Firm's ability to accommodate special requests
Daugherty, Stank & Rogers (1992)	Soft	Service capabilities of firm
Diewert & Smith (1992)	Hard	Total factor productivity
Fawcett & Vellenga (1992)	Soft	Carrier performance
Fawcett & Closs (1993)	Soft	"Competitive position" of firm/profit center on 5 perceptual measures

Adapted from: Chow, Heaver and Henriksson (1994)

Table 2.4 illustrates three key points. First, considering that Chow *et al.* (1994) looked at published logistics research from 1982 - 1992, it is apparent that research into logistics performance is a relatively recent logistics research phenomenon. Significant numbers of articles did not appear until the late 1980s.

Second, perceptual or "soft" measures have dominated the research efforts. There are several notable exceptions that used "hard" or objective performance data. However, Chow *et al.* (1994) note the difficulty that most researchers have in obtaining proprietary performance data broken down to functional or departmental levels. Finally, a perusal of the list of measures perhaps explains why, in their framework discussion, Chow *et al.* do not offer a definition of logistics performance. Few researchers have used the same measure to investigate logistics performance!

The interest in logistics performance has not slackened after 1992. In 1995 alone, academics were reporting on the relationship of firm responsiveness and performance (Daugherty, Ellinger and Rogers 1995), comparisons of domestic and international distributors' performance (Cabaniss 1995), impact of information technology on performance measurement (Bowersox and Daugherty 1995), and performance characteristics of world-class logistics firms (Council of Logistics Management 1995). Most of these initiatives used soft, perceptual measures of logistics performance. And, as evidenced by the titles, performance was measured in a variety of contexts.

Although this might be disconcerting to some researchers, it reflects the multidimensional character of performance. What is important is that the performance measures can be justified as realistic evaluations of the performance of the logistics

system (Dröge and Germain 1989). Chow *et al.* believe there is a place for both "hard" and "soft" measures of logistics performance. What appears to be lacking is reliable measures and scale development of the various dimensions (i.e., customer service, productivity measures, cost considerations, etc.) of performance itself (Dunn, Seaker and Waller 1994).

STRATEGY AND STRUCTURE

A long-standing belief and dominant paradigm in organizational theory holds that structure follows strategy (Chandler 1962). Numerous researchers in the organizational field support this position (e.g., Rumelt 1974; Lewis and Fandt 1989; Ansoff 1991). Amburgey and Dacin (1994) note that this relationship has also been posited in a variety of other theoretical schools (e.g., design school of strategic management (Mintzberg 1990); organizational ecology (Hannan and Freeman 1984)).

A contrary view was hypothesized by Bower (1970) and Hall and Saias (1980). They argued that structure must partly determine strategy. In their view, the firm develops an initial strategy based on environmental conditions and firm resources. A structure develops to support the strategy. Thereafter, however, the structure that is in place limits the strategic alternatives available to the firm. This is believed to be particularly true in the case of incremental shifts in strategy. Only when severe disruptive changes in strategy occur must structure once again follow. Thus, a reciprocal relationship exists between strategy and structure.

Amburgey and Dacin (1994) posited that "the link from strategy to structure is based on efficiency and effectiveness, and the link from structure to strategy is based

on the evolution of managerial cognitions and skills" (p.1432). Results from their study support Chandler's position, structure follows strategy:

> Our results indicate that reciprocity is not the same as equality; changes in strategy are more likely to produce changes in structure than the reverse, and changes in strategy produce changes in structure more quickly than the latter produce changes in strategy (p.1448).

In contrast, Keats and Hitt (1988) were unable to support the structure-follows-strategy link. They found that structure affects strategic choice, with the latter being limited by the type of information gathered. However, an important distinction between the Amburgey and Dacin study and the Keats and Hitt work is that temporal considerations were built into the Amburgey and Dacin design. Keats and Hitt note this limitation in their research.

In the logistics literature there is no guidance about reciprocity in the strategy-structure relationship. An interesting consideration is that most of the work in the organizational theory and strategic management level is done at an overall corporate or strategic business unit level. There is little written about a strategy-structure linkage at the functional level. Given the uncertainty, Chow *et al.* have indicated they believe in a reciprocal relationship at the logistics level.

ENVIRONMENT-STRATEGY-STRUCTURE-PERFORMANCE

The environment-strategy-structure-performance paradigm has been criticized for being implemented in research designs by single contingency/bivariate approaches (Galunic and Eisenhardt 1994). Galunic and Eisenhardt cite the example of a single contingency -- strategy -- requiring a specific structural arrangement to obtain desired

performance. They argue that this interaction of strategy and structure does not capture the complexity of either the contingency variable or the structural adjustment.

Studies that comprehensively cover the entire paradigm are relatively few in number. Their results are generally not directly comparable due to differences in performance measures, industry settings, etc. At best, mixed results have been obtained on the various relationships within the paradigm.

But the underlying reasoning of the ESSP paradigm continues to attract interest. It states that where "fit" exists between environment and strategy and between strategy and structure, better performance should result. Chow *et al.* advocate use of the paradigm at the logistics level to develop and facilitate comparability among studies. Although no logistics study to date has tested the entire paradigm, components have been examined. For example, environmental/strategy (McGinnis and Kohn 1993), environmental/strategy/structure (Germain and Dröge 1995; Germain, Dröge, and Daugherty 1994), environmental/structure (Germain, Dröge, and Daugherty 1994), and structure/performance (Dröge and Germain 1989) linkages have appeared in the logistics literature. In each case, organizational theory concepts have been integrated into the respective studies without any apparent problems. This is an important consideration as researchers should be concerned whether theoretical developments in other fields can be imported wholesale into a different field. The results of the aforementioned studies have generally supported the findings in related organizational theory and strategic management literature, further buttressing the use of a contingency-based strategy, structure, and performance approach to logistics research. If that is true, a brief review of comprehensive studies in organizational theory and

strategic management should provide some insights into what might be reasonably expected in the logistics area.

Prescott (1986) found that strategy and performance were related and that environment modified the strength but not the form of the relationship. Davis and Schul (1993) found a particularly interesting relationship between strategy and performance when examining resource sharing. Resource sharing was defined by "the extent to which a business unit shares functional activities like logistics ... with other business units" (p.185). Davis and Schul found that such sharing positively influences performance in firms pursuing an overall corporate strategy of lowest cost. No such relationship was found for firms pursing a differentiation strategy.

Miller's (1988) research produced several results with potential significance to logistics research. Using Porter's strategies, a number of hypotheses were developed regarding the environment and structure -- particularly integrative mechanisms -- and performance. The relationship of Porter's strategy to environment was consistent with previous literature (i.e., differentiation is associated with high environmental uncertainty, low cost with stable environments). The structural property of integrative devices received support and was found most strongly in uncertain environments using the differentiation strategy. Together, these results point to the more successful differentiated firms employing these tactics than the unsuccessful firms. It again underscores the issue of overall corporate or business unit strategy and its influence, if any, on logistics strategy and structure.

In a unique approach, Keats and Hitt (1988) used three different models to test variables of interest from the organizational science and strategic management

literatures. The external control model found environmental instability to have a significant impact on organizational structure, consistent with other findings mentioned previously. The strategic management model found that performance was actually negatively impacted by firms trying to reduce uncertainty by curtailing their diversification efforts. This supports Miller and Friesen's (1978) finding that suggests some firms intentionally pursue uncertain environments and still maintain high levels of performance. This again raises an interesting question from the logistics perspective: What is the appropriate strategy-structure fit in response to an organization pursuing market opportunities in continuously uncertain environments? The third model used by Keats and Hitt is the inertia model. Its primary finding of interest to this research is that strategy follows structure.

The ESSP paradigm has been utilized in examining service organizations as well as manufacturing or retailing industries. Jennings and Seaman (1994) studied the savings and loan industry. They specifically looked at firms' adaptive characteristics in relation to the Miles and Snow (1978) typology, then compared financial performance. Their research supports the idea of a fit between strategy and structure leading to better firm performance.

The preceding discussion is not intended to be exhaustive. It is intended to illustrate that: (1) complete examination of the ESSP paradigm in one study is still infrequent, (2) findings from the entire paradigm do support narrower studies in the organizational theory and strategic management literature that only focus on selected elements and relationships within the paradigm, and (3) studies reported in the logistics literature are consistent in the methods and findings of organizational theory and

strategic management, thereby supporting the use of the paradigm in logistics research.

LOGISTICS CONTINGENCY MODEL

Chow *et al.*'s general conceptual framework is reproduced in Figure 2.2. As discussed in the preceding section, much of the framework is based upon organizational science research. However, certain variables and relationships are not adequately defined or are subject to different interpretations when viewed from a logistics perspective. These concerns suggest that a competing framework may be better suited to conduct research in logistics using the environment-strategy-structure-performance paradigm.

THE ESSP PARADIGM - CHOW *ET AL.*

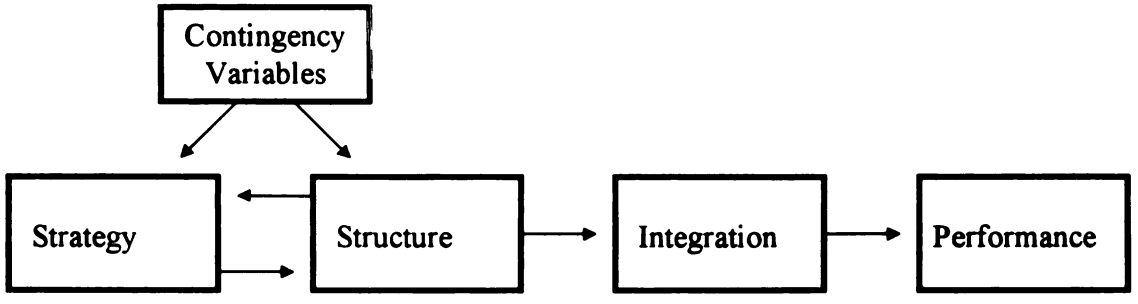

Figure 2.2
Logistics Organization and Performance

An alternative framework, termed *Logistics Contingency Model*, is presented in Figure 2.3. As indicated in Figure 2.3, the *Logistics Contingency Model* contains all of the major components traditionally used in the organizational science literature. The details of each major component are briefly described in this section. Research hypotheses are addressed in Chapter Three.

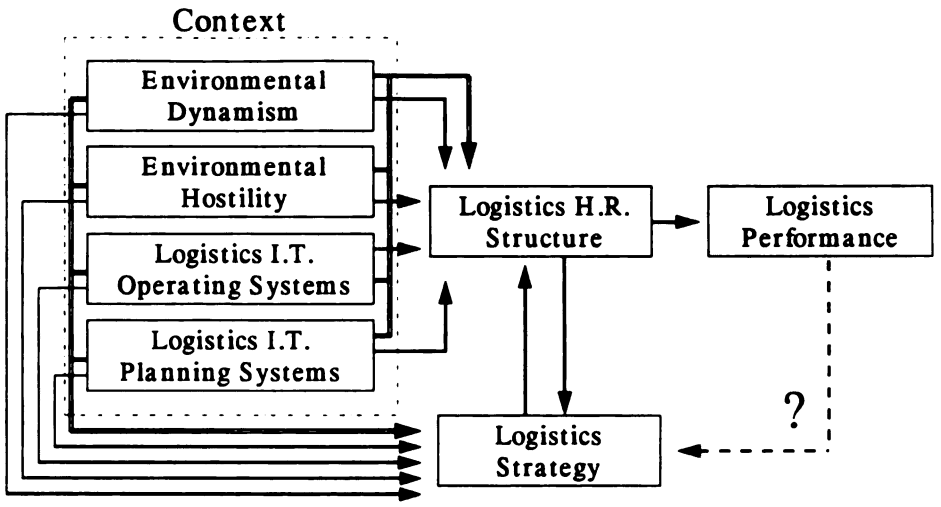

Figure 2.3
Logistics Contingency Model

CONTEXT

Although "environment" was originally used in the ESSP paradigm, context is used here for two reasons. First, the term context has a broader meaning, extending beyond traditional "environmental" variables. Given the two information technology variables, context more accurately depicts the nature of the relationships under investigation. Second, in much of the work done in this area in logistics, context is more commonly used (e.g., Germain 1996; Germain and Dröge 1994). It is hoped that a standard terminology will reduce confusion in continued research.

Four contingent contextual variables are contained in the model. They are: (1) environmental dynamism, (2) environmental hostility, (3) logistics information technology operating systems, and (4) logistics information technology planning systems. The first two are well known in the organizational science literature and were discussed earlier under "environmental uncertainty." However, to avoid any confusion

with the proliferation of environmental uncertainty characteristics, they are precisely identified in the model as dynamism and hostility. In this sense, they retain the meanings as developed in the organizational science literature. Their inclusion provides an opportunity to examine whether environmental variables affect functional level components in the same manner as they have affected corporate level components in other studies. In addition, it is hoped they can be compared to other studies conducted in logistics.

Chow *et al.* (1995) suggest that information technology has become critical to the functioning of logistics. They cite Schary and Coakley (1991) in noting that the nature of logistics organization is being changed by information technology. Presumably, strategic considerations are also influenced by the deployment of information technology. For these reasons, two aspects of logistics information technology -- operating (i.e., tactical) and planning systems -- are included in the *Logistics Contingency Model.*

STRATEGY

The Bowersox and Daugherty logistics strategy typology is used in the model. The strategies of Process, Market and Channel have received empirical support (Clinton and Closs 1997). Their organizational emphasis is consistent with the ESSP framework and represent logistics strategies - not overall corporate strategy.

STRUCTURE

Four dimensions of structure are used in the *Logistics Contingency Model:* integration, formalization, centralization, and span of control. Chow *et al.*'s

conceptualization of integration as an outcome variable is rejected. Although their argument is interesting, the long history of integration as a structural property and the recent investigations of researchers in the area of integrated logistics (e.g., Stank, Daugherty and Gustin 1994) are more persuasive. Formalization and centralization are well-known structural properties and have received support in logistics research (e.g., Dröge and Germain 1989; Germain, Dröge and Daugherty 1994). The traditional definition of span of control -- number of subordinates under a superior -- is used in this research.

PERFORMANCE

As indicated earlier in this chapter, performance has been measured in many different ways in the organizational science literature as well as in logistics. The more "global" measures (e.g., market share, profitability) typically used in the organizational science literature are inappropriate when investigating logistics performance. For that reason, logistics-specific measures were used. A "soft" construct based on perceptual measures of logistics performance (e.g., delivery dependability, order fill capacity) was developed and used.

An additional feature of the model includes a feedback loop from performance to strategy. Ginsberg and Venkatraman (1985) advocated this path in their model of a systems model of contingency theory-based strategic research. They suggested that performance can be considered a contingency variable that then affects the range of a firm's strategy responses.

This is consistent with the *World Class Logistics* model. This model, depicted as a circle or wheel, represents the dynamic nature of a business. As firms make adjustments to changes (i.e., contingent situations) they strive to measure their performance in relation to the changes. But the act of performance measurement then causes further adjustments and assessments. The *Logistics Contingency Model's* feedback loop captures this dynamic nature of the business environment.

SUMMARY

This chapter introduced relevant sources in contingency theory and the variables specified by Chow *et al.* in their framework. Where appropriate, other variables were introduced. An overview of the ESSP framework was provided and an alternative model, the *Logistics Contingency* Model, was introduced. The various items comprising the major components of the model were briefly described. This review and model provide a basis from which research questions and hypotheses can be framed in a manner consistent with a contingency approach to the ESSP paradigm in logistics research.

CHAPTER THREE - RESEARCH METHODOLOGY

This chapter describes research methodology. It contains three sections. First, the research purpose and objectives are presented. The second section then details the specific research questions. The third section addresses the operationalization of the methodology. This particular section discusses the unit of analysis, sample selection, interview protocol, data collection, and analyzes.

RESEARCH PURPOSE AND OBJECTIVES

The purpose of this research was to investigate if logistics structure and performance were contingent upon specified logistics context and strategic orientation and to what extent, if any, that subsequent performance evaluation impacted strategy. The research procedure consisted of two related approaches. The first approach utilized the database generated from the *World Class Logistics* research. A sample of approximately sixty (60) American and Canadian manufacturers and retailers was used to explore relationships hypothesized by the proposed *Logistics Contingency Model.* The second approach used additional survey data generated from a select group of approximately forty (40) *World Class Logistics* research firms. This second database permitted time series analysis of the dynamic nature of the hypothesized performance --> strategy link.

The specific objectives of this research were:

(1) Test empirically if context variables directly or indirectly affected strategy, structure and performance.

(2) Test if a relationship, possibly reciprocal, existed between structure and strategy.

(3) Test if there was any support for a feedback mechanism whereby performance influenced strategy.

(4) Suggest refinements to the proposed CSSP model in an effort to develop additional hypotheses and directions for future logistics research.

RESEARCH QUESTIONS

In accordance with the preceding objectives and review of the literature, the following fifteen research questions were addressed:

(1) What is the relationship of environmental dynamism to logistics strategy?

(2) What is the relationship of environmental dynamism to logistics structure?

(3) What is the relationship of environmental hostility to logistics strategy?

(4) What is the relationship of environmental hostility to logistics structure?

(5) What is the relationship of logistics information technology operating systems to logistics strategy?

(6) What is the relationship of logistics information technology operating systems to logistics structure?

(7) What is the relationship of logistics information technology planning systems to logistics strategy?

(8) What is the relationship of logistics information technology planning systems to logistics structure?

(9) What is the relationship of context to logistics strategy?

(10) What is the relationship of context to logistics structure?

(11) What indirect relationships, if any, exist between the contextual variables, strategy, and/or structure and performance?

(12) Is there evidence of a reciprocal relationship between strategy and structure?

(13) What is the direct relationship, if any, between logistics structure and performance?

(14) What is the relationship of logistics strategy on performance as mediated by structure?

(15) Does the level of logistics performance affect logistics strategy?

RESEARCH HYPOTHESES

Environmental dynamism has routinely been found to be significantly related to strategy and structure (Miller and Friesen 1978). Generally-speaking, the organizational science and strategic management literatures have found high levels of perceived environmental dynamism to be linked to decentralized, less formalized, "organic" structures and differentiated (i.e., Porter) or prospector (i.e., Miles and Snow) strategies. It was expected that comparable findings would be evident at the logistics level. This research used the environmental dynamism measure developed by Miller and Dröge (1986).

Hypothesis 1a: Under conditions of high environmental dynamism, firms will choose more externally-oriented logistics strategies (i.e., market or channel) than under conditions of low environmental dynamism.

Hypothesis 1b: Under conditions of high environmental dynamism, firms will use more decentralized structures than under conditions of low environmental dynamism.

Hypothesis 1c: Under conditions of high environmental dynamism, firms will use less formalized structures than under conditions of low environmental dynamism.

Hypothesis 1d: Under conditions of high environmental dynamism, firms will use more integrated structures than under conditions of low environmental dynamism.

Hypothesis 1e: Under conditions of high environmental dynamism, firms will use narrower spans of control than under conditions of low environmental dynamism.

Environmental hostility is the second dimension of Miller and Friesen's (1978) environment construct. It focuses on the range of behaviors and has been found to affect a firm's structure.

Hypothesis 2a: Under conditions of high environmental hostility, firms will choose more externally-oriented logistics strategies (i.e., market and channel) than under conditions of low environmental hostility.

Hypothesis 2b: Under conditions of high environmental hostility, firms will use more decentralized structures than under conditions of low environmental hostility.

Hypothesis 2c: Under conditions of high environmental hostility, firms will use less formalized structures than under conditions of low environmental hostility.

Hypothesis 2d: Under conditions of high environmental hostility, firms will use more integrated structures than under conditions of low environmental hostility.

Hypothesis 2e: Under conditions of high environmental hostility, firms will use narrower spans of control than under conditions of low environmental hostility.

Information technology has only recently been examined in the logistics literature. As indicated previously in Chapter Two, there is little guidance in the technology literature concerning information technology specifically. For the purposes of this research, information technology was defined rather broadly to encompass both logistics operating and planning systems in the manner used by Closs *et al.* (1997).

Hypothesis 3a: Under conditions of highly capable logistics information technology operating systems, firms will choose more externally-oriented logistics strategies (i.e., market and channel) than under conditions of less capable logistics information technology operating systems.

Hypothesis 3b: Under conditions of highly capable logistics information technology operating systems, firms will use decentralized structures than under conditions of less capable logistics information technology operating systems.

Hypothesis 3c: Under conditions of highly capable logistics information technology operating systems, firms will use more formalized structures than under conditions of less capable logistics information technology operating systems.

Hypothesis 3d: Under conditions of highly capable logistics information technology operating systems, firms will use more integrated structures than under conditions of less capable logistics information technology operating systems.

Hypothesis 3e: Under conditions of highly capable logistics information technology operating systems, firms will use broader spans of control than under conditions of less capable logistics information technology operating systems.

Hypothesis 3f: Under conditions of highly capable logistics information technology planning systems, firms will choose more externally-oriented logistics strategies (i.e., market and channel) than under conditions of less capable logistics information technology planning systems.

Hypothesis 3g: Under conditions of highly capable logistics information technology planning systems, firms will use more decentralized structures than under conditions of less capable logistics information technology planning systems.

Hypothesis 3h: Under conditions of highly capable logistics information technology planning systems, firms will use more formalized structures than under conditions of less capable logistics information technology planning systems.

Hypothesis 3i: Under conditions of highly capable logistics information technology planning systems, firms will use more integrated structures than under conditions of less capable logistics information technology planning systems.

Hypothesis 3j: Under conditions of highly capable logistics information technology planning systems, firms will use broader spans of control than under conditions of less capable logistics information technology planning systems.

In addition to the individual main effects of each contextual variable on strategy and structure, the interaction effects of an overall "context" effect were considered. This addressed the issue of whether fit between all of the contextual variables was the primary determinant of, respectively, strategy and structure (Venkatraman 1989).

Hypothesis 3k: With respect to strategy, there will be a significant interaction effect between the levels of environmental dynamism, environmental hostility, information technology operating systems, and information technology planning systems.

Hypothesis 3l: With respect to structure, there will be a significant interaction effect between the levels of environmental dynamism, environmental hostility, information technology operating systems, and information technology planning systems.

Indirect effects are studied within the ESSP paradigm. In the strategic management literature the focus is usually on the environment-strategy-performance fit while the organizational theory literature has a tendency to look at environment-structure-performance. The strategy, structure, and performance paradigm combines the two approaches. Environmental dynamism is again the most frequently used "environmental" variable. Mixed results have been obtained in previous research concerning its impact on performance via strategy. Environmental complexity has fallen from use due to the inability of earlier researchers to establish causal relationships. The two remaining contextual contingency variables, logistics

information technology operating and planning systems, have no precedent in this area.

Hypothesis 4a: Structure is a significant mediator of the environmental dynamism --> performance relationship.

Hypothesis 4b: Structure is a significant mediator of the environmental hostility --> performance relationship.

Hypothesis 4c: Structure is a significant mediator of the logistics information technology operating systems --> performance relationship.

Hypothesis 4d: Structure is a significant mediator of the logistics information technology planning systems --> performance relationship.

Hypothesis 4e: Strategy is a significant mediator of the environmental dynamism --> structure relationship.

Hypothesis 4f: Strategy is a significant mediator of the environmental hostility --> structure relationship.

Hypothesis 4g: Strategy is a significant mediator of the logistics information technology operating systems --> structure relationship.

Hypothesis 4h: Strategy is a significant mediator of the logistics information technology planning systems --> structure relationship.

Chow *et al.* conceptualized the strategy and structure relationship as reciprocal in nature. The discussion in Chapter Two indicated some support for this position (e.g., Hall and Saias 1980; Miller 1987) though many authors adhere to Chandler's (1962) position that structure follows strategy. It is generally agreed, however, that a fit between strategy and structure is indispensable to high levels of performance. The following hypotheses focused on the logistics strategy-logistics structure fit specifically as well as its overall performance. In addition, the contingent relationship whereby performance influenced strategy was considered (Ginsberg and Venkatraman 1985).

Hypothesis 5a: Externally-oriented logistics strategy (i.e., market or channel) is associated with less centralized structure than internally-oriented logistics strategy (i.e., process).

Hypothesis 5b: Externally-oriented logistics strategy (i.e., market or channel) is associated with less formalized structure than internally-oriented logistics strategy (i.e., process).

Hypothesis 5c: Externally-oriented logistics strategy (i.e., market or channel) is associated with more integrated structure than internally-oriented logistics strategy (i.e., process).

Hypothesis 5d: Externally-oriented logistics strategy (i.e., market or channel) is associated with broader spans of control structure than internally-oriented logistics strategy (i.e., process).

Hypothesis 5e: Under conditions of satisfactory performance, less strategic changes will occur than under conditions of unsatisfactory performance.

Finally, there was the question of a relationship between logistics strategy, structure and performance. Dalton *et al.* (1980) noted that there was little empirical support, particularly of a structure-performance association. Subsequent work in the logistics area has empirically supported the existence of such a relationship (Dröge and Germain 1989; Germain 1989).

Hypothesis 6a: Logistics structure, by itself, has no significant relationship to performance.

Hypothesis 6b: Logistics structure will be a significant mediator of the logistics strategy --> performance relationship.

METHODOLOGY OPERATIONALIZATION

This section describes how this dissertation's research methodology was conducted. The relevant unit of analysis is identified and described, the sample size and sample characteristics are discussed, and proposed data collection and analyses are reviewed.

UNIT OF ANALYSIS

For the purposes of this research, the unit of analysis was the firm's logistics operations. Encompassed in this unit of analysis was the firm's perceived view of the external logistics environment and its internal logistics planning, control, and measurement mechanisms. It was anticipated that examination of the environment and mechanisms would reveal the pattern of relationships within the strategy, structure, and performance framework.

SAMPLE SIZE AND CHARACTERISTICS

All firms involved in this research were drawn from the *World Class Logistics* research database. Specifically, the firms must have participated as a case study or been involved as a fax respondent completing relevant sections of the case study workbook. Additionally, only manufacturing and retailing firms were included in this analysis. As a result, the actual sample size for the main body of this analysis was forty-eight (48) case study firms and nine (9) fax respondents, an effective sample of fifty-seven (57) firms. This first sample was used to statistically test the *Logistics Contingency Model.*

The time-series section of this research contains a smaller sample. Due to original respondents changing or vacating positions, firm acquisitions, etc., only fifty (50) firms were eligible for the follow-up questionnaire associated with the time-series analysis. Of the fifty firms, usable responses were received from thirty-nine (39) companies.

This smaller sample was used to closely examine the hypothesized relationship of performance impacting strategy (Ginsberg and Venkatraman 1985). Participating firms were asked to complete a limited set of questions originally asked in the *World Class Logistics* workbook. This matched set of responses at different time intervals facilitated a time-series analysis, thereby allowing investigation of the dynamic nature of the *Logistics Contingency Model.*

Other than the aforementioned restriction limiting analysis to manufacturing and retailing firms, there were two other characteristics of note. First, all of the case study firms were identified by expert opinion as leading practitioners of logistics. Thus, they were not randomly chosen. Also, given that these firms were generally considered among the top ten percent logistics performers they were not representative of the general population. Additionally, the case study firms and fax respondents were all members of the Council of Logistics Management, presumably indicating a greater professional awareness and interest in logistics than a random sample of manufacturing and retailing firms. This potential bias was recognized. However, given the intent of the research - to identify whether certain relationships exist in logistics - one was more likely to find such relationships in highly motivated logistics organizations than in the general population.

The second characteristic was firm size. Although there was no explicit measure built into the research to control for firm size, a cursory review of the firms involved identified most of them as Fortune 500 firms. Therefore, they would be generally characterized as large firms.

Firms were drawn from numerous industries. There was no single dominant industry represented in this research. Previous research in logistics has routinely found that there was no discernible difference between firms from different industries in terms of their overall logistics practices and capabilities.

