THE ROLE OF LOGISTICS IN NEW PRODUCT DEVELOPMENT

by

Zach G. Zacharia
Texas Christian University

and

John T. Mentzer
The University of Tennessee

INTRODUCTION

New product development (NPD), a core business process (Srivastava, Shervani, and Fahey 1999), has long been an important concern of management (Nakata and Sivakumar 1996), especially with the advent of shorter product life cycles and faster product development times (Griffin 1997). Even though developing new products is critically important to the firm, several researchers have noted the high failure rates typically associated with NPD (Booz, Allen, and Hamilton 1982; Cooper 1990; Sivadas and Dwyer 2000). NPD processes have moved from functional, sequential approaches to multifunctional approaches with the number of business units in a firm responsible for NPD increasing (Griffin 1997). The focus on improving competitive advantage through NPD in recent years has been on time-to-market, overlapping problem solving, and multifunctional teamwork (Twigg 1998). Many of the approaches used to improve the success of the NPD process focus on the need to improve the coordination between the marketing, manufacturing, and R&D departments within the firm (Gupta, Raj, and Wilemon 1986; House and Price 1991; Olson, Walker, and Ruekert 1995). NPD is much improved by including all the functions relevant to the product life cycle – from the concept through the disposal of the product (Ettlie 1997). However, there has been very little empirical research considering the role of the logistics in NPD, even though logistics plays a strategic role in many companies (Mentzer, Flint, and Hult 2001; Mentzer and Williams 2001).

To develop support for the concept of logistics involvement in NPD, senior logistics and product development managers in a number of industries were asked during the qualitative phase of this research to discuss examples of NPD projects where logistics played a role and where logistics did not play a role. Here are two typical examples:

An automotive engineer redesigned the vehicle floor pan from a separate center and rear floor pan to a single combined floor pan to save manufacturing costs. When the floor pan was separate, it was possible to transport 60 pieces per container but with the new single piece design, it was possible to only transport 20 pieces per container. The new design greatly increased the total cost of the part, especially since the parts were manufactured in Mexico and shipped to the U.S. Unfortunately by the time logistics personnel got involved it was too late to change the design.

A consumer product company developed a new bleach formulation but R&D noted the product had a maximum temperature that could not be exceeded or the product would breakdown. The specifications were sent to the logistics department, which was unable to guarantee the product would not be exposed to temperatures above the maximum limit, which led to the elimination of the product at the design stage not after the product was launched.

The interviews provided general support for the benefit of logistics involvement in NPD. Resource dependence theory provided the theoretical support for the involvement of logistics in NPD. Resource dependence theory suggests that as a function becomes salient within the firm and controls critical resources, the more likely the function is to be involved in important activities like new product development. To better understand the role of logistics in NPD, a research project with three objectives was conducted. The first objective was to identify (through interviews) how practitioners view the role of logistics in new product development. The second objective was to review the literature, specifically on resource dependence theory, to develop a conceptual model, and operationalize the constructs relating logistics involvement in NPD and NPD performance. The third objective was to test the proposed conceptual model.

Over a period of two months, a total of 21 senior logistics and new product development managers in the automotive, rail transportation, consumer goods, logistics, truck transportation, telecommunications, Internet, returnable packaging, and chemical industries took part in interviews that typically lasted about half an hour. Participants were asked to discuss examples of NPD projects where logistics played a role and where logistics did not play a role. The full interview protocol is provided in the Appendix A. The following are another two examples from the interviews:

The R&D department in a large consumer products company came up with a new formulation for a fabric softener that was superior to previous formulations. Fabric softeners are 5% ingredient and 95% water, which meant if the product becomes exposed to freezing temperatures, the product would conglomerate and become lumpy. Unfortunately, the logistics department was not consulted and enough retailers complained about shipments of lumpy fabric softeners that the new product had to be withdrawn from production incurring significant losses.

An NPD team decided to source a component part from Asia that needed to be transported several miles from the U.S. west coast port to the final assembly plant. This product was so large that it was in a special 20 feet by 20 feet by 40 foot container which was not a problem when on the deck of a ship. Logistics was notified two years before the component part was scheduled to arrive which allowed them to work with the rail carrier to move the switch stands, signals, track site devices to enable this huge container to be transported from the port to the plant. Without the two year advance notice for logistics it would have been highly cost prohibitive to move this large container from the port to the plant.

The interviews provided support for the benefit of logistics involvement in NPD. The automotive company executives who participated specifically noted that since 1990 logistics involvement in NPD has become standard practice in their industry. Other company executives provided additional examples, noting the changing role and importance of logistics within the company, and the increasing involvement of logistics in NPD.

Logistics processes over a number of years have also been an important component of business strategy and can provide a basis for a competitive profit edge (Heskett 1977). Logistics can provide critical information on decisions about transportation modes, the most efficient transportation choice within the mode, the impact of packaging, and delivering the product in the necessary condition. Logistics has become a source of competitive advantage, especially after transportation deregulation and improvements in information technology that have enabled companies to gain competitive advantage through competence in delivery speed, reliability, responsiveness, and low cost distribution. In other words, logistics plays a strategic role in many companies.

Given the interviews and these examples, there is anecdotal support for the concept that logistics can play an important role in new product development. The next step in the project was to review the relevant literature to find theoretical support for the concept of logistics involvement in NPD. One theory that provides particular support for the involvement of logistics in NPD is resource dependence theory and, thus, it is reviewed first.

RESOURCE DEPENDENCE THEORY

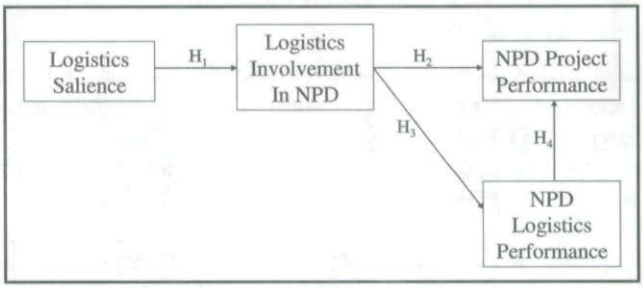
Resource dependence theory suggests that management decisions are influenced by those who control critical resources, both internal and external to the firm (Pfeffer and Salancik 1978). The resource dependence perspective suggests that some functions may control resources critical to the success of the company and those functional areas can derive power from the control of these important resources (Tremblay, Cote, and Balkin 2003). The relative influence of one subunit over another is a function of the resources the subunit contributes (Pfeffer and Salancik 1978). Homburg, Workman, and Krohmer (1999) used resource dependence theory to suggest subunits that provide valued resources, with no close substitutes, on which others are dependent, have more power and influence than other subunits. Functions that are important within the firm are those that provide valued

information or upon which other functions in the firm depend. Therefore, if functions such as logistics provide resources other functions need, logistics could become more salient within the firm.

Logistics has been shown to play an important role in many contexts, such as customer service (Langley and Holcomb 1992), product availability, time advantages, low cost distribution (Stalk, Evans, and Shulman 1992), and global manufacturing (Fawcett and Closs 1993). Logistics also interfaces with manufacturing, marketing, and R&D to deal with procurement, inventory, warehousing, and distribution (Morash, Dröge, and Vickery 1996). The NPD process can also benefit from information provided by both suppliers and customers, which can be facilitated by logistics. Supply chain management has become more important in companies and in the context of NPD can be considered the incorporation of suppliers and customers ideas – again facilitated by logistics. Logistics is more salient in firms that belong to industries that emphasize information technology and time based competition (Zacharia and Mentzer 2004). Firms where logistics provides a competitive advantage or is important within the firm will likely benefit from logistics involvement in NPD. This led to the development of a conceptual framework relating the involvement of logistics in new product development (Figure 1).

