Taxonomy in Logistics Management: A Resource-Based Perspective

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A survey of 1,200 manufacturing firms in Taiwan was undertaken in order to examine taxonomy in logistics management, using the resource-based perspective and cluster analysis approach. Results showed that intensive logistics competency cluster, which had excellent logistic competencies in all four logistics competencies, had better logistics, market, and financial performance. The results demonstrated that logistics competencies should not exist in a vacuum, but should leverage each other to create sustained competitive advantage.

1. Introduction

Empirical taxonomic approaches, which can reduce complexity or achieve parsimony by breaking the organisation into distinct and internally consistent categories without losing the main information or characteristics that exist within the taxa (Bailey, 1994; Rich, 1992; Ketchen, et al., 1993), have become prominent in research on strategic management (e.g. Miller, 1996), marketing management (e.g. Vorhies and Harker, 2000; Gordon and Milne, 1999), and operation management (e.g. Frohlich and Dixon, 2001; Miller and Roth, 1994; Kathuria, 2000; Boyer et al., 1996), but very few published empirical studies have focused on logistics and supply chain management (SCM). Further, even if researchers have employed the taxonomic approach to logistics or SCM, they have used narrow criteria or a few variables to classify firms in taxonomy such as logistics strategy (Kohn et al., 1990; McGinnis and Kohn, 1990), logistics strategic orientation (McGinnis and Kohn, 1993) or logistics technology adoption (Germain et al., 1994; Germain, 1996). Miller (1996) warned that a too narrowly focus on a few key elements was dangerous because an organisation would lose its resilience and relevance.

Another critical problem on taxonomic study is clustering dimensions disconnected form theory which may result in the taxa viewed as "data dredging" and not reflecting actual organisational real conditions (Miller, 1996; Ketchen and Shook, 1996; Bozarth and McDermott, 1998). Thus, the resource-based view (RBV) of the firm (Wernerfelt, 1984; Barney, 1991; Barney et al., 2001), which contends that the nonimitable resources and capabilities of firms are the key sources of sustained competitive advantage (Hoskisson et al., 1999; Oliver, 1997; Prahalad and Hamel, 1990), is one of the most influential theories in taxonomic studies (Miller, 1996; Vorhies and Harker, 2000) and strongly recommended by logistics/SCM researchers (Lynch et al., 2000; Skjoett-Larsen, 1999; Olavarrieta and Ellinger, 1997).

In addition, most logistics and SCM empirical studies have concentrated on Western developed countries (Luo et al., 2001), displaying a particular bias towards the USA. Non-Western developed countries, such as Taiwan, have been the focus of very few logistics and SCM studies, even though 60% of the world's desktop PCs or PC's motherboards are made in Taiwan or by Taiwanese company (Ernst, 2000).

In summary, the empirical taxonomic approach and the resource-based view of the firm have become two important theories in other disciplines, but not in the logistics and SCM fields. The present study will combine them, utilising logistics competency factors to classify organisations in the manufacturing industry of Taiwan.

2. Literature Review

2.1 Logistics competency approaches: a resource-based explanation

The strategic role of logistics has not received attention because logistics is still largely viewed as a separate entity or its activities as operational or tactical functions. However, the logistics competency approach can be regarded as a key strategic resource for acquiring sustained competitive advantage when resources or competencies are valuable, scarce and difficult to imitate (Olavarrieta and Ellinger, 1997).

A resource is valuable because it can exploit opportunities and threats in a firm's environment and thereby enhance efficiency and effectiveness (Barney, 1991). Likewise, logistics competency approaches are valuable because they can help organisations gain the benefit of both value-added maximisation and cost minimisation (Novack et al., 1992; Christopher, 1998).

Logistics relative capability approaches are, nevertheless, scarce because they involve a set of physical assets, knowledge, technology, organisational routines, and people skills (Gammelgaard and Larson, 2001), which need time to develop and integrate and are difficult to buy from the market. Additionally, logistics relative capability may include the need to effectively manage the relationship with suppliers, logistics service providers, and customers, and however, suitable and appropriate, supply chain partnerships may be difficult to build (Dyer and Ouchi, 1993; Cooper and Gardner, 1993).

Logistics relative capability approaches are also difficult and costly to imitate because of causal ambiguity. It is difficult to copy something that you do not know exactly what it is! Furthermore, it is difficult to discern the real cause of competitive advantage due to the complex relations existing within logistics partnerships or logistics networks (Fernández, et al., 2000). 'These exist in a complex web of social interactions and may even depend critically on particular individuals' (Collis and Montgomery, 1995: 122).

Several empirical studies have focused on logistical capability approaches. Bower and Hout (1992) and Daugherty and Pittman (1995) concentrated on *fast cycle capabilities* and indicated how firms can utilise time-based strategies to acquire competitive advantage. Fawcett et al. (1996, 2000) employed cross-function research (i.e. logistics and manufacturing) and concluded that *flexibility*, *quality*, and *cost* are important

capabilities that help firms enhance their performance and manage worldwide resources and markets. Morash et al. (1996a, 1996b) explored logistics capabilities conducting cross-function research (i.e. production, logistics, marketing, and new product development) and sole-function research (i.e. logistics) on 65 furniture manufacturing firms. The former (Morash et al., 1996a) concluded that excellence solely in one functional area is *not* the source of competitive advantage. Rather, boundary-spanning interface capabilities, including *demand management* and *supply management interface capabilities*, across functional areas become a source of SCA. In contrast, the latter (Morash et al., 1996b) identified logistics capabilities as *demand-oriented* and *supply-oriented capabilities* and concluded that some (i.e. delivery speed, reliability, responsiveness, and low cost distribution) are sources of SCA. Gilmour (1999) undertook a cross-national study of Australia, Japan, South Korea and Taiwan, exploring and identifying supply chain capabilities, including *process*, *technology*, and *organisation capabilities*. Morash and Clinton (1997) concluded that *transportation capabilities* may play a lead role in the integration and coordination of supply chain flow.