STATISTICAL ANALYSIS

The statistical analyses performed in this research were based on data gained from the original case study workbook and subsequent replication of a limited number of questions in a follow-up survey. The case study workbook was a twenty-four page document divided into seven sections: (1) Background, (2) Strategy, (3) Performance Competencies, (4) Organization, (5) Performance Measurement, (6) Information Technology, and (7) Alliances. It is reproduced in its entirety in Appendix I. This research drew upon all sections except for 'Alliances'. Specific questionnaire items are discussed in relationship to the results presented in Chapter Four.

The research questions and related hypotheses were presented earlier. These hypotheses were investigated using t-tests, chi-square, analysis of variance, and regression analysis. Regression analysis was used to test for the existence of significant mediational relationships between the variables and constructs. Given a mixture of new and established measures, $\alpha = .10$ was used to test for statistical significance.

RATIONALE OF OVERALL DESIGN

The overall design of this research was driven by two facts: (1) in the area of organizational science and strategic management, a considerable contingency-based strategy, structure, and performance literature exists, and (2) most of the literature is not based on task or function-based research.

The first fact permitted insights into the relationships conceptualized by the *Logistics Contingency Model.* By taking advantage of prior work, this research was able to generate hypotheses at an early stage. The *World Class Logistics* database contained a majority of the variables used in the framework. This permitted statistical analysis with the intent of evaluating the efficacy of transferring organizational science and corporate-level concepts to logistics research with a much more functional perspective. Previous work by Dröge, Germain, and Daugherty (1994) strongly suggested that this transferal would work.

It was fully expected that the statistical testing would lead to more questions than answers. Such was the expected result of this design. In that sense, this research served to both validate the logic of the general model and identify its strengths and weaknesses when applied to logistics.

CHAPTER FOUR - RESULTS

This chapter presents the research results. Discussion of the results is reserved for Chapter Five. Chapter Four is composed of the following sections: (1) assessment of construct unidimensionality and reliability; (2) evaluation of research questions and hypotheses; and (3) a brief summary of the results.

ASSESSMENT OF CONSTRUCT UNIDIMENSIONALITY AND RELIABILITY

A major focus of this research concerns the use of latent constructs in logistics research. A limited amount of logistics research has used latent constructs (e.g., Dröge and Germain 1989; Germain 1989, 1996; Germain, Dröge and Daugherty 1994). In this particular research the relationship of latent constructs and item indicators is illustrated in Figure 4.1. For the purposes of this research, the focus is on the secondary constructs (as indicated in Figure 4.1) and their associated items. To avoid confusion, unless otherwise noted, any reference to constructs throughout the remainder of this chapter means secondary constructs.

In order to use latent constructs in logistics research, it is necessary to establish the unidimensionality and reliability of such constructs. This section details the results of a multistep process used in the evaluation of this research's context and structure constructs.

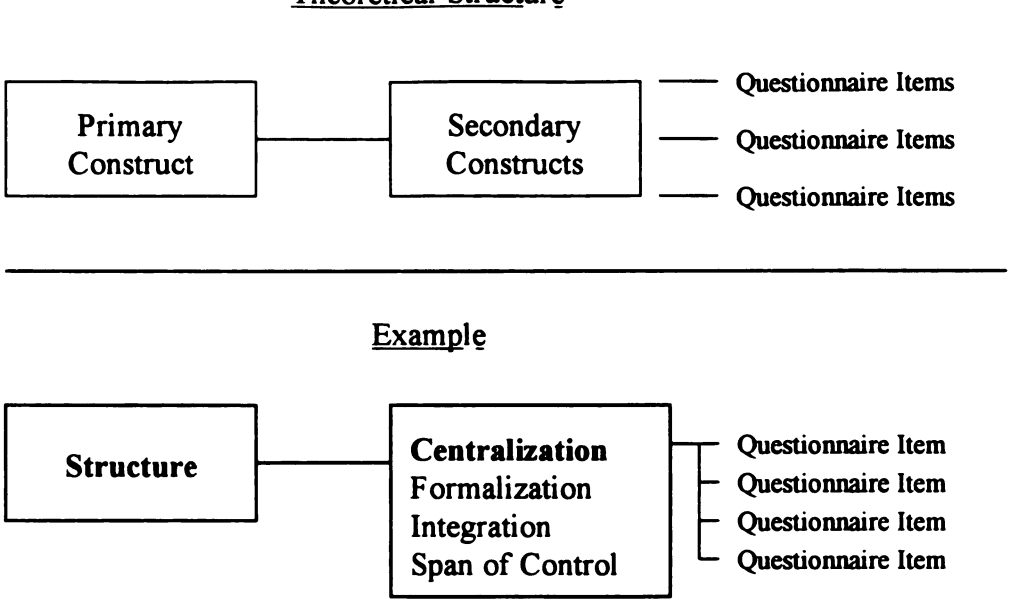

Figure 4.1
Construct Relationships

Following the guidelines of Gerbing and Anderson (1988), the various constructs were examined using a three-step procedure. First, exploratory factor analysis (EFA) was conducted. EFA is typically used to determine the underlying structure of data in exploratory phases of research. Although the organizational science and logistics literatures provide sufficient theoretical basis for some of this research's constructs, others are exploratory or relatively new to logistics applications. For consistency, EFA was used in this research to further substantiate existing theoretical constructs or to aid in the development of new constructs.

The second step in the Gerbing and Anderson paradigm calls for confirmatory factor analysis (CFA). This step allows for each item to be simultaneously evaluated, thereby directly addressing unidimensional and discriminant measurement. The third step, assessment of construct reliability, is determined through coefficient alpha (i.e.,

Cronbach's alpha). Results of the three-step procedure for each construct group are presented next.

CONTEXT

Environmental Dynamism and Environmental Hostility

As discussed in Chapter Two, environmental dynamism and environmental hostility are two related concepts that have been used extensively in organizational science research. Their usage in logistics research is limited (e.g., Kohn *et al.* 1990).Table 4.1 reproduces the "background" section of the workbook in which respondents answered questions concerning environmental factors. Several of the items (e.g., #1, #2, #3) have been frequently used to measure elements of environmental uncertainty. Therefore, it was anticipated that factors representing environmental dynamism and environmental hostility would emerge from a series of EFAs.

Using the common criteria of a .40 loading requirement, minimum eigenvalues of one, and examination of scree plots, successive EFAs were examined. The number of items was reduced to eight. Items 4, 5 and 10 were eliminated. Table 4.2 contains the results of the final EFA performed on the remaining eight items. Factor loadings greater than .40 are indicated in bold.

Table 4.1

Initial Items in EFA Analysis: Environmental Dynamism and Environmental Hostility

	Question	
Item	(Left Anchor) 1 2 3 4 5	(Right Anchor)
1	Minimal time, effort, resources and managerial attention are required to keep up with major competitors.	Much time, effort, resources and managerial attention are required to keep up with major competitors.
2	When decisions are made within my firm, competitor reaction or retaliation is not an important consideration.	When decisions are made within my firm, competitor reaction or retaliation is an important consideration.
3	Our major competitors are not particularly aggressive.	Our major competitors are fiercely aggressive.
4	Actions of competitors are easy to predict.	Actions of competitors are difficult to predict.
5	A minimal amount of time is spent analyzing major competitors' strategies and actions.	A great deal of time is spent analyzing major competitors' strategies and actions.
6	Our firm rarely changes marketing practices to keep up with competitors.	Our firm frequently changes its marketing practices to keep up with competitors.
7	Our firm must rarely change its logistics practices to keep up with competitors.	Our firm must change its logistics practices extremely frequently to keep up with competitors.
8	Supplier capabilities change at a very slow rate.	Supplier capabilities change at a very rapid rate.
9	The rate at which products/services are becoming obsolete in the industry is very slow.	The rate of product/service obsolescence in the industry is very high (e.g., some fashion goods).
10	Demand for logistics services is easy to forecast.	Demand for logistics services is difficult to forecast.
11	Production and/or service technology is stable and well established.	The modes of production and/or service change often and in a major way.

Table 4.2
Factor Loadings: Environmental Dynamism / Environmental Hostility

Item	Factor 1	Factor 2
3	**0.72546**	0.09191
1	**0.62977**	0.01975
2	**0.62960**	0.11730
8	-0.10729	**0.54826**
11	0.18382	**0.54826**
9	-0.04002	**0.50827**
7	0.26734	**0.50435**
6	0.25548	**0.48584**
Variance explained by each factor: Factor 1: 1.5029 Factor 2: 1.3377		
Rotation Method: Varimax		

Factor 1 represents environmental hostility. As discussed in Chapter Two, each of the three items comprising environmental hostility concerns the *level* of competition. Factor 2 represents the *amount and unpredictability of change* - commonly characterized as environmental dynamism. This EFA result is consistent with organizational science literature.

Information Technology Operating Systems and Information Technology Planning Systems

Information technology operating systems concern the day-to-day tasks performed within a logistics network, whereas the planning systems are concerned with forecasting and longer range management issues. Therefore, it was expected that the characteristics associated with each system would differ. The characteristics are detailed in Table 4.3.

Table 4.3
Information Technology Characteristics

Using the following scale, respondents rated the level of each characteristic in terms of their firm's logistics operating and planning systems. Low 1 2 3 4 5 High
(1) TIMELINESS
(2) ACCURACY
(3) AVAILABILITY
(4) EXCEPTION BASIS FORMATTED
(5) FORMATTED TO FACILITATE USAGE
(6) INFORMATION SHARING (Defined as willingness to share common information across functions within the firm.)
(7) FLEXIBILITY (Defined as ability to adapt processes and capabilities to specific customer segment requirements.)
(8) INTERNAL CONNECTIVITY (Defined as ability to effectively exchange information across managerial areas within our firm.)
(9) EXTERNAL CONNECTIVITY (Defined as ability to effectively exchange information with next destination customers and/or suppliers.)

Closs, Goldsby and Clinton (1997) have found that these characteristics explain different capabilities within logistics operating and planning systems. Building upon their findings, the nine characteristics were subjected to an EFA conducted simultaneously across both logistics operating systems and logistics planning systems (i.e., an initial total of eighteen items). A series of EFAs resulted in three factors, each meeting the criterion of a minimum eigenvalue of one. These factors are shown in Table 4.4. Factor loadings greater than .40 are indicated in bold.

The first factor is composed of information technology characteristics associated with logistics planning systems (LPS). Again, logistics planning systems within the

questionnaire were described as forecasting, inventory management and distribution requirements planning. As might be expected in a planning environment, Factor 1's associated characteristics facilitate the accurate and timely dissemination of planning reports in a manner or format which facilitates their usage. Additionally, the planning system appears to encourage sharing of this information beyond the boundaries of the responding firms (i.e., external connectivity). However, external connectivity also cross-loads on the third factor.

Factor 2 is represented by items from logistics operating systems (LOS). Flexibility of the information technology operating system is a key requirement if firms are to be responsive to immediate operating concerns and conditions. Similarly, having the information available and being able to exchange this information internally and externally are key items loading on Factor 2. From a shorter term operational perspective, the items contained in Factor 2 are logical. Again, it should be noted that external connectivity cross-loads on Factor 2.

As indicated by the preceding discussion, external connectivity cross-loaded on Factors 1 and 2. However, external connectivity of planning and operating systems were the only items loading at .40 or above on Factor 3. Given that the respective cross-loadings (i.e., 0.53894 on LPS; 0.55175 on LOS) were quite strong - and that these two items were the only items meeting the loading criterion on Factor 3 - a decision was made to proceed using only Factors 1 and 2. Clearly external connectivity was an important item. However, it was still captured in Factors 1 and 2 with no loss of information concerning any other variable in Factor 3.

Table 4.4
Factor Loadings: Logistics Operating Systems / Logistics Planning Systems

Item	Factor 1	Factor 2	Factor 3
Formatted for Usage (LPS)	**0.83829**	0.09795	0.14130
Information Sharing (LPS)	**0.77393**	0.23953	0.03968
Accuracy (LPS)	**0.76429**	0.01909	0.24020
Availability (LPS)	**0.74524**	0.34165	0.07845
Timeliness (LPS)	**0.73953**	0.25549	0.27967
External Connectivity (LPS)	**0.53894**	0.22186	**0.67819**
Flexibility (LOS)	0.17643	**0.74591**	0.03505
Internal Connectivity (LOS)	0.10864	**0.73446**	0.31598
Availability (LOS)	0.22142	**0.69216**	0.17473
External Connectivity (LOS)	0.14450	**0.55175**	**0.68120**
Variance explained by each factor: Factor 1: 3.3914 Factor 2: 2.1779 Factor 3: 1.2192			
Rotation Method: Varimax			

Based on these EFA results, there is tentative support for the four secondary constructs -- environmental dynamism, environmental hostility, logistics information technology operating systems, and logistics information technology planning systems. The next step in the process involved assessment via confirmatory factor analysis (CFA).

Within this research, CFA was designed to test the discriminant validity between the four secondary constructs as well as the unidimensionality of each secondary construct. The graphical representation of the overall context construct and the affiliated secondary constructs is provided in Figure 4.2.

Figure 4.2 is depicted in EQS nomenclature as that program was used to test the relationships. Parameter estimates for the model were calculated from the covariances of the eighteen indicator variables. The variances of the common factors (i.e., F1-F4) were fixed at 1.0, thereby standardizing the unit variance of the latent factors. The remaining paths were set free to be estimated. As noted by Bentler (1992) this is a common approach in CFA. The program was run using the generalized least squares (GLS) method using a sample of 46 cases. The corresponding indicators (i.e., V1-V18) were as follows:

V1: Much time, effort, resources and managerial attention are required to keep up with major competitors. (Right-hand anchor of 1-5 scale.)

V2: When decisions are made within my firm, competitor reaction or retaliation is an important consideration. (Right-hand anchor of 1-5 scale.)

V3: Our major competitors are fiercely aggressive. (Right-hand anchor of 1-5 scale.)

V4: Our firm frequently changes its marketing practices to keep up with competitors. (Right-hand anchor of 1-5 scale.)

V5: Our firm must change its logistics practices extremely frequently to keep up with competitors. (Right-hand anchor of 1-5 scale.)

V6: Supplier capabilities change at a rapid rate. (Right-hand anchor of 1-5 scale.)

V7: The rate of product/service obsolescence in the industry is very high. (Right-hand anchor of 1-5 scale.)

V8: The modes of production and/or service change often and in a major way. (Right-hand anchor of 1-5 scale.)

V9: Availability (LOS) - (Measured Low/High on 1 - 5 Scale)

V10: Flexibility (LOS) - (Measured Low/High on 1 - 5 Scale)

V11: Internal Connectivity (LOS) - (Measured Low/High on 1 - 5 Scale)

V12: External Connectivity (LOS) - (Measured Low/High on 1 - 5 Scale)

V13: Timeliness (LPS) - (Measured Low/High on 1 - 5 Scale)

V14: Accuracy (LPS) - (Measured Low/High on 1 - 5 Scale)

V15: Availability (LPS) - (Measured Low/High on 1 - 5 Scale)

V16: Formatted to Facilitate Usage (LPS) - (Measured Low/High on 1 - 5 Scale)

V17: Information Sharing (LPS) - (Measured Low/High on 1 - 5 Scale)

V18: External Connectivity (LPS) - (Measured Low/High on 1 - 5 Scale)

Complete results of this initial CFA analysis are presented in Appendix C. The results indicated that several variables should not be included in the secondary constructs. Based on these results, several revised models were tested, each dropping one individual indicator successively. Indicators V2, V9 and V12 were ultimately deleted from the original overall context construct. As a check, several other variables that appeared troublesome in the initial model were dropped. However, their exclusion negatively affected the subsequent results. The resulting overall context construct is presented in Figure 4.3. Table 4.4 provides detailed results from the revised context construct model.

No convergence problems existed in the revised context model. It converged in thirty iterations, yielding the best fitting measurement equations for the model. The average off-diagonal standardized residual was an acceptable 0.0880. A plot (not shown) of the standardized residuals graphically provides evidence of a reasonably symmetrical distribution. As indicated in Table 4.4, the major fit indices (i.e., chi-square, normed fit index, etc.) are well above acceptable thresholds. These characteristics, in conjunction with the other results presented in Table 4.4, provide ample support for the revised context construct.

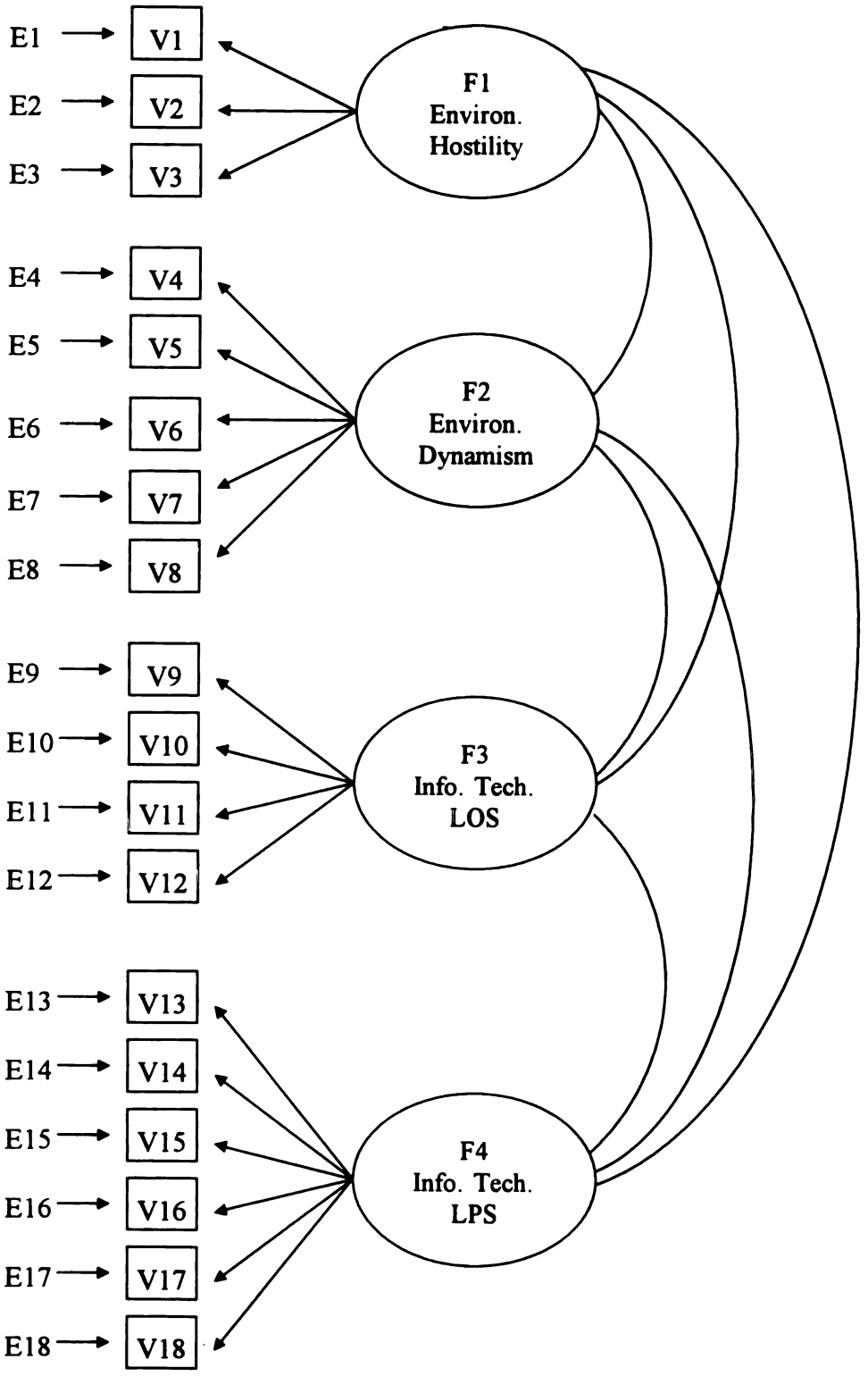

Figure 4.2
Confirmatory Factor Analysis: Initial Context Construct

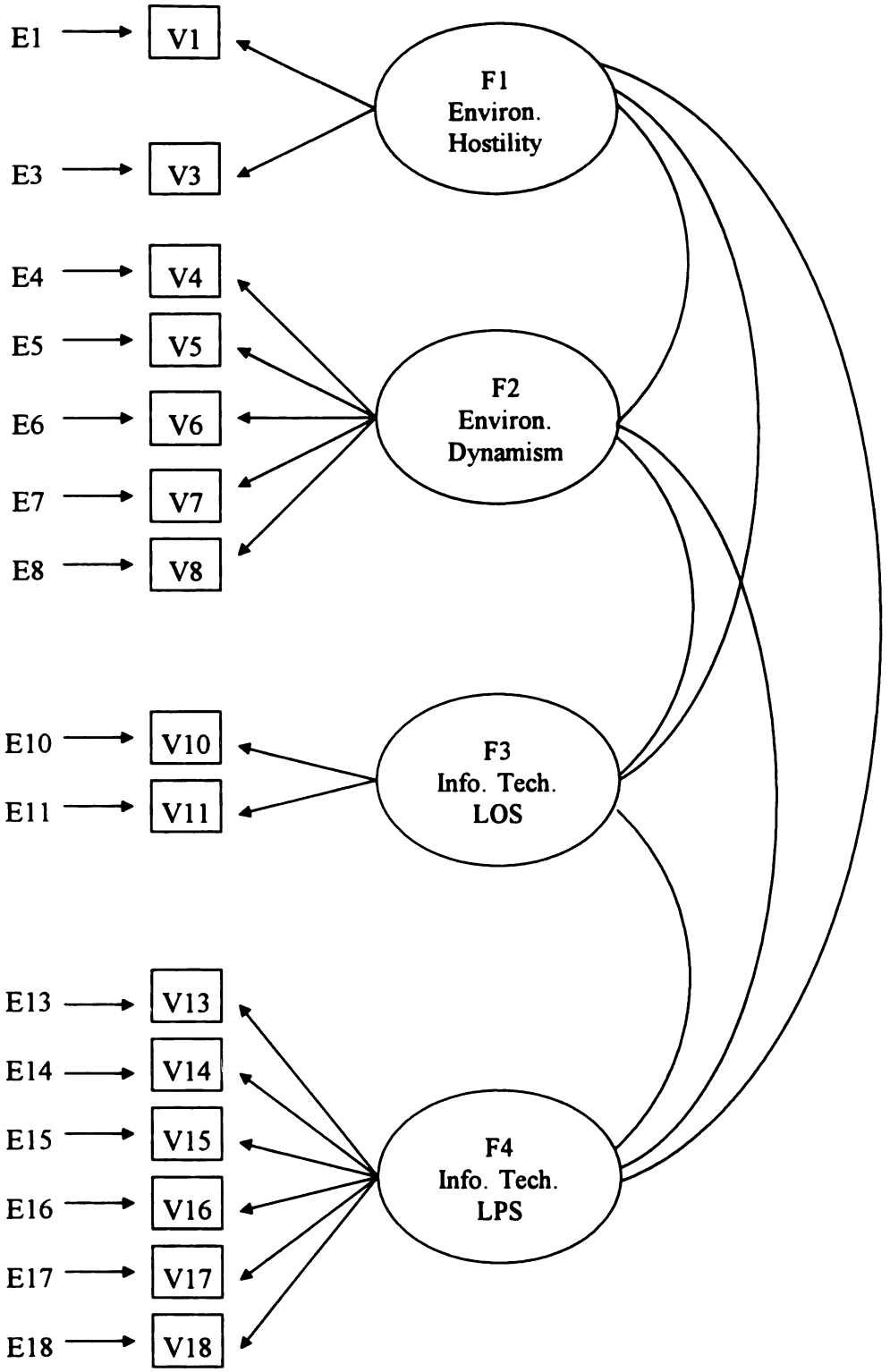

Figure 4.3
Confirmatory Factor Analysis: Revised Context Construct

Table 4.5
Results of Revised Context Construct Model

CONSTRUCT LOADINGS (*t* values)	
Environmental Hostility	
V1	.538
	(4.447)
V3	.579
	(5.363)
Environmental Dynamism	
V4	.602
	(3.987)
V5	.496
	(3.049)
V6	.333
	(2.874)
V7	.292
	(2.003)
V8	.318
	(2.190)
Information Technology LOS	
V10	.475
	(2.818)
V11	.569
	(3.194)
Information Technology LPS	
V13	.976
	(8.032)
V14	.813
	(5.446)
V15	.932
	(6.339)
V16	.824
	(6.792)
V17	.808
	(6.225)
V18	.900
	(5.921)

GOODNESS-OF-FIT MEASURES	
Chi-square (χ^2)	76.12
Degrees of Freedom	84
Significance Level	0.71
Bentler-Bonett Normed Fit Index (NFI)	0.982
Bentler Bonett Nonnormed Fit Index (NNFI)	1.002
Comparative Fit Index	1.000

Table 4.5 (continued)
Results of Revised Context Construct Model

Standardized Residual Matrix

	V1	V3	V4	V5	V6	V7	V8	V10	V11
V1	0.290								
V3	0.120	0.135							
V4	-0.201	-0.120	0.373						
V5	0.035	-0.067	0.134	0.367					
V6	-0.219	-0.167	0.090	0.078	0.584				
V7	-0.038	-0.118	-0.016	0.196	0.207	0.325			
V8	-0.118	-0.055	0.065	0.175	0.173	0.316	0.338		
V10	-0.006	-0.069	0.149	0.181	-0.081	-0.030	0.133	0.445	
V11	0.082	-0.037	0.051	0.016	-0.070	-0.165	-0.058	0.359	0.465
V13	0.009	-0.014	-0.043	-0.014	0.249	-0.082	-0.014	-0.031	0.057
V14	0.022	0.097	-0.016	-0.062	0.024	-0.028	0.005	-0.151	-0.107
V15	-0.106	-0.001	0.014	-0.048	-0.061	-0.139	-0.093	0.089	0.133
V16	0.044	0.053	0.013	-0.006	-0.083	-0.123	-0.072	-0.174	-0.115
V17	-0.005	0.036	-0.126	-0.268	-0.063	-0.143	-0.140	-0.113	-0.106
V18	-0.217	-0.126	0.305	0.143	0.197	0.018	0.155	0.024	-0.009

	V13	V14	V15	V16	V17	V18
V13	0.212					
V14	0.008	0.077				
V15	-0.083	-0.006	0.223			
V16	0.001	0.042	-0.006	0.127		
V17	0.003	0.034	0.068	0.009	0.192	
V18	0.015	0.034	0.027	0.016	-0.113	0.292

The revised model provides support for both the unidimensionality and discriminatory value of the four constructs. Each construct is considered distinct for the purposes of further evaluation within this research. Of course, it should be noted that two of the secondary constructs are now measured by only two items.

Table 4.6
Reliability Estimates: Context's Secondary Constructs

Environmental Hostility
Standardized Cronbach's Alpha: .75

Environmental Dynamism
Standardized Cronbach's Alpha: .68

	Correlation With Total
V4	0.3928
V5	0.4627
V6	0.4321
V7	0.4528
V8	0.4708

Information Technology - Logistics Operating Systems
Standardized Cronbach's Alpha: .74

Information Technology - Logistics Planning Systems
Standardized Cronbach's Alpha: .91

	Correlation With Total
V13	0.8141
V14	0.6954
V15	0.7195
V16	0.7788
V17	0.7515
V18	0.7193

Finally, the revised secondary context constructs were evaluated for reliability. The Cronbach's alpha and item-to-total correlations (where applicable) are provided in Table 4.5. With the exception of environmental dynamism (.68), the other reliability measures are well in excess of the generally accepted .70 threshold.