FIGURE 1

LOGISTICS INVOLVEMENT IN NPD MODEL



THEORETICAL MODEL DEVELOPMENT

The logistics involvement in NPD model proposes that logistics salience leads to logistics involvement in NPD, which leads to NPD project performance and NPD logistics performance. We propose that firms where logistics is involved in NPD have better NPD project performance and NPD logistics performance.

Logistics Salience and Logistics Involvement

Logistics salience is defined as the influence/importance of logistics relative to other functions within the firm (Zacharia and Mentzer 2004). Logistics, as a function, is increasingly viewed as strategically important to the firm (Bienstock, Mentzer, and Bird 1997; Mentzer, Flint, and Hult 2001). Inbound logistics, internal logistics, and outbound logistics are important processes within the firm (Srivastava, Shervani, and Fahey 1999). Logistics within the firm has an important role in managing international suppliers and international customers (Fawcett and Closs 1993). An empirical study by Ellinger, Daugherty, and Keller (2000) found logistics is of strategic importance to the firm and affects corporate performance (customer satisfaction and overall profitability). Logistics has become more salient in companies where logistics excellence has an impact on the company's profitability, such as Dell, Nabisco, and FedEx (Mentzer and Williams 2001), and companies have used logistics to create a competitive advantage (Bowersox, Mentzer, and Speh 1995; Morash, Dröge, and Vickery 1996). In firms where logistics is salient and provides a competitive advantage, there might be a benefit in involving logistics in firm-wide activities where logistics currently does not play a prominent role, such as new product development (Zacharia and Mentzer 2004). Resource dependence theory also suggests that functions that are important and provide an advantage within the firm are more likely to be involved in core business processes within the firm such as supply chain management and NPD. Srivastava, Shervani, and Fahey (1999) identified three core business processes: supply chain management, customer relationship management, and new product development. Companies where logistics is salient are more likely to have logistics involvement in NPD.

Zacharia and Mentzer (2004) conceptualized logistics salience as a second order construct made up of two indicator constructs: Degree of Importance (DI) and Advantage Provided (AP). The degree of importance construct was based on research conducted by Forker, Ruch, and Hershauer (1999), who found the importance of quality management within the firm was dependent on access to top management, decision-making influence, and visibility within the firm. The advantage provided construct was based on research conducted by McGinnis and Vallopra (1999), who found the importance of suppliers during new product development was dependent on the competitive advantage, cost advantage, service quality advantage, and profitability advantage. Therefore, as logistics provides a competitive advantage within the company there is a greater chance logistics is salient within the firm, leading to greater logistics involvement in core business processes within the firm (like NPD).

The logistics involvement in NPD construct is defined as the act of integrating logistics professionals in decision making processes (for the purposes of this paper, this means decision making processes associated with NPD). NPD researchers (Meyers and Tucker 1989; Morash, Dröge, and Vickery 1996) have noted the benefits of logistics involvement in NPD in terms of improved NPD project performance. Gaining involvement from other departments provides the opportunity to coordinate development to raise the level of NPD success (Ayers, Dahlstrom, and Skinner 1997). Just as supplier involvement in NPD (Clark 1989; McGinnis and Vallopra 1999) and manufactur-

ing involvement in NPD have an impact on NPD project performance (McDermott and Handfield 2000; Song, Montoya-Weiss, and Schmidt 1997), logistics involvement should benefit NPD.

Logistics involvement in NPD can be of benefit in many ways. When product life cycle times are short, as in fashion goods or electronic products like cell phones, logistics processes can make critical contributions to the time it takes to bring a new product to market (LaLonde and Powers 1993). Companies like Dell, Intel, and Sony – that use a modular product design – or automotive companies like Toyota, Ford, and General Motors – that use just-in-time manufacturing – benefit in part from early involvement of logistics in NPD. Logistics feedback influences new product design and parts configuration, based upon reliability, serviceability, shipping, storage, and installation requirements (Meyers and Tucker 1989).

The timing of when logistics becomes involved likely affects the type of logistics involvement in NPD. Costs incurred during the design stages of the NPD process may be no more than 8% of the total product development cost, but the decisions made in this stage determine as much as 60-80% of total NPD costs (Raia 1993). If logistics were involved earlier, it would be much easier to make cost trade-off decisions between the logistics implications of a particular design. One of the executives who participated in the qualitative phase of this research provided the following example.

> *Logistics identifies the cost of transportation associated with a proposed new vehicle design years before production starts. In one specific case of a popular automobile, logistics noted if the design team were able to reduce the overall length by 2 inches it would allow 18 vehicles per railcar instead of 15 vehicles per railcar as in the proposed design. The design team developed a new length that met the reduction in size, and also dramatically reduced the costs of transportation on the order of several million dollars over the life of the vehicle. Reducing the length would have been impossible even if logistics was able to point out the cost savings once the vehicle reached production.*

This suggests the earlier logistics becomes involved in the product development process the easier it is to make production cost versus logistics benefit trade-off decisions.

A review of the NPD literature also identified many similarities between logistics involvement and supplier involvement in the context of a NPD team. Supplier involvement in NPD can be characterized as a multidimensional construct (McGinnis and Vallopra 2001). Birou and Fawcett (1994), researching supplier involvement in NPD, noted supplier involvement is characterized by the timing and quality of involvement in the new product team. Before identifying a construct as a second order or first order construct, it is important to assess how respondents typically view the phenomenon of logistics involvement (Garver and Mentzer 1999). Our interviews also provided support to the concept of logistics involvement in NPD as a complex, multidimensional construct. Since there has been very little research on the role of logistics in NPD, we decided to focus on three specific dimensions: when logistics first became involved (timing), the quality of involvement (quality), and the strength of the relationship (relationship). Timing assesses when logistics first becomes involved or at what percent of NPD completion (0% to 100%) logistics becomes involved.

Quality assesses what impact logistics provided to the NPD process. Clearly, the quality of logistics involvement in NPD could vary from simply attending meetings to actually contributing ideas that are implemented. This range of involvement in the creativity, the independent contribution, the number of ideas generated, and the number of ideas implemented when logistics became involved in the NPD process define Quality. Relationship assesses the strength of the relationship that logistics has with other team members. Understanding the closeness of the relationship helps to better identify the value that logistics has with the NPD team. The level of commitment, cooperation, and value of logistics placed by other team members identifies the closeness of the relationship. Therefore logistics involvement in NPD can best be described in terms of timing, quality and relationship. This leads to the first hypothesis that relates the importance of logistics within the firm and the opportunity for logistics to be involved in core business processes within the firm (like NPD).

H_1: Companies where logistics has higher levels of logistics salience have greater logistics involvement in NPD.

Logistics involvement in NPD should lead to new product designs that mitigate logistics costs and thereby improve NPD project performance and NPD logistics performance.

Logistics Involvement in NPD and NPD Project Performance

One of the major goals of this research was to determine if logistics involvement in NPD improved the process of new product development, and one of the best methods to measure the impact of logistics involvement in NPD is to measure NPD project performance. Much of the research that has examined methods to improve NPD typically used NPD project performance as the outcome measure (Griffin and Hauser 1996; Montoya-Weiss and Calantone 1994). Researchers who have conducted meta-analyses or reviews of the NPD literature found global outcome measures are typically used to measure NPD project performance (Brown and Eisenhardt 1995; Griffin and Page 1996). NPD project performance is defined as the overall performance of an NPD project after the product has been in the marketplace for at least one year. The performance measures that were used (profit, budget, market share, speed to market, and quality/performance) as overall measures are consistent with the NPD literature (Griffin and Hauser 1996; Rochford and Rudelius 1992). The purpose of analyzing the performance of the NPD project is to better define the potential benefit of logistics involvement in NPD. If NPD project performance improves, there is a greater likelihood that logistics involvement in NPD was of benefit.