An examination of logistics capabilities was performed by MSUGLRT (1995) and later extended by Bowersox et al. (1999). MSUGLRT (1995) identified 17 logistics capabilities included in four logistics competencies. Bowersox et al. (1999) further expanded the 17 logistics capabilities to 25 supply chain capabilities related to 6 supply chain competencies and confirmed that the capabilities were critical to firms' success. Following on from this work, Stank and Lackey (1997) examined capabilities related to competence and found integration and agility to be of particular importance to logistical performance. Lynch et al. (2000) combined industrial organisation economics and resource-based theory to explore the relationship between logistics capabilities, generic business strategies, and performance. They identified two logistics capabilities: *process capabilities* and *value-added service capabilities,* and concluded that logistics capabilities are associated with strategy and need to be combined in order to achieve superior firm performance. Goldsby and Stank (2000) later confirmed the positive relationship between 17 logistics capabilities, and the implementation of environmentally responsible logistics. More recently, Zhao et al. (2001) found *customer-focused capabilities* directly affect performance. In contrast, *information-focused capabilities* indirectly affect performance. A typology of logistics competencies or capabilities is presented in Table 1.

2.2 Taxonomic criteria: four logistics competencies

In this study, we will utilise MSUGLRT's (1995) four logistics competencies as the criteria of taxonomy. The four logistics competencies are introduced below:

2.2.1 Positioning Competency

Strategic positioning is defined as "...performing *different* activities from rivals, or performing similar activities in *different* ways" (Porter, 1996: 62), and is the essential starting point to logistical excellence (MSUGLRT, 1995). "World class" firms view logistics positioning competency as a *differentiator* that can lead to competitive advantage (MSUGLRT, 1995).

Table 1. Typology of Logistics Competencies and Capabilities

Author(s)	Capabilities or Competencies	Sub-dimension of Capabilities or Competencies
Bower and Hout (1992); Daugherty and Pittman (1995)	Fast cycle	
MSUGLRT(1995); Bowersox, Closs and Stank (1999);	Positioning Integration	Strategy, Supply chain, Network, Organisation Supply chain unification, Information technology, Information sharing, connectivity, standardisation, Simplification, Discipline
Goldsby and Stank (2000)	Agility Measurement	Relevancy, Flexibility, Accommodation Functional Assessment, Process Assessment, Benchmarking
Fawcett, Calantone, and Smith (1996)	Flexibility	Manufacturing flexibility Logistics flexibility
Fawcett, Stanley, and Smith (1997b)	Delivery, Quality, Flexibility, Cost, and Innovation	
Morash, Dröge, and Vickery, (1996a)	Demand-Management Interface Supply-Management Interface	Customer service Logistics quality Channel distribution Total cost minimisation
Morash, Dröge, and Vickery (1996b)	Demand-Oriented Supply-Oriented	Pre-sale customer service, Post-sale customer service, Delivery speed, Delivery reliability, Responsiveness to target market (s) Widespread distribution coverage (availability), Selective distribution coverage, Low total cost distribution
Morash and Clinton (1997)	Transportation	Time compression, Reliability, Standardisation, JIT delivery, Information systems support, Flexibility, customisation
Stank and Lackey (1997)	Position Integration Agility Measurement	Customer focus, Organisational control, Organisational implementation Connectivity, Functional integration, Information sharing, Information technology, Supplier relations Operational flexibility, Personnel flexibility Activity-based costing, Benchmarking, Performance assessment
Bowersox, Closs and Stank (1999)	Customer Integration Internal Integration Material/Service Supplier Integration Technology and Planning Measurement Integration Relationship Integration	Segmental focus, Relevancy, Responsiveness, Flexibility. Cross-functional unification, Standardisation, Simplification, Compliance, Structural adaptation Strategic alignment, Operational fusion, Financial linkage. Supplier management Information management, Internal communication, connectivity, collaborative forecasting and planning Functional assessment, Activity based and total cost methodology, Comprehensive metrics, Financial impact Role specificity, Guidelines, Information Sharing, Gain/Risk sharing
Gilmour (1999)	Process Information Technology Organisation	Customer-driven supply chain, Efficient logistics, Demand-driven sales planning, Lean manufacturing, Supplier partnering, Integrated supply chain management. Integrated information systems Advanced technology Integrated performance measurement, Teamwork, Aligned organisation structure
Fawcett, Calantone and Roath (2000)	Quality Cost	Logistics quality Manufacturing quality Logistics cost Manufacturing cost
Lynch, Keller and Ozment (2000)	Process Value-added Service	
Zhao, Dröge and Stank (2001)	Customer-Focused Information-Focused	Segmental focus, Relevancy, Responsiveness, Flexibility. Information sharing, Information technology, connectivity.

Source: Summarised from the Literature and Tabled by the Authors.