The overall results of the exploratory factor analysis, confirmatory factor analysis and reliability estimates provide strong support for the revised context construct. Therefore, it is reasonable to proceed using an overall context variable composed of environmental hostility, environmental dynamism, information technology logistics operating systems, and information technology logistics planning systems. For the remainder of this document any reference to context assumes the revised measure.

STRUCTURE

The four secondary constructs used in the overall structure construct are span of control, integration, formalization, and centralization. As discussed in Chapter 2, each of these secondary constructs has been used extensively in organizational science literature and to varying degrees in logistics research.

Span of Control

Span of control is a single item measure in this research. Respondents were asked: "How many individuals report directly to each of the following executives (do not include secretaries or assistants)?" The list of executives included: (1) chief executive of the business unit; (2) senior manufacturing executive; (3) senior distribution/logistics executive; and (4) senior sales (or marketing) executive. Only the responses concerning the number of individuals under the senior distribution/logistics

executive are used. Previous research has used summated scales based on responses to each category of executive (e.g., Germain, Dröge, and Daugherty 1994). That approach is not used in this research as the focus is limited to logistics organization and does not deal with questions of a broader scope.

Similarly, levels within a firm are often closely linked with span of control. However, levels are more appropriately considered part of complexity. For that reason, even though the information was available, it was not used in this research.

Integration

A number of questions concerning teaming and cross job coordination were asked in the mail survey. The same or similar questions and/or scales have previously been used in logistics research (Germain, Dröge, and Daugherty 1994). Their results indicated two operational measures of integration: (1) integrative committees, and (2) integrative mechanisms. This set of questions was factor analyzed. A series of EFAs resulted in a two factor model. The individual items and their respective scales are presented in Table 4.7. The final rotated EFA is presented in Table 4.8.

It must be noted, however, that in this case the second factor did not meet the minimum eigenvalue requirement. In fact, its eigenvalue of 0.45 is well below the generally accepted cutoff of 1.0. However, it was decided to retain the second factor based on the following: (1) the scree test (not shown) suggests the factor should be retained; (2) the items composing the second factor have been previously used in logistics research; and (3) the subsequent CFA would provide a further test of the factor's suitability.

Table 4.7
Underlying Indicators of Integration Construct

Item 1 In my firm, interdepartmental committees are set up to allow departments to engage in joint decision-making. Scale Strongly Disagree 1 2 3 4 5 Strongly Agree
Item 2 In my firm, task forces or temporary groups are set up to facilitate interdepartmental collaboration on a specific project. Scale Strongly Disagree 1 2 3 4 5 Strongly Agree
Item 3 In my firm, liaison personnel exist whose specific job it is to coordinate the efforts of several departments for purposes of a project. Scale Strongly Disagree 1 2 3 4 5 Strongly Agree
Item 4 In my firm, cross-functional teams make decisions concerning distribution or logistics strategy. Scale Strongly Disagree 1 2 3 4 5 Strongly Agree
Item 5 In my firm, cross-functional teams make decisions concerning marketing or sales strategy. Scale Strongly Disagree 1 2 3 4 5 Strongly Agree

Consistent with the work of Germain, Dröge, and Daugherty (1994), the first factor represents items relating to project or committee groups and the second factor represents cross-functional team activity and strategic decision-making. However, a smaller number of measures emerge in this research. Unlike Germain *et al.* this

research includes both manufacturers and retailers. Retailers did not answer two of the possible questions in the overall set. For that reason, those questions were not considered as a manufacturer/retailer-consistent construct was desired.

Table 4.8
EFA of Integration Construct

	Factor 1	Factor 2
Item 1	**0.69650**	0.09207
Item 2	**0.56494**	0.23193
Item 3	**0.45693**	0.26982
Item 4	0.16727	**0.64454**
Item 5	0.19796	**0.61596**
Variance explained by each factor: Factor 1: 1.0802 Factor 2: 0.9299		
Rotation Method: Varimax		

It appears that the distinguishing feature of the two factors is temporal duration. The first factor implies integrative mechanisms that come together periodically as a group, then return to their respective tasks. The second factor suggests a team that is together on a daily basis, continually working as a group to foster integrative processes. In order to fully investigate this subtle difference, a CFA was conducted. The CFA model is presented in Figure 4.4.

As was the case with the context CFA, the proposed integration construct was examined using EQS. V1 through V5 correspond to Items 1-5 shown in Table 4.8. Factor 1 represents the short duration committee or project groups whereas Factor 2 represents the integrated teams working together on a daily basis.

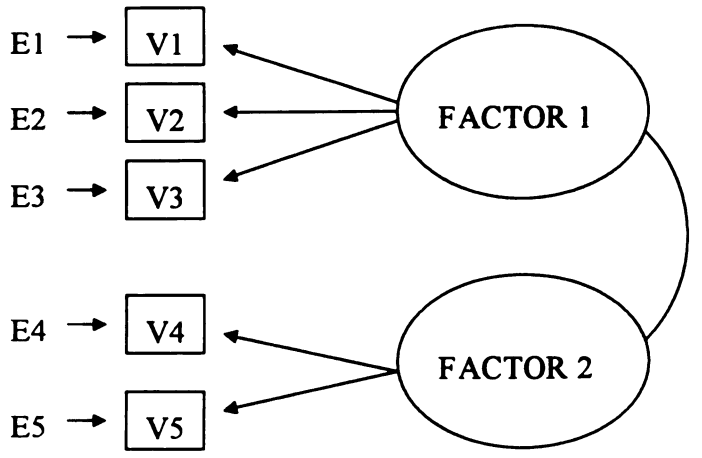

Figure 4.4
Confirmatory Factor Analysis: Integration Construct

The results of the integration construct CFA are presented in Table 4.9. As indicated in Table 4.9, the major fit indices (i.e., chi-square, normed fit index, etc.) are well above acceptable thresholds. The factor loadings for each equation are significant.

No convergence problems existed in the model. It converged in twenty iterations with no appreciable improvement after seventeen iterations. The average off-diagonal standardized residual was an acceptable 0.0812. The standardized residual matrix in Table 4.9 indicates that the individual residuals are reasonably small. A plot (not shown) of the standardized residuals graphically provides evidence of a slightly leftward skewed distribution. These characteristics, in conjunction with the results presented in Table 4.9, provide ample support for the two dimensional integration construct.

Table 4.9
Results of Integration Construct Model

CONSTRUCT LOADINGS (*t* values)

Factor 1	
V1	.884
	(4.536)
V2	.549
	(3.939)
V3	.683
	(3.281)
Factor 2	
V4	.649
	(3.057)
V5	.800
	(3.297)

GOODNESS-OF-FIT MEASURES

Chi-square (χ^2)	6.976
Degrees of Freedom	4
Significance Level	0.137
Bentler-Bonett Normed Fit Index (NFI)	0.979
Bentler-Bonett Nonnormed Fit Index (NNFI)	0.977
Comparative Fit Index	0.991

Standardized Residual Matrix

	V1	V2	V3	V4	V5
V1	0.033				
V2	-0.011	0.057			
V3	-0.007	-0.107	0.105		
V4	-0.119	0.056	0.167	0.166	
V5	-0.091	0.096	0.053	0.106	0.085

Cronbach's alpha was calculated for both integration factors. Factor 1 had a reliability estimate of .64. Factor 2 had a reliability estimate of .69. Although these levels were above Nunnally's (1967) acceptable range of .50 - .60 for exploratory measures the measures cannot be considered entirely exploratory. They were quite new in logistics research but have been used in organizational science research. If judged by the more stringent .70 level commonly used for established measures, the reliability

of these integration factors would be considered somewhat marginal.

Formalization

Seven binary (i.e., yes/no) measures were used to measure formalization. Respondents were asked if logistics had a separate mission statement. Additionally, respondents were asked to identify if their firm had a formal benchmarking initiative in each of the following six areas: (1) asset management; (2) logistics cost; (3) productivity; (4) customer service (i.e., internal measures); (5) logistics quality; and (6) customer expectations concerning customer service (i.e., external measures). Each response was assigned a value of either zero for "no" or one for "yes."

The summated scale was then treated as a continuous scale with a range of zero to seven. Higher summed totals represented higher levels of formalization. The reliability of this summated scale was evaluated using the Kuder-Richardson 20 (KR-20) test of internal consistency. The summated formalization measure had a KR 20 score of .74 (Calculations are provided in Appendix D). KR 20 scores in excess of .50 are generally considered indicative of reliable measures (Kaplan and Saccuzzo 1989).

Centralization

Centralization is typically described as the vertical locus of decision-making authority. As briefly described in Chapter Two, the organizational science literature generally equates centralization with concentrated decision-making authority (i.e., authority residing with one or few people in an organization). Closely related to this concept is the idea that if decision-making is made at corporate headquarters, then the organization is centralized. If decision-making authority is diffused to field locations, then the organization is considered decentralized.

Within the logistics literature, the usage of centralization is not as clear-cut. Germain (1989), in his study of product standardization and logistics, used line responsibility to represent centralization: "The sum out of 15 (line responsibility only) reporting to logistics was assumed to represent the extent to which logistics activities were centrally consolidated within a single department (p. 24)." This presents a problem. If a firm were considered centralized on the basis of "presence" of responsibility but that responsibility was for the most part at the staff level (i.e., not centralized according to Germain's (1989) usage), is the firm's logistics centralized or decentralized? Organizational science researchers would likely argue that if line personnel control the responsibility then decentralization exists. If, however, staff are in a position of responsibility and decision-making, then centralization results.

For the purposes of this research, the question of centralization was handled in the following manner: Consolidation of an activity in a single department was considered centralization. No differentiation was made based on line or staff responsibility. The rationale was that once an activity was positioned under the jurisdiction of a single logistics department, fewer people *overall* throughout the entire organization would have decision-making authority over the activity.

Within the questionnaire, respondents were asked to indicate whether a number of activities (Table 4.10) were part of the formal responsibility of logistics. Respondents were asked to indicate the number of years each activity had been under logistics control. If the activity was not part of the formal responsibility of logistics, respondents were instructed to indicate zero years.

Consequently, these responses were recoded as "0 / 1." A zero represented that the activity was not part of logistics' responsibility. A one indicated that the activity was under logistics' control - irrespective of the number of years. The sixteen measures were then summed. Given the binary "0 / 1" scoring pattern, the summated scale could range from 0 to 16. Again, a KR 20 test was used to assess the measure's reliability. The overall KR 20 score for the sixteen items was .88. This was above acceptable limits.

Table 4.10
Activities Under Logistics Responsibility

Sales Forecasting
Sourcing/Purchasing
Inbound Transportation
Finished Goods Inventory Management
Intra-Company Transportation
Finished Goods Warehousing
Order Processing
Customer Service
Outbound Transportation
Logistics Systems Planning
Facilities Design
Materials Handling
Logistics Administration
International Logistics
Capital Equipment Procurement
Data Processing for Distribution Apps.

STRATEGY

The Bowersox-Daugherty logistic strategy typology (1987) is used in this research to operationalize strategy. Clinton and Closs (1997) have investigated the validity of the typology using data from an earlier phase of this research. Their findings support the typology and identify the underlying elements of each strategy (i.e., process, market and channel). Additionally, their work involved a much broader sample of American and Canadian firms than the present subset. Based on their findings, no further construct validation is performed within this research framework. The definitions are repeated in Table 4.11.

Table 4.11
Process / Market / Channel Definitions

Process strategy is concerned with managing a broad group of logistics activities as a value-added chain. Emphasis is on achieving efficiency from managing purchasing, manufacturing, scheduling and physical distribution as an integrated system.
Market strategy is concerned with managing a limited group of logistics activities for a multidivision single business unit or across multiple business units. The logistics organization seeks to make joint product shipments to common customers for different product groups and seeks to facilitate sales and logistical coordination by a single-order invoice.
Channel strategy is concerned with managing logistics activities performed jointly with dealers and distributors. The strategic orientation places a great deal of attention on external control. Significant amounts of finished inventories are typically maintained forward or downstream in the distribution channel.

Source: Bowersox *et al.* (1989) *Leading Edge Logistics: Competitive Positioning for the 1990s*, Oak Brook, IL: Council of Logistics Management.

PERFORMANCE

In the survey instrument, respondents were asked a series of questions concerning thirty-two (32) performance measures (Appendix 1 - Section Three - Relative Performance Competencies). Respondents provided perceptual measures of importance (Least Important = 1; Most Important = 5) and performance (Worse than Competitors = 1; Better than Competitors = 5). Based on previous studies and case study responses, eight measures were selected to represent the performance construct. These measures are shown in Table 4.12.

Table 4.12
Indicators of Performance / Importance

PERFORMANCE COMPETENCY	MEAN
Advanced Shipment Notification	3.73
Delivery Dependability	4.75
Delivery Speed	4.15
Delivery Time Flexibility	4.19
Low Logistics Cost	4.17
Order Fill Capacity	4.65
Order Flexibility	3.67
Responsiveness to Key Customers	4.45

As indicated by the mean scores in Table 4.14, each performance competency is considered to be important. In fact, delivery dependability, order fill capacity and responsiveness to key customers were rated the three most important performance competencies of the thirty-two original measures. The overall reliability of this performance construct is .62. As this construct is somewhat exploratory this reliability is acceptable. The summated score of the eight measures is used in all of the statistical

analyzes that follow.

SUMMARY OF PRIMARY AND SECONDARY CONSTRUCTS

The preceding section of Chapter 4 has critically examined and explained the primary and secondary constructs detailed in the *Logistics Contingency Model*. It has been demonstrated that the constructs are acceptable in terms of empirical research. Using these constructs, the remainder of this chapter is devoted to results pertaining to the research questions and the associated research hypotheses.

EVALUATION OF RESEARCH QUESTIONS AND HYPOTHESES

This research addressed fifteen research questions. In most cases there are multiple research hypotheses attached to each question. The following section presents the statistical approach and results pertaining to each research hypothesis.

ENVIRONMENTAL DYNAMISM

Environmental dynamism was evaluated on a summated scale as discussed earlier. The sum was then divided by the number of items to return to a 1 - 5 scale with the right-hand anchor representing higher levels of dynamism. The mean summated response for environmental dynamism was 3.21, indicating a slightly dynamic average environment. Two groups were created from this continuous variable. Respondents answering at the mean or below were considered to be experiencing comparatively low levels of environmental dynamism. Respondents indicating a response above the mean of 3.21 were considered to be experiencing high levels of environmental dynamism. This two group categorical variable was then used

in the statistical analysis of environmental dynamism and strategy and structure.

> *Hypothesis 1a: Under conditions of high environmental dynamism, firms will choose more externally-oriented logistics strategies (i.e., market or channel) than under conditions of low environmental dynamism.*

Due to small sample sizes, market and channel strategies were combined into one group representing external-oriented logistics strategies. Therefore, the two levels of environmental dynamism were examined in terms of process (i.e., internally-oriented) and externally-oriented strategies. Given the presence of two categorical variables, the categorical ANOVA program (CATMOD) in SAS was used in this analysis. Table 4.13 displays the results.

Table 4.13
Categorical ANOVA: Environmental Dynamism and Strategy

Response Levels: 2
Populations: 2
N=52
Prob: 0.4910

Table 4.13 indicates that the result was not significant and that H1(a) was not supported. It had been expected that higher levels of environmental dynamism would encourage firms to gravitate to externally-oriented strategies. Such strategies and their associated information exchange would - theoretically - counteract the uncertainty created by the dynamic environment.

A one-tailed *t* test was used as a cross-check. Using strategy as the categorical variable, an uncategorized environmental dynamism was examined. As with the

CATMOD procedure, the results were not statistically significant ($p > .20$). Process firms reported a mean level of environmental dynamism of 3.26 and externally-oriented firms reported a mean of 3.10.

> *Hypothesis 1b: Under conditions of high environmental dynamism, firms will use more decentralized structures than under conditions of low environmental dynamism.*

A one-tailed *t* test ($\alpha = .10$) was performed comparing the two levels of environmental dynamism to firms' levels of centralization. The results are shown in Table 4.14. The summated centralization scale was arranged in such a manner that a higher mean score represented greater centralization of activities in the logistics department.

Table 4.14
T-Test: Influence of Environmental Dynamism (E.D.) on Centralization

	CENTRALIZATION				
	N	Mean	STD	*t*	P
LOW E.D.	31	10.58	4.08	0.07	.47
HIGH E.D.	26	10.50	4.41	0.07	.47

The results were not significant. Respondents in the low environmental dynamism group reported, on average, 10.58 activities out of sixteen (16) being consolidated in the logistics department. The mean was 10.50 for respondents operating under conditions of a high environmental dynamism. Consequently, H1(b) was not supported.

Hypothesis 1c: Under conditions of high environmental dynamism, firms will use less formalized structures than under conditions of low environmental dynamism.

A one-tailed *t* test (α = .10) was performed comparing the two levels of environmental dynamism to firms' levels of formalization. The results are shown in Table 4.15. The summated formalization scale was arranged in such a manner that a higher mean score represented greater formalization

Table 4.15
T-Test: Influence of Environmental Dynamism (E.D.) on Formalization

	FORMALIZATION				
	N	Mean	STD	*t*	P
LOW E.D.	30	2.87	1.87	-1.46	.07
HIGH E.D.	25	3.72	2.35	-1.50	.07

As indicated in Table 4.15, the influence of environmental dynamism on formalization was not supported as the difference was opposite the hypothesized direction. Although this was initially surprising, there is a plausible explanation. There is an emerging thought that greater levels of logistics formalization lead to greater levels of logistics flexibility. Flexibility, in turn, leads to more logistically responsive firms. Therefore, given this sample of generally above-average logistics performers, it is plausible that this result is not surprising and may merit further investigation. Perhaps in their quest for flexibility, more competent logistics performers choose formalization regardless of the dynamic environmental state. In any event, H1(c) was not supported.

Hypothesis 1d: Under conditions of high environmental dynamism, firms will use more integrated structures than under conditions of low environmental dynamism.

A one-tailed *t* test (α = .10) was performed comparing the two levels of environmental dynamism to firms' levels of integration. The results are shown in Table 4.16. The summated integration scale was arranged in such a manner that a higher mean score represented greater integration.

Table 4.16
T-Test: Influence of Environmental Dynamism (E.D.) on Integration

	N	Mean	STD	*t*	P
INTEGRATION (Committees)					
LOW E.D.	29	3.52	0.73	-1.36	.09
HIGH E.D.	23	3.86	0.95	-1.40	.08
INTEGRATION (Cross-functional)					
LOW E.D.	28	3.32	0.98	-0.89	.19
HIGH E.D.	23	3.56	0.96	-0.89	.19

As indicated in Table 4.16, the influence of environmental dynamism on the two dimensions of integration was mixed. Integration through committees was significantly different whereas cross-functional integration was not. Under conditions of high environmental dynamism, firms were significantly more likely to use committees as an integrative mechanism. In contrast, firms operating under high levels of environmental dynamism report, on average, a cross-functional integration mean of 3.56. Firms in less dynamic environments report a mean of 3.32 for cross-functional integration. Thus, H1(d) is partially supported.

Hypothesis 1e: Under conditions of high environmental dynamism, firms will use narrower spans of control than under conditions of low environmental dynamism.

A one-tailed *t* test (α = .10) was performed comparing the two levels of environmental dynamism to firms' spans of control. The results are shown in Table 4.17. For span of control, respondents were simply asked to indicate the number of people under their control. Higher mean scores represented a wider span of control.

Table 4.17
T-Test: Influence of Environmental Dynamism (E.D.) on Span of Control

	SPAN OF CONTROL				
	N	Mean	STD	*t*	P
LOW E.D.	25	6.40	2.68	0.06	.48
HIGH E.D.	20	6.35	2.74	0.06	.48

As indicated in Table 4.17, the influence of environmental dynamism on span of control was non-significant and H1(e) was not supported. This result may reflect the impact of information technology and downsizing in American industry. Span of control may be independent of environmental forces due to the monitoring and coordinating ability of information technology linkages. Additionally, perhaps the stripping away of layers in organizations is forcing span of control to increase regardless of the environmental state, thereby lessening the differences that may have appeared in the past.

ENVIRONMENTAL HOSTILITY

Environmental hostility was evaluated on a summated scale as discussed earlier. The sum was then divided by the number of items to return to a 1 - 5 scale with the right-hand anchor representing higher levels of hostility. Respondents answering at the mean or below were considered to be experiencing comparatively low levels of environmental hostility. Respondents indicating a response above the mean of 4.28 were considered to be experiencing high levels of environmental hostility. This two group categorical variable was then used in the statistical analysis of environmental hostility and strategy and structure.

> *Hypothesis 2a: Under conditions of high environmental hostility, firms will choose more externally-oriented logistics strategies (i.e., market and channel) than under conditions of low environmental hostility.*

As was the case with environmental dynamism and strategy, the relationship between environmental hostility and strategy was examined through categorical ANOVA (CATMOD). The categories are the two levels of environmental hostility and two levels of strategy (i.e., process versus externally-oriented). Results are shown in Table 4.18.

Table 4.18
Categorical ANOVA: Environmental Hostility and Strategy

Response Levels: 2
Populations: 2
N=52
Prob: 0.2209

Table 4.18 indicates that the result was not significant and that H2(a) was not supported. As mentioned earlier, it had been expected that higher levels of environmental hostility would encourage firms to gravitate to externally-oriented strategies in order to reduce uncertainty created by the hostile environment. The greater level of communication and cooperation of externally-oriented strategies was expected to serve as a counterbalance to the uncertainties in the environment.

A one-tailed *t* test was used as a cross-check. Using strategy as the categorical variable, an uncategorized environmental hostility was examined. As with the CATMOD procedure, the results were not statistically significant ($p > .32$). Process firms reported a mean level of environmental dynamism of 4.28 and externally-oriented firms reported a mean of 4.36.

> *Hypothesis 2b: Under conditions of high environmental hostility, firms will use more decentralized structures than under conditions of low environmental hostility.*

A one-tailed *t* test ($\alpha = .10$) was performed comparing the two levels of environmental hostility to firms' levels of centralization. The results are shown in Table 4.19. The summated centralization scale was arranged in such a manner that a higher mean score represented greater centralization of activities in the logistics department.

Table 4.19
T-Test: Influence of Environmental Hostility (E.H.) on Centralization

	CENTRALIZATION				
	N	Mean	STD	*t*	P
LOW E.H.	25	10.12	5.08	-0.64	.26
HIGH E.H.	32	10.86	3.41	-0.67	.25

The results in Table 4.19 indicate that there was not a significant difference between the low environmental hostility and high environmental hostility groups. The former reported an average of 10.12 activities under the responsibility of logistics whereas the latter reported a mean of 10.86 activities. Consequently, H2(b) was not supported.

Hypothesis 2c: Under conditions of high environmental hostility, firms will use less formalized structures than under conditions of low environmental hostility.

A one-tailed *t* test (α = .10) was performed comparing the two levels of environmental hostility to firms' levels of formalization. The results are shown in Table 4.20.

Table 4.20
T-Test: Influence of Environmental Hostility (E.H.) on Formalization

	FORMALIZATION				
	N	Mean	STD	*t*	P
LOW E.H.	23	2.74	2.16	-1.53	.07
HIGH E.H.	32	3.63	2.06	-1.54	.06

As indicated in Table 4.20, the influence of environmental hostility on formalization was not supported. Similar to the environmental dynamism/formalization outcome, the results are opposite the hypothesis. Firms indicating high levels of environmental hostility reported a mean of 3.63 for formalization. Firms in less hostile situations reported a mean of 2.74. The same potential explanation holds true: It is possible that formalization is so important to flexibility - and flexibility so important in dynamic and hostile environments - that contrary to the long-established organizational science view, formalization may be more relevant to adverse logistics environments rather than the opposite. In any event, H2(c) was not supported.

> *Hypothesis 2d: Under conditions of high environmental hostility, firms will use more integrated structures than under conditions of low environmental hostility.*

A one-tailed *t* test ($\alpha = .10$) was performed comparing the two levels of environmental hostility to firms' levels of integration. The results are shown in Table 4.21. The two dimensional integration construct was arranged in such a manner that a higher mean score represented greater integration.

As indicated in Table 4.21, the influence of environmental hostility on the two dimensions of integration was not significant. Within the high environmental hostility group, the mean use of integrative committees was 3.77. The low environmental hostility group reported a mean of 3.52 for usage of integrative committees. Both groups reported less usage of cross-functional integration, with a mean of 3.42 for high environmental dynamism and 3.45 for low environmental dynamism. H2(d) was not supported.

Table 4.21
T-Test: Influence of Environmental Hostility (E.H.) on Integration

	INTEGRATION (Committees)				
	N	Mean	STD	*t*	P
LOW E.H.	21	3.52	0.76	-1.08	.14
HIGH E.H.	31	3.77	0.89	-1.05	.15
	INTEGRATION (Cross-functional)				
LOW E.H.	20	3.45	1.02	0.11	.46
HIGH E.H.	31	3.42	0.95	0.11	.46

Hypothesis 2e: Under conditions of high environmental hostility, firms will use narrower spans of control than under conditions of low environmental hostility.

A one-tailed *t* test (α = .10) was performed comparing the two levels of environmental dynamism to firms' spans of control. The results are shown in Table 4.22. For span of control, respondents were simply asked to indicate the number of people under their control. Higher mean scores represented a wider span of control.

Table 4.22
T-Test: Influence of Environmental Hostility (E.H.) on Span of Control

	SPAN OF CONTROL				
	N	Mean	STD	*t*	P
LOW E.H.	16	5.81	1.42	-1.28	.10
HIGH E.H.	29	6.69	3.14	-1.05	.15

As indicated in Table 4.22, the influence of environmental hostility on span of control was not significant and H2(e) was not supported. Respondents facing a more

hostile environment reported a mean of 6.69 employees under the senior logistics executive's control. Respondents operating in a less hostile environment reported, on average, 5.81 employees under the senior logistics executive's control.

LOGISTICS INFORMATION TECHNOLOGY: OPERATING AND PLANNING SYSTEMS

Logistics information technology was evaluated in terms of operating and planning systems. Both constructs represent a summated scale as discussed earlier. The sum was then divided by the number of items to return to a 1 - 5 scale with the right-hand anchor representing greater capability. Respondents answering at the mean or below were considered to have less capable systems. For operating systems, respondents indicating a response above the mean of 3.41 were considered to have highly capable operating systems whereas respondents at or below this mean were considered to have less capable operating systems. Similarly, for planning systems the dividing point was a mean of 3.06. These two group categorical variables were then used in the statistical analysis of logistics information technology and strategy and structure. Operating systems results are presented first, followed by planning systems results.

> *Hypothesis 3a: Under conditions of highly capable logistics information technology operating systems, firms will choose more externally-oriented logistics strategies (i.e., market and channel) than under conditions of less capable logistics information technology operating systems.*

Consistent with previously reported analyses involving context variables and strategy, the relationship between logistics information technology operating systems and strategy was examined through categorical ANOVA (CATMOD). The categories

are two levels of operating systems and two levels of strategy (i.e., process versus externally-oriented). Results are shown in Table 4.23.

Table 4.23
Categorical ANOVA: Operating Systems and Strategy

Response Levels: 2
Populations: 2
N=52
Prob: 0.11874

Table 4.23 indicates that the result was not significant and that H3(a) was not supported. Contrary to the hypothesis, there is no discernible evidence that firms with highly capable operating systems are significantly more engaged in externally-oriented logistics strategies.

As with the previously reported tests involving CATMOD, a one-tailed *t* test was performed as a cross-check. Strategy was the categorical variable and the operating systems variable was measured on its 1-5 scale. The result was not significant ($p > .34$). Externally-oriented strategy respondents reported a logistics operating system mean capability of 3.47. Process strategy respondents reported a mean of 3.35.