H_2: Companies with higher levels of logistics involvement have greater NPD project performance.

Another way to measure the impact of logistics involvement in NPD is to focus on NPD logistics performance measures. NPD logistics performance is defined as the performance typically associated with distribution and handling of the product, such as the order fill rate, on-time delivery, and damage free delivery (Chow, Heaver, and Henriksson 1994). Logistics, by being involved in the NPD process, could make suggestions to help reduce the cost and damage associated with deliv-

ering the new product. Another example from the interviews illustrates the role logistics played in ensuring the new products were delivered without damage:

Automobiles, that are transported on rail cars, used to be held in place with chains that were attached to the frame and ratcheted down into place. Engineering redesigned the automobiles from having heavy solid frames to a monocoque construction (practically eliminating the frame) to reduce weight and save on fuel costs. Unfortunately, logistics was not aware of this change, and by the time the automobiles reached the final destination, their frames were bent!

Logistics can also provide feedback on shipping conditions, such as exposure to water, air, dust, vibration, and temperature, that can affect the damage free delivery and transport of the new product. Having logistics involved in the NPD process should improve NPD logistics performance, especially during product delivery and transport.

H_3: Companies with higher levels of logistics involvement have greater NPD logistics performance.

NPD Logistics Performance and NPD Project Performance

One aspect of NPD logistics performance is to consider it as a component of NPD project performance. Improving NPD logistics performance in areas such as order fill rate or damage free delivery should translate into more satisfied customers, which should directly impact the bottom line. Increasing customer satisfaction will likely lead to improvements in NPD project performance areas such as profit and speed to market.

H_4: Companies with higher levels of NPD logistics performance have higher levels of NPD project performance.

METHOD

A survey research design, following the total design method (Dillman 1978), was used to collect the data. Multi-item measures were developed or adapted to evaluate the constructs proposed earlier (Churchill 1979; Gerbing and Anderson 1988). The unit of analysis in this research was a completed NPD project that had a product in the marketplace for at least a year, since NPD project performance is an important outcome variable (Brown and Eisenhardt 1995; Kessler and Chakrabarti 1996; Montoya-Weiss and Calantone 1994). This ensured the respondents were providing actual performance and not an estimate of the potential performance of the new product. Another advantage of using the project as the unit of analysis was that specific practices and their influence on project success tend to be more readily identifiable than using the firm as the unit of analysis.

Measure Development and Pretest

The method for scale development followed procedures and guidelines recommended by Churchill (1979), Gerbing and Anderson (1988), and Dunn, Seaker, and Waller (1994). Established

scales were either adopted directly or modified slightly to measure the constructs in this research (see Appendix B).

The 21 interview respondents from the qualitative phase of the research reviewed the survey to determine if the questions captured the important concepts associated with logistics involvement in NPD, identified any ambiguity or other difficulties in responding to the items, and offered suggestions to improve the questionnaire. Five academic experts evaluated measurement items and drafts of the survey from the standpoint of representativeness, item specificity, clarity of construction, readability, content validity, and face validity. Based upon the feedback, some items were rewritten or eliminated, and others were added.

All of the variables of interest were estimated through managers' perceptual evaluations of logistics salience, logistics involvement in NPD, NPD project performance, and NPD logistics performance. The survey, in addition to questions about logistics and NPD, also contained control variables such as the size of the firm, annual sales, percentage of revenue from new products, and the competitive nature of the industry.

Sampling Frame

The major focus of this research was to evaluate the involvement of logistics in new product development. Therefore, it was critical to find companies with logistics departments or executives who are familiar with logistics to answer the survey. This eliminated sending the survey to the general population, which led us to approach the Council of Supply Chain Management Professionals directly to utilize their mailing list of U.S. manufacturing firms. Target firms were not limited to those in any single industry, but open to various industries in hopes of obtaining study results more applicable across industries in the U.S. By selecting manufacturing related companies, there was a greater likelihood these companies had experience developing new products. The sample consisted of randomly selected individuals, represented by logistics and supply chain professionals with titles such as logistics manager, director of logistics, director of materials, vice president of supply chain, and executive vice president. These individuals were chosen as the respondent group because they are uniquely informed about the subject matter in the survey instrument, specifically logistics, NPD project performance and NPD logistics performance.

Out of the original list of 2,041 potential participants, a random sample of 268 participants was contacted as part of the pretest. Participants were contacted through mail, telephone, and e-mail. Sixty-five respondents indicated they were in some way prohibited from completing the survey, which left a sample size of 203. Forty-eight usable surveys were returned, for an effective pretest response rate of 23.6%. The response rate ranged from a low of 2% for mail, 21% for e-mail, and 28% for telephone.

Griffis, Goldsby, and Cooper (2003), testing both e-mail (web surveys) and traditional mail surveys, concluded that e-mail surveys are comparable in quality to mail surveys and can be used to support the same conclusions. Advantages of e-mail surveys were the higher response rate, lower costs for repeat mailings, and the response data can be added to a database directly; while disad-

vantages of e-mail surveys include not being able to jot notes beside particular questions, it is not as universally available, and it is more prone to technological errors (Griffis, Goldsby, and Cooper 2003). The significantly low response rate for the mail survey and the advantages of the e-mail surveys led to eliminating contacting potential respondents by mail. Even though contacting respondents by telephone had the highest response rate, it was also very difficult and time consuming to contact respondents directly as the vast majority of calls went to voice mail. The response rate was comparable between e-mail and telephone with a lot less effort, which led to the use of e-mail as the primary method of soliciting participation from potential respondents for the final survey.

For the final survey, eliminating names of those who indicated they were unable to participate (740), had already participated in the pre-test (268), or had incorrect e-mail addresses (229) left a final sample of 804. Out of this group, using a 4-wave mailing process, 304 surveys were returned. Eight surveys were deleted for not answering 11 or more questions out of 67 (missed 16% of the survey). This left a final response of 296 usable surveys, for an effective response rate of 36.8%.

Demographic information on the survey respondents can be found in Table 1. The majority of the respondents were either in management (84%) or executives (12%). Respondents were highly experienced with NPD projects, 69% had been involved in over ten NPD projects and 49% of the respondents indicated over 30% of their company's profits came from products less than five years old. A large number of industries were represented, with the three largest in the Electronics (18%), Food (18%), and Pharmaceuticals (12%) industries. Respondents came from well-established companies (94% over 11 years old), and large companies (65% over 5000 employees and 43% over $5 billion in sales). The most common department the respondents belonged to was logistics (67%). Manufacturing and marketing department members who are typically involved in NPD comprised about 10% of the sample, which could be considered unduly biased. However, since much of the research was exploratory to determine if the role of logistics was different in NPD than what is typically found in the literature, there was a need to ensure logistics was well represented in the sample. Since this is one of the first research projects that specifically examines the role of logistics in NPD, there is value in ensuring the majority of the respondents are from logistics. If this research establishes that logistics plays an important role in NPD, then further research should involve other departments to further corroborate these findings. To assure the logistics function did not unduly influence or bias the sample, T-tests were conducted on all of the constructs and the specific items. Out of the 27 items that were tested, one item from the advantage provided construct was different between logistics and non-logistics respondents. This item was deleted from the subsequent analysis. All other constructs and items had no significant difference between logistics and non-logistics respondents at ($p < 0.001$).