2.2.2 Integration Competency

Integration may be the most important issue in logistics and SCM because the "...most fundamental shift in logistics thinking is to view functional excellence in terms of performance that enhances *overall* supply chain integration" (Bowersox et al., 1999: 19). Notably, the Dell computer's virtual integration, blurring of traditional boundaries and roles in the value chain, may become a new organisational model in the new information generation (Magretta, 1998). Integration is not a new concept in the field of management or organisational science. For example, Fayol (1949) identified co-ordination as one of the five critical functions of management and Lawrence and Lorsch (1967) stated that differentiation and integration are the basic principles for understanding organisational structures. However, in the logistics and SCM field, integration is central to logistics (Chow et al., 1995) and the key to SCM (Oliver and Webber, 1992). Some logistics researchers have viewed integration as a dimension of organisational structure or design (Germain et al., 1994a; Claycomb et al., 1999a) whereas others have identified integration as an outcome of organisational structure (Chow et al., 1995; Stank and Traichal, 1998). In this study, integration is viewed as the outcome of organisational structure and its scope includes intra-firm and other firms supporting the same supply chain. Integration is therefore identified as "...the degree to which logistics tasks and activities within the firm and across the supply chain are managed in a coordinated fashion" (Chow et al., 1995: 291).

2.2.3 Agility Competency

Agility is a business-wide capability "...to thrive in a competitive environment of continually and unpredictably changing market opportunities" (Goldman and Nagel, 1995:8). Agility has replaced delivery speed (1990s), quality (1980s), cost (1970s) and become the main competitive priority in the twenty-first century (Geris and Kasarda, 1997). Creating agile supply chains has become a source of competitive advantage (Lau and Hurley, 2001). Most studies have viewed agility as a general management or a strongly biased manufacturing concept (Yusuf et al., 1999; Gunasekaran, 1999; Zhang and Sharifi, 2000), not focused on the concept in the "supply chain as a whole" (Christopher, 2000), and also shown a bias towards the USA (van Hoek et al., 2001). Thus, this study focuses on the concept of agility in the logistics and total supply chain in the manufacturing industry in Taiwan.

2.2.4 Measurement Competency

Measurement refers to a firm's performance measurement system which plays an important role in managing the business because it offers the information necessary for decision making and actions (Novack et al., 1994; Holmberg, 2000: 848). Keebler et al. (1999) indicated that an excellent measurement system should produce three primary benefits: reduced costs, improved service, and the generation of healthy growth. Measurement is not solely a logistics and supply chain problem, but is particularly critical in the logistics and SCM field because of cross-functional and inter-organisational requirement (Bowersox et al., 1999; Gunasekaran, 2001; Holmberg, 2000). Recent

research has identified performance measurement as one of the top three areas of logistics research needs (Bowersox and Closs, 1996).

3. Methodology

A questionnaire survey was administered to 1,200 of the largest manufacturing firms in Taiwan drawn from the annual report entitled "The Top 5000: the largest corporations in Taiwan" (China Credit Information Service Company, 2000). Questionnaires were sent to the offices of the presidents or chief executive officers of the 1,200 firms targeted.

The revised seven-page survey instrument was mailed to respondents, after a pilot study interviewing academic and practice experts, together with a cover letter explaining the purpose of the study on university letterhead paper. A postage paid return envelope was attached to the questionnaire. After two weeks, follow-up mailings were sent to those respondents who had not returned questionnaires in the first wave of the survey. Eleven questionnaires were returned as non-deliverable. Ten of the 208 returned questionnaires were discarded because respondents had put the same answers on all Likert-scale items. The total response rate was 16.5% (198/1200).

To detect any potential non-response bias, Armstrong and Overton (1977) and Lambert and Harrington (1990) recommend that the last quartile or second wave of respondents' responses is assumed to be most similar to those of non-respondents. The returned second wave questionnaire responses were compared with those of the first wave, by *t*-test analysis. Results showed there were no significant differences (at $p<0.05$) as regards all Likert-scale items and therefore non-response bias was not a problem. A summary of respondents' demographic characteristics is presented in Table 2.

The 17 items to determine logistics capabilities were mainly based upon MSUGLRT's (1995) work. It developed and defined these capabilities from a base-line survey administered by mail to 3,700 respondents in 11 countries of North America, Europe, and the Pacific Rim, and subsequent in-depth interviews with 111 firms in order to refine the research framework. Seven-point Likert-type scale anchors were used. Respondents were asked to provide a rating of the strategy business unit (SBU) or the firm's logistics competency relative to its major competitors for each item, where 1 represented "Much Worse" and 7 represented "Much Better". In contrast, logistics, market, and financial performance were measured using a 11-item performance scale most frequently utilised by logistics and SCM researchers (e.g., Stank et al., 1999; Bowersox et al., 1999; Ellinger et al., 2000; Lynch et al., 2000; Stock, et al., 2000).

4. Data Analysis and Results

A series of confirmatory factor analyses (CFA) were performed by AMOS (Arbuckle, 1997) to provide evidence of the validity and reliability of the variables before submitting the data to cluster analysis. Missing data existed but the amount of missing data in respect of each variable was small (less than 6.6%). Accordingly, the regression substitution approach was used for remedying missing data (Roth, 1994) and the sample size was kept at the original size (i.e. 198).