> *Hypothesis 3b: Under conditions of highly capable logistics information technology operating systems, firms will use more decentralized structures than under conditions of less capable logistics information technology operating systems.*

A one-tailed *t* test ($\alpha = .10$) was performed comparing the two levels of logistics information technology operating systems to firms' levels of centralization. A

higher mean represented greater centralization of activities in the logistics department. The results are shown in Table 4.24.

Table 4.24
T-Test: Influence of Operating Systems (O.S.) on Centralization

	CENTRALIZATION				
	N	Mean	STD	*t*	P
LOW O.S.	29	10.48	4.35	-0.11	.46
HIGH O.S.	28	10.61	4.11	-0.11	.46

As indicated in Table 4.24, H3(b) is not supported. Respondents reporting a lower capability operating system had, on average, 10.48 activities under the responsibility of logistics. The other group, higher capability operating systems, reported a mean of 10.61 activities under the responsibility of logistics.

Hypothesis 3c: Under conditions of highly capable logistics information technology operating systems, firms will use more formalized structures than under conditions of less capable logistics information technology operating systems.

A one-tailed *t* test ($\alpha = .10$) was performed comparing the two levels of operating systems to firms' levels of formalization. The results, shown in Table 4.25, are significant and H(3)c is supported.

Table 4.25
T-Test: Influence of Operating Systems (O.S.) on Formalization

	FORMALIZATION				
	N	Mean	STD	*t*	P
LOW O.S.	28	2.75	1.86	-1.82	.04
HIGH O.S.	27	3.78	2.29	-1.83	.04

According to the results in Table 4.25, firms with more highly capable operating systems exhibit greater levels of formalization. This was expected as firms with highly capable information systems usually have extensive documentation and procedures related to those systems. In addition, the information inputs are typically quite specific, thereby necessitating strict compliance by personnel. Such practices or requirements can then be expected to appear in other areas of the firm.

> *Hypothesis 3d: Under conditions of highly capable logistics information technology operating systems, firms will use more integrated structures than under conditions of less capable logistics information technology operating systems.*

A one-tailed *t* test (α = .10) was performed comparing the two levels of logistics information technology operating systems to firms' levels of integration. The results are shown in Table 4.26.

Table 4.26
T-Test: Influence of Operating Systems (O.S.) on Integration

	N	Mean	STD	*t*	P
	INTEGRATION (Committees)				
LOW O.S.	26	3.72	0.92	0.38	.35
HIGH O.S.	26	3.63	0.77	0.38	.35
	INTEGRATION (Cross-functional)				
LOW O.S.	25	3.36	0.96	-0.51	.31
HIGH O.S.	26	3.50	0.99	-0.51	.31

As indicated in Table 4.26, the influence of operating systems on the two dimensions of integration was not significant and H3(d) was not supported. The

underlying rationale, that better capability would foster easier integration and would therefore be exploited, was not supported. Firms with highly capable operating systems report means of 3.63 and 3.50, respectively, regarding the usage of integration committees and cross-functional teams. Firms with less capable operating systems report means of 3.72 and 3.36 on the two integration measures.

> *Hypothesis 3e: Under conditions of highly capable logistics information technology operating systems, firms will use broader spans of control than under conditions of less capable logistics information technology operating systems.*

A one-tailed *t* test (α = .10) was performed comparing the two levels of logistics information technology operating systems to firms' spans of control. The results are shown in Table 4.27. For span of control, respondents were simply asked to indicate the number of people under their control. Higher mean scores represented a wider span of control.

Table 4.27
T-Test: Influence of Operating Systems (O.S.) on Span of Control

	SPAN OF CONTROL				
	N	Mean	STD	*t*	P
LOW O.S.	20	5.75	1.83	-1.51	.07
HIGH O.S.	25	6.88	3.14	-1.43	.08

As indicated in Table 4.27, the influence of operating systems on span of control was significant and H3(e) was supported. Firms with higher operating systems capability indicated a greater number of personnel under the direction of the senior logistics executive (6.88) compared to firms reporting less capable operating systems

(5.75). This supports the general belief that information technology enables managers to maintain or increase their span of control.

> *Hypothesis 3f: Under conditions of highly capable logistics information technology planning systems, firms will choose more externally-oriented logistics strategies (i.e., market and channel) than under conditions of less capable logistics information technology planning systems.*

The relationship between logistics information technology planning systems and strategy was examined through categorical ANOVA (CATMOD). The categories are two levels of planning systems and two levels of strategy (i.e., process versus externally-oriented). Results are shown in Table 4.28.

Table 4.28
Categorical ANOVA: Planning Systems and Strategy

Response Levels: 2
Populations: 2
N=52
Prob: 0.2080

Table 4.28 indicates that the result was not significant and that H3(f) was not supported. Firms with highly capable planning systems did not appear likely to choose one strategic orientation over another based on the results of Table 4.28.

As with the previously reported tests involving CATMOD, a one-tail *t* test was performed. Strategy was the categorical variable and the planning systems variable was measured on its 1-5 scale. The result was marginally non-significant ($p > .10$). Externally-oriented strategy respondents reported a mean planning system capability of 3.32. Process strategy respondents reported a mean of 2.94.

Hypothesis 3g: Under conditions of highly capable logistics information technology planning systems, firms will use more decentralized structures than under conditions of less capable logistics information technology planning systems.

A one-tailed *t* test (α = .10) was performed comparing the two levels of logistics information technology planning systems to firms' levels of centralization. The summated measure is such that higher mean scores represent greater centralization of activities in a logistics department. The results are shown in Table 4.29.

Table 4.29
T-Test: Influence of Planning Systems (P.S.) on Centralization

	CENTRALIZATION				
	N	Mean	STD	*t*	P
LOW P.S.	34	10.03	4.31	-1.15	.13
HIGH P.S.	23	11.30	3.99	-1.13	.13

As indicated in Table 4.29, H3(g) was not supported. There was no significant difference between firms exhibiting different levels of planning system capability. The lower capability planning system group reported 10.03 activities (out of sixteen) under the responsibility of logistics. The higher capability planning system group reported 11.30 activities under the responsibility of logistics.

Hypothesis 3h: Under conditions of highly capable logistics information technology planning systems, firms will use more formalized structures than under conditions of less capable logistics information technology planning systems.

A one-tailed *t* test (α = .10) was performed comparing the two levels of planning systems to firms' levels of formalization. The results are indicated in Table

4.30. The summated formalization scale was arranged in such a manner that a higher mean score represented greater formalization.

Table 4.30
T-Test: Influence of Planning Systems (P.S.) on Formalization

	FORMALIZATION				
	N	Mean	STD	*t*	P
LOW P.S.	33	3.00	2.09	-1.08	.14
HIGH P.S.	22	3.64	2.17	-1.09	.14

Firms with highly capable planning systems reported a formalization mean of 3.64. Firms with less capable planning systems reported a formalization mean of 3.00. However, the results were not statistically significant and H3(c) is not supported.

> *Hypothesis 3i: Under conditions of highly capable logistics information technology planning systems, firms will use more integrated structures than under conditions of less capable logistics information technology planning systems.*

A one-tailed *t* test (α = .10) was performed comparing the two levels of logistics information technology planning systems to firms' levels of integration. The results are shown in Table 4.31. The two dimensional integration construct was arranged in such a manner that a higher mean score represented greater integration.

As indicated in Table 4.31, the influence of planning systems on the two dimensions of integration was not significant and H3(i) is not supported. What is rather curious about the results of Table 4.31 is how closely matched the two levels of planning systems appear to be. In this particular case, the reported means from the two

groups are remarkably similar for both integrative measures.

Table 4.31
T-Test: Influence of Planning Systems (P.S.) on Integration

	N	Mean	STD	*t*	P
INTEGRATION (Committees)					
LOW P.S.	30	3.67	0.87	-0.06	.47
HIGH P.S.	22	3.68	0.82	-0.06	.47
INTEGRATION (Cross-functional)					
LOW P.S.	29	3.41	1.07	-0.15	.44
HIGH P.S.	22	3.45	0.84	-0.15	.44

Hypothesis 3j: Under conditions of highly capable logistics information technology planning systems, firms will use broader spans of control than under conditions of less capable logistics information technology planning systems.

A one-tailed *t* test (α = .10) was performed comparing the two levels of logistics information technology planning systems to firms' spans of control. The results are shown in Table 4.32. For span of control, respondents were simply asked to indicate the number of people under their control. Higher mean scores represented a wider span of control.

As indicated in Table 4.32, the influence of planning systems on span of control was significant and H3(j) was supported. As hypothesized, higher capability in the area of planning systems appears to support broader span of control. This lends further support to the idea that information technology enhances managers' ability to monitor greater numbers of personnel.

Table 4.32
T-Test: Influence of Planning Systems (P.S.) on Span of Control

	SPAN OF CONTROL				
	N	Mean	STD	*t*	P
LOW P.S.	24	5.54	2.54	-2.35	.01
HIGH P.S.	21	7.33	2.56	-2.35	.01

In addition to the main effects described above there is the question of an overall interaction effect. Do the four context variables - environmental dynamism, environmental hostility, logistics information technology operating systems, and logistics information planning systems - interact in any manner that affects strategic orientation or elements of structure? These interaction effects were tested using the general linear models (GLM) procedure in SAS.

Hypothesis 3k: With respect to strategy, there will be a significant interaction effect between the levels of environmental dynamism, environmental hostility, information technology operating systems, and information technology planning systems.

Using two levels of strategy (i.e., internally focused or processed and externally focused or market/channel) and two levels for each of the context variables, the result was not significant. An F value of 1.60 was obtained with a p-value of .12. The conclusion was that a significant interaction effect between context and strategy does not exist in the *Logistics Contingency Model* and H3(k) was not supported.

Hypothesis 3l: With respect to structure, there will be a significant interaction effect between the levels of environmental dynamism, environmental hostility, information technology operating systems, and information technology planning systems.

Again, the GLM procedure was used to assess the effect of the interaction of context variables on each of the elements of structure. The results are summarized in Table 4.33. As indicated, none of the interaction effects are significant at the 0.10 level. Therefore, the premise that context variables interact and serve as predictors of elements of structure is rejected. H3(l) is not supported.

Table 4.33
Interaction Effects of Context on Structure

	ED*EH*ITOS*ITPS	
DEPENDENT VARIABLE	*F* Value	*p* Value
Formalization	1.52	0.1466
Centralization	0.45	0.9487
Integration (Committees)	0.90	0.5685
Integration (X-functional)	1.06	0.4190
Span of Control	0.89	0.5728

MEDIATION ISSUES

Within the general CSSP framework, there is ample opportunity to study potential mediational effects. The general mediational model is depicted in Figure 4.5. As illustrated, there are two causal paths to the outcome variable, with paths *a* and *b* representing the mediation path.

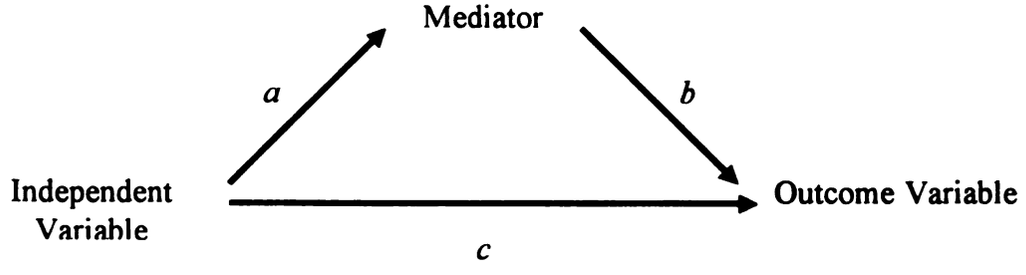

Figure 4.5
Mediational Model

As described by Baron and Kenny (1986), tests of mediation can be conducted through a series of regression models. Three equations must be estimated. These equations correspond to paths *a, b* and *c* indicated in Figure 4.5. Baron and Kenny state:

> These three regression equations provide the tests of the linkages of the mediational model. To establish mediation, the following conditions must hold: First, the independent variable must affect the mediator in the first equation; second, the independent variable must be shown to affect the dependent variable in the second equation; and third, the mediator must affect the dependent variable in the third equation. If these conditions all hold in the predicted direction, then the effect of the independent variable on the dependent variable must be less in the third equation than in the second. Perfect mediation holds if the independent variable has no effect when the mediator is controlled (p.1177).

Similar estimates are provided for in structural equation modeling (e.g., *LISREL*). However, given the limited sample size of this research and the typical requirements of fully developed structural equation models, the Baron and Kenny approach was used in this research.

Hypotheses 4a-d evaluated the mediational effects of structure on the context-performance relationship. Figure 4.6 provides a corresponding mediational model of the hypothesized relationships. Each specific path was evaluated (e.g., environmental hostility --> span of control --> performance). The context, structure and performance variables were treated as continuous variables for estimation purposes (i.e., unlike some of the previous statistical approaches, no levels or classes were utilized). Tables 4.34-37 provide the results of the tests.

Hypothesis 4a: Structure is a significant mediator of the environmental dynamism --> performance relationship.

Hypothesis 4b: Structure is a significant mediator of the environmental hostility --> performance relationship.

Hypothesis 4c: Structure is a significant mediator of the logistics information technology operating systems --> performance relationship.

Hypothesis 4d: Structure is a significant mediator of the logistics information technology planning systems --> performance relationship.

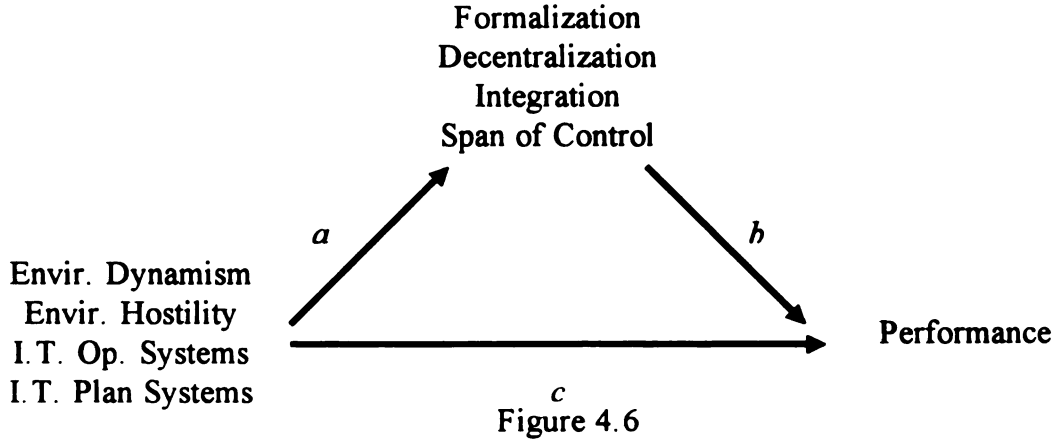

Figure 4.6
Mediational Model: Context-Structure-Performance

The results indicate that H4(a)-(d) are not supported. There were no mediational effects present in this model. This led to the rejection of the premise that the impact of context effects on performance would be mediated through structure variables. Although mediation was the main area of interest within this set of hypotheses, an interesting finding did emerge. Information technology planning systems did have a significant main effect on performance. This suggests that even though context is fixed in the short run, organizations with performance concerns may potentially alter their information technology planning systems to impact performance.

Table 4.34
Tests of Mediation: Environmental Dynamism (ED)-Structure-Performance

PATH	*t*-VALUE	PROB.
Env. Dynamism --> Formalization	1.048	0.2991
Env. Dynamism --> Performance	0.064	0.9491
Env. Dynamism --> Formalization --> Perf.		
Env. Dynamism	0.180	0.8581
Formalization	-0.523	0.6033
Conclusion: No direct effect of ED on performance nor is there an indirect effect of ED through formalization on performance.		
Env. Dynamism --> Centralization	-0.037	0.9708
Env. Dynamism --> Performance	0.064	0.9491
Env. Dynamism --> Centralization --> Perf.		
Env. Dynamism	0.206	0.8377
Centralization	-1.362	0.1798
Conclusion: No direct effect of ED on performance nor is there an indirect effect of ED through centralization on performance.		
Env. Dynamism --> Integration (Committees)	1.989	0.0522
Env. Dynamism --> Performance	0.064	0.9491
Env. Dynamism --> Integration --> Perf.		
Env. Dynamism	-0.323	0.7481
Integration	1.577	0.1217
Conclusion: No direct effect of ED on performance nor is there an indirect effect of ED through integration (committees) on performance.		
Env. Dynamism --> Integration (Teams)	1.201	0.2356
Env. Dynamism --> Performance	0.064	0.9491
Env. Dynamism --> Integration --> Perf.		
Env. Dynamism	-0.230	0.8191
Integration	1.629	0.1103
Conclusion: No direct effect of ED on performance nor is there an indirect effect of ED through integration (teams) on performance.		
Env. Dynamism --> Span of Control	-0.292	0.7721
Env. Dynamism --> Performance	0.064	0.9491
Env. Dynamism --> Span of Control --> Perf.		
Env. Dynamism	0.730	0.4696
Span of Control	0.571	0.5709
Conclusion: No direct effect of ED on performance nor is there an indirect effect of ED through span of control on performance.		

Table 4.35
Tests of Mediation: Environmental Hostility (EH)-Structure-Performance

PATH	*t*-VALUE	PROB.
Env. Hostility --> Formalization	0.929	0.3569
Env. Hostility --> Performance	-1.183	0.2429
Env. Hostility --> Formalization --> Perf.		
Env. Hostility	-1.139	0.2605
Formalization	-0.419	0.6768
Conclusion: No direct effect of EH on performance nor is there an indirect effect of EH through formalization on performance.		
Env. Hostility --> Centralization	0.951	0.3458
Env. Hostility --> Performance	-1.183	0.2429
Env. Hostility --> Centralization --> Perf.		
Env. Hostility	-1.333	0.1891
Centralization	-1.492	0.1424
Conclusion: No direct effect of EH on performance nor is there an indirect effect of EH through centralization on performance.		
Env. Hostility --> Integration (Committees)	1.359	0.1803
Env. Hostility --> Performance	-1.183	0.2429
Env. Hostility --> Integration --> Perf.		
Env. Hostility	-1.672	0.1012
Integration	1.959	0.0561
Conclusion: No direct effect of EH on performance but there is an indirect effect of EH through integration (committees) on performance.		
Env. Hostility --> Integration (Teams)	-0.288	0.7743
Env. Hostility --> Performance	-1.183	0.2429
Env. Hostility --> Integration --> Perf.		
Env. Hostility	-1.097	0.2784
Integration	1.545	0.1293
Conclusion: No direct effect of EH on performance nor is there an indirect effect of EH through integration (teams) on performance.		
Env. Hostility --> Span of Control	0.905	0.3703
Env. Hostility --> Performance	-1.183	0.2429
Env. Hostility --> Span of Control --> Perf.		
Env. Hostility	-1.275	0.2097
Span of Control	0.704	0.4857
Conclusion: No direct effect of EH on performance nor is there an indirect effect of EH through span of control on performance.		

Table 4.36
Tests of Mediation: I.T. Operating Systems (ITOP)-Structure-Performance

PATH	*t*-VALUE	PROB.
ITOP --> Formalization	1.551	0.1272
ITOP --> Performance	1.521	0.1356
ITOP --> Formalization --> Perf.		
ITOP	1.589	0.1195
Formalization	-0.544	0.5895
Conclusion: No direct effect of ITOP on performance nor is there an indirect effect of ITOP through formalization on performance.		
ITOP --> Centralization	-0.009	0.9932
ITOP --> Performance	1.521	0.1356
ITOP --> Centralization --> Perf.		
ITOP	1.410	0.1658
Centralization	-0.752	0.4561
Conclusion: No direct effect of ITOP on performance nor is there an indirect effect of ITOP through centralization on performance.		
ITOP --> Integration (Committees)	-0.727	0.4710
ITOP --> Performance	1.521	0.1356
ITOP --> Integration --> Perf.		
ITOP	1.609	0.1151
Integration	1.523	0.1353
Conclusion: No direct effect of ITOP on performance nor is there an indirect effect of ITOP through integration (committees) on performance.		
ITOP --> Integration (Teams)	0.958	0.3431
ITOP --> Performance	1.521	0.1356
ITOP --> Integration --> Perf.		
ITOP	1.369	0.1786
Integration	1.288	0.2051
Conclusion: No direct effect of ITOP on performance nor is there an indirect effect of ITOP through integration (teams) on performance.		
ITOP --> Span of Control	1.090	0.2819
ITOP --> Performance	1.521	0.1356
ITOP --> Span of Control --> Perf.		
ITOP	1.100	0.2781
Span of Control	0.214	0.8317
Conclusion: No direct effect of ITOP on performance nor is there an indirect effect of ITOP through span of control on performance.		

Table 4.37
Tests of Mediation: I.T. Planning Systems (ITPLAN)-Structure-Performance

PATH	*t*-VALUE	PROB.
ITPLAN --> Formalization	1.527	0.1335
ITPLAN --> Performance	2.496	0.0167
ITPLAN --> Formalization --> Perf.		
ITPLAN	2.568	0.0141
Formalization	-0.701	0.4876
Conclusion: There is a significant direct effect between ITPLAN and performance with no mediating influence through formalization.		
ITPLAN --> Centralization	-0.126	0.9006
ITPLAN --> Performance	2.496	0.0167
ITPLAN --> Centralization --> Perf.		
ITPLAN	2.358	0.0234
Centralization	-0.645	0.5227
Conclusion: There is a significant direct effect between ITPLAN and performance with no mediating influence through centralization.		
ITPLAN --> Integration (Committees)	0.940	0.3522
ITPLAN --> Performance	2.496	0.0167
ITPLAN --> Integration --> Perf.		
ITPLAN	2.302	0.0266
Integration	1.181	0.2447
Conclusion: There is a significant direct effect between ITPLAN and performance With no mediating influence through integration (committees).		
ITPLAN --> Integration (Teams)	0.315	0.7540
ITPLAN --> Performance	2.496	0.0167
ITPLAN --> Integration --> Perf.		
ITPLAN	2.425	0.0200
Integration	0.782	0.4387
Conclusion: There is a significant direct effect between ITPLAN and performance With no mediating influence through integration (teams).		
ITPLAN --> Span of Control	3.249	0.0023
ITPLAN --> Performance	2.496	0.0167
ITPLAN --> Span of Control --> Perf.		
ITPLAN	1.497	0.1430
Span of Control	0.561	0.5782
Conclusion: There is a significant direct effect between ITPLAN and performance With no mediating influence through span of control.		

Hypotheses 4e-h evaluate the mediational effects of strategy on the context-structure relationship. Figure 4.7 provides a corresponding mediational model of the hypothesized relationships. Each specific path was evaluated (e.g., environmental hostility --> strategy --> span of control). The context and structure performance variables were treated as continuous variables for estimation purposes. Strategy was treated as a dummy variable with internally and externally-oriented strategies. Tables 4.37-40 provide the results of the tests.

Hypothesis 4e: Strategy is a significant mediator of the environmental dynamism --> structure relationship.

Hypothesis 4f: Strategy is a significant mediator of the environmental hostility --> structure relationship.

Hypothesis 4g: Strategy is a significant mediator of the logistics information technology operating systems --> structure relationship.

Hypothesis 4h: Strategy is a significant mediator of the logistics information technology planning systems --> structure relationship.

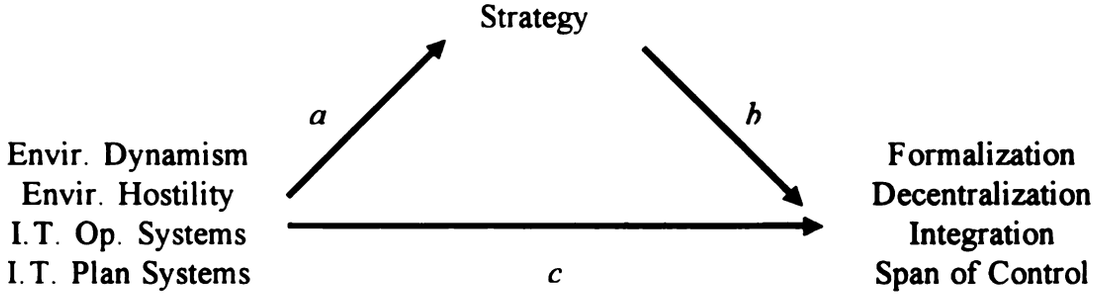

Figure 4.7
Mediational Model: Context-Strategy Structure

The results of Tables 4.38-41 indicate that H4e-h were not supported. No mediating effects were present in the model in terms of context-strategy-structure arrangements. Therefore, the hypotheses suggesting a mediational role for strategy in terms of context and structure must be rejected. There were two significant main effects. However, these were expected based on the results of the earlier *t* tests. These main effects were: (1) environmental dynamism --> integration (committees); and (2) information technology planning systems --> span of control.

Table 4.38
Tests of Mediation: Environmental Dynamism (ED)-Strategy-Structure

PATH	*t*-VALUE	PROB.
Env. Dynamism --> Strategy	0.823	0.4143
Env. Dynamism --> Formalization	1.048	0.2991
Env. Dynamism --> Strategy --> Formalization		
Env. Dynamism	1.458	0.1514
Strategy	0.708	0.4822
Conclusion: No direct effect of ED on formalization nor is there an indirect effect of ED through strategy on formalization.		
Env. Dynamism --> Strategy	0.823	0.4143
Env. Dynamism --> Centralization	-0.037	0.9708
Env. Dynamism --> Strategy --> Centralization		
Env. Dynamism	0.973	0.3352
Strategy	-0.637	0.5271
Conclusion: No direct effect of ED on centralization nor is there an indirect effect of ED through strategy on centralization.		
Env. Dynamism --> Strategy	0.823	0.4143
Env. Dynamism --> Integration (Committees)	1.989	0.0522
Env. Dynamism --> Strategy --> Integration		
Env. Dynamism	2.178	0.0343
Strategy	-1.525	0.1336
Conclusion: There is a significant direct effect between ED and integration (committees) with no mediating influence through strategy.		
Env. Dynamism --> Strategy	0.823	0.4143
Env. Dynamism --> Integration (Teams)	1.201	0.2356
Env. Dynamism --> Strategy --> Integration		
Env. Dynamism	1.443	0.1555
Strategy	-1.793	0.0793
Conclusion: No direct effect of ED on integration (teams) nor is there an indirect effect of ED through strategy on integration.		
Env. Dynamism --> Strategy	0.823	0.4143
Env. Dynamism --> Span of Control	-0.292	0.7721
Env. Dynamism --> Strategy --> Span of Control		
Env. Dynamism	-0.190	0.8503
Strategy	-1.319	0.1944
Conclusion: No direct effect of ED on span of control nor is there an indirect effect of ED through strategy on span of control.		

Table 4.39
Tests of Mediation: Environmental Hostility (EH)-Strategy-Structure

PATH	*t*-VALUE	PROB.
Env. Hostility --> Strategy	-0.405	0.6875
Env. Hostility --> Formalization	0.929	0.3569
Env. Hostility --> Strategy --> Formalization		
Env. Hostility	0.635	0.5285
Strategy	0.902	0.3712
Conclusion: No direct effect of EH on formalization nor is there an indirect effect of EH through strategy on formalization.		
Env. Hostility --> Strategy	-0.405	0.6875
Env. Hostility --> Centralization	0.951	0.3458
Env. Hostility --> Strategy --> Centralization		
Env. Hostility	-0.431	0.6683
Strategy	-0.548	0.5864
Conclusion: No direct effect of EH on centralization nor is there an indirect effect of EH through strategy on centralization.		
Env. Hostility --> Strategy	-0.405	0.6875
Env. Hostility --> Integration (Committees)	1.359	0.1803
Env. Hostility --> Strategy --> Integration		
Env. Hostility	1.295	0.2015
Strategy	-1.169	0.2481
Conclusion: No direct effect of EH on integration (committees) nor is there an indirect effect of EH through strategy on integration (committees).		
Env. Hostility --> Strategy	-0.405	0.6875
Env. Hostility --> Integration (Teams)	-0.288	0.7743
Env. Hostility --> Strategy --> Integration		
Env. Hostility	-0.342	0.7335
Strategy	-1.602	0.1157
Conclusion: No direct effect of EH on integration (teams) nor is there an indirect effect of EH through strategy on integration (teams).		
Env. Hostility --> Strategy	-0.405	0.6875
Env. Hostility --> Span of Control	0.905	0.3703
Env. Hostility --> Strategy --> Span of Control		
Env. Hostility	0.772	0.4445
Strategy	-1.256	0.2159
Conclusion: No direct effect of EH on span of control nor is there an indirect effect of EH through strategy on span of control.		