TABLE 1

DEMOGRAPHIC DATA

Survey Question	Largest Group	2nd Largest Group	3rd Largest Group	4th Largest Group
Job Title	Managers 84%	Executive 12 %	Analyst 4%	
NPD projects	10-25 37%	Over 25 32%	1-4 17%	5-9 14%
Profit from products Less than 5 years old	Over 30% 49%	1-10% 21%	11-20% 19%	21-30% 11%
Industries	Other 25%	Electronics 18%	Food/tobacco 18%	Pharmaceuticals 12%
Company Age	>15 yrs 89.1%	11-15 yrs 5.1%	6-10 yrs 3.4%	<5 yrs 1.7%
Company Size (Employees)	5,001-50,000 43.2%	501-5,000 30.4%	>50,000 22.3%	<500 4.4%
Company Annual Sales (Billions)	> 5 43.6%	1-5 28.0%	0.100-0.999 27.3%	< 0.099 4.4%
Department	Logistics 67%	Other 21%	Manufacturing 7%	Marketing 3.4%

The potential for non-response bias was tested by comparing early and late respondents for all of the constructs included in the study using ANOVA (Armstrong and Overton 1977). Six questions for NPD project performance were tested for any bias between the different waves of responses. There were no statistical differences between the waves for NPD project performance at $p < 0.05$. In addition, a random sample of 34 non-respondents was contacted to compare their responses on the dependent variable NPD project performance with those of respondents to assess the potential for non-response bias (Mentzer and Flint 1997). There were no significant statistical differences between the respondents and non-respondents at $p < 0.05$. Given these two tests, non-response bias was not considered a problem in the final sample.

Analysis

A basic analysis of the returned surveys, including examination for incorrect coding, item normality, skewness, kurtosis, means, standard deviations, and outliers (Mentzer, Flint, and Kent 1999), was acceptable. Structural Equation Modeling (SEM) using AMOS 5.0 was the main statistical analysis tool for this research. Gerbing and Anderson's (1988) two-step method was followed, where a measurement model is developed first and followed by a structural model. Three of the con-

structs, logistics involvement in NPD relationship, NPD project performance, and NPD logistics performance, each had one item deleted to significantly improve their construct reliability or Cronbach α. Advantage provided, as explained earlier, had one item deleted as logistics respondents and nonrespondents had significant differences on this item. The remaining items and constructs met the requirements for unidimensionality, reliability, and construct validity through their standardized regression weights, squared multiple correlations, standardized residuals, modification indices, and goodness of fit indicators. The measurement model was tested using AMOS 5.0 and Table 2 contains the parameter estimates, Cronbach's alpha, and t-values from the confirmatory analysis.

A number of statistical tests were conducted to confirm logistics salience and logistics involvement in NPD are second order constructs, as proposed in the model. If the correlation coefficients between the first order factors are relatively high (> .70), then from a statistical perspective the respondents are viewing this phenomenon at the second order factor level (Garver and Mentzer 1999). The regression weights were .71 and .67 for degree of importance and advantage provided respectively for logistics salience. The regression weights were 0.78 for timing, 0.85 for quality, and 0.79 for relationship.

Another test to determine if a second order factor is more reasonable is to determine the improvement in chi-square in comparison to the cost in terms of degrees of freedom and p-values of the associated paths (Hair et al. 1998). There was an improvement in chi-square, degrees of freedom, and highest p-value in comparing the first order construct for logistics salience ($\chi^2 = 584.2$, DF = 229, $p < 0.0001$) and the second order construct for logistics salience ($\chi^2 = 460.6$, DF = 228, $p < 0.0001$). There was a significant improvement for logistics involvement in NPD in terms of the chi-square, degrees of freedom, and highest p-value in comparing the first order construct ($\chi^2 = 878$, DF = 227, $p < 0.0001$) and the second order construct ($\chi^2 = 480$, DF = 229, $p < 0.0001$). Therefore, both logistics salience and logistics involvement in NPD can be considered second order constructs.

The structural model was then tested, which resulted in the following three SEM indices of model adequacy: (1) the chi-square, goodness-of-fit test, ($\chi^2 = 460.6$, DF = 228), (2) the Bentler comparison fit index (CFI = 0.948), and (3) Root Mean Square Error of Approximation (RMSEA = 0.059). All regression weights were significant at the $p < 0.001$ level, except for the path from logistics involvement in NPD to NPD logistics performance, which was significant at the $p < 0.008$ level. The final model, with the items and standardized values for the regression weights, is presented in Figure 2. Table 3 summarizes the hypotheses, regression weights and P values for the first and second order constructs.

TABLE 2

PARAMETER ESTIMATES, CRONBACH'S α AND T-VALUES FROM CONFIRMATORY ANALYSIS

Construct Label	Item Description	Degree of Importance (DI)	Advantage Provided (AP)	Timing (T)	Quality (Q)	Relationship (R)	NPD Project Perform. (PP)	NPD Logistics Perform. (LP)
		α = (0.93)	α = (0.90)	α = (0.93)	α = (0.95)	A = (0.94)	α = (0.89)	α = (0.73)
DI_1	Logistics importance	0.86 (19.2)						
DI_2	Visibility in firm	0.96 (22.8)						
DI_3	Top mgmt. access	1						
AP_1	Cost advantage		0.85 (17.4)					
AP_2	Service quality advantage		0.84 (17.3)					
AP_3	Competitive advantage		0.99 (19.9)					
AP_4	Profitability advantage		1					
T	Timing			1				
Q_1	Creativity				1			
Q_2	Contribution				0.98 (26.6)			
Q_3	Ideas generated				0.96 (24.5)			
Q_4	Ideas implemented				0.98 (22.5)			
R_1	Highly committed					1		
R_2	Highly cooperative					0.93 (30.9)		

TABLE 2 (CONT.)

PARAMETER ESTIMATES, CRONBACH'S α AND T-VALUES FROM CONFIRMATORY ANALYSIS

Construct Label	Item Description	Degree of Importance (DI)	Advantage Provided (AP)	Timing (T)	Quality (Q)	Relationship (R)	NPD Project Perform. (PP)	NPD Logistics Perform. (LP)
		α = (0.93)	α = (0.90)	α = (0.93)	α = (0.95)	A = (0.94)	α = (0.89)	α = (0.73)
PP_1	Profit						1.3 (19.3)	
PP_2	Budget						0.88 (12.7)	
PP_3	Market share						1.3 (17.6)	
PP_5	Competitive advantage						0.88 (13.1)	
PP_6	Speed to market						0.57 (6.9)	
PP_7	Quality or performance						1	
LP_2	Filled orders							1
LP_3	On time delivery							0.93 (9.4)
LP_4	Damage free deliveries							0.57 (5.9)

$\chi^2 = 522.2$, DF = 232, $p < 0.0001$, CFI = 0.935, RMSEA = 0.065, All t-values (in parenthesis) sig. ($p < 0.01$)

FIGURE 2

LINPD MODEL WITH STANDARDIZED VALUES (ERROR TERMS OMITTED FOR CLARITY)