4.1 Validity of the Cluster Variables

Content validity was satisfied because measured constructs were derived from a comprehensive analysis of relevant literature and expert judgment (Ahire et al., 1996). Other types of validity were identified, elaborated and assessed by CFA and Cronbach's alpha analyses. The results of CFA showed that the measurement models were a good fit on business performance (χ^2 =89.162; *d.f.*=41; CFI=0.972; TLI=0.962), but a poor-fit on logistics competency (χ^2 =322.226; *d.f.*=113; CFI=0.901; TLI=0.881). Thus, further post hoc analysis was necessary on the logistics competency model. After deleting a7, the model was a marginal fit (χ^2 =256.892; *d.f.*=98; CFI=0.918; TLI=0.900). For the two measurement models, unidimensionality and convergent validity were satisfactory (Dunn et al., 1994; Hair et al., 1998; Koufteros, 1999; Segars, 1997; Byrne, 2001) because (1) the goodness-of-fit indexes satisfied the cutoff criteria (i.e. CFI and TLI > 0.90); (2) no pair of standardised residual values was greater than ±2.58; (3) no specifically larger modification indices (MI) values were expected to be modified; (4) all expected parameter change (EPC) values were smaller than ±0.3; and (5) all the t-values of variables were significant (i.e. t-values > ±1.96). In addition, scale reliability

Table 2 Respondents' Demographic Characteristics

Employees

<100	101-200	201-400	401-600	601-1000	>1001	N[a]
4%	21.2%	28.8%	12.1%	14.1%	18.6%	1%

Sales (Hundred Million New Taiwanese Dollars)

<10	11-20	21-30	31-40	41-100	>101	N
13.1%	29.3%	12.1%	12.1%	19.2%	12.6%	1%

Industry Description - Leading Categories

Electronic	Semi-Conductor	Information/ Communication	Chemical Product	Automotive/ Accessories	Metal Refinery	Others[b]
17.7%	10.1%	9.6%	9.1%	9.1%	9.1%	35.3%

Respondents' Position

Vice-president or above	Department/ Area manager	Senior manager	President's assistant	Junior manager	Other	N
17.1%	21.7%	11.6%	10.1%	12.1%	18.7%	8.1%

Length of Service in The Company

<3	4-6	7-9	10-12	13-15	>15	N
26.3%	19.7%	10.6%	10.1%	7.1%	22.2%	4%

a No response.

b Other industries include metal work, textiles, chemicals, paper, rubber, plastic, machinery, pharmaceutical, and so forth. No industry represented more than 6% of the total sample.

was also verified because all values of Cronbach's alpha were larger than 0.8 (Garver and Mentzer, 1999) (as shown in Table 3). Discriminant validity, which was assessed using the $\chi^2_{\text{different}}$ test to compare the base model (unconstrained) and other pairs of constructs (constrained) (Anderson and Gerbing, 1988), was satisfactory because all pairs of latent variables were statistically significant ($p<0.05$) on the two measurement models, respectively.

Table 3 presents the entire list of finalised items, means, and standard deviation (SD) for each measure.

4.2 Cluster Analysis

To develop the empirical taxonomy of logistics competencies, a two-stage procedure was employed to take advantage of the strengths of hierarchical and nonhierarchical clustering approaches (Hair et al., 1998; Ketchen and Shook, 1996). A hierarchical algorithm (Ward's method) was used firstly to define the number of clusters and cluster centroids which then served as the starting points for subsequent nonhierarchical cluster analysis. Constructs used in the cluster analysis were logistics competency factors, including positioning, integration, agility, and measurement.

It was difficult to determine how many clusters were appropriate. Hair et al.(1998) recommend a relatively simple stopping rule, that is, look for large increases in the average within-cluster distance. Because of the large increases in agglomeration coefficient, the Ward's hierarchical clustering results indicated that a two-cluster solution was adequate and the cluster centres became the initial starting point for nonhierarchical cluster analysis.

4.3 Validation and Profiling of the Clusters

"Validation may be the most neglected issue in cluster analysis" (Ketchen and Shook, 1996: 449). A second nonhierarchical analysis was performed to confirm consistency by allowing the programme to randomly select the initial starting points for a two-cluster solution (Hair et al., 1998; Miller, 1996). The results indicated that 93% (185/198) of firms were assigned to the same clusters, which gave some confidence in the stability of the clustering results.

Table 3 Constructs and Items

	Constructs and Items	Mean/S.D.	λ
***Positioning Competency (α=0.83)**			
a1	Strategy: The establishment of financial, channel and customer objectives and the means to achieve them.	5.07/1.19	0.746
a2	Supply Chain: The alignment of logistics resources through channel alliances	5.07/1.11	0.752
A3	Network: The structure and deployment of physical resources	4.95/1.14	0.823
A4	Organisation:The structure and deployment of human resources.	5.00/1.09	0.666

***Integration Competency (α=0.87)**			
a5	Supply chain unification: Relative intensity across the distribution channel.	4.89/1.10	0.678
a6	Information technology: The hardware, software and network investment and design to facilitate processing and exchange	4.92/1.20	0.631
a8	Connectivity: The capability to exchange data in a timely, responsive and usable format.	4.64/1.14	0.744
a9	Standardisation: Establishment of common policies and procedures to facilitate logistics operations.	4.94/1.15	0.817
a10	Simplification: Designing routines and work to improve efficiency and effectiveness.	4.80/1.14	0.775
a11	Discipline: Adherence to common operational policies and procedures.	5.00/1.11	0.740
***Agility Competency (α=0.86)**			
a12	Relevancy: The ability to maintain a focus on the changing needs of customers.	5.20/1.08	0.883
a13	Accommodation: The ability to respond to unique customer requests.	5.33/1.05	0.828
A14	Flexibility: The ability to adapt to unexpected circumstances.	5.16/1.06	0.751
***Measurement Competency (α=0.83)**			
a15	Functional assessment: The development of comprehensive functional performance measurement capability.	5.08/1.08	0.830
a16	Process assessment: The extension of performance measurement systems across internal and external logistical processes.	4.99/1.04	0.762
a17	Benchmarking: The comparison of metrics and processes with best practice performance.	4.84/1.17	0.753
****Financial Performance (α=0.95)**			
P1	Profit (before tax).	4.61/1.38	0.887
P2	Return on assets (ROA).	4.57/1.26	0.943
P3	Return on investment (ROI).	4.54/1.26	0.954
****Market Performance (α=0.82)**			
P4	Market Share.	4.77/1.35	0.847
P5	Market share growth.	4.80/1.15	0.845
****Logistics Performance (α=0.91)**			
P6	To meet quoted or anticipated delivery dates and quantities on a consistent basis.	5.00/1.09	0.822
P7	To provide desired quantities on a consistent basis.	5.22/1.09	0.900
P8	To respond to the needs and wants of key customers.	5.30/1.02	0.831
p9	To notify customers in advance of delivery delays or product shortages.	5.00/1.02	0.745
P10	To accommodate special customer service requests	5.18/1.07	0.651
P11	To accommodates new product Introductions (rollouts to the market)	5.02/1.10	0.758