Table 4.40
Tests of Mediation: I.T. Operating Systems (ITOP)-Strategy-Structure

PATH	*t*-VALUE	PROB.
ITOP --> Strategy	-0.395	0.6947
ITOP --> Formalization	1.551	0.1272
ITOP --> Strategy --> Formalization		
ITOP	1.526	0.1340
Strategy	0.817	0.4182
Conclusion: No direct effect of ITOP on formalization nor is there an indirect effect of ITOP through strategy on formalization.		
ITOP --> Strategy	-0.395	0.6947
ITOP --> Centralization	-0.009	0.9932
ITOP --> Strategy --> Centralization		
ITOP	-0.667	0.5082
Strategy	-0.305	0.7615
Conclusion: No direct effect of ITOP on centralization nor is there an indirect effect of ITOP through strategy on centralization.		
ITOP --> Strategy	-0.395	0.6947
ITOP --> Integration (Committees)	-0.727	0.4710
ITOP --> Strategy --> Integration		
ITOP	-0.802	0.4267
Strategy	-1.241	0.2209
Conclusion: No direct effect of ITOP on integration (committees) nor is there an indirect effect of ITOP through strategy on integration (committees).		
ITOP --> Strategy	-0.395	0.6947
ITOP --> Integration (Teams)	0.958	0.3431
ITOP --> Strategy --> Integration		
ITOP	0.891	0.3778
Strategy	-1.511	0.1380
Conclusion: No direct effect of ITOP on integration (teams) nor is there an indirect effect of ITOP through strategy on integration (teams).		
ITOP --> Strategy	-0.395	0.6947
ITOP --> Span of Control	1.090	0.2819
ITOP --> Strategy --> Span of Control		
ITOP	1.018	0.3145
Strategy	-1.640	0.1086
Conclusion: No direct effect of ITOP on span of control nor is there an indirect effect of ITOP through strategy on span of control.		

Table 4.41
Tests of Mediation: I.T. Planning Systems (ITPLAN)-Strategy-Structure

PATH	*t*-VALUE	PROB.
ITPLAN --> Strategy	-1.315	0.1952
ITPLAN --> Formalization	1.527	0.1335
ITPLAN --> Strategy --> Formalization		
ITPLAN	1.478	0.1468
Strategy	1.170	0.2483
Conclusion: No direct effect of ITPLAN on formalization nor is there an indirect effect of ITPLAN through strategy on formalization.		
ITPLAN --> Strategy	-1.315	0.1952
ITPLAN --> Centralization	-0.126	0.9006
ITPLAN --> Strategy --> Centralization		
ITPLAN	-0.885	0.3813
Strategy	-0.350	0.7283
Conclusion: No direct effect of ITPLAN on centralization nor is there an indirect effect of ITPLAN through strategy on centralization.		
ITPLAN --> Strategy	-1.315	0.1952
ITPLAN --> Integration (Committees)	0.940	0.3522
ITPLAN --> Strategy --> Integration		
ITPLAN	0.755	0.4541
Strategy	-0.843	0.4040
Conclusion: No direct effect of ITPLAN on integration (committees) nor is there an indirect effect of ITPLAN through strategy on integration (committees).		
ITPLAN --> Strategy	-1.315	0.1952
ITPLAN --> Integration (Teams)	0.315	0.7540
ITPLAN --> Strategy --> Integration		
ITPLAN	0.087	0.9309
Strategy	-1.199	0.2372
Conclusion: No direct effect of ITPLAN on integration (teams) nor is there an indirect effect of ITPLAN through strategy on integration (teams).		
ITPLAN --> Strategy	-1.315	0.1952
ITPLAN --> Span of Control	3.249	0.0023
ITPLAN --> Strategy --> Span of Control		
ITPLAN	2.843	0.0071
Strategy	-1.622	0.1128
Conclusion: There is a significant direct effect between ITPLAN and span of control with no mediating influence through strategy.		

STRATEGY AND STRUCTURE

The preceding section examined the relationship between strategy and structure as part of mediational models. This section specifically isolates the strategy-structure relationship. It is examined through a series of *t* tests, dividing strategy into internal and external strategies (i.e., process versus market and channel). Structure variables continue to be used in the same manner as previously reported in this research.

Hypothesis 5a: Externally-oriented logistics strategy (i.e., market or channel) is associated with less centralized structure than internally-oriented logistics strategy (i.e., process).

A one-tailed *t* test (α = .10) was performed comparing the two levels of strategy to centralization. The results are shown in Table 4.42. The summated centralization scale was arranged in such a manner that a higher mean score represented greater centralization.

Table 4.42
T-Test: Influence of Strategy on Centralization

	CENTRALIZATION				
	N	Mean	STD	*t*	P
INTERNAL	34	11.41	2.20	0.53	.30
EXTERNAL	18	11.83	3.55	0.46	.33

The results in Table 4.42 indicate that there is no significant difference in terms of centralization between the two strategy groups. H5(a) is not supported. Within this sample, the internally-oriented strategy group reported a mean of 11.41 activities consolidated under the responsibility of logistics. Externally-oriented strategy

respondents reported a mean of 11.83 activities consolidated under the responsibility of logistics.

Hypothesis 5b: Externally-oriented logistics strategy (i.e., market or channel) is associated with less formalized structure than internally-oriented logistics strategy (i.e., process).

A one-tailed *t* test (α = .10) was performed comparing the two levels of strategy to formalization. The results are shown in Table 4.43. The summated formalization scale was arranged in such a manner that a higher mean score represented greater formalization.

Table 4.43
T-Test: Influence of Strategy on Formalization

	FORMALIZATION				
	N	Mean	STD	*t*	P
INTERNAL	34	3.59	2.06	-0.86	.20
EXTERNAL	18	3.06	2.15	-0.87	.19

As indicated in Table 4.43, the result was not significant. H5(b) is not supported. The group using an internally-oriented strategy reported a mean formalization measure of 3.59. The externally-oriented strategy group reported a mean of 3.06.

Hypothesis 5c: Externally-oriented logistics strategy (i.e., market or channel) is associated with more integrated structure than internally-oriented logistics strategy (i.e., process).

A one-tailed *t* test (α = .10) was performed comparing the two levels of strategy to firms' levels of integration. The results are shown in Table 4.44. The summated integration scale was arranged in such a manner that a higher mean score represented greater integration.

Table 4.44
T-Test: Influence of Strategy on Integration

	N	Mean	STD	*t*	P
INTEGRATION (Committees)					
INTERNAL	34	3.56	0.87	1.24	.11
EXTERNAL	18	3.87	0.78	1.28	.10
INTEGRATION (Cross-functional)					
INTERNAL	33	3.27	1.05	1.61	.06
EXTERNAL	18	3.72	0.75	1.77	.04

As indicated in Table 4.44, the influence of strategy on the two dimensions of integration was mixed. Integration through cross-functional teams was significant whereas committee-driven integration was not. The results show that externally-oriented strategy has a higher level of cross-functional team integration compared to internally-focused strategy. As for committee-driven integration, externally-oriented strategy reported a mean of 3.72 while internally-oriented firms reported a mean of 3.27. Thus, H5(c) is partially supported.

Hypothesis 5d: Externally-oriented logistics strategy (i.e., market or channel) is associated with broader spans of control structure than internally-oriented logistics strategy (i.e., process).

A one-tailed *t* test ($\alpha = .10$) was performed comparing the two strategy groups to firms' spans of control. The results are shown in Table 4.45. For span of control, respondents were simply asked to indicate the number of people under control of the senior logistics executive. Higher mean scores represented a wider span of control.

Table 4.45
T-Test: Influence of Strategy on Span of Control

	SPAN OF CONTROL				
	N	Mean	STD	*t*	P
INTERNAL	30	6.00	2.52	1.35	.09
EXTERNAL	15	7.13	2.90	1.29	.10

As indicated in Table 4.45, the influence of strategy on span of control was significant and H5(d) was supported. As hypothesized, externally-oriented strategy favors broader span of control. On average, the externally-oriented firms report more than one full person under the senior logistics executive as compared to the internally-focused strategy. This wider span of control is most likely necessary as firms extend linkages beyond their own boundaries and interface with channel partners.

STRATEGY, STRUCTURE AND PERFORMANCE

This final section of specific results focuses on the relationships between strategy, structure and performance as hypothesized in the *Logistics Contingency Model.* The investigation of the strategy-performance-strategy feedback loop necessitated collection of time-series data. This was accomplished by sending a highly focused questionnaire to the respondents comprising the database used thus far in this research. This follow-up questionnaire solicited responses to replications of strategy and performance items used in the initial questionnaire (i.e., "Workbook" as reprinted in Appendix A). The follow-up questionnaire is reproduced in Appendix B.

The initial data was collected during the first half of 1994. The follow-up sample was collected during the period of March-May 1997. Therefore, the approximate time lag throughout the sample is three years. Of course, as a result of this lag, certain respondents were no longer at the same position and responses could not be obtained. Consequently, the follow-up sample is smaller.

> *Hypothesis 5e: Under conditions of satisfactory performance, less strategic changes will occur than under conditions of unsatisfactory performance.*

A review of the merged data reveals that selected logistics strategies do change. There were thirty-nine (39) usable responses after the data was merged. Of these thirty-nine firms, twenty-one (21) or 54% of the firms, had changed strategy during the last three years. Within this group, there was one clear pattern: Of the initial thirty-nine firms, fifteen (15) indicated an externally-oriented strategy in 1994. Eighty percent of these firms (i.e., 12/15) reported using a different strategy in 1997. Eight

of the changing firms changed focus and went to the internally-focused process strategy. The remaining four firms simply changed to a different externally-oriented strategy.

But what of the total sample? Table 4.46 presents the results of a chi-square test that examined 1994 performance and strategic change between 1994 and 1997. For the purposes of this test, performance was simply divided into two groups, those at or below the mean of 3.78 from the thirty-nine (39) firms and those above the mean. Performance above the mean was considered satisfactory, performance at or below the mean was considered non-satisfactory.

Table 4.46
Chi-Square Test of Performance and Change in Strategy

	No Change in Strategy from 1994 to 1997	Change in Strategy from 1994 to 1997	TOTAL
Performance At or Below Mean (1994)	12	9	21
Performance Above Mean (1994)	6	12	18
TOTAL	18	21	39

The results do not support H5(e). At $\alpha = .10$, the chi-square value of 2.21 was not significant ($p=.137$). There is no statistical evidence supporting the linkage between performance and subsequent change in logistics strategy.

Hypothesis 6a: Logistics structure, by itself, has no significant relationship to performance.

A series of two-tailed *t* tests ($\alpha = .10$) were performed using two levels of each structure variable. The mean of each structure variable was determined. Values at or below the mean were coded as "low" and values above the mean were coded as "high" in a given structure variable. The results are presented in Table 4.47.

There were no significant differences between the different levels of the structure variables and their relationship to performance. Thus, H6(a) was supported as it was hypothesized that independent of the other model variables, structure would not impact performance. This is consistent with the idea of "fit" and the alignment of a firm's strategy and structure with its context in order to produce desired performance.

In addition to the individual *t* tests, a general linear model was tested. It checked for interaction effects of a combined structure variable on performance. The resulting *F* value was 1.25 ($p=0.29$). This provides further support for H6(a).

Table 4.47
T-Test: Influence of Structure on Performance

VARIABLE	N	MEAN	STD	*t*	P
Low Formalization	26	3.75	0.3807	0.57	0.57
High Formalization	23	3.67	0.5882	0.58	0.56
Low Centralization	20	3.76	0.4033	0.64	0.53
High Centralization	29	3.68	0.5392	0.60	0.55
Low Integ. (Committee)	26	3.65	0.5203	-0.82	0.42
High Integ. (Committee)	23	3.77	0.4470	-0.81	0.42
Low Integ. (Teams)	19	3.64	0.4368	-0.87	0.39
High Integ. (Teams)	30	3.76	0.5158	-0.84	0.40
Low Span of Control	33	3.64	0.4275	-1.28	0.21
High Span of Control	16	3.85	0.5777	-1.42	0.16

Hypothesis 6b: Logistics structure will be a significant mediator of the logistics strategy --> performance relationship.

This final research hypothesis probes the relationship between logistics strategy, the elements of structure and the outcome as represented by performance. The relationships are pictured in Figure 4.8. As with the previous mediational models presented in this research, Baron and Kenny's (1986) approach was used. Three regression equations were estimated for each relationship. The results are presented in Table 4.48.

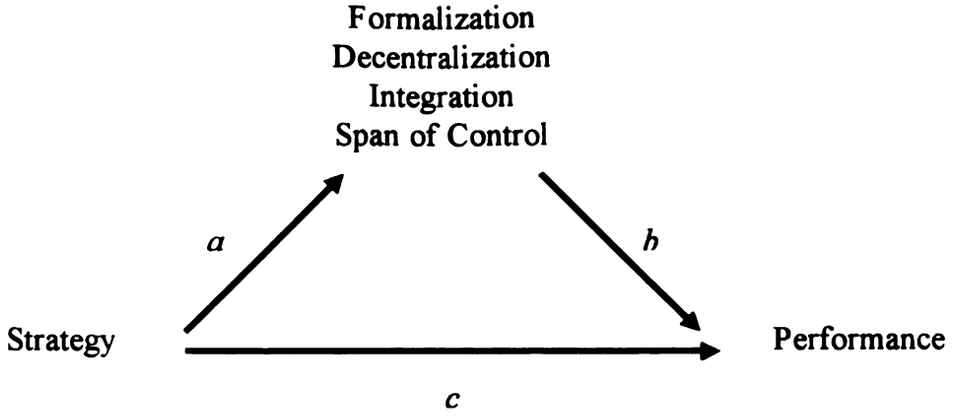

Figure 4.8
Mediational Model: Strategy-Structure-Performance

Contrary to the hypothesized mediation effects, there was no evidence of any significant effects. Of course, in the absence of a main effect between strategy and performance the only possible outcome could have been complete mediation by the elements of structure. As Table 4.48 shows, no such mediation occurred in the *Logistics Contingency Model.* Therefore, H6(b) is not supported.

Table 4.48
Tests of Mediation: Strategy-Structure-Performance

PATH	*t*-VALUE	PROB.
Strategy--> Formalization	0.873	.3869
Strategy--> Performance	-0.245	.8074
Strategy--> Formalization --> Perf.		
Strategy	-0.179	.6425
Formalization	-0.179	.8589
Conclusion: No direct effect of strategy on performance nor is there an indirect effect of strategy through formalization on performance.		
Strategy--> Centralization	-0.528	.5996
Strategy--> Performance	-0.245	.8074
Strategy--> Centralization --> Perf.		
Strategy	-0.381	.7048
Centralization	-1.380	.1742
Conclusion: No direct effect of strategy on performance nor is there an indirect effect of strategy through centralization on performance.		
Strategy--> Integration (Committees)	-1.237	.2220
Strategy--> Performance	-0.245	.8074
Strategy--> Integration --> Perf.		
Strategy	0.105	.9167
Integration	1.527	.1337
Conclusion: No direct effect of strategy on performance nor is there an indirect effect of strategy through integration (committees) on performance.		
Strategy--> Integration (Teams)	-1.607	.1145
Strategy--> Performance	-0.245	.8074
Strategy--> Integration --> Perf.		
Strategy	0.084	.9334
Integration	1.595	.1177
Conclusion: No direct effect of strategy on performance nor is there an indirect effect of strategy through integration (teams) on performance.		
Strategy--> Span of Control	-1.353	.1831
Strategy--> Performance	-0.245	.8074
Strategy--> Span of Control --> Perf.		
Strategy	-0.185	.8539
Span of Control	0.457	.6504
Conclusion: No direct effect of strategy on performance nor is there an indirect effect of strategy through span of control on performance.		

SUMMARY

This chapter has presented the results of the statistical tests performed in relation to the research questions (RQ) and related research hypotheses. Table 4.49 presents a condensed summary of these results. For ease of reference, the research hypotheses are repeated in Appendix C.

Table 4.49
Summary of Statistical Tests and Related Research Hypotheses

Research Hypothesis	Test	Result
RQ #1: What is the relationship of environmental dynamism to logistics strategy?		
H1a	Categorical ANOVA	Not Supported
RQ #2: What is the relationship of environmental dynamism to logistics structure?		
H1b	*T* Test	Not Supported
H1c	*T* Test	Contradicted
H1d	*T* Test	Partially Supported
H1e	*T* Test	Not Supported
RQ #3: What is the relationship of environmental hostility to logistics strategy?		
H2a	Categorical ANOVA	Not Supported

Table 4.49 (con't)
Summary of Statistical Tests and Related Research Hypotheses

RQ #4: What is the relationship of environmental hostility to logistics structure?		
Research Hypothesis	Test	Result
H2b	*T* Test	Not Supported
H2c	*T* Test	Contradicted
H2d	*T* Test	Not Supported
H2e	*T* Test	Not Supported
RQ #5: What is the relationship of logistics information technology operating systems to logistics strategy?		
H3a	Categorical ANOVA	Not Supported
RQ #6: What is the relationship of logistics information technology operating systems to logistics structure?		
H3b	*T* Test	Not Supported
H3c	*T* Test	Supported
H3d	*T* Test	Not Supported
H3e	*T* Test	Supported
RQ #7: What is the relationship of logistics information technology planning systems to logistics strategy?		
H3f	Categorical ANOVA	Not Supported

Table 4.49 (con't)
Summary of Statistical Tests and Related Research Hypotheses

Research Hypothesis	Test	Result
RQ #8: What is the relationship of logistics information technology planning systems to logistics structure?		
H3g	*T* Test	Not Supported
H3h	*T* Test	Not Supported
H3i	*T* Test	Not Supported
H3j	*T* Test	Supported
RQ #9: What is the relationship of context to logistics strategy?		
H3k	GLM	Not Supported
RQ #10: What is the relationship of context to logistics structure?		
H3l	GLM	Not Supported
RQ #11: What indirect relationships, if any, exist between the contextual variables, strategy, and/or structure and performance?		
H4a	Regression	Not Supported
H4b	Regression	Not Supported
H4c	Regression	Not Supported
H4d	Regression	Not Supported
H4e	Regression	Not Supported
H4f	Regression	Not Supported
H4g	Regression	Not Supported
H4h	Regression	Not Supported

Table 4.49 (con't)
Summary of Statistical Tests and Related Research Hypotheses

RQ #12: Is there evidence of a reciprocal relationship between strategy and structure?

Research Hypothesis	Test	Result
H5a	*T* Test	Not Supported
H5b	*T* Test	Not Supported
H5c	*T* Test	Partially Supported
H5d	*T* Test	Supported

RQ #13: What is the direct relationship, if any, between logistics structure and performance?

H6a	*T* Tests	Supported

RQ #14: What is the relationship of logistics strategy on performance as mediated by structure?

H6b	Regression	Not Supported

RQ #15: Does the level of logistics performance affect logistics strategy?

H5e	Chi-Square	Not Supported

CHAPTER FIVE - CONCLUSIONS

This final chapter is divided into six sections. The first section summarizes research results. The results are grouped and discussed according to the major relationships of the *Logistics Contingency Model.* These relationships are: (1) Context - Strategy; (2) Context - Structure; (3) Strategy - Structure; (4) Structure - Performance; (5) Performance - Strategy; and (6) Mediational Paths between Context - Strategy - Structure, Context - Structure - Performance, and Strategy - Structure - Performance.

The second and third sections examine, respectively, the academic and managerial contributions of this research. The fourth section addresses limitations of this research. The fifth section, propositions and directions for future research, suggests ways in which the *Logistics Contingency Model* can be used in continuing research. Finally, a brief summary ends the chapter.

RESEARCH RESULTS

Four major constructs were used in this research: (1) Context, (2) Strategy, (3) Structure, and (4) Performance. Each is briefly described.

Context is increasingly being used in contingency research in lieu of environment. In both cases, the variables are fixed in the short-term. However, whereas environment is typically limited to variables outside the control of the firm, context is more expansive. Not only does context usually

incorporate environment variables, it also includes variables under the direct control of the firm (e.g., information technology). In this sense, context represents the firm's short-term situation as determined by environmental considerations and previous firm decisions. Beyond the short-term, it is expected that the firm adjusts those variables under its control in order to improve its operational situation.

Strategy was defined in this research according to the Bowersox and Daugherty (1987) typology. These classifications were process, market and channel. Within this specific research design, process strategy was considered an internally-focused strategy while market and channel strategies were considered externally-oriented strategy.

Structure in this research was investigated from a human resource perspective. Consequently, formalization, centralization, integration, and span of control were all considered in terms of their relationships to personnel and their deployment.

Performance, as discussed in Chapter Two, is measured in numerous ways in the logistics literature. This research used self-reporting perceptual measures. Respondents compared themselves to their competition in terms of specific logistics measures.

CONTEXT AND STRATEGY

Contingency theory posits that strategy is designed to cope with a firm's context. For example, if a firm faces a highly variable environment, strategy should account for that variability. Within this research design, the basic premise was that higher or lower levels of context variables would account for differences between internally-oriented and externally-oriented strategies. Figure 5.1 highlights the

relationship being discussed.

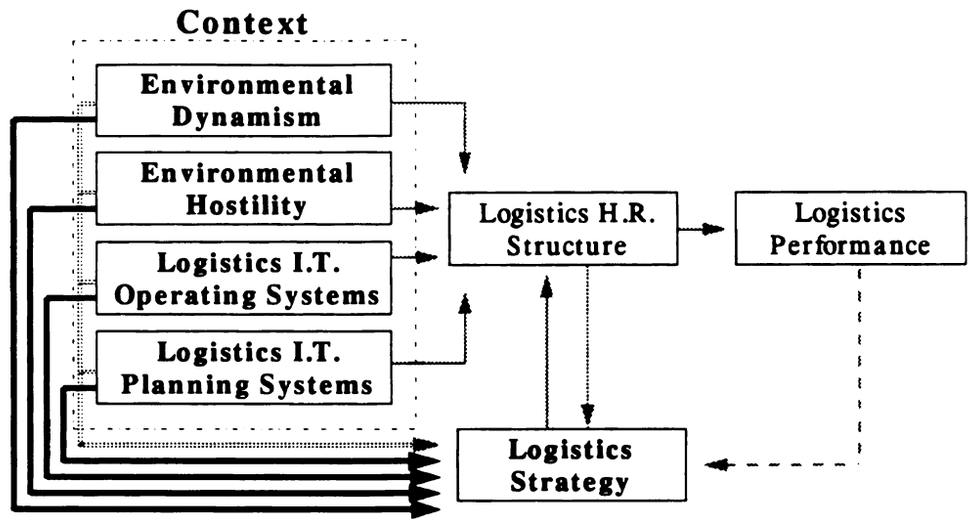

Figure 5.1
Logistics Contingency Model: Context-Strategy

It was hypothesized that less dynamic and hostile environments would be more conducive to internally-oriented strategy. In the absence of environmental uncertainty, firms would focus on the efficiency of internal operations. External linkages would not be crucial as environmental monitoring would not be as important as in a highly uncertain environment.

In contrast, highly dynamic and hostile environments should encourage firms to utilize externally-oriented strategy. By building links beyond their firm's boundaries, firms might reduce uncertainty through information exchange, co-location of employees, etc. Such efforts should then serve as a buffer between a firm's fortunes and the volatility of the business environment.

Hypotheses 1(a) and 2(a) reflected this general relationship of environmental dynamism and hostility and strategic choice. However, the results of this research did

not support the premise that environmental dynamism and hostility impact logistics strategic orientation. The internally and externally-oriented strategies were not significantly different from each other on either environmental dimension.

The non-significant result between dynamism and strategy is consistent with the findings of Kohn *et al.* (1990) in which they found no association. However, this research's non-significant result between hostility and strategy contrasts with Kohn *et al.* They reported a significant positive association between hostility and strategy.

This raises several considerations. First, it is possible that logistics strategy is formed independently of traditional environmental variables. Much of the work in environmental dynamism and hostility in organizational science has focused on firm-level conditions. Severity of market competition or rate of change in a given industry may impact corporate strategy but have considerably less influence on logistics strategy. Environmental dynamism and hostility in this research were used and measured in the traditional sense. This approach may not have adequately captured an environmental-strategic link at the logistics departmental level. Perhaps product type, distribution network or other such factors are much more important in logistics strategic orientation.

Second, logistics strategy, as defined in this research, may not adequately capture strategic intent in the same manner as organizational science research and its focus on Porter's or Miles and Snow's strategic typologies. As Chow *et al.* (1995) pointed out, the Bowersox and Daugherty typology is heavily based on organizational characteristics. This stands in rather stark contrast to a low cost or differentiation strategy based on manufacturing strategy. Further work and research in logistics

strategy is necessary to better understand the similarities and differences between corporate-level and departmental or task-driven strategies.

Closely related to the first consideration is a third possible explanation -- the nature of this research's sample. The majority of this sample was composed of highly regarded logistics organizations. It is entirely possible that this select group, having mastered and elevated many logistics practices, determines logistics strategy orientation on substantially different criteria than most firms. Environmental considerations, though not ignored, may play a relatively minor role.

The other two context variables, information technology operating systems and planning systems, were examined in hypotheses 3(a) and (f). The general premise was that highly capable information systems afford firms the opportunity to interface with other firms -- both operationally and strategically. Therefore, the expectation was that the more highly capable firms would favor externally-oriented strategies. This position was not supported. However, it should be noted that operating systems narrowly missed being significant ($p=.11$). This is encouraging for a new construct.

But if information technology is as pervasive as academic and managerial articles would lead one to believe, why does it not clearly differentiate between the strategic orientations? The answer may lie in the mean responses obtained in this research. Operating on a 1-5 scale, with five representing high levels of capability, the self-reports indicated means of 3.47 (externally-oriented) and 3.35 (internally-oriented) for operating systems capability and 3.32 and 2.94 for planning systems. It is clear that the groups do not consider themselves as highly capable on either information technology measure.

Even in highly rated logistics organizations *strategic* deployment of information technology is still in an early stage of development. It is one thing to automate manual procedures, generate shipping documents and collect data for status reports. It is an entirely different approach to link vendors and customers electronically, willingly share proprietary information and design an information system to support a strategic orientation.

This may also explain why the operating systems were close to being a significant differentiator while planning systems were not. The emphasis may currently be on operational issues as that information is more likely to be less proprietary and deliver more immediate impact for the investment. Although no statistical inference should be drawn from the mean scores for the respective strategies, their reported capabilities may provide a hint of the future. One can speculate that externally-oriented strategy firms will continue to push development of outside electronic linkages to support their strategy.

In the final analysis, however, context did not have any statistically significant association with strategy in this research. Nonetheless, these results do provide a point of comparison with Kohn *et al.* and future research within the framework of the *Logistics Contingency Model.*

CONTEXT AND STRUCTURE

A significant amount of research has been conducted into the context-structure relationship. Previous research in organizational science and logistics has demonstrated that context does influence organizational structure. In this research, four common

elements of structure were used - centralization, formalization, integration, and span of control. Figure 5.2 highlights the relationship.