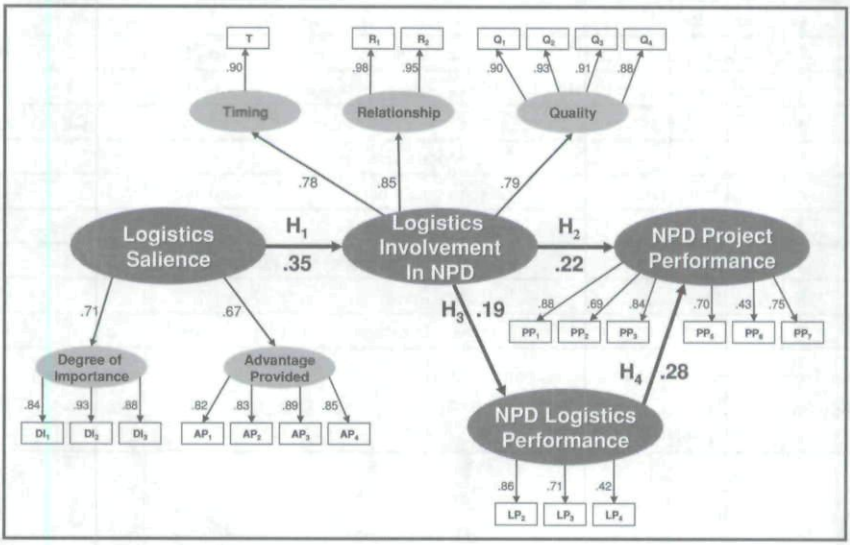


TABLE 3

PATH WEIGHTS OF STRUCTURAL MODEL*

Hyp.	1st Order Construct	1st Order Construct	Path Weights	T Value	P Value
H_1	Logistics Salience	Logistics Involvement in NPD	0.354	4.09	0.001
H_2	Logistics Involvement in NPD	NPD Project Performance	0.217	3.31	0.001
H_3	Logistics Involvement in NPD	NPD Logistics Performance	0.186	2.65	0.008
H_4	NPD Logistics Performance	NPD Project Performance	0.283	4.04	0.001
	Dimensions	**2nd Order Construct**			
	Degree of Importance	Logistics Salience	0.708	10.83	0.001
	Advantage Provided	Logistics Salience	0.667	9.98	0.001
	Timing	Logistics Involvement in NPD	0.777	12.12	0.001
	Relationship	Logistics Involvement in NPD	0.852	15.58	0.001
	Quality	Logistics Involvement in NPD	0.794	13.14	0.001

*Note: Goodness of Fit Measures of Structural Model

AGFI 0.86	GFI 0.885	NFI 0.902	RFI 0.892	RMSEA 0.059
CFI 0.948	IFI 0.948	PGFI 0.731	RMR 0.156	TLI 0.942

FINDINGS

Hypothesis 1 stated that logistics salience leads to greater logistics involvement in NPD. As confirmed previously, logistics salience is a second order construct made up of two first order constructs: degree of importance and the advantage provided (Zacharia and Mentzer 2004). Based on the path estimate of 0.35, this hypothesis was supported as a positive relationship at the $p = 0.001$ level. This suggests there is a relationship in companies where logistics plays an important or salient role and the involvement of logistics in NPD. Therefore, in this sample the more salient logistics is within the firm the greater the likelihood logistics is involved in NPD.

Hypothesis 2 stated that logistics involvement in NPD leads to greater NPD project performance. Logistics involvement in NPD is also a second order construct made up of three first order constructs, or three dimensions: timing, quality, and relationship. Timing had a value of 0.78, which suggests when logistics first becomes involved in NPD is important to consider. Quality had a value of 0.79, which suggests the creativity, the number of ideas generated and implemented, matter in logistics involvement. Relationship had a value of 0.85, which suggests the cooperation and commitment can impact logistics involvement in NPD. Based on the path estimate of 0.22, the positive relationship between logistics involvement in NPD and NPD project performance was supported at the $p = 0.01$ level. NPD project performance is a key output construct in this model. The fact that logistics

involvement in NPD leads to better NPD project performance bodes well for the concept of logistics involvement in NPD.

Hypothesis 3 stated that logistics involvement in NPD leads to better NPD logistics performance. Based on the path estimate of 0.19, the relationship between logistics involvement in NPD and NPD logistics performance was supported as a positive relationship at the $p = 0.001$ level. Therefore, logistics involvement in NPD has a direct effect on NPD logistics performance.

Hypothesis 4 stated that improvements in NPD logistics performance lead to better NPD project performance. Based on the path estimate of 0.28, the positive relationship between NPD logistics performance and NPD project performance was supported at the $p = 0.001$ level. Therefore, NPD logistics performance has a direct effect on NPD project performance.

MANAGERIAL IMPLICATIONS

The primary managerial implication is that NPD project performance improves with logistics involvement in the NPD process. Companies frequently search for ways to improve NPD project performance, and NPD is essential for long-term survival for many firms. Much of the NPD literature suggests companies still do a poor job of NPD and this research should be of great value for companies that do not currently involve logistics in NPD. This research did not specifically consider the type of new product; however, it is possible to speculate on the role of logistics involvement in NPD. If the shipping conditions, such as exposure to water, air, dust, vibration, and temperature, can affect the final product, there is value in having logistics involved during NPD. When the physical characteristics of the product prevent the efficient utilization of cubic space, there is value in getting logistics involved in the NPD process. If the new product requires special transportation, it is important to get logistics involved in the NPD process. When the product launch becomes critical or there is a need to distribute products to a large number of retail locations in a very short time, logistics involvement in NPD is valuable. If the new product requires changes to the existing method of distribution, logistics needs to be involved in the NPD process. If the cost of distributing the product is a significant component of the final cost of the product, then it is critical to have logistics involved in the NPD process. From the examples discussed above, it is also possible to suggest that the opposite of these examples are where logistics involvement in NPD is less important.

The second managerial implication is that logistics involvement in NPD improves NPD logistics performance. This suggests that companies concerned with the efficient distribution of new products, damage free delivery, or those competing on the basis of logistics capabilities, benefit from logistics involvement in NPD. Given that a large proportion of NPD projects fail, any effort by the firm to improve performance is warranted. Since involvement of logistics in NPD project teams improves NPD project performance and subsequent performance of logistics, firms should consider the strategic advantage this double performance enhancement brings to the firm.

The third managerial implication is that the timing of logistics involvement in the NPD process is important. Both interview and survey data supported the idea that logistics involvement in the NPD

team led to designs that better incorporated logistics trade-offs. Over 50% of the respondents were involved with the new product team before 50% of the NPD project was completed, suggesting many of the companies already practice early logistics involvement in NPD. This provides support for the notion that involving logistics after the new product is completely developed is not as valuable as involving logistics early in the NPD process. In this research study, 32% of the sample did not involve logistics until after the product was approximately 80% completed, which indicates the majority of companies do involve logistics before the product is completed. However, many companies could involve logistics earlier in the NPD process. Companies developing new products where logistics issues are important clearly benefit from early logistics involvement in NPD.

The fourth managerial implication is the importance of logistics within the firm directly leads to greater logistics involvement in NPD. Companies where logistics has become a source of competitive advantage or where logistics is salient within the firm benefit from logistics involvement in NPD. Managers can evaluate the salience of logistics in their own firm by considering factors such as access to top management, decision making influence and visibility within the firm. The advantage logistics provides in terms of cost, service quality, competitive advantage and profitability also impacts the importance of logistics within the firm.