* Seven point scale, Strongly disagree (1) to Strongly agree (7).
** Seven point scale, Relative to major competitors, Much worse (1) to Much Better (7)

Criterion-related validity was assessed through an independent-samples t-test with three performance constructs (i.e. external variables) (Ketchen and Shook, 1996), because the external variables in strategy research are often performance measures. The results (as shown in Table 4) confirm the measures of performance were significantly different ($p<0.01$) in these two clusters, supporting the criterion-related validity of the taxonomy.

An independent samples t-test was also employed and indicated there were significant differences ($p<0.01$) between clusters of the four logistics competencies as shown in Table 4. Discriminant analysis was utilised to confirm the correct assigned rate (Lu and Marlow, 1999). Ninety-five per cent (188/198) of the firms were assigned to the correct clusters. These results provided evidences of the relative stability and reliability of the clusters identified.

To investigate the sources of the differences driving the clustering, a χ^2 test was performed on respondents' demographic characteristics. The results (presented in Table 4) indicated that firms' size, sales, and industry were not the main influential factors on the two clusters.

Table 4. Validation and Profiling of the Clusters

	Cluster 1	Cluster 2 Extensive logistics competency (N=108)	*t*-value Intensive logistics competency (N=90)	Comparison or χ^2 -value
Cluster Variables				
Positioning	4.45	5.71	t= -13.489**	2>1
Integration	4.28	5.57	t= -14.674**	2>1
Agility	4.63	5.96	t= -14.511**	2>1
Measurement	4.37	5.69	t= -13.971**	2>1
Demographic Characteristics				
Employees (Firms' Size)			$\chi^2_{(5)}$=8.692	N.A.
Sales			$\chi^2_{(5)}$=8.547	N.A.
Industry			$\chi^2_{(6)}$=10.041	N.A.
Business Performances				
Financial	3.94	5.33	-9.444**	2>1
Market	4.19	5.49	-9.411**	2>1
Logistics	4.58	5.78	-13.351**	2>1

P<0.05 ** p<0.01

4.4 Interpreting Cluster Results

Cluster 1 Extensive logistics competency (108 firms; 54.5% of 198 total firms). The main distinguishing feature of this cluster was that respondents' agreement was low on all four logistics competencies.

Cluster 2 Intensive logistics competency (90 firms, 45.5% of 198 total firms). Respondents' agreement was high on all four logistics competencies. Thus, cluster 1 reflected lower business performance on all indexes, including financial, market, and logistics, than cluster 2.

5. Discussion and Conclusions

The research findings reveal that the intensive logistics competency cluster (cluster 2) had excellent logistic competencies in all four logistics factors, thus positioning, integration, agility, and measurement, could produce better performance. The findings also demonstrate that the logistic competency cluster is not associated with employees, sales, and industry. The findings suggest that logistics competencies are directly related to logistics, market, and financial performance and should not exist in a vacuum, but should leverage each other to create sustained competitive advantage. The more logistics competencies are combined together, the more difficult it will be for competitors to imitate them. This viewpoint is the central theme of resource-based theory.

Of particular note, the findings also confirm Kohn et al.'s (1990) and McGinnis and Kohn's (1993) research. Therefore, logistics competencies can be regarded as a key strategic resource for acquiring sustained competitive advantage. Logistics or top managers should constantly seek to enhance and refine their firms' four logistics competencies in relation to those of their competitors in order to acquire and maintain long-term superior performance.

Two important study limitations should be noted. First, this study's sample was drawn from the top, largest 1,200 manufacturing firms in Taiwan. Therefore, the conclusions inferred can only be generalised to include the top largest manufacturing firms in Taiwan and must exclude other smaller or less successful and non-manufacturing firms. Second, all participants responded within a particular time frame and were only given a single opportunity to respond. Therefore, it cannot be reliably established whether such data would hold true over time, especially in dynamic business environments. In particular, different firms have distinct strategic goals in the short term, such as customer satisfaction, market share, growth, etc. Moreover, firms may enhance market share by sacrificing short-term profit in order to acquire long-term profit. The performance items in this study could not reflect these varying situations.

The resource-based view (RBV) of the firm is an excellent theory for application in the logistics and supply chain management field, however, 'due to the intangible nature of important firm resources, researchers have used detailed field-based studies, longitudinal case studies, outlier samples, and case surveys…to test RBV hypotheses' (Hoskisson et al., 1999: 447). Thus, more qualitative-based methodologies are possible alternatives for exploring firms' special logistics resources and capabilities.