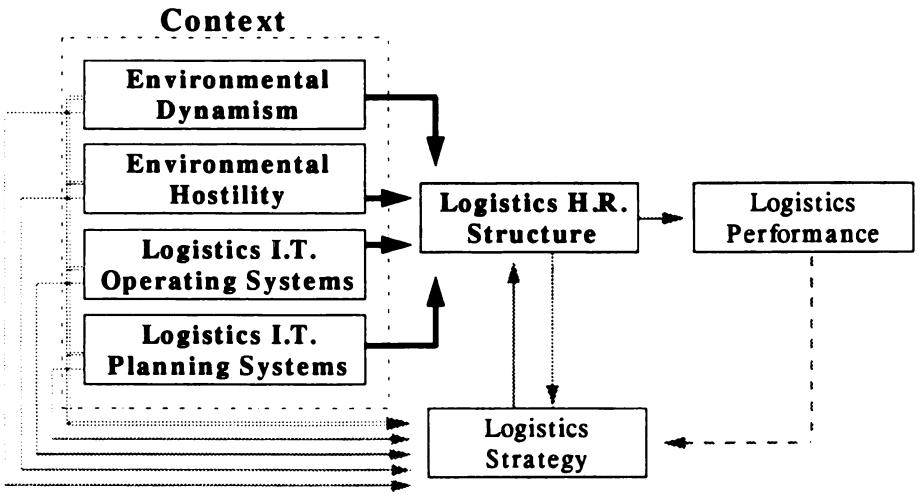

Figure 5.2
Logistics Contingency Model: Context-Structure

Environmental dynamism was shown to have no significant impact on centralization and cross-functional integration. These results were not consistent with the prevailing beliefs of organizational science. The logistics work of Germain, Dröge, and Daugherty (1994) and Germain and Dröge (1995) found environmental uncertainty predicted integration and operations decentralization but not scheduling decentralization. Thus, the results of the present research are at odds with some of these previous findings. However, it should be noted that the environmental uncertainty construct used in the former efforts is more expansive than environmental dynamism. Direct comparisons should therefore be made with caution.

As hypothesized, span of control and integration through committees were predicted by environmental dynamism. Firms experiencing higher levels of

environmental dynamism reported narrower spans of control and greater use of integrative committees. This is consistent with the organizational science literature which states that as dynamism increases, firms take action to mitigate against the increased volatility accompanying the increased dynamism. Under such conditions, managers are only able to effectively manage smaller numbers of subordinates and integrative measures are used to increase information flow and thereby offset uncertainty.

This result raises a question concerning integration. Why are integrative committees significant but not cross-functional teams? The answer may be tied to strategy. In addition to the temporal consideration of the integration dimensions mentioned earlier in this dissertation, there is also the reason committees are formed. The questionnaire links committees to specific projects and cross-functional teams to strategic decision-making. Environmental dynamism had no association to logistics strategy. It would appear reasonable that cross-functional teams related to strategy would also not have an association. It is possible that environmental dynamism periodically creates a perceived need to deal with a particular situation. In these situations the shorter duration committees are brought together for a particular project. Rather than being part of an overall strategic resolution, perhaps committees represent an "adjustment" to changes brought on by environmental dynamism.

The remaining dyad in this group - environmental dynamism-formalization - produced the most surprising result. Formalization was predicted to be higher when environmental dynamism was lower. The organizational science perspective underlying this premise is that the "quieter" the environment, the easier it is to have set rules and

procedures. Not only was hypothesis 1(c) rejected, it was contradicted. Firms identified as experiencing high levels of environmental dynamism reported mean levels of formalization of 3.72. The low environmental dynamism group reported a mean of 2.87. The contradictory finding and relatively high levels of formalization reported by the high environmental dynamism group were unexpected. It was expected that the low environmental dynamism group would indicate greater formalization as per the organizational science literature.

This result is consistent with another emerging theory in logistics. Research at Michigan State University (1995) has demonstrated that routinization of tasks leads to increased flexibility. Flexibility is considered crucial to good logistics performance.

The findings of the present research regarding formalization advance the "routinization leads to flexibility" concept. Routinization is built upon the capabilities of standardization, simplification and discipline (*World Class Logistics*, p.207). Underlying those capabilities - particularly standardization and discipline - is formalization. Whereas routinization typically focuses on the actual work practices in the logistics system, formalization can be thought of as the essential building block of the related capabilities. In order to achieve standardization, simplification and discipline, firms must have well-understood operating rules and processes. To the extent that these rules and processes are clearly documented and closely adhered to, they represent formalization.

For this sample of highly competent logistics performers, highly dynamic environments pose a potential threat - loss of flexibility. In such an environment there exists greater opportunity for problems to occur simply because of dynamic and

fluctuating changes. To combat this and retain maximum flexibility, formalization is instituted. Procedures are standardized and simplified - thereby reducing the decision-making options regarding the routine, repetitive logistics tasks. Adherence to these procedures (i.e., discipline) ensures a similarity of outcomes that customers can anticipate and appreciate. As argued in *World Class Logistics,* this approach reduces the time managerial talent devotes to routine requirements and instead can "take advantage of and accommodate unexpected events (p. 207)."

In summary, the contradictory finding refutes traditional organizational science beliefs concerning dynamism and formalization. But the finding does support the emerging tenets of superior logistics performance. It is, therefore, reasonable to assume that formalization underlies logistical routinization and contributes to the goal of maintaining or enhancing flexibility in the logistics system. This represents an important step in understanding the counter-intuitive position that formalization --> routinization does not equal rigidity. It represents competitive advantage at the logistics level.

A second plausible explanation exists concerning the dynamism-formalization finding. This concerns the formalization construct used in this research. Composed of seven benchmarking measures and a question concerning existence of a mission statement, the construct does follow the normally accepted definition of formalization (i.e., presence of written rules and procedures). But upon reflection, one might pose the question: Which firm is most likely to benchmark, the one in the less volatile environment or the more volatile environment? Although not statistically significant, the results of this research indicate that firms in more volatile environments are more

likely to benchmark. To combat an uncertain environment, it is advantageous to benchmark. Therefore, the outcome is that firms in highly dynamic environments benchmark more than firms in less dynamic environments. This is consistent with the results of this research.

Turning to environmental hostility and structure, the same contradictory finding exists between hostility and formalization as between dynamism and formalization. Firms in more hostile environments reported a mean score of 3.63 versus 2.74 for firms operating in less hostile environments. This result closely parallels the dynamism-formalization outcome. In all likelihood, the same explanations hold true in the hostility-formalization analysis. In an effort to avoid redundancy, those explanations are not repeated here.

The other environmental hostility-structure relationships (i.e., centralization, integration and span of control) were not supported. It was expected that firms experiencing low levels of environmental hostility would be characterized by greater centralization, less integration and broader span of control. There is little guidance offered in the logistics literature concerning this outcome. Previously mentioned studies incorporating environmental uncertainty do not break out the hostility component separately. Kohn *et al.* (1990) did not assess the impact of environmental hostility on logistics structure.

The results suggest that logistics structure is unaffected by environmental hostility. The traditional view of hostility is the intensity of competitors' actions. But those actions are generally described in terms of market share, product line, etc. It may be that this form of hostility is not perceived as relevant to the structuring of a

logistics department or organization.

It should be noted that integration through committees and span of control approached the significance level of .10. The results may be more reflective of sample size and homogeneity than theoretical deficiencies. As such, they offer support for the continued use of these constructs and posited relationships in subsequent research utilizing the *Logistics Contingency Model.*

The information technology component of this research was new in terms of logistics contingency research. Unlike environmental dynamism and hostility, the firm exercises direct control over information technology operating and planning systems. Fixed in the short-term, such systems can be improved upon over a period of time.

With no precedent to serve as a guide in this area, exploratory positions were staked out according to general logic concerning information technology. It was expected that information technology would serve as an integrative mechanism of the firm. Electronic linkages would increase span of control by increasing supervisory monitoring ability, provide integration through the transfer of information, decentralize decision-making as information increased in content and accessibility, and be accompanied by greater formalization as written procedures and rules dictated the "new rules of the game." Firms with more capable systems would exhibit more of these characteristics than less capable firms.

These associations were examined for operating systems through hypotheses 3(b)-(e). The results supported two of the four hypotheses. Firms with highly capable operating systems were significantly more likely to have greater formalization and span of control. In fact, firms with highly capable operating systems indicated a span of

control (6.88) that is, on average, more than one full person greater than the less capable firms (5.75).

If viewed from a resource allocation perspective, highly capable operating systems are worthwhile as they extend managerial input and control over a larger number of employees. As logistics operations are asked to "do more with less," this is an important consideration. It suggests that if firms are going to make investments in information technology, there are potential pay-offs for going beyond mere adequacy.

The result for formalization was particularly strong (at a significance level of .04): The mean formalization score for firms with highly capable operating systems was 3.78, a full point higher than the other group at 2.75. What might explain this difference?

One explanation is that the construct, though rigorously evaluated, does not capture the important dimensions of operating systems. That explanation is rejected. Not only did the construct hold up under critical examination, a cross-check indicated that it also incorporated most of the measures deemed important by the sample. Absent that explanation, one is left to conclude that less capable firms appear unwilling or unable to include documentary support and procedures for their information technology operating systems.

As for centralization and integration, operating systems have little impact. Of the two constructs, the lack of association with integration is more surprising. It was expected that information technology operating system capability would be closely identified with the shorter duration committee work. Again, it may be the promise of information technology has yet to be fully realized and harnessed in logistics.

Information technology planning systems (hypotheses 3(f)-(j)) had only one significant relationship - span of control. It was, however, the strongest relationship ($p=.01$) uncovered in this research. Centralization, formalization and integration were not predicted by planning systems.

One explanation for greater spans in firms with highly capable planning systems (7.33 versus 5.54) is the type of work performed by the planning systems. Defined in this research as forecasting, inventory management and distribution resource planning, such systems would be heavily computerized. Monitoring these activities would therefore seem to be easier. It is also reasonable to assume that the personnel associated with planning are fairly autonomous and require less oversight, thereby allowing managers to supervise more of them compared to other personnel. Any system that is less capable would therefore reduce the ability of management to remotely monitor these subordinates, effectively reducing span of control.

The other results in the area of planning systems and structure may be due to the constructs. While the activities associated with planning systems could easily be conceived as candidates for centralization and formalization, the centralization and formalization constructs used in the research are quite different. There is little reason to expect that forecasting and inventory management would predict whether or not such activities would be consolidated in a logistics department. Such planning activities are unlikely to predict whether or not a firm benchmarks (i.e., formalization) or forms integrative committees or cross-functional teams. In hindsight, it is probable that the constructs were a bit too far removed from the original intent of the individual hypotheses.

STRATEGY AND STRUCTURE

A long-standing tenet of organizational science is that structure follows strategy. Although mixed results have been widely reported - and some have argued for acceptance of a reciprocal relationship - structure follows strategy is the prevailing belief. There is no published research that uses a pure logistics strategy as the strategy construct in terms of predicting structure. Figure 5.3 highlights this relationship.

This research has identified significant relationships between strategy and cross-functional integration and strategy and span of control. Non-significant relationships exist between strategy and centralization, formalization and integrative committees. The strategy-structure relationships were investigated through hypotheses 5(a)-(d).

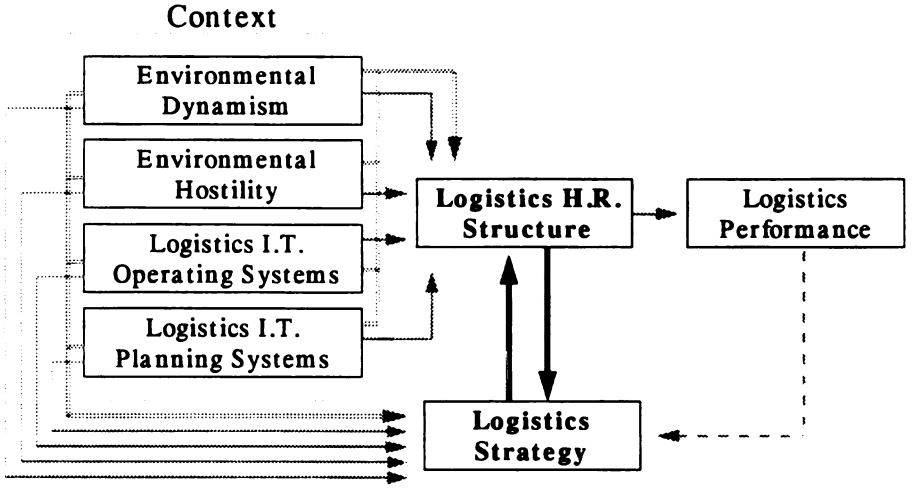

Figure 5.3
Logistics Contingency Model: Strategy-Structure

As hypothesized, externally-oriented strategy firms reported greater numbers of personnel (7.13) under the senior logistics executive than internally-oriented strategy firms (6.00). The externally-oriented strategies are focused on an "extended firm"

view. Under this perspective, span of control is a necessary coordinating mechanism. The decision to extend the firm beyond its traditional boundaries challenges typical command and control practices. Tight control is not possible or perhaps even warranted. With less concern about monitoring, a natural offshoot is greater span of control.

As for cross-functional integration, externally-oriented strategies are predicated on cross-functional effectiveness. It logically follows that externally-oriented strategy firms would encourage and embrace the formation of cross-functional teams within their organization. These teams are much more important to firm and partner success than to the internally-oriented strategy firms.

It may also be plausible to speculate that span of control and cross-functional integration are highly complementary and necessary in externally-oriented firms. As integrative supply chain strategies are put in place by progressive boundary-spanning firms, cross-functional teams must be used to interface with teams from other channel members. This "stretching" across both internal and external boundaries forces participating firms to rethink span of control and accept greater spans. Afterall, in many cases the cross-functional teams are charged with the responsibility of facilitating the supply chain approach. As they accept greater responsibility, it is reasonable that they require less supervisory direction and oversight. The managerial talent formerly expended on these individuals can be redeployed and extended to other personnel.

Centralization and formalization were not predicted by strategy. It was hypothesized that externally-oriented strategy would favor less centralization and less formalization. The rationale behind this position was that in dealing with extended

enterprises, decision-making would have to be pushed away from a centralized authority and that the give and take of such a relationship might not be amenable to high levels of formalization. The fact that this position must be rejected in the present research suggests that as of yet there is no consensus on the organizational structure of the extended firm. It may also be related to the rather short duration of some externally-oriented strategies. As reported in Chapter Four, eighty percent of external strategists changed strategies in the last three years. Under such conditions of change it may be difficult to identify the appropriate level of centralization and formalization.

STRUCTURE AND PERFORMANCE

Within the organizational science literature, structure and performance linkages have received less attention than other areas of the CSSP paradigm. In the logistics literature there exists some evidence of structure impacting logistics performance (e.g., Dröge and Germain 1989). But by and large, there is little empirical support in this area. However, within the frameworks of context-structure-performance and strategy-structure-performance, the general premise is that structure mediates the relationship. Based on that idea, hypothesis 6(a) predicted that in this research there would be no significant relationship between the structure variables and performance. Figure 5.4 highlights the relationship.

This hypothesis was supported. The results are consistent with organizational science theory. Specifically, neither formalization, centralization, integration, nor span of control had a significant, direct association with performance. In this research, the conclusion is that logistics organizational structure and its relationship to specific

logistics performance mirrors the corporate structure-corporate performance relationship reported in organizational science literature.

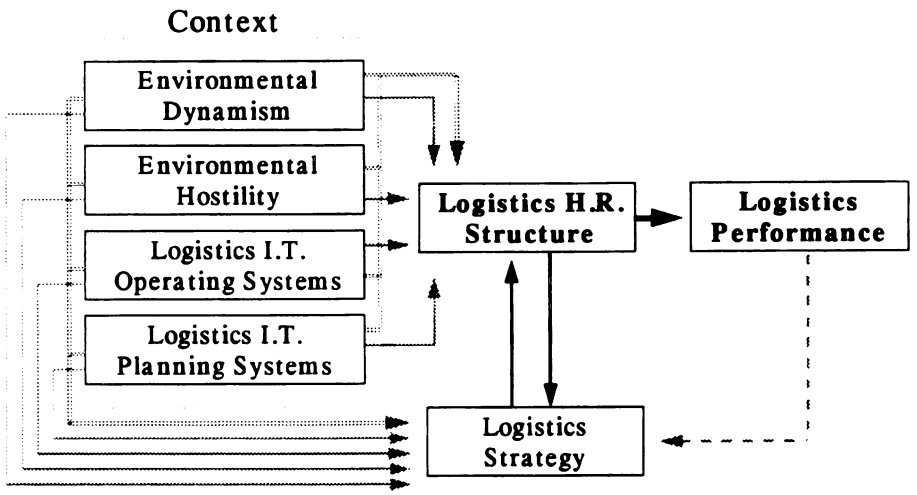

Figure 5.4
Logistics Contingency Model: Structure-Performance

Of course, this is only part of the structure-performance story. Organizational science theory holds that the reason no direct relationship exists between structure and performance is due to the fact that structure serves as a mediational variable. This role is discussed next.

INTERACTIONS AND MEDIATION

At the heart of contingency theory is the idea of fit. Earlier in this research the concept of fit was discussed in terms of alignment. That is, if a firm has an alignment or fit between context, strategy and structure then better performance should result. This is not to say, however, that there is a single best fit for a given set of conditions. Equifinality posits that different fit combinations can produce satisfactory performance.

This idea of fit as alignment necessitates consideration of interaction and mediational effects. Performance outcomes are contingent upon this interplay of variables and effects. Within this research, specific interaction and mediational paths were isolated and tested. Unfortunately, no statistically significant relationships were found to support the various paths of the *Logistics Contingency Model.*

It was hypothesized that the context variables would interact to predict strategy (H3(k)) and the different structure variables (H3(l)). The lack of support for these hypotheses leads to the conclusion that significant interaction effects are not present in the model. It should be stressed that, in general, very few interaction effects have been demonstrated in logistics research. It remains an elusive target.

Three mediational models were examined: (1) Context --> mediated by Structure --> Performance; (2) Context --> mediated by Strategy --> Structure; and (3) Strategy --> mediated by Structure --> Performance. These models represent, respectively, hypotheses 4(a)-(d), 4(e)-(h), and 6(b). Figure 5.5 highlights the three mediational paths.

There are several possible reasons mediation effects were not observed in the research. Certainly one explanation is that they simply did not exist. If so, logistics researchers need to identify why organizational science constructs and theory do not adequately capture logistics relationships. A second possibility relates to one of the chief criticisms of contingency theory - poor specification of the variables. Some of the constructs - specifically information technology operating and planning systems and strategy - have never been used in this type of research. Given that they represent fifty percent of context and the entire strategy construct, problems within the constructs

would pose a substantial obstacle in the examination of mediation effects. A third possibility is that the limited sample size created effect size problems. It is possible that small and medium effects could not be detected.

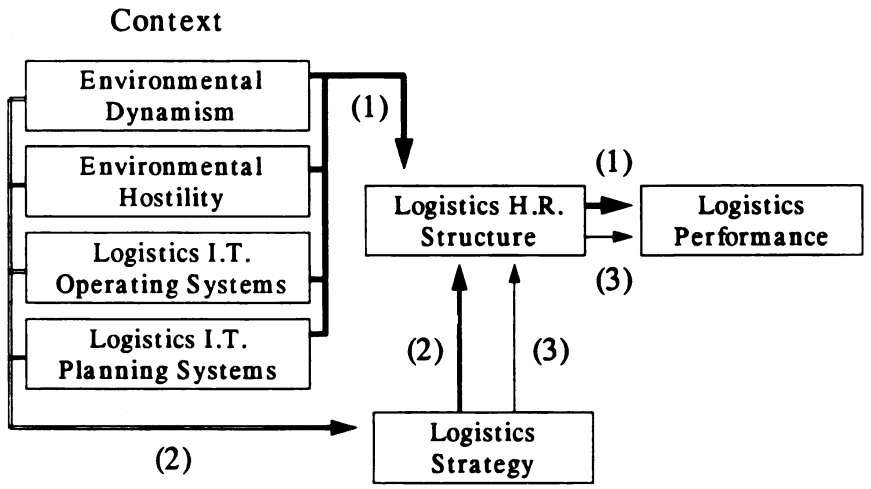

Figure 5.5
Logistics Contingency Model: Mediation Paths

Although statistically significant results were not obtained, there was some evidence supporting mediation. For example, the direct effect of environmental hostility on performance resulted in a *t*-value of -1.183 and $p = .24$. However, when mediated by centralization, environmental hostility had a higher *t*-value of -1.333 and $p = .18$. Even more compelling was the hostility-integration (committees) relationship. In this case, the *t*-value improved from -1.183 to -1.672 and the *p*-value from .24 to .10. In this case it was evident there was an indirect effect of environmental hostility through integrative committees on performance.

These were not isolated examples. Throughout the mediational relationships, there was frequently improvement when moving from direct to indirect effects. Of course, the opposite was also true. But overall, the results offer some encouragement that future testing might reveal statistically significant relationships which support the mediational hypotheses.

PERFORMANCE-STRATEGY FEEDBACK LOOP

Certainly one of the most intuitively appealing ideas in organizational science and management research is the idea that poor performance will lead to an adjustment in strategy. Despite what most would claim to be the obviousness of this assertion, it has been impossible to empirically demonstrate. This research collected longitudinal data in an effort to examine this feedback loop in the *Logistics Contingency Model.*

As discussed in Chapter Four, over half of the respondent firms have changed their logistics strategic orientation during a three-year time period. Firms characterized as having above average performance were more likely to change strategies than those firms indicating subpar performance. It is difficult in those cases to argue that poorer relative performance led to strategic reevaluation and change. This is particularly true given that the survey questions asked respondents to assess their performance relative to competitors.

Using the available data, a comparison was made between 1994 strategic choice and associated perceived performance and 1997 strategy. A chi-square test was performed to determine if a relationship existed between 1994 strategy-performance and subsequent 1997 strategy. The test failed to substantiate any statistically

meaningful relationship. The performance --> logistics strategy results obtained in this research failed to offer any empirical justification for the feedback loop included in the *Logistics Contingency Model.*

The results indicated that firms are much more content to remain in an internally-oriented strategy than an externally-oriented strategy. Of those externally-oriented firms changing strategies, a majority shifted to an internally-oriented strategy. What then caused both the strategic inertia and change present in this research?

Several factors may be impacting strategic choice. First, resistance to change may explain why many firms have not changed strategies. Given the adjustments that logistics has made in the wake of deregulation and increased competition, firms may be content with the status quo. This may be particularly true in the case of internally-oriented firms. There would be no outside party pushing them to improve, compared to the extended channel arrangements associated with the externally-oriented strategy firms. Closely related to that is performance and benchmarking. Earlier examination of data by *World Class Logistics* revealed a tendency of non-benchmarking firms to consistently overrate their performance. The same phenomenon occurred within this sample. These firms do not recognize their comparatively poor performance and therefore feel no need to change.

In terms of those firms changing strategic orientation, it is important to note two key points: (1) A majority of firms making a change were above average performers, and (2) The majority of firms had indicated an externally-oriented strategy in 1994 with many reverting to an internally-focused strategy in 1997. In terms of the first point, these dynamic firms are not satisfied with their performance. They recognize the need

to safeguard against complacency and continually seek strategic renewal. The push for improvement drives their strategic change. As for the second group, information technology may not have supported their strategic initiatives. Although no longitudinal information technology data was gathered, an externally-oriented logistics strategy requires numerous external interfaces. Accurate and up-to-date information is needed to execute the interfaces. Given the rather harsh assessments concerning operating and planning systems, it is probable that the information technology systems simply could not deliver the necessary information in a timely and accurate fashion. Although trade magazines trumpet the success stories of integrated logistics information systems and extended enterprises, the mere adequacy of operating and planning systems capability indicated by this research's respondents may be the norm rather than the exception. Faced by this realization, firms may be regrouping under an internally-oriented strategy.

It is also possible that logistics finds itself in a "pendulum" mode. If customer service is emphasized perhaps an externally-oriented strategy gains favor. But if provision of that customer service is accompanied by too-high costs, the decision may be made to rein in costs through an internal focus. Therefore, this "pendulum" swing may explain the shifts in strategy.

CONTRIBUTIONS: ACADEMIC

This research contributes to the body of logistics knowledge in several ways. First, although not considered in the discussion portion of this chapter, the construct validation process is crucial in theory development. This research has demonstrated

application of a method that greatly increases the validity of constructs. This answers one of the challenges put forth by Mentzer and Kahn (1995) and should encourage other researchers in the field of logistics to consider such approaches. At the same time, it has called into question the applicability of using formalization in the traditional organizational science sense. This research demonstrates that logistics characterizes the formalization-environmental dynamism and hostility relationship in an entirely different manner than organizational science.

Second, the construct validation process has introduced information technology operating and planning systems variables to the field. Their demonstrated importance should encourage other researchers to push forward in the investigation of information technology and its critical role in predicting logistics structure. Given the current interest and resources devoted to information technology, this is an important finding.

Third, the *Logistics Contingency Model* breathes life into - and supersedes - the Chow *et al.* framework. It demonstrates one configuration through which contingent relationships may be examined in logistics. The fact that no significant mediational or interaction effects were found does not invalidate the model. After all, this was the model's baptism, not its burial. The fact that it has been used with some success should encourage other researchers to move forward in this area.

This leads to a closely related fourth contribution, theory testing. Mentzer and Kahn (1995) lamented the relative lack of theory testing in logistics. The *Logistics Contingency Model* provides one vehicle for theory testing. Already it has demonstrated some interesting results.

The fifth contribution is empirical support for a number of relationships. The following relationships were substantiated:

- Higher levels of environmental dynamism and hostility result in greater formalization. This finding is contrary to empirical results in organizational science. In addition, it provides underlying support for the belief that routinization leads to flexibility, with formalization being a key component of routinization.
- Highly dynamic environments produce significant usage of integrative committees within logistics organizations.
- Highly capable operating systems extend span of control and are associated with higher levels of formalization. Highly capable planning systems also extend span of control. Other results concerning operating and planning systems suggest that substantial room for improvement still exists in the area of information technology.
- Externally-oriented logistics strategy firms were significantly more likely to use integrative committees compared to non-externally-oriented strategy firms. Neither strategic orientation could be linked to significantly better performance.
- Logistics structure did not impact performance. However, the corollary relationship - that structure would mediate contextual and strategic influences on performance - was not supported.

The sixth and final major academic contribution of this research is the holistic nature of the *Logistics Contingency Model*. Logistics research has typically focused on single or limited numbers of relationships. Comprehensive models defining logistical operations are rare. Although much of the preceding discussion has been atomistic in nature, the *Logistics Contingency Model* provides a holistic view of the interrelatedness of logistics operations. In so doing, the overall results raise an issue that is easily ignored or missed when conducting highly focused research. The issue is: Are constructs developed in other disciplines transferable to logistics research?

The number of non-significant findings calls into question the transferability of constructs from other fields. Although the general meaning of the constructs may be useful, results of this research definitely suggest that the transfer of knowledge from one field may be inappropriate when used in a logistics context. The use of borrowed constructs and verbatim application in logistics research may create more obstacles than opportunities in conducting meaningful logistics research.

If the theory testing challenge of Mentzer and Kahn (1995) is to be properly addressed, it should not be built upon simple substitution of borrowed theory. Nowhere is this more evident in this research than in the results concerning formalization. Whereas a lengthy and impressive body of organizational science literature posits a distinct environmental uncertainty and formalization relationship, the results of this research resoundingly reject that relationship. This does not discredit the aforementioned literature, it merely points out the potential problems encountered in borrowing constructs and applying them in a logistics setting. This is not to suggest that every imported construct is inappropriate. Some constructs such as span of control

are relatively straightforward and need not be laboriously scrutinized. But in general, this research highlights the need for further development of constructs and theory specifically rooted in logistics thought and practices, based on holistic relationships posited in a comprehensive model.