The fifth managerial implication is the type of logistics involvement in the NPD project impacts NPD project performance and NPD logistics performance. The quality of logistics involvement in terms of creativity, contribution, ideas generated, and ideas implemented, does matter. Therefore, having logistics personnel simply attending a few meetings of the NPD team might not directly translate into improvements in NPD project performance and NPD logistics performance. Logistics involvement in NPD should focus on developing new creative ideas that can be implemented. The relationship logistics has with other members of the NPD team also impacts the outcome of the project. The commitment and cooperation by logistics to the NPD team seems to be important. Again, if logistics is unable to significantly commit and cooperate with the NPD team, there is little benefit in involving logistics in NPD. Both the quality and the type of relationship of the logistics involvement in NPD affect the outcome. For those projects where logistics factors are important, managers need to commit significant logistics resources to help ensure improvements in NPD project performance and NPD logistics performance.

LIMITATIONS

The large number of industries represented here, coupled with the significant response rate, suggests the results are generalizable in many different NPD contexts. However, there are limitations. Even though the respondents had relevant knowledge for logistics and NPD, the data are based on hindsight and could contain subjective bias. In addition, using single respondents instead of multiple respondents increases the risk of single source error typical of survey based research. This study utilized logistics respondents to evaluate the role of logistics in NPD, which might positively affect the results. Finally, this research also did not incorporate a longitudinal design, which limits the ability to test the direct causal relationships implied by the hypotheses.

FURTHER RESEARCH

Further research should attempt to extend this study in a number of different ways to better understand the role of logistics in NPD. There is value in determining what new product/service characteristics or what industries benefit the most from logistics involvement in NPD. For example, the environmental uncertainty of the industry, the level of global competition, the sophistication of the information technology, and the average product life cycle could all potentially affect the role of logistics in NPD.

The involvement of logistics could also be affected by the degree of innovativeness of the new product. Is logistics involvement of greater value when developing a radical new product or when developing an incremental new product? Radical products do not have an existing logistics infrastructure, which might suggest logistics involvement is of greater value than an incremental innovation where the logistics infrastructure is already in existence. Another argument could be that logistics costs are not a concern with a radical product since the greater concern is just to get the product completed and launched. In an incremental innovation, every cost is scrutinized, which might make logistics input of greater value.

Another area of further research is to replicate this study with non-logistics respondents. Ensuring the departments that are typically involved in NPD – such as R&D, manufacturing, and marketing – are well represented in a survey would add further support to the valuable role that logistics plays in NPD. Incorporating multiple respondents from the same NPD project might provide different insights than what was currently discovered. Multiple respondents could further expand on the role of resource interdependence as the driver of involving logistics in the NPD team.

This research focused on U.S. manufacturing companies. Does the role of logistics change in companies from other countries that might affect the potential benefit of logistics involvement in NPD? Does the availability of a logistics and transportation infrastructure in another country affect the benefit of logistics involvement in NPD? Is logistics involvement in NPD of value in countries where logistics is not viewed as part of the competitive advantage of a company?

In this research, there was a clear focus on new products instead of new services. Can logistics play a role in the development of new services and is it of value? What kinds of services are more appropriate for logistics involvement? Further research could target companies that provide services to determine the role of logistics new service development.

This research focused on NPD projects that were developed within the firm. However, there has been a greater emphasis on the value of supply chain management and incorporating suppliers and customers in the NPD process. Further research should evaluate the role of logistics members from customer firms, supplier firms, and other companies in the supply chain as part of the NPD process.

There are many different ways to delineate the process or number of steps associated with NPD, but a common NPD model distinguishes idea generation, idea screening, and opportunity analysis from product development, product testing, and product launch (Gupta, Raj, and Wilemon 1986;

Song and Montoya-Weiss 1998). This research was able to determine logistics involvement in NPD before product launch was of value. Does the role of logistics change in these different steps and in which of these steps does logistics involvement have the greatest value?

Finally this research used a survey approach to be broadly generalizable across multiple industries. Further research could instead rely on case study methodologies focusing on a single industry, or on a few companies, to better develop a deeper understanding of the role of logistics in NPD.

CONCLUSION

This paper serves to fill a gap in the literature with respect to relating logistics involvement in NPD and firm performance, and is one of the few to examine the relationship between logistics involvement in NPD and NPD project performance and NPD logistics performance. This research suggests there is strategic value in considering the role of logistics in NPD and also supports the basic tenets of resource dependence theory that the value of functions changes as they provide valued information. As logistics continues to provide valuable information, there is a benefit in involving logistics in NPD. We hope this research will encourage both practitioners and researchers to consider the involvement of logistics in NPD within the firm to improve NPD project performance and NPD logistics performance.

NOTES

Armstrong, J. Scott and Terry S. Overton (1977), "Estimating Non-Response Bias in Mail Surveys," *Journal of Marketing Research,* Vol. 14, No. 3, pp. 396-402.

Ayers, D., R. Dahlstrom, and S. J. Skinner (1997), "An Exploratory Investigation of Organizational Antecedents to New Product Success," *Journal of Marketing Research,* Vol. 34, No. 1, pp.107-116.

Bienstock, Carol C., John T. Mentzer, and Monroe Murphy Bird (1997), "Measuring Physical Distribution Service Quality," *Journal of the Academy of Marketing Science,* Vol. 25, No. 2, pp. 35-44.

Birou, Laura M. and Stanley E. Fawcett (1994), "Supplier Involvement in Integrated Product Development: A Comparison of U.S. and Europe Practices," *International Journal of Physical Distribution and Logistics Management,* Vol. 24, No. 5, pp. 4-14.

Booz, Allen and Hamilton, Inc. (1982), *New Product Management for the 1980's,* New York: Booz Allen and Hamilton.

Bowersox, Donald J., John T. Mentzer, and Thomas W. Speh (1995), "Logistics Leverage," *Journal of Business Strategies,* Vol. 12, No. 1, pp. 36-46.

Brown, Shona L. and Kathleen M. Eisenhardt (1995), "Product Development: Past Research, Present Findings and Future Directions," *Academy of Management Review,* Vol. 20, No. 2, pp. 343-378.

Chow, Garland, Trevor D. Heaver, and Lennar Henriksson (1994), "Logistics Performance: Definition and Measurement," *International Journal of Physical Distribution and Logistics Management,* Vol. 24, No. 1, pp. 17-28.

Churchill, Gilbert A. (1979), "A Paradigm for Developing Better Measures of Marketing Construct," *Journal of Marketing Research,* Vol. 16, No. 1, pp. 64-73.

Clark, Kim B. (1989), "Project Scope and Project Performance: The Effect of Parts Strategy and Supplier Involvement on Product Development," *Management Science,* Vol. 35, No. 10, pp. 1247-1263.

Cooper, Robert G. (1990), "Stage-Gate Systems: A New Tool for Managing New Products," *Business Horizons,* Vol. 33, No. 3, pp. 44-54.

Dillman, Don A. (1978), *Mail and Telephone Surveys: The Total Design Method,* New York: John Wiley & Sons.

Dunn, Steven C., Robert F. Seaker, and Matthew A. Waller (1994), "Latent Variables in Business Logistics Research: Scale Development and Validation," *Journal of Business Logistics,* Vol. 15, No. 2, pp. 145-172.

Ellinger, Alexander E., Patricia J. Daugherty, and Scott B. Keller (2000), "The Relationship Between Marketing/Logistics Interdepartmental Integration and Performance in U.S. Manufacturing Firms: An Empirical Study," *Journal of Business Logistics,* Vol. 21, No. 1, pp. 1-22.

Ettlie, John E. (1997), "Integrated Design and New Product Success," *Journal of Operations Management,* Vol. 15, No. 1, pp. 33-45.