References

Ahire, S. L., Golhar, D. Y., and Waller, M. A. (1996) Development and validation of TQM implementation constructs. *Decision Sciences*. Vol. 27, No. 1, pp. 23-56

Anderson, J. C. and Gerbing, D. W. (1988) Structural equation modelling in practice: a review and recommended two-step approach. *Psychological Bulletin*, Vol. 103, No. 3, pp. 411-423.

Arbuckle, J. L. (1996) Full information estimation in the presence of incomplete data. In Marcoulides, G. A. and Schumacker, R. E. (Eds.) *Advanced Structural Equation Modeling: Issues and Techniques*. Mahwah, N.J.: Lawrence Erlbaum Associates.

Armstrong, J. S. and Overton, T. S. (1977) Estimating non-response bias in mail surveys. *Journal of Marketing Research*. Vol. 14, No. 3, pp. 396-402.

Bailey, K. D. (1994), *Typologies and taxonomies: an introduction to classification techniques* (Sage University paper series on quantitative applications in the social sciences, 07-102). Thousand Oaks, CA: Sage.

Barney, J. B. (1991), "Firm resources and sustained competitive advantage", *Journal of Management*, Vol. 17, No. 1, pp. 99-120.

Barney, J. B., Wright, M., and Ketchen, Jr., D. J. (2001), "The resource-based view of the firm: ten years after 1991", *Journal of Management,* Vol. 27, pp. 625-641.

Bower, J. L. and Hout, T. M. (1992) Fast-cycle capability for competitive power. In Christopher, M. (Ed.). *Logistics: The Strategic Issues*. London: Chapman &Hall.

Bowersox, D. J. and Closs, D. J. (1996) *Logistical Management: The Integrated Supply Chain Process*. International Editions. Singapore: McGraw-Hill.

Bowersox, D. J. and Daugherty, P. J. (1995) Logistics paradigms: the impact of information technology. *Journal of Business Logistic*. Vol. 16, No. 1, pp. 65-80.

Bowersox, D. J., Closs, D. J., and Stank, T. P. (1999) *21st Century Logistics: Making Supply Chain Integration a Reality*. Oak Book, IL: Council of Logistics Management.

Boyer, K. K., Ward, P. T., and Leong, G. K. (1996), "Approaches to the factory of the future: an empirical taxonomy" *Journal of Operations Management,* Vol. 14, No.4, pp. 297-313.

Bozarth, C. and McDermott, C. (1998), "Configurations in manufacturing strategy: a review and directions for future research", *Journal of Operations Management*, Vol. 16, No.4 , pp. 427-439.

Byrne, B. M. (2001) *Structural Equation Modelling With AMOS: Basic Concepts, Applications, and Programming*. New Jersey: Lawrence Erlbaum Associates.

China Credit Information Service Company (2000) *The Top 5000: The Largest Corporations in Republic of China*, Taipei: China Credit Information Service Ltd.

Chow, G., Heaver, T. D. and Henriksson, L. E. (1995) Strategy, structure and Performance: a framework for logistics research. *Logistics and Transportation Review,* Vol. 31, No. 4, pp. 285-303.

Christopher, M. (1998) *Logistics and Supply Chain Management: Strategies for Reducing Cost and Improving Service.* 2nd Edition. London: Financial Times-Pitman Publishing.

Christopher, M. (2000) The agile supply chain: competing in volatile markets. *Industrial Marketing Management.* Vol. 29, No. 1, pp. 37-44.

Claycomb, C., Dröge, C, and Germain, R. (1999a) The effect of just-in-time with customers on organizational design and performance. *The International Journal of Logistics Management.* Vol. 10, No. 1, pp. 37-58.

Collis, D. J. and Montgomery, C. (1995) Competing on resources: strategy in the 1990s. *Harvard Business Review.* Vol. 73, No. 4, pp. 118-128.

Cooper, M. C. and Gardner, J. T. (1993) Building good business relationships: more than just partnering or strategic alliances? *International Journal of Physical Distribution and Logistics Management.* Vol. 23, No. 6, pp. 14-26.

Daugherty, P. and Pittman, P. H. (1995) Utilization of time-based strategies: creating distribution flexibility/responsiveness. *International Journal of Operations & Production Management.* Vol. 15, No. 2, pp. 54-60.

Dunn, S. C., Seaker, R. F., and Waller, M. A. (1994) Latent variables in business logistics research: scale development and validation. *Journal of Business Logistics.* Vol. 15, No. 2, pp. 145-172.

Dyer, J. H. and Ouchi, W. G. (1993) Japanese-style partnerships: giving companies a competitive edge. *Sloan Management Review.* Vol. 35, No. 1, pp. 51-63.

Ellinger, A. E., Daugherty, P. J. and Keller, S. B. (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.

Ernst, D. (2000), "Inter-organizational knowledge outsourcing: what permits small Taiwanese firms to compete in the computer industry?", *Asia Pacific Journal of Management,* Vol. 17, No. 2, pp. 223-255.

Fawcett, S. E., Calantone, R. J. and Roath, A. (2000) Meeting quality and cost imperatives in a global market. *International Journal of Physical Distribution and Logistics Management.* Vol. 30, No. 6, pp. 472-499.

Fayol, H. (1949) *General and Industrial Management.* London: Pitman.

Fernández, E. Montes, J. M., and Vázquez, C. J. (2000) Typology and strategic analysis of intangible resources: a resource-based approach. *Technovation.* Vol. 20, No. 2, pp. 81-92.

Frohlich, M. T. and Dixon, J. R. (2001), "A taxonomy of manufacturing strategies revisited", *Journal of Operations Management*, Vol. 19, No.4, pp. 541-558.