CONTRIBUTIONS: MANAGERIAL

The theoretical challenge of Mentzer and Kahn (1995) was prominently discussed earlier in this dissertation. While that challenge is necessary, most academicians studying logistics would agree that ultimately research should have relevancy to practitioners. The *Logistics Contingency Model* was designed with these dual aims in mind. This section discusses the managerial implications of this research. The following section discusses academic contributions.

The results of this research contribute seven key managerial insights. First, this research demonstrates the impact of highly capable information technology systems on logistics. Span of control can be extended through both highly capable information technology operating and planning systems. Similar to other functional areas within firms, information technology extends the reach of logistics executives and managers. The result has been a decrease in middle management. This research suggests that logistics is traveling the same road, implementing highly capable information technology systems and extending span of control. As logistics is asked to do more with a level or decreased budget, information technology - if properly deployed - may offer logistics managers the opportunity to decrease personnel while not sacrificing command and control responsibility.

Second, despite the positive impact of information technology on span of control, other anticipated relationships did not materialize. This was due to underdeveloped information technology capabilities. Respondents reported, on average, that their logistics information technology operating and planning systems were not highly capable. Lacking higher capability, most firms have not been able to differentiate themselves from their competitors in structuring logistics operations. Those firms that do achieve higher capability in logistics information technology will enjoy a competitive advantage as they become more integrative and formalized.

This mention of formalization leads to a third point. As discussed earlier in this chapter, in this research higher levels of formalization were associated with more dynamic and hostile environments. It was speculated that this relationship demonstrated a means of achieving flexibility - a highly desired operational attribute in an uncertain environment. This possibility, that formalization may ultimately lead to flexibility, should encourage managers to examine their written processes and procedures. While it is fashionable to speak of "empowerment," it may be that empowerment is more beneficial in exceptional circumstances than in standard, repetitive situations.

Fourth, managers should note the absence of most hypothesized significant relationships between environmental dynamism and hostility - strategy and structure. Considering that most firms in the sample were highly regarded for their logistics prowess, the absolute absence of concern for environmental dynamism and hostility in fashioning strategy or structure (other than formalization) might be a clue to other firms. They may be concerned about the wrong things if they are expending significant

resources on environmental monitoring.

The fifth managerial contribution of this research concerns strategy. Externally-oriented strategies do typically have broader span of control. This suggests that firms are successful in implementing a management style that extends span of control internally and externally. Closely tied to this extended firm is an internal mechanism designed to foster integration. In this research, firms with externally-oriented strategies led the way in the use of integrative cross-functional teams. Although this research does not demonstrate that increased span of control and greater integration make the strategy successful, it does clearly differentiate externally-oriented strategy from internally-oriented strategy. Firms contemplating a change in strategy should expect to see operational positives in those two areas.

Sixth, strategy is dynamic and equifinality is supported. Over half the firms responding to the follow-up questionnaire reported strategic change from 1994 to 1997. Many of the firms opting for change had above-average performance in 1994. Lack of success did not force change upon them - it was deliberate. In addition, there was no discernible pattern to high performance levels. Both internally and externally-oriented strategies produced high performance. This was true in 1994 and 1997. The key appears to be that firms accurately identify the strategy appropriate to their operational situation. Internally-oriented strategy continues to be the predominant strategy type. There was evidence of many 1994 externally-oriented strategy firms shifting in 1997 to an internally-oriented strategy while the reverse rarely occurred. Further research is necessary as it is unclear why firms choose not to remain in an externally-oriented strategy.

Finally, in the area of performance, practitioners are urged to benchmark. The *World Class Logistics Research* revealed that non-benchmarking firms consistently overrated their own performance in comparison to competitors. This research further substantiates that finding. The non-benchmarking firms again rated their performance (in 1994 and 1997) better than their competitors. An aggregated measure of the perceived competencies indicated a different result. Non-benchmarking firms typically scored below average on the aggregated measure. Also, these firms were the most static in terms of logistics strategy. Few showed any change in strategic choice between 1994 and 1997, obviously deluded by their own observations. Although there was no statistical evidence that benchmarking led to high performance, it does appear lack of benchmarking impeded serious self-assessment.

LIMITATIONS

As is the case with any research, this effort has several limitations. First, and foremost, is the size and homogeneity of the sample. The sample size restricted the application of certain statistical approaches. A larger sample may have resulted in different conclusions. The homogeneity of the sample is an issue. For the most part, participating firms represented highly adept logistics practitioners. Also, as members of the Council of Logistics Management they were more likely to be attuned to logistics issues and practices. These characteristics limit the generalizability of the results. Ironically, the homogeneity of the sample may have also limited the number of significant results that might otherwise have been obtained from a randomly drawn sample.

A second limitation is the operationalization of the variables. Constructs imported from different literatures have been, to varying degrees, modified for logistics research. There is a concern that these constructs may not adequately represent logistics thought and practice.

The third limitation is that any model or research must be limited in scope in order to make it tractable. This effort was no different. The number of possible variables was intentionally limited. A different selection or combination of variables might have produced different results and/or insights.

DIRECTIONS AND PROPOSITIONS FOR FUTURE RESEARCH

The most immediate and apparent direction for future research is to obtain a larger, random sample. Before any changes are made to the *Logistics Contingency Model* it should be evaluated in terms of a larger sample. This would effectively broaden the range of firms beyond top performers.

A larger sample would afford the opportunity to use a methodology comparable to that used in the limited number of published studies to date. Specifically, assuming an adequate sample size, the model would be evaluated using structural equation modeling. The simultaneous evaluation procedure is better suited for testing the entire model than the approach used in this research.

Following the evaluation through a larger sample, and any necessary adjustments to the model, a number of directions are open. The most obvious is the use of different variables in the model. Size has frequently been demonstrated to have an impact on organization structure. It should be included in future model use.

Environmental dynamism and hostility might be collapsed into an environmental uncertainty construct. Pfohl and Zöllner (1987) suggest using type of product in further research. Certainly there are many more variables to draw upon.

The information technology variables should be refined and possibly expanded. Any number of other context variables might be introduced into the model. However, as a cautionary note, inclusion of any variable should be demonstrated on a theoretical basis. Proper steps should be taken to ensure the validity and reliability of any new constructs or variables.

There is also the idea of integration as an outcome variable as proposed by Chow *et al.* (1995). The *Logistics Contingency Model* is flexible enough that one could easily remove integration from structure and place it between structure and performance. The results from this research have demonstrated the significance of the integration construct. Perhaps similar to the contradictory findings associated with formalization, one might discover that integration does have a different role within logistics.

Beyond these fairly immediate suggestions, the model should be used in an international setting. With the growing interest in global supply chain management, the *Logistics Contingency Model* is potentially well suited and adaptable enough to use in testing international applications. Of course, any attempts to do so should be accompanied by rigorous and thorough construct evaluation. Cultural differences could easily lead to false findings if the proper preparatory work is not first performed in the international setting.

These future research suggestions should be accompanied by consideration of a number of propositions emerging from this research. These are as follows:

(1) Environmental dynamism and hostility should be recast in a more appropriate logistics context. As transferred from organizational science literature there is considerable question, based on results of this research, as to whether or not they adequately capture the intent of dynamism and hostility at the logistics level.

(2) Similarly, the use of some structure components from organizational science should be reexamined and considered from a logistics perspective. Specifically, further work should be conducted in the area of formalization and the closely related area of routinization. Centralization should be investigated to determine how best to define it in terms of logistics.

(3) Logistics strategy merits updating. As more is learned about strategy, more precise dimensions should be identified. A cost versus customer service focus is too limiting and the Bowersox and Daugherty typology should be reexamined within the context of ten years of additional research. Also, factors driving strategic change deserve attention. This research revealed substantial strategic movement among firms but it did not identify the major influences behind the change.

(4) Performance dimensions pertinent to logistics should be rigorously investigated. In all likelihood hard performance data will remain difficult to obtain. Therefore, logistics researchers must determine perceptual measures of logistics performance that maintain relevancy to logistics and not broader corporate-level performance. If performance dimensions can be defined with greater accuracy, then it becomes much easier to determine if firms have "fit" in their system. It is reasonable

to believe that different firms employ different strategies due to different performance criteria. But the current state of logistics performance constructs makes researching "fit" a difficult proposition as firms are measured on relatively crude performance constructs.

SUMMARY

At the heart of the CSSP paradigm is the concept of "fit." According to the organizational science research it is hypothesized that it is the alignment of a firm's strategy and structure in accordance with its context that will determine performance. Thus, it is not a single variable that produces a successful outcome but the interaction of many. It was expected that this research might demonstrate elements of fit through interaction and mediation tests. The fact that none could be statistically supported raises a host of questions about sample characteristics, construct definition, hypothesized relationships, and the relevance of fit with respect to logistics. This research represents an early step in this investigative journey of fit and logistics. The *Logistics Contingency Model* offers a unified and coherent framework to continue the investigation.

Results from this research provided limited support for long-standing organizational science relationships. For example, highly dynamic environments did result in firms using more integrative measures. But more frequently, the results did not support the hypothesized relationships. For example, the relatively long history of environmental dynamism and hostility did not predict centralization or formalization of logistical activities.

In fact, in terms of formalization the hypothesized relationship was contradicted. Firms in highly dynamic and hostile environments reported higher levels of formalization compared to firms operating in less dynamic and hostile environments. This surprising result indicates that logistics organizations react differently to uncertainty than corporations as a whole. In order to cope with dynamic and hostile environments, logistics organizations formalize procedures whenever possible. This finding can further be viewed in the context of the emerging belief that "routinization leads to flexibility." Formalization can be thought of as an underlying element of routinization - providing the mechanism to create routinization through formalization's impact on standardization and simplication of procedures.

The investigation of an information technology dimension was fruitful. Operating and planning systems have impacts on span of control, integrative mechanisms and formalization. Such findings are important as future researchers contemplate contingency designs.

With the exception of the work of Kohn *et al.* (1990), this is the first research to demonstrate the use of logistics strategy in a CSSP framework. The lack of any positive findings associated with logistics strategy does not invalidate its use. It simply raises the question of how to pursue this issue in the future. Perhaps further refinement is necessary in this area.

The use of longitudinal data represents an important move forward in logistics research. The inability to demonstrate support for the purported performance --> strategy feedback loop places findings of this research in the company of others who have found evidence of this connection elusive. This research did indicate that logistics

strategy is a dynamic concept within firms. Over fifty percent of the firms involved in the follow-up questionnaire had changed strategic direction over the observation period. Clearly a relationship exists that merits continued research.

Future research in logistics through a CSSP contingency approach offers promising potential. The flexibility of the *Logistics Contingency Model* permits highly focused examinations into parts of the model or full-blown analysis of the entire network of relationships. Perhaps most importantly, it provides a point of departure for logistics researchers wishing to build the theoretical basis of logistics within a framework whereby results should be comparable. As logistics gains increasing stature in the boardroom, a stream of research emanating from the *Logistics Contingency Model* may potentially offer important direction to academics and practitioners alike.

APPENDICES

APPENDIX A

WORKBOOK QUESTIONNAIRE

Section One - Background

Please circle the number closest to the competitive situation your company faces.

Minimal time, effort, resources and managerial attention are required to keep up with major competitors.	1 2 3 4 5	Much time, effort, resources and managerial attention are required to keep up with major competitors.
When decisions are made within my firm, possible competitor reaction or retaliation is not an important consideration.	1 2 3 4 5	When decisions are made within my firm, possible competitor reaction or retaliation is an important consideration.
Our major competitors are not particularly aggressive.	1 2 3 4 5	Our major competitors are fiercely aggressive.
Actions of competitors are easy to predict.	1 2 3 4 5	Actions of competitors are difficult to predict.
A minimal amount of time is spent analyzing major competitors' strategies and actions.	1 2 3 4 5	A great deal of time is spent analyzing major competitors' strategies and actions.
Our firm rarely changes marketing practices to keep up with competitors.	1 2 3 4 5	Our firm frequently changes its marketing practices to keep up with competitors.
Our firm must rarely change its logistics practices to keep up with competitors.	1 2 3 4 5	Our firm must change its logistics practices extremely frequently to keep up with competitors.
Supplier capabilities change at a very slow rate.	1 2 3 4 5	Supplier capabilities change at a rapid rate.

The rate at which products/ services are becoming obsolete in the industry is very slow.	1 2 3 4 5	The rate of product/service obsolescence in the industry is very high (e.g., some fashion goods).
Demand for logistics services is easy to forecast.	1 2 3 4 5	Demand for logistics services is difficult to forecast.
Production/service technology is stable and well established.	1 2 3 4 5	The modes of production/ service change often and in a major way.

Region Specific Information

Indicate by a check mark if your firm manufactures or distributes/sells or sources in each of the following regions.

	Manufacturing	Distribution/Sales	Sourcing
Africa	_____	_____	_____
Central/Eastern Europe	_____	_____	_____
Mainland Asia	_____	_____	_____
North America	_____	_____	_____
Pacific Rim	_____	_____	_____
South America	_____	_____	_____
Western Europe	_____	_____	_____

For the regions you checked above, indicate the percent of your firm's sales in each of the following geographic regions.

	Sales
Africa	_____
Central/Eastern Europe	_____
Mainland Asia	_____
North America	_____
Pacific Rim	_____
South America	_____
Western Europe	_____

The following questions concern trends in the expansion or contraction through growth, acquisition or diversification of manufacturing and logistics facilities in various areas of the world.

1. Please check the categories which describe trends in <u>manufacturing facilities</u> in each geographic area:

   a. Europe ___ Expansion ___ Contraction ___ No Change

   b. North America ___ Expansion ___ Contraction ___ No Change
   (includes Canada and Mexico)

   c. Pacific Rim ___ Expansion ___ Contraction ___ No Change
   (includes Australia)

2. Please check the categories which describe trends in <u>logistics facilities</u> in each geographic area:

   a. Europe ___ Expansion ___ Contraction ___ No Change

   b. North America ___ Expansion ___ Contraction ___ No Change
   (includes Canada and Mexico)

   c. Pacific Rim ___ Expansion ___ Contraction ___ No Change
   (includes Australia)

Section Two - Logistics Strategy

1. Logistics has a separate mission statement. ____ Yes ____ No

2. If available, please attach a copy of your logistics mission statement.

3. Logistics strategy includes a priority to <u>reduce:</u>

   a. The number of logistics facilities
   Strongly Disagree 1 2 3 4 5 Strongly Agree

   b. The number of product/material suppliers
   Strongly Disagree 1 2 3 4 5 Strongly Agree

   c. The number of logistics service providers
   Strongly Disagree 1 2 3 4 5 Strongly Agree

   d. The number of marginal customers (retailers need not answer)
   Strongly Disagree 1 2 3 4 5 Strongly Agree

   e. The number of products or UPC's
   Strongly Disagree 1 2 3 4 5 Strongly Agree

   f. Overall complexity of logistics operation
   Strongly Disagree 1 2 3 4 5 Strongly Agree

4. Using the following scale, what is the primary emphasis of your logistics strategy?

Lowest						Highest
Total Cost	1	2	3	4	5	Customer Service

5. Please check the statement that most accurately describes your primary logistics strategy.

PROCESS ___	A process-based strategy is concerned with managing a broad group of logistics activities as a value-added chain. Emphasis is on achieving efficiency from managing purchasing, manufacturing, scheduling and physical distribution as an integrated system.
MARKET ___	A market-based strategy is concerned with managing a limited group of logistics activities for a multidivisional single business or across multiple business units. The logistics organization seeks to make joint product shipments to common customers for different product groups and seeks to facilitate sales and logistical coordination by a single order-invoice. Often the senior sales and logistics executives report to the same manager.
CHANNEL ___	A channel-based strategy is concerned with managing logistics activities performed jointly with dealers and distributors. The strategic orientation places a great deal of attention on external control. Significant amounts of finished inventories are typically maintained forward or downstream in the distribution channel.
OTHER ___	If your strategy does not fit into one of the above, please describe it below. _____ _____ _____ _____

Section Three - Relative Performance Competencies

This part of the questionnaire requires three answers for each question. First, please indicate the degree of importance you attach to each listed competency. The five point scale below should be used to assess the degree of importance of each competency. Although all of the competencies listed may be important to your firm's success, please carefully assess each with respect to the contribution it makes to the achievement of overall business success.

Five point scale for importance rating

Least important 1 2 3 4 5 Most Important

Second, please specify the performance of your firm in relation to its major competitors for the past year (1993) for each competency. A five point scale is provided below for you to use in assessing the performance of your firm with respect to each competency. Please specify the appropriate response by choosing a single scale value.

Five point scale for importance rating

Worse than Competitors 1 2 3 4 5 Better than Competitors

Lastly, please indicate the approximate percent responsibility of each managerial area for each competency. Respond 0% if an area has no responsibility. (The total need not equal 100%)

Response codes for functional areas:

Manufacturing (Mfg): example, Mfg = 30%
Distribution/Logistics (Log): example, Log = 40%
Marketing/Sales (Mkt): example, Mkt = 20%

For retailers, where appropriate please respond to "customer" questions as your next logistical destination (could be a retail store serviced by a company-owned distribution center).

1. Product Flexibililty (Customization): The ability to handle difficult, nonstandard orders to meet special customer specifications and to manufacture products characterized by numerous features, options, size and/or colors.

   Importance ___ Performance ___ Mfg=___% Log=___% Mkt=___%

2. Volume Flexibility: The ability to rapidly modify production capacity so as to accelerate or decelerate production in response to changes in customer demand.

   Importance ___ Performance ___ Mfg=___% Log=___% Mkt=___%

3. Process Flexibility: The ability to supply low quantities of product efficiently so that product mix changes are easily accommodated.

   Importance ___ Performance ___ Mfg=___% Log=___% Mkt=___%

4. Low Logistics Cost: The ability to achieve the lowest total cost of logistics through efficient operations, technology and/or scale economies.

   Importance ___ Performance ___ Mfg=___% Log=___% Mkt=___%

5. Delivery Speed: The ability to reduce the time between order receipt and customer delivery to as close to zero as possible.

   Importance ___ Performance ___ Mfg=___% Log=___% Mkt=___%

6. Delivery Dependability: The ability to meet quoted or anticipated delivery dates and quantities on a consistent basis.

   Importance ___ Performance ___ Mfg=___% Log=___% Mkt=___%

7. Problem Avoidance: The ability to proactively seek solutions to logistics problems before they occur.

   Importance ___ Performance ___ Mfg=___% Log=___% Mkt=___%

8. Problem and Complaint Resolution: The ability to quickly solve logistically-related customer problems and complaints.

   Importance ___ Performance ___ Mfg=___% Log=___% Mkt=___%

9. Responsiveness to Key Customers: The ability to respond to the needs and wants of key customers.

   Importance ___ Performance ___ Mfg=___% Log=___% Mkt=___%

10. Fill Capacity: The ability to provide desired quantities on a consistent basis.

    Importance ___ Performance ___ Mfg=___% Log=___% Mkt=___%

11. Value-Added Service: The ability to perform services that add value for the customer during the actual sales process.

    Importance ___ Performance ___ Mfg=___% Log=___% Mkt=___%

12. Widespread Distribution Coverage: The ability to effectively provide widespread distribution coverage.

    Importance ___ Performance ___ Mfg=___% Log=___% Mkt=___%

13. Selective Distribution Coverage: The ability to effectively target selective or exclusive customers.

    Importance ___ Performance ___ Mfg=___% Log=___% Mkt=___%

14. Customer Service Flexibility: The ability to accommodate special customer service requests.

    Importance ___ Performance ___ Mfg=___% Log=___% Mkt=___%

15. Product Introduction: The ability to accommodate new product introductions (rollouts to market).

    Importance ___ Performance ___ Mfg=___% Log=___% Mkt=___%

16. Product Phase Out: The ability to facilitate old product phase out.

    Importance ___ Performance ___ Mfg=___% Log=___% Mkt=___%

17. Disruption in Supply: The ability to accommodate supply disruption in a manner that does not adversely affect customers.

    Importance ___ Performance ___ Mfg=___% Log=___% Mkt=___%

18. Product Recall: The ability to accommodate product recalls.

    Importance ___ Performance ___ Mfg=___% Log=___% Mkt=___%

19. Product Flexibility During Logistics: The ability to handle product modifications while in the logistics system.

    Importance ___ Performance ___ Mfg=___% Log=___% Mkt=___%

20. Location Flexibility: The ability to service customers from alternative warehouse locations.

    Importance ___ Performance ___ Mfg=___% Log=___% Mkt=___%

21. Reverse Logistics Timing: The ability to perform reverse logistics operations in a timely manner.

    Importance ___ Performance ___ Mfg=___% Log=___% Mkt=___%

22. Differentiation: The ability to differentiate logistical service offerings from that offered by competitors.

    Importance ___ Performance ___ Mfg=___% Log=___% Mkt=___%

23. Product Innovation: The ability to continuously add new products or variations.

    Importance ___ Performance ___ Mfg=___% Log=___% Mkt=___%

24. Order Flexibility: The ability to modify order size, volume or items during logistics operation.

    Importance ___ Performance ___ Mfg=___% Log=___% Mkt=___%

25. Delivery Time Flexibility: The ability to accommodate delivery times for specific customers.

    Importance ___ Performance ___ Mfg=___% Log=___% Mkt=___%

26. Expedited Delivery: The ability to expedite shipments or partial shipments.

    Importance ___ Performance ___ Mfg=___% Log=___% Mkt=___%

27. Advanced Notification: The ability to notify customers in advance of delivery delays or product shortages.

    Importance ___ Performance ___ Mfg=___% Log=___% Mkt=___%

28. Advanced Delivery Notification: The ability to notify customers in advance of delivery when products will arrive.

    Importance ___ Performance ___ Mfg=___% Log=___% Mkt=___%

29. Substitution Flexibility: The ability to substitute product or service offerings in the event of a delay or stockout (versus backorder or line cancellation).

    Importance ___ Performance ___ Mfg=___% Log=___% Mkt=___%

30. Innovativeness: The ability to create innovative logistical solutions for specific situations, emergencies or customers.

    Importance ___ Performance ___ Mfg=___% Log=___% Mkt=___%

31. Operational Simplification: The ability to simplify the overall logistical process.

    Importance ___ Performance ___ Mfg=___% Log=___% Mkt=___%

32. Operational Standardization: The ability to provide a consistent approach to performing key logistics work.

    Importance ___ Performance ___ Mfg=___% Log=___% Mkt=___%

Section Four - Organization

Structure

1. How many levels are there in your firm's overall organization? That is, count the levels along the longest line from direct worker to senior executive. (Please include the extremes.)

    ___ Levels for business unit (Firm)
    ___ Levels for manufacturing
    ___ Levels for distribution/logistics
    ___ Levels for sales (or marketing)

2. How many individuals report directly to each of the following executives (do not include secretaries or assistants)?

    ___ Chief executive of the business unit
    ___ Senior distribution/logistics executive
    ___ Senior manufacturing executive
    ___ Senior sales (or marketing) executive

3. In our firm, an organizational chart is given to:

    ___ No one ___ Chief executive only ___ Top two or three executives only
    ___ Chief executive and most division or department heads
    ___ Chief executive and <u>all</u> division or department heads

4. If the following activities are typically part of the formal responsibility of logistics, as appropriate indicate how long they have been part of logistics and the nature of responsibility (line or staff). If the activities are not part of logistics, respond with zero years and indicate if they are likely to be added in the future.

	Length of time as part of logistics (in years)	Nature of responsibility		Likely to be added in future	
		line	staff	yes	no
a. Sales forecasting	_____	[ ]	[ ]	[ ]	[ ]
b. Production planning ...	_____	[ ]	[ ]	[ ]	[ ]
c. Sourcing/purchasing	_____	[ ]	[ ]	[ ]	[ ]
d. Production planning ...	_____	[ ]	[ ]	[ ]	[ ]
e. Raw materials/work in process inventory mgmt.	_____	[ ]	[ ]	[ ]	[ ]
f. Finished goods inventory management.....	_____	[ ]	[ ]	[ ]	[ ]
g. Intra-company transportation	_____	[ ]	[ ]	[ ]	[ ]
h. Finished goods warehousing	_____	[ ]	[ ]	[ ]	[ ]
i. Order processing	_____	[ ]	[ ]	[ ]	[ ]
j. Customer Service	_____	[ ]	[ ]	[ ]	[ ]
k. Outbound transportation	_____	[ ]	[ ]	[ ]	[ ]
l. Logistics systems planning	_____	[ ]	[ ]	[ ]	[ ]
m. Facilities design.....	_____	[ ]	[ ]	[ ]	[ ]
n. Materials handling.....	_____	[ ]	[ ]	[ ]	[ ]
o. Logistics administration	_____	[ ]	[ ]	[ ]	[ ]
p. International Logistics	_____	[ ]	[ ]	[ ]	[ ]
q. Capital equipment procurement	_____	[ ]	[ ]	[ ]	[ ]
r. Data processing for distribution applications	_____	[ ]	[ ]	[ ]	[ ]

5. In some companies the senior logistics executive manages activities that are not typically part of a logistics organization. For example, some logistics organizations have responsibility for data processing, real estate, dealer services and/or facilities. Does your logistical organization have responsibility for such non-typical activities? If so, please list in the space below:

_____
_____
_____
_____
_____
_____
_____

6. Highly centralized reflects single decision-making authority, usually the firm's corporate headquarters. Highly decentralized reflects flexibility in decision-making among individual business units.

   a. Our logistical planning process is:

Highly Centralized	1	2	3	4	5	Highly Decentralized

   b. Management of our firm's daily logistical activities are:

Highly Centralized	1	2	3	4	5	Highly Decentralized

Dimensions of Change

1. In my firm, quality programs are used extensively to achieve continuous improvement.

Strongly Disagree	1	2	3	4	5	Strongly Agree

2. In my firm, logistics quality programs have been very successful.

Strongly Disagree	1	2	3	4	5	Strongly Agree

3. My firm has undergone extensive logistics process reengineering during the past five years.

Strongly Disagree	1	2	3	4	5	Strongly Agree

4. The logistics network of my firm is substantially different than five years ago.

   Strongly Disagree 1 2 3 4 5 Strongly Agree

5. Over the last five years, my firm has made a serious effort to empower decision making among employees.

   Strongly Disagree 1 2 3 4 5 Strongly Agree

6. In the last five years, my firm has significantly centralized decision making.

   Strongly Disagree 1 2 3 4 5 Strongly Agree

Customer Contact (Retailers should answer these questions considering their end consumers.)

1. The following levels within the logistics organization have direct customer access.

	yes	no
a. Chief logistics officer	[ ]	[ ]
b. Director	[ ]	[ ]
c. Department manager	[ ]	[ ]
d. Sub-department manager	[ ]	[ ]
e. First-level supervisor	[ ]	[ ]

Please indicate whether you agree or disagree with the following statements.

2. In my firm, customer complaints are systematically collected and analyzed.

   Strongly Disagree 1 2 3 4 5 Strongly Agree

3. In my firm, customer complaints/suggestions are used to improve performance.

   Strongly Disagree 1 2 3 4 5 Strongly Agree

4. In my firm, customer complaints/suggestions are used to determine pay and/or bonuses.

   Strongly Disagree 1 2 3 4 5 Strongly Agree

5. Employees at lower levels in my organization are empowered to make customer service decisions on the spot.

   Strongly Disagree 1 2 3 4 5 Strongly Agree

Teaming and Cross Job Coordination

In assuring the compatibility among decisions made in one area (e.g., logistics) with those in other areas (e.g., marketing/sales) certain integrative mechanisms may or may not be used. Please indicate the extent to which the following are used by answering these questions.