Fawcett, Stanley E. and David J. Closs (1993), "Coordinated Global Manufacturing: The Logistics Manufacturing Interaction and Firm Performance," *Journal of Business Logistics,* Vol. 14, No. 1, pp. 1-25.

Forker, Laura B., William A. Ruch, and James C. Hershauer (1999), "Examining Supplier Improvement Efforts from Both Sides," *The Journal of Supply Chain Management,* Vol. 35, No.3, pp. 40-50.

Garver, Michael S. and John T. Mentzer (1999), "Logistics Research Methods: Employing Structural Equation Modeling to Test for Construct Validity," *Journal of Business Logistics,* Vol. 20, No. 1, pp. 33-57.

Gerbing, David W. and James C. Anderson (1988), "An Updated Paradigm for Scale Development Incorporating Unidimensionality and Its Assessment," *Journal of Marketing Research,* Vol. 25, No. 2, pp. 186-192.

Griffin, Abbie (1997), "The Effect of Project and Process Characteristics on Product Development Cycle Time," *Journal of Marketing Research,* Vol. 34, No. 1, pp. 24-35.

Griffin, Abbie and John R. Hauser (1996), "Integrating R&D and Marketing: A Review and Analysis of the Literature," *Journal of Product Innovation Management,* Vol. 13, No. 3, pp. 191-215.

Griffin, Abbie and Albert L. Page (1996), "PDMA Success Measurement Project: Recommended Measures for Product Development Success and Failure," *Journal of Product Innovation Management,* Vol. 13, No. 6, pp. 478-496.

Griffis, Stanley E., Thomas J. Goldsby, and Martha Cooper (2003), "Web-Based and Mail Surveys: A Comparison of Response, Data, and Cost," *Journal of Business Logistics,* Vol. 24, No. 2, pp. 237-258.

Gupta, Ashok K., S. P. Raj, and David L. Wilemon (1986), "A Model for Studying R&D – Marketing Interface in the Product Innovation Process," *Journal of Marketing,* Vol. 50, No. 2, pp. 7-17.

Hair, Joseph F., Rolph E. Anderson, Ronald L. Tatham, and Willam C. Black (1998), *Multivariate Data Analysis,* 5th Ed. Upper Saddle River, NJ: Prentice Hall, pp. 577-664.

Heskett, James L. (1977), "The Coming of the New Organization," *Harvard Business Review,* Vol. 55, No. 6, pp. 85-96.

Homburg, Christian, John P. Workman, Jr., and Harley Krohmer (1999), "Marketing's Influence Within the Firm," *Journal of Marketing,* Vol. 63, No. 2, pp.1-16.

House, Charles H. and Raymond L. Price (1991), "The Return Map: Tracking Product Teams," *Harvard Business Review,* Vol. 69, No. 1, pp. 92-100.

Kessler, Eric H. and Alok K. Chakrabarti (1996), "Innovation Speed: A Conceptual Model of Context, Antecedents and Outcomes," *Academy of Management Review,* Vol. 21, No. 4, pp. 1143-1191.

LaLonde, Bernard J. and Richard F. Powers (1993), "Disintegration and ReIntegration: Logistics of the 21st Century," *The International Journal of Logistics Management,* Vol. 4, No. 2, pp.1-12.

Langley, C. John and Mary C. Holcomb (1992), "Creating Logistics Customer Value," *Journal of Business Logistics,* Vol. 13, No. 2, pp. 1-27.

McDermott, Christopher and Robert Handfield (2000), "Concurrent Development and Strategic Outsourcing: Do the Rules Change in Breakthrough Innovation?" *Journal of High Technology Management Research,* Vol. 11, No. 1, pp. 35-58.

McGinnis, Michael A. and Rafeekh M. Vallopra (2001), "Managing Supplier Involvement in Process Improvement in Manufacturing," *The Journal of Supply Chain Management,* Vol. 37, No. 3, pp. 48-54.

McGinnis, Michael A. and Rafeekh M. Vallopra (1999), "Purchasing and Supplier Involvement: Issues and Insights Regarding New Product Success," *The Journal of Supply Chain Management,* Vol. 35, No. 4, pp. 4-15.

Mentzer, John T. and Daniel J. Flint (1997), "Validity in Logistics Research," *Journal of Business Logistics,* Vol. 18, No. 1, pp. 199-216.

Mentzer, John T., Daniel J. Flint, and John L. Kent (1999), "Developing Logistics Service Quality Scale," *Journal of Business Logistics,* Vol. 20, No.1, pp. 9-32.

Mentzer, John T., Daniel J. Flint, and G. Tomas M. Hult (2001), "Logistics Service Quality as a Segment-Customized Process," *Journal of Marketing,* Vol. 65, No. 4, pp. 82-105.

Mentzer, John T. and Lisa R. Williams (2001), "The Role of Logistics Leverage in Marketing Strategy," *Journal of Marketing Channels,* Vol. 8, No. 3/4, pp. 29-48.

Meyers, Patricia W. and Frances G. Tucker (1989), "Defining Roles for Logistics During Routine and Radical Technological Innovation," *Journal of the Academy of Marketing Science,* Vol. 17, No. 1, pp. 73-82.

Montoya-Weiss, Mitzi M. and Roger J. Calantone (1994), "Determinants of New Product Performance: A Review and Meta-Analysis," *Journal of Product Innovation Management,* Vol. 11, No. 5, pp. 397-417.

Morash, Edward A., Cornelia Dröge, and Shawanee Vickery (1996), "Boundary Spanning Interfaces between Logistics, Production, Marketing and NPD," *International Journal of Physical Distribution and Logistics Management,* Vol. 26, No. 8, pp. 43-62.

Nakata, C. and K. Sivakumar (1996), "Culture and New Product Development: An Integrative Review," *Journal of Marketing,* Vol. 60, No.1, pp. 61-72.

Olson, Eric M., Orville C. Walker, Jr., and Robert W. Ruekert (1995), "Organizing for Effective New Product Development: The Moderating Role of Product Innovativeness," *Journal of Marketing*, Vol. 59, No. 1, pp. 48-62.

Pfeffer, Jeffery and Gerald R. Salancik (1978), *The External Control of Organizations: A Resource Dependence Perspective*, New York: Harper and Row.

Raia, Ernst. (1993), "The Design Team: Suppliers Move into the Line of Fire," *Purchasing*, Vol. 115, No. 8, pp. 9-13.

Rochford, Linda and William Rudelius (1992), "How Involving More Functional Areas within a Firm Affects the New Product Process," *Journal of Product Innovation Management*, Vol. 9, No. 4, pp. 287-299.

Sivadas, Eugene and F. Robert Dwyer (2000), "An Examination of Organizational Factors Influencing New Product Success in Internal and Alliance-Based Processes," *Journal of Marketing*, Vol. 64, No.1, pp. 31-49.

Song, X. Michael, Mitzi M. Montoya-Weiss, and Jeffrey Schmidt (1997), "Antecedents and Consequences of Cross-Functional Cooperation: A Comparison of R&D, Manufacturing, and Marketing Perspectives," *The Journal of Product Innovation Management*, Vol. 14, No. 1, pp. 35-47.

Song, X. Michael and Mitzi M. Montoya-Weiss (1998), "Critical Development Activities for Really New Versus Incremental Products," *Journal of Product Innovation Management*, Vol. 15, No. 2, pp. 124-135.