Gammelgaard, B. and Larson, P. D. (2001) Logistics skills and competencies for supply chain management. *Journal of Business Logistics*. Vol. 22, No. 2, pp. 27-50.

Garver, M. S. and Mentzer, J. T. (1999) Logistics research methods: employing structural equation modelling to test for construct validity. *Journal of Business Logistics*. Vol. 20, No. 1, pp. 33-58.

Geris, N. P. and Kasarda, J. D. (1997) Enterprise logistics in the information era. *California Management Review*. Vol. 39, No. 3, pp. 55-78.

Germain, R. (1996), "The role of context and structure in radical and incremental logistics innovation adoption", *Journal of Business Research*, Vol. 35, No. 2, pp. 117-127.

Germain, R., Dröge, C, and Daugherty, P. J. (1994), "A cost and impact typology of logistics technology and the effect of its adoption on organizational practice", *Journal of Business Logistics,* Vol. 15, No. 2, pp. 227-248.

Germain, R., Dröge, C, and Daugherty, P. J. (1994a) A cost and impact typology of logistics technology and the effect of its adoption on organizational practice. *Journal of Business Logistics*. Vol. 15, No. 2, pp. 227-248.

Gilmour, P (1999) A strategic audit framework to improve supply chain performance. *Journal of Business & Industrial Marketing*. Vol. 14, No. 5/6, pp. 355-363.

Goldman, S. L. and Nagel, R. N. (1995) *Agile Competitors And Virtual Organizations: Strategies For Enriching The Customer*. NY: International Thomson Publishing.

Goldsby, T. J. and Stank, T. P. (2000) World class logistics performance and environmentally responsible logistics practices. *Journal of Business Logistics*. Vol. 21, No. 2, pp. 187-208.

Gordon, M. E. and Milne, G. R. (1999), "Selecting the dimensions that define strategic groups: a novel market-driven approach", *Journal of Management Issues*, Vol. __ , No. 2, pp. 213-233.

Gunasekaran (1999) Agile manufacturing: a framework for research and development. *International Journal of Production Economics*. Vol. 62, No. 1/2., pp. 87-105.

Gunasekaran, A. Patel, C. and Tirtiroglu, E. (2001) Performance measures and metrics in a supply chain environment. *International Journal of Operations & production Management*. Vol. 21, No. 1/2, pp. 71-87.

Hair, J. F., Anderson, R. E., Tatham, R. L. and Black, W. C. (1998) *Multivariate Data Analysis*, 5th edition, Prentice-Hall.

Holmberg, S. (2000) A systems perspective on supply chain measurements. *International Journal of Physical Distribution and Logistics Management*. Vol. 30, No. 10, pp. 847-868.

Hoskisson, R. E., Hitt, M. A. Wan, W. P. and Yu, D. (1999). "Theory and research in strategic management, swings of a pendulum", *Journal of Management*, Vol. 25, No. 3, pp. 417-456.

Kathuria, R. (2000), "Competitive priorities and managerial performance: a taxonomy of small manufacturers", *Journal of Operations Management,* Vol.18, No.6, pp. 627-641.

Keebler, J. S., Manrodt, K. B., Curtsche, D. A., and Ledyard, D. M. (1999) *Keeping Score: Measuring the Business Value of Logistics in the Supply Chain.* Oak Brook, IL: Council of Logistics Management

Ketchen, D. J. and Shook, C. L. (1996), "The application of cluster analysis in strategic management research: an analysis and critique", *Strategic Management Journal,* Vol. 17, No.6 , pp.441-458.

Ketchen, Jr., D. J., Thomas, J. B., and Snow, C. C. (1993), "Organizational configurations and performance: a comparison of theoretical approaches", *Academy of Management Review*, Vol. 36, No. 6, pp. 1276-1313.

Kohn, J. W., McGinnis, M. A. and Kesava, P. K. (1990), "Organisational environment and logistics strategy: an empirical study", *International Journal of Physical Distribution & Logistics Management,* Vol.20, No.2, pp.22-30.

Koufteros, X. A. (1999) Testing a model of pull production: a paradigm for manufacturing research using structural equation modelling. *Journal of Operations Management.* Vol. 17, No. 4, pp. 467-488.

Lambert, D. M. and Harrington, T. C. (1990) Measuring nonresponse bias in customer service mail surveys. *Journal of Business Logistics.* Vol. 11, No. 2, pp. 5-25.

Lau, R. S. M. and Hurley, N. M. (2001) Creating agile supply chains for competitive advantage. *Business Review.* Vol.!h, No. 1, pp. 4-7.

Lawrence, P. R. and Lorsch, J. W. (1967) *Organisation and Environment: Managing Differentiation and Integration.* Homewood: Irwin.

Lu, C. S. and Marlow, P. (1999), "Strategic groups in Taiwan liner shipping", *Maritime Policy and Management*, Vol. 26, No.1, pp. 1-26.

Luo, W., van Hoek, R. I., and Roos, H. H. (2001), "Cross-cultural logistics research: a literature review and propositions", *International Journal of Logistics: Research and Applications,* Vol. 4, No. 1, pp. 57-78.

Lynch, D. F., Keller, S. B. and Ozment, J. (2000), "The effects of logistics capabilities and strategy on firm performance", *Journal of Business Logistics,* Vol. 21, No. 2, pp. 47-67.

Magretta, J. (1998) the power of virtual integration: an interview with Dell Computer's Michael Dell. *Harvard Business Review.* Vol. 76, No. 2, pp. 72-84.