1. In my firm, interdepartmental committees are set up to allow departments to engage in joint decision-making.

   Strongly Disagree 1 2 3 4 5 Strongly Agree

2. In my firm, task forces or temporary groups are set up to facilitate interdepartmental collaboration.

   Strongly Disagree 1 2 3 4 5 Strongly Agree

3. In my firm, liaison personnel exist whose specific job it is to coordinate the efforts of several departments for purposes of a project.

   Strongly Disagree 1 2 3 4 5 Strongly Agree

4. In my firm, cross-functional teams make decisions concerning manufacturing strategy.

   Strongly Disagree 1 2 3 4 5 Strongly Agree

5. In my firm, cross-functional teams make decisions concerning distribution or logistics strategy.

   Strongly Disagree 1 2 3 4 5 Strongly Agree

6. In my firm, cross-functional teams make decisions concerning marketing or sales strategy.

   Strongly Disagree 1 2 3 4 5 Strongly Agree

7. Please indicate on the following scale the degree of integration between daily logistical activities and marketing.

   Not Highly Integrated 1 2 3 4 5 Highly Integrated

8. Please indicate on the following scale the degree of integration between daily logistical activities and manufacturing.

   Not Highly Integrated 1 2 3 4 5 Highly Integrated

Trends

1. Please indicate whether each trend listed below has increased or decreased. Use the following scale:

   1 = Has increased substantially
   2 = Has increased somewhat
   3 = Has remained constant
   4 = Has decreased somewhat
   5 = Has decreased substantially
   n.a. = Not Applicable

	Has Increased substantially				Has Decreased substantially	
a. Global sourcing	1	2	3	4	5	n.a.
b. Percent of total inventory held by suppliers	1	2	3	4	5	n.a.
c. Percent of total inventory at manufacturing facilities	1	2	3	4	5	n.a.
d. Percent of total inventory at field distribution centers	1	2	3	4	5	n.a.
e. Percent of total inventory with next destination customers	1	2	3	4	5	n.a.
f. Percent of inbound shipments using JIT ...	1	2	3	4	5	n.a.
g. Percent of outbound shipments using Quick Response (QR)	1	2	3	4	5	n.a.
h. Percent of outbound shipments utilizing Continuous Replenishment (CR)	1	2	3	4	5	n.a.
i. Percent of inbound shipments utilizing cross-docking	1	2	3	4	5	n.a.
j. Percent of outbound shipments utilizing cross-docking	1	2	3	4	5	n.a.
k. The use of time-based strategies in logistics	1	2	3	4	5	n.a.
l. Postponement strategies	1	2	3	4	5	n.a.

Section Five - Performance Measurement

Below is a list of logistics performance measures. Please indicate if information is available to perform each measurement. Also, on a scale of 1 to 5, indicate the importance of these measurements in monitoring operations or identifying problems. If you don't use it, circle n.a. on the scale.

Measurement	Information Available? yes	no	Unimportant - Important					
ASSET MANAGEMENT								
Inventory turns	[ ]	[ ]	1	2	3	4	5	n.a.
Inventory levels, number of days supply	[ ]	[ ]	1	2	3	4	5	n.a.
Obsolete inventory	[ ]	[ ]	1	2	3	4	5	n.a.
Return on net assets	[ ]	[ ]	1	2	3	4	5	n.a.
Return on investment	[ ]	[ ]	1	2	3	4	5	n.a.
Inventory classification (A,B,C)	[ ]	[ ]	1	2	3	4	5	n.a.
COST (Logistics Cost Only)								
Total cost	[ ]	[ ]	1	2	3	4	5	n.a.
Cost per unit	[ ]	[ ]	1	2	3	4	5	n.a.
Cost as a percentage of sales	[ ]	[ ]	1	2	3	4	5	n.a.
Inbound freight	[ ]	[ ]	1	2	3	4	5	n.a.
Outbound freight	[ ]	[ ]	1	2	3	4	5	n.a.
Administrative	[ ]	[ ]	1	2	3	4	5	n.a.
Warehouse order processing	[ ]	[ ]	1	2	3	4	5	n.a.
Direct labor	[ ]	[ ]	1	2	3	4	5	n.a.
Comparison of actual versus budget	[ ]	[ ]	1	2	3	4	5	n.a.
Cost trend analysis	[ ]	[ ]	1	2	3	4	5	n.a.
Direct product profitability	[ ]	[ ]	1	2	3	4	5	n.a.
Customer or customer segment profitability	[ ]	[ ]	1	2	3	4	5	n.a.
Inventory carrying	[ ]	[ ]	1	2	3	4	5	n.a.
Cost of returned goods	[ ]	[ ]	1	2	3	4	5	n.a.

COST (Logistics Cost Only)								
Cost of damage	[ ]	[ ]	1	2	3	4	5	n.a.
Cost of service failure	[ ]	[ ]	1	2	3	4	5	n.a.
Cost of backorders	[ ]	[ ]	1	2	3	4	5	n.a.
PRODUCTIVITY								
Units shipped per employee	[ ]	[ ]	1	2	3	4	5	n.a.
Units per labor dollar	[ ]	[ ]	1	2	3	4	5	n.a.
Orders per sales representative	[ ]	[ ]	1	2	3	4	5	n.a.
Comparison to historical standard ...	[ ]	[ ]	1	2	3	4	5	n.a.
Goal programs	[ ]	[ ]	1	2	3	4	5	n.a.
Productivity index	[ ]	[ ]	1	2	3	4	5	n.a.
Equipment downtime	[ ]	[ ]	1	2	3	4	5	n.a.
Order entry productivity	[ ]	[ ]	1	2	3	4	5	n.a.
Warehouse labor productivity	[ ]	[ ]	1	2	3	4	5	n.a.
Transportation labor productivity ...	[ ]	[ ]	1	2	3	4	5	n.a.
CUSTOMER SERVICE								
Fill rate	[ ]	[ ]	1	2	3	4	5	n.a.
Stockouts	[ ]	[ ]	1	2	3	4	5	n.a.
Shipping errors	[ ]	[ ]	1	2	3	4	5	n.a.
On time delivery	[ ]	[ ]	1	2	3	4	5	n.a.
Backorders	[ ]	[ ]	1	2	3	4	5	n.a.
Cycle time	[ ]	[ ]	1	2	3	4	5	n.a.
Delivery consistency	[ ]	[ ]	1	2	3	4	5	n.a.
Response time to inquiries	[ ]	[ ]	1	2	3	4	5	n.a.
Response accuracy	[ ]	[ ]	1	2	3	4	5	n.a.
Complete orders	[ ]	[ ]	1	2	3	4	5	n.a.
Customer complaints	[ ]	[ ]	1	2	3	4	5	n.a.
Sales force complaints	[ ]	[ ]	1	2	3	4	5	n.a.
Overall reliability	[ ]	[ ]	1	2	3	4	5	n.a.
Overall satisfaction	[ ]	[ ]	1	2	3	4	5	n.a.

LOGISTICS QUALITY

Damage frequency	[ ]	[ ]	1	2	3	4	5	n.a.
Order entry accuracy	[ ]	[ ]	1	2	3	4	5	n.a.
Picking/shipping accuracy	[ ]	[ ]	1	2	3	4	5	n.a.
Document/invoicing accuracy	[ ]	[ ]	1	2	3	4	5	n.a.
Information availability	[ ]	[ ]	1	2	3	4	5	n.a.
Number of credit claims	[ ]	[ ]	1	2	3	4	5	n.a.
Number of customer returns	[ ]	[ ]	1	2	3	4	5	n.a.

Please indicate if you formally benchmark each of the following performance areas relative to competitors. Please indicate your performance relative to major competitors.

	Formally Benchmark?		Much Worse than Competition - Much Better Than Competition				
	yes	no					
Asset Management	[ ]	[ ]	1	2	3	4	5
Logistics cost	[ ]	[ ]	1	2	3	4	5
Productivity	[ ]	[ ]	1	2	3	4	5
Customer Service	[ ]	[ ]	1	2	3	4	5
Logistics quality	[ ]	[ ]	1	2	3	4	5

Do you formally measure customer expectations concerning customer service?

___ Yes ___ No

If you use unique performance measures aimed at controlling some integrated aspects of logistical operations, please describe them in the space below:

_____

_____

_____

_____

_____

_____

Section Six - Information Technology

Please indicate whether you disagree or agree with the following statements.

1. My firm's logistics information systems capability is better today than five years ago.

   Strongly Disagree 1 2 3 4 5 Strongly Agree

2. My firm's current logistics information systems are satisfactory in terms of meeting our requirements.

   Strongly Disagree 1 2 3 4 5 Strongly Agree

3. Relative to other areas within my firm, logistics' share of information system resources has increased over the last five years.

   Strongly Disagree 1 2 3 4 5 Strongly Agree

4. Within my firm, the percentage of transactions completed using EDI has increased over the last five years.

   Strongly Disagree 1 2 3 4 5 Strongly Agree

5. My firm utilizes industry standards rather than proprietary standards for:

   a. The majority of our EDI transmissions.

      Strongly Disagree 1 2 3 4 5 Strongly Agree

   b. The majority of our bar codes.

      Strongly Disagree 1 2 3 4 5 Strongly Agree

6. My firm uses bar coding:

   a. with key customers

      Strongly Disagree 1 2 3 4 5 Strongly Agree

   b. with all customers

      Strongly Disagree 1 2 3 4 5 Strongly Agree

   c. with key suppliers

      Strongly Disagree 1 2 3 4 5 Strongly Agree

   d. with all suppliers

      Strongly Disagree 1 2 3 4 5 Strongly Agree

7. My firm uses EDI applications:
   a. with key customers
      Strongly Disagree 1 2 3 4 5 Strongly Agree
   b. with all customers
      Strongly Disagree 1 2 3 4 5 Strongly Agree
   c. with key suppliers
      Strongly Disagree 1 2 3 4 5 Strongly Agree
   d. with all suppliers
      Strongly Disagree 1 2 3 4 5 Strongly Agree

8. My firm uses Real Time Communications (e.g., Satellite, Direct Connect):
   a. with key customers
      Strongly Disagree 1 2 3 4 5 Strongly Agree
   b. with all customers
      Strongly Disagree 1 2 3 4 5 Strongly Agree
   c. with key suppliers
      Strongly Disagree 1 2 3 4 5 Strongly Agree
   d. with all suppliers
      Strongly Disagree 1 2 3 4 5 Strongly Agree

9. My firm views the following as essential to increase our competitiveness:
   a. Bar Code Technologies
      Strongly Disagree 1 2 3 4 5 Strongly Agree
   b. EDI Applications
      Strongly Disagree 1 2 3 4 5 Strongly Agree
   c. Real Time Communication Systems
      Strongly Disagree 1 2 3 4 5 Strongly Agree

10. My firm's primary rationale for enhanced logistics information systems is service improvement.
    Strongly Disagree 1 2 3 4 5 Strongly Agree

11. My firm's primary rationale for improved logistics information systems is cost reduction.
    Strongly Disagree 1 2 3 4 5 Strongly Agree

12. Our firm has or is currently completing substantial development or replacement of our logistics operating systems. (Including order entry, order processing, warehousing and transportation applications.)

Strongly Disagree 1 2 3 4 5 Strongly Agree

13. Our firm plans substantial development or replacement of our logistics operating systems within the next 3 to 5 years.

Strongly Disagree 1 2 3 4 5 Strongly Agree

14. Our firm has or is currently completing substantial development or replacement of our logistics planning systems. (Including forecasting, inventory, distribution, requirements planning and logistics decision support systems.)

Strongly Disagree 1 2 3 4 5 Strongly Agree

15. Our firm plans substantial development or replacement of our logistics planning systems within the next 3 to 5 years.

Strongly Disagree 1 2 3 4 5 Strongly Agree

16. Our logistics operating systems are substantially (over 60%) purchased from outside software suppliers or developers.

Strongly Disagree 1 2 3 4 5 Strongly Agree

17. Our logistics planning systems are substantially (over 60%) purchased from outside software suppliers or developers.

Strongly Disagree 1 2 3 4 5 Strongly Agree

Systems Evaluation

This section requests an evaluation of your current logistics information system capabilities. You are asked to evaluate overall adequacy of current logistics operating and logistics planning systems. *Logistics operating systems* include such applications as order entry, order processing, warehousing and transportation. *Logistics planning systems* include such applications as forecasting, inventory management and distribution requirements planning. The following characteristic definitions are offered to improve understanding of the question.

Information Sharing - Willingness to share common information across functions within the firm.

Flexibility - Ability to adapt processes and capabilities to specific customer segment requirements.

Internal Connectivity - Ability to effectively exchange information across managerial areas within our firm.

External Connectivity - Ability to effectively exchange information with next destination customers and/or suppliers.

1. Using the following scale, please indicate the characteristics of information related to logistics operating and planning systems.

Low 1 2 3 4 5 High

	Logistics Operating Systems					Logistics Planning Systems				
Timeliness	1	2	3	4	5	1	2	3	4	5
Accuracy	1	2	3	4	5	1	2	3	4	5
Availability	1	2	3	4	5	1	2	3	4	5
Exception basis formatted	1	2	3	4	5	1	2	3	4	5
Formatted to facilitate usage	1	2	3	4	5	1	2	3	4	5
Information sharing ..	1	2	3	4	5	1	2	3	4	5
Flexibility	1	2	3	4	5	1	2	3	4	5
Internal Connectivity	1	2	3	4	5	1	2	3	4	5
External Connectivity	1	2	3	4	5	1	2	3	4	5

2. Using the scale below, please indicate your firm's *willingness* to share the following types of information with your suppliers and customers.

Very Unlikely 1 2 3 4 5 Very Likely

Suppliers		Next Destination Customers	
Inventory Status	___	Inventory Status	___
Shipment Release Status	___	Shipment Release Status	___
Forecasts	___	Forecasts	___
Production Schedules	___	Production Schedules	___
POS (Point of Sale)	___	POS (Point of Sale)	___
New Product	___	New Product	___
Marketing/Promotion	___	Marketing/Promotion	___

3. Using the following scale, please indicate the *ease* with which your firm is able to exchange each of the types of information with suppliers and next destination customers. Ease is defined in terms of speed of information transfer and responsiveness, not in technological capability.

Difficult to Share 1 2 3 4 5 Easy to Share

Suppliers		Next Destination Customers	
Inventory Status	___	Inventory Status	___
Shipment Release Status	___	Shipment Release Status	___
Forecasts	___	Forecasts	___
Production Schedules	___	Production Schedules	___
POS (Point of Sale)	___	POS (Point of Sale)	___
New Product	___	New Product	___
Marketing/Promotion	___	Marketing/Promotion	___

Author's note: The questionnaire had a seventh section entitled Alliances. However, this dissertation did not use any questions from that section. Therefore, that section is not reproduced in this appendix.

APPENDIX B

APPENDIX B

FOLLOW-UP QUESTIONNAIRE

ALL RESPONSES WILL BE CONFIDENTIAL AND WILL BE CODED TO SUPPRESS COMPANY AND RESPONDENT IDENTIFICATION

1. Please check the statement that most accurately describes your primary logistics strategy.

PROCESS ___

A process-based strategy is concerned with managing a broad group of logistics activities as a value-added chain. Emphasis is on achieving efficiency from managing purchasing, manufacturing, scheduling and physical distribution as an integrated system.

MARKET ___

A market-based strategy is concerned with managing a limited group of logistics activities for a multidivisional single business or across multiple business units. The logistics organization seeks to make joint product shipments to common customers for different product groups and seeks to facilitate sales and logistical coordination by a single order-invoice. Often the senior sales and logistics executives report to the same manager.

CHANNEL ___

A channel-based strategy is concerned with managing logistics activities performed jointly with dealers and distributors. The strategic orientation places a great deal of attention on external control. Significant amounts of finished inventories are typically maintained forward or downstream in the distribution channel.

OTHER ___

If your strategy does not fit into one of the above, please describe it below.

_____

_____

_____

_____

2. Using the following scale, what is the primary emphasis of your logistics strategy?

Lowest						Highest
Total Cost	1	2	3	4	5	Customer Service

3. During the past two years my firm has increased its organizational commitment to a more comprehensive integrated supply chain.

Strongly Disagree 1 2 3 4 5 Strongly Agree

4. An executive title, using the words "Supply Chain" is being used in my firm.

___ Yes ___ No

5. Logistics Strategy

For the six subparts of Question #5 please use the following scale. Indicate your response in the space provided.

Strongly Disagree 1 2 3 4 5 Strongly Agree

Logistics strategy includes a priority to reduce:

___ a. The number of logistics facilities.

___ b. The number of product/material suppliers.

___ c. The number of logistics service suppliers.

___ d. The number of marginal customers (retailers need not answer).

___ e. The number of products or UPCs.

___ f. Overall complexity of logistics operation.

6. Relative Performance

Please specify the performance of your firm in relation to its major competitors for the past year (1996) for each indicated competency. The following five point scale is provided for assessing the relative performance of your firm.

Worse than Competitors 1 2 3 4 5 Better than Competitors

___ a. Product Flexibility (Customization): The ability to handle difficult, nonstandard orders to meet special customer specifications and to manufacture products characterized by numerous features, options, size and/or colors.

___ b. Low Logistics Cost: The ability to achieve the lowest total cost of logistics through efficient operations, technology and/or scale economies.

___ c. Delivery Speed: The ability to reduce the time between order receipt and customer delivery to as close to zero as possible.

___ d. Delivery Dependability: The ability to meet quoted or anticipated delivery dates and quantities on a consistent basis.

___ e. Responsiveness to Key Customers: The ability to respond to the needs and wants of key customers.

___ f. Order Fill Capacity: The ability to provide desired quantities on a consistent basis.

___ g. Order Flexibility: The ability to modify order size, volume or composition during logistics operation.

___ h. Delivery Time Flexibility: The ability to accommodate delivery times for specific customers.

___ i. Advanced Shipment Notification: The ability to notify customers in advance of delivery when products will arrive.

7. Benchmarking

Please indicate if you formally benchmark each of the following performance areas relative to competitors. Please indicate your performance relative to major competitors.

	Formally Benchmark? yes	no	Much Worse than Competition -				Much Better Than Competition
Asset Management	[ ]	[ ]	1	2	3	4	5
Logistics cost	[ ]	[ ]	1	2	3	4	5
Productivity	[ ]	[ ]	1	2	3	4	5
Customer Service	[ ]	[ ]	1	2	3	4	5
Logistics quality	[ ]	[ ]	1	2	3	4	5

THANK YOU FOR YOUR PARTICIPATION!

To receive an analysis of the information collected in this update please complete the following information.

Name: _____

Company: _____

Mailing Address: _____

_____

_____

APPENDIX C

APPENDIX C

INITIAL CONFIRMATORY FACTOR RESULTS: CONTEXT

CONSTRUCT LOADINGS (t values)

Environmental Hostility		Information Technology LOS	
V1	.259	V10	.224
	(2.351)		(1.557)
V2	.058	V11	.377
	(0.428)		(2.705)
V3	.564	V12	.611
	(7.439)		(5.450)
Environmental Dynamism		**Information Technology LPS**	
V4	.334	V13	.862
	(2.434)		(8.046)
V5	.269	V14	.740
	(1.762)		(5.103)
V6	.467	V15	.599
	(5.607)		(4.260)
V7	.541	V16	.766
	(3.879)		(6.503)
V8	.314	V17	.758
	(2.182)		(6.159)
V9	-.097	V18	.705
	(-.748)		(6.427)

GOODNESS-OF-FIT MEASURES

Chi-square (χ^2)	129.43
Degrees of Freedom	129
Significance Level	0.4728
Bentler-Bonett Normed Fit Index (NFI)	0.993
Bentler-Bonett Nonnormed Fit Index (NNFI)	1.000
Comparative Fit Index	1.000

Standardized Residual Matrix

	V1	V2	V3	V4	V5	V6	V7	V8	V9
V1	0.442								
V2	0.227	0.633							
V3	0.242	0.272	0.228						
V4	0.087	0.420	0.174	0.707					
V5	0.259	0.348	0.164	0.373	0.783				
V6	-0.027	-0.023	0.003	0.125	0.115	0.484			
V7	0.076	-0.008	-0.006	-0.021	0.206	0.003	0.180		
V8	0.036	0.181	0.082	0.153	0.267	0.099	0.202	0.326	
V9	-0.030	-0.093	-0.072	0.028	-0.041	0.165	-0.096	0.028	0.624
V10	-0.008	-0.005	-0.052	0.229	0.271	-0.022	0.023	0.176	0.554
V11	0.076	-0.053	-0.023	0.141	0.087	0.010	-0.087	-0.004	0.638
V12	-0.013	-0.050	-0.046	0.575	0.473	0.324	0.081	0.296	0.512
V13	-0.031	-0.137	-0.076	-0.017	0.010	0.275	-0.038	0.013	0.507
V14	-0.011	-0.148	0.027	0.010	-0.058	0.058	0.009	0.030	0.230
V15	-0.141	-0.116	-0.051	0.045	-0.044	-0.031	-0.119	-0.086	0.481
V16	0.004	0.061	-0.018	0.044	0.018	-0.033	-0.072	-0.044	0.238
V17	-0.038	-0.015	-0.028	-0.111	-0.300	-0.019	-0.098	-0.116	0.258
V18	-0.260	-0.113	-0.168	0.423	0.223	0.234	0.058	0.205	0.370

	V10	V11	V12	V13	V14	V15	V16	V17	V18
V10	0.892								
V11	0.604	0.879							
V12	0.613	0.615	1.320						
V13	0.336	0.491	0.415	0.482					
V14	0.125	0.215	0.349	0.165	0.265				
V15	0.483	0.599	0.550	0.282	0.306	0.791			
V16	0.127	0.226	0.242	0.144	0.151	0.302	0.216		
V17	0.180	0.224	0.041	0.138	0.137	0.385	0.094	0.344	
V18	0.380	0.386	1.033	0.291	0.257	0.456	0.221	0.050	0.971

APPENDIX D

APPENDIX D

KUDER-RICHARDSON CALCULATIONS

$$KR_{20} = R = \frac{N}{N-1}\left(\frac{S^2 - \Sigma pq}{S^2}\right)$$

Where KR_{20} = the reliability estimate (R)
N = the number of items
S^2 = the variance
p = the proportion of respondents answering "yes"
q = the proportion of respondents answering "no"
Σpq = the sum of the products of p times q for each item on the questionnaire

Source: Psychological Testing - Principles, Applications, and Issues
Robert M. Kaplan and Dennis P. Saccuzzo (1989)

Centralization

$$KR_{20} = \frac{16}{16 - 1}\left(\frac{17.61 - 3.138}{17.61}\right) = .8766$$

Formalization

$$KR_{20} = \frac{7}{7 - 1}\left(\frac{4.55 - 1.679}{4.55}\right) = .7362$$

APPENDIX E

APPENDIX E

RESEARCH HYPOTHESES

Hypothesis 1a: Under conditions of high environmental dynamism, firms will choose more externally-oriented logistics strategies (i.e., market or channel) than under conditions of low environmental dynamism.

Hypothesis 1b: Under conditions of high environmental dynamism, firms will use decentralized structures than under conditions of low environmental dynamism.

Hypothesis 1c: Under conditions of high environmental dynamism, firms will use less formalized structures than under conditions of low environmental dynamism.

Hypothesis 1d: Under conditions of high environmental dynamism, firms will use more integrated structures than under conditions of low environmental dynamism.

Hypothesis 1e: Under conditions of high environmental dynamism, firms will use narrower spans of control than under conditions of low environmental dynamism.

Hypothesis 2a: Under conditions of high environmental hostility, firms will choose more externally-oriented logistics strategies (i.e., market and channel) than under conditions of low environmental hostility.

Hypothesis 2b: Under conditions of high environmental hostility, firms will use decentralized structures than under conditions of low environmental hostility.

Hypothesis 2c: Under conditions of high environmental hostility, firms will use less formalized structures than under conditions of low environmental hostility.

Hypothesis 2d: Under conditions of high environmental hostility, firms will use more integrated structures than under conditions of low environmental hostility.

Hypothesis 2e: Under conditions of high environmental hostility, firms will use narrower spans of control than under conditions of low environmental hostility.

Hypothesis 3a: Under conditions of highly capable logistics information technology operating systems, firms will choose more externally-oriented logistics strategies (i.e., market and channel) than under conditions of less capable logistics information technology operating systems.

Hypothesis 3b: Under conditions of highly capable logistics information technology operating systems, firms will use decentralized structures than under conditions of less capable logistics information technology operating systems.

Hypothesis 3c: Under conditions of highly capable logistics information technology operating systems, firms will use more formalized structures than under conditions of less capable logistics information technology operating systems.

Hypothesis 3d: Under conditions of highly capable logistics information technology operating systems, firms will use more integrated structures than under conditions of less capable logistics information technology operating systems.

Hypothesis 3e: Under conditions of highly capable logistics information technology operating systems, firms will use broader spans of control than under conditions of less capable logistics information technology operating systems.

Hypothesis 3f: Under conditions of highly capable logistics information technology planning systems, firms will choose more externally-oriented logistics strategies (i.e., market and channel) than under conditions of less capable logistics information technology planning systems.

Hypothesis 3g: Under conditions of highly capable logistics information technology planning systems, firms will use decentralized structures than under conditions of less capable logistics information technology planning systems.

Hypothesis 3h: Under conditions of highly capable logistics information technology planning systems, firms will use more formalized structures than under conditions of less capable logistics information technology planning systems.

Hypothesis 3i: Under conditions of highly capable logistics information technology planning systems, firms will use more integrated structures than under conditions of less capable logistics information technology planning systems.

Hypothesis 3j: Under conditions of highly capable logistics information technology planning systems, firms will use broader spans of control than under conditions of less capable logistics information technology planning systems.

Hypothesis 3k: With respect to strategy, there will be a significant interaction effect between the levels of environmental dynamism, environmental hostility, information technology operating systems, and information technology planning systems.

Hypothesis 3l: With respect to structure, there will be a significant interaction effect between the levels of environmental dynamism, environmental hostility, information technology operating systems, and information technology planning systems.

Hypothesis 4a: Structure is a significant mediator of the environmental dynamism --> performance relationship.

Hypothesis 4b: Structure is a significant mediator of the environmental hostility --> performance relationship.

Hypothesis 4c: Structure is a significant mediator of the logistics information technology operating systems --> performance relationship.

Hypothesis 4d: Structure is a significant mediator of the logistics information technology planning systems --> performance relationship.

Hypothesis 4e: Strategy is a significant mediator of the environmental dynamism --> structure relationship.

Hypothesis 4f: Strategy is a significant mediator of the environmental hostility --> structure relationship.

Hypothesis 4g: Strategy is a significant mediator of the logistics information technology operating systems --> structure relationship.

Hypothesis 4h: Strategy is a significant mediator of the logistics information technology planning systems --> structure relationship.

Hypothesis 5a: Externally-oriented logistics strategy (i.e., market or channel) is associated with less centralized structure than internally-oriented logistics strategy (i.e., process).

Hypothesis 5b: Externally-oriented logistics strategy (i.e., market or channel) is associated with less formalized structure than internally-oriented logistics strategy (i.e., process).

Hypothesis 5c: Externally-oriented logistics strategy (i.e., market or channel) is associated with more integrated structure than internally-oriented logistics strategy (i.e., process).

Hypothesis 5d: Externally-oriented logistics strategy (i.e., market or channel) is associated with broader spans of control structure than internally-oriented logistics strategy (i.e., process).

Hypothesis 5e: Under conditions of satisfactory performance, less strategic changes will occur than under conditions of unsatisfactory performance.

Hypothesis 6a: Logistics structure, by itself, has no significant relationship to performance.

Hypothesis 6b: Logistics structure will be a significant mediator of the logistics strategy --> performance relationship.

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