Srivastava, Rajendra K., Tasadduq A. Shervani, and Liam Fahey (1999), "Marketing, Business Process, and Shareholder Value: An Organizationally Embedded View of Marketing Activities and the Discipline of Marketing," *Journal of Marketing*, Vol. 63, No. 4, pp. 168-180.

Stalk, George, Jr., Phillip Evans, and Lawrence E. Schulman (1992), "Competing on Capabilities: The New Rule of Corporate Strategy," *Harvard Business Review*, Vol. 70, No. 2, pp. 54-65.

Tremblay, Michel, Jerome Cote, and David B. Balkin (2003), "Explaining Sales Pay Strategy Using Agency, Transaction Cost, and Resource Dependence Theories," *Journal of Management Studies*, Vol. 40, No. 7, pp. 1651-1682.

Twigg, David (1998), "Managing Product Development within a Design Chain," *International Journal of Operations & Production Management*, Vol. 18, No. 5, pp. 508-524.

Zacharia, Zach G. and John T. Mentzer (2004), "Logistics Salience in a Changing Environment," *Journal of Business Logistics*, Vol. 25, No. 1, pp. 187-210.

APPENDIX A

INTERVIEW PROTOCOL

The purpose of the interview conveyed to the participants was to *identify measures that could be used to develop a survey to determine if early logistics involvement in new product development would be of benefit.*

After asking the participants to briefly describe their company, their competitive environment, their new product development process, and their function in that company, the following five questions were then asked:

1. *Do you know of any examples where logistics was not involved in new product development until launch, and did that affect project performance?*
2. *Do you know of any examples where logistics was involved in new product development, and did that affect project performance?*
3. *What are some of the factors that are used to measure new product development project performance?*
4. *What are some of the factors that are used to measure new product development logistics performance?*
5. *Do you have any contacts that are involved in new product development (who are not in logistics) that I could interview?*

APPENDIX B

CONSTRUCT ITEMS AND THEIR SOURCES

Item Label	Scale Item	Likert Scale	Source
DI_1 modified	The logistics/distribution department is an important department in your firm	1 = Strongly Disagree 7 = Strongly Agree	Forker, Ruch, and Hershauer (1999)
	The logistics department has become important in the firm in terms of…		
DI_2 modified	visibility within the firm	1 = Strongly Disagree 7 = Strongly Agree	Forker, Ruch, and Hershauer (1999)
DI_3 modified	degree of access to top management	1 = Strongly Disagree 7 = Strongly Agree	Forker, Ruch, and Hershauer (1999)
DI_4 modified	degree of decision-making influence*	1 = Strongly Disagree 7 = Strongly Agree	Forker, Ruch, and Hershauer (1999)
AP_1 modified	a cost advantage	1 = Strongly Disagree 7 = Strongly Agree	McGinnis and Vallopra (1999)
AP_2 modified	a service quality advantage	1 = Strongly Disagree 7 = Strongly Agree	McGinnis and Vallopra (1999)
AP_3 modified	a competitive advantage	1 = Strongly Disagree 7 = Strongly Agree	McGinnis and Vallopra (1999)
AP_4 modified	a profitability advantage	1 = Strongly Disagree 7 = Strongly Agree	McGinnis and Vallopra (1999)
T modified	When did Logistics/Distribution first become involved in the new product development project (from just started to 100% completed)?	1 = 0% complete 4 = 50% complete 7 = 100% complete	McGinnis and Vallopra (1999)
	Once logistics became involved, the level of logistics		
Q_1 modified	creativity was…	1 = Low, 7 = High	Birou and Fawcett (1994)
Q_2 modified	independent contribution was…	1 = Low, 7 = High	Birou and Fawcett (1994)
Q^3 modified	ideas generated (number of ideas) were…	1 = Low, 7 = High	Birou and Fawcett (1994)
Q_4 modified	ideas that were implemented were…	1 = Low, 7 = High	Birou and Fawcett (1994)
	In this project team, logistics…		Birou and Fawcett (1994)

APPENDIX B (CONT.)

CONSTRUCT ITEMS AND THEIR SOURCES

Item Label	Scale Item	Likert Scale	Source
R_1 modified	...was highly committed	1 = Strongly Disagree 7 = Strongly Agree	Birou and Fawcett (1994)
R_2 modified	...was highly cooperative	1 = Strongly Disagree 7 = Strongly Agree	Birou and Fawcett (1994)
R_3 new	...was highly valued by other team members *	1 = Strongly Disagree 7 = Strongly Agree	New item
	To what extent did this new product meet its...		
PP_1 adopted	profit objectives	1 = Fell far short 7 = Far Exceeded	Rochford and Rudelius (1992)
PP_2 adopted	budget objectives	1 = Fell far short 7 = Far Exceeded	Rochford and Rudelius (1992)
PP_3 adopted	market share objectives	1 = Fell far short 7 = Far Exceeded	Griffin and Hauser (1996)
PP_4 New	customer satisfaction objectives *	1 = Fell far short 7 = Far Exceeded	New item
PP_5 adopted	competitive advantage objectives	1 = Fell far short 7 = Far Exceeded	Griffin and Hauser (1996)
PP_6 adopted	speed to market objectives	1 = Fell far short 7 = Far Exceeded	Griffin and Hauser (1996)
PP_7 adopted	quality or performance objectives	1 = Fell far short 7 = Far Exceeded	Griffin and Hauser (1996)
	In your opinion, compared to other new products developed within your firm, this product's...		
LP_1 adopted	logistics/distribution costs were...*	1 = Fell far short 7 = Far Exceeded	Chow, Heaver, and Henriksson (1994)
LP_2 modified	orders that were filled as requested...	1 = Fell far short 7 = Far Exceeded	Chow, Heaver, and Henriksson (1994)
LP_3 adopted	on time delivery was...	1 = Fell far short 7 = Far Exceeded	Chow, Heaver, and Henriksson (1994)
LP_4 adopted	number of damage free deliveries was...	1 = Fell far short 7 = Far Exceeded	Chow, Heaver, and Henriksson (1994)

*Deleted

ABOUT THE AUTHORS

Zach G. Zacharia (Ph.D., The University of Tennessee) is an Assistant Professor in the Department of Information Systems and Supply Chain Management at Texas Christian University. He has published in the *Journal of Business Logistics, Journal of Retailing, Journal of Vehicle Design,* and *Transportation Research Record, Materials Performance,* and written several chapters in the book, *Supply Chain Management.*

John T. (Tom) Mentzer (Ph.D., Michigan State University) is the Harry J. and Vivienne R. Bruce Excellence Chair of Business in the Department of Marketing and Logistics at the University of Tennessee. He has written six books and published more than 170 articles and papers in the *Journal of Business Logistics, Journal of Marketing, Journal of Business Research, International Journal of Physical Distribution and Logistics Management, Transportation and Logistics Review, Transportation Journal, Journal of the Academy of Marketing Science, Columbia Journal of World Business, Industrial Marketing Management, Research in Marketing, Business Horizons,* and other journals.

ACKNOWLEDGEMENT

The authors wish to thank Robert F. Lusch, David W. Cravens, William L. Cron, Shannon H. Shipp, and Charles W. Lamb, Jr. for their insightful comments on earlier versions of this paper. This article has improved greatly from the suggestions of the anonymous *JBL* reviewers. Support from the Charles Tandy American Enterprise Center Faculty Research Award Program is gratefully acknowledged by the first author.

Copyright of Journal of Business Logistics is the property of Council of Logistics Management and its content may not be copied or emailed to multiple sites or posted to a listserv without the copyright holder's express written permission. However, users may print, download, or email articles for individual use.