McGinnis, M. A. and Kohn, J. W. (1990), "A factor analytic study of logistics strategy", *Journal of Business Logistics,* Vol.11, No.2, pp.41-63.

McGinnis, M. A. and Kohn, J. W. (1993), "Logistics strategy, organizational environment, and time competitiveness", *Journal of Business Logistic,* Vol.14, No.2, pp.1-23.

Michigan State University Global Logistics Research Team (MSUGLRT): (1995) *World Class Logistics: The Challenge of Managing Continuous Change.* Oak Brook, IL: Council of Logistics Management.

Miller, D. (1996), "Configurations revisited", *Strategic Management Journal*, Vol. 17, No.7 , pp.505-512.

Miller, J. G. and Roth, A. V. (1994), "A taxonomy of manufacturing strategies", *Management Science,* Vol. 40, No.3, pp. 285-304.

Morash, E. A and Clinton, S. R. (1997) The role of transportation capabilities in international supply chain management. *Transportation Journal.* Vol. 36, No. 3, pp. 5-17.

Morash, E. A., Dröge, C. and Vickery, S. K. (1996a) Boundary spanning interfaces between logistics, production, marketing and new product development. *International Journal of Physical Distribution and Logistics Management.* Vol. 26, No. 8, pp. 43-62.

Morash, E. A., Dröge, C. L. M. and Vickery, S. K. (1996b) Strategic logistics capabilities for competitive advantage and firm success. *Journal of Business Logistics.* Vol. 17, No. 1, pp. 1-22.

Novack, R. A., Rinehart, L. M. and Langley, C. J. Jr. (1994) An internal assessment of logistics value. *Journal of Business Logistics.* Vol. 15, No. 1, pp. 113-152.

Novack, R., Rinehart, L., and Wells, M. (1992) Rethinking concept foundations in logistics management. *Journal of Business Logistics.* Vol. 13, No. 2, pp. 233-68.

Olavarrieta, S. and Ellinger. A. E. (1997), "Resource-based theory and strategic logistics research", *International Journal of Physical Distribution & Logistics Management,* Vol. 27, No. 9/10, pp. 559-587.

Oliver, C. (1997), "Sustainable competitive advantage: combining institutional and resource-based view", *Strategic Management Journal.* Vol. 18, No. 9, pp. 697-713.

Oliver, R. K. and Webber, M. D. (1992) Supply-chain management: logistics catches up with strategy. In Christopher, M. (Ed.). *Logistics: The Strategic Issues.* London: Chapman & Hall.

Porter, M. E. (1996) What is strategy? *Harvard Business Review.* Vol. 74, No. 6, pp. 61-79.

Prahalad, C. K. and Hamel, G. (1990), "The core competence of the corporation", *Harvard Business Review,* Vol. 68, No. 3, pp. 79-91.

Rich, P. (1992), "The organizational taxonomy: definition and design", *Academy of Management Review*, Vol. 17, No. 4, pp. 758-781.

Roth, A. V. and Jackson !b, W. E. (1995) Strategic determinants of service quality and performance: evidence from the banking industry. *Management Science*. Vol. 41, No. 11, pp. 1720-1733.

Segars, A. (1997) Assessing the unidimensionality of measurement: a paradigm and illustration within the context of information systems research. *Omega*, Vol. 25, No. 1, pp. 107-121.

Skjoett-Larsen, T. (1999), "Supply chain management: a new challenge for researchers and managers in logistics", *The International Journal of Logistics Management*. Vol. 10, No. 2, pp. 41-53.

Stank, T. P. and Lackey. Jr, C. W. (1997) Enhancing performance through logistical capabilities in Mexican maquiladora firms. *Journal of Business Logistics*. Vol. 18, No. 1, pp. 91-123.

Stank, T. P. and Traichal, P. A. (1998) Logistics strategy, organizational design, and performance in a cross-border environment. *Transportation Research Part E-Logistics and Transportation Review*. Vol. 34, No. 1, pp. 75-86.

Stank, T. P., Daugherty, P. J. and Ellinger, A. E. (1999b) Marketing/ Logistics integration and firm performance. *The International Journal of Logistics Management*. Vol. 10, No. 1, pp. 11-24.

Stock, G. N., Greis, N. P., and Kasarda, J. D. (2000) Enterprise logistics and supply chain structure: the role of fit. *Journal of Operations Management*. Vol. 18, No. 5, pp.531-547.

van Hoek, R. I., Harrison, A, and Christopher, M. (2001) Measuring agile capabilities in the supply chain. *International Journal of Operation and Production Management*. Vol. 21, No. 1/2, pp. 126-147.

Vorhies, D. W. and Harker, M. (2000), "The capabilities and performance advantages of market-driven firms: an empirical investigation", *Australian Journal of Management*, Vol. 25, No. 2, pp. 145-171.

Wernerfelt, B. (1984), "A resource-based view of the firm", *Strategic Management Journal*, Vol. 5, No. 2, pp. 171-180.

Yusuf, Y. Y., Sarhadi, M. and Gunasekaran, A. (1999) Agile manufacturing: the drivers, concepts and attributes. *International Journal of Production Economics*. Vol. 62, No. 1/2, pp. 33-43.

Zhang, Z and Sharifi, H. (2000) A methodology for achieving agility in manufacturing organisations. *International Journal of Operations & Production Management*. Vol. 20, No. 4, pp. 496-512.

Zhao, M., Dröge, C. and Stank, T. (2001) The effects of logistics capabilities on firm performance: customer-focused versus information-focused capabilities. *Journal of Business Logistics*. Vol. 22, No. 2., pp. 91-107.

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