Make-or-buy decisions in logistics: an empirical analysis

H.I. Hsiao[a], R.G.M. Kemp[a], J.G.A.J. van der Vorst[b], S.W.F. (Onno) Omta[a]
[a]Management Studies Group, Wageningen University, Wageningen, The Netherlands
[b]Logistics & Operations Research Group, Wageningen University, Wageningen, The Netherlands, Mansholtlaan 10-12, 6708PG, Wageningen
lilly.hsiao@wur.nl

Abstract
The objective of this paper is to study determinants for outsourcing of successive levels of logistics activities in food processing industry. The decision examined is the outsourcing (buying) versus development of five logistics activities internally (making). Surveys were mailed to logistics managers in firms with at least forty employees in the Netherlands and Taiwan. Of the 890 surveys mailed, a valid sample size of 114 was received, yielding a response rate of 14.25%. Main findings are that asset specificity and core business closeness determine the lower level of logistics outsourcing (transportation and transportation management); and supply chain complexity determines higher level of logistics outsourcing (distribution network design). Thus, considerations of outsourcing in different logistics activities should be varied, and supply chain complexity is suggested to be included as well.

Keywords: Logistics outsourcing, Levels of outsourcing, Fourth-party logistics service provider, Food industry.

1. Introduction

The objective of this paper is to study determinants for outsourcing of successive levels of logistics activities in food processing industry. The decision examined is the outsourcing (buying) versus development of five logistics activities internally. In sequence of levels, these activities are transportation (1^{st}), packaging (2^{nd}), transportation management and inventory management (3^{rd}) and distribution network design (4^{th}).

Many have been written in recent years about logistics outsourcing (third-party logistics, logistics alliances). Most of the early papers focus on reasons, concerns, acquisition process for logistics outsourcing logistics (R C Lieb 1992; R C Lieb and Randall 1996; Mclvor 2000; Millen et al. 1997; Pache 1998), but most of them look at general tactical activities, such as transportation or warehousing functions, or look at only one region or country. Whereas recently additional attention has been given to success factors, the role of logistics service providers in supply chain management, comparison of multi-region (Arroyo et al. 2006; Koster and Warffemius 2005; Wilding and Juriado 2004). However, these existing literature still provides almost no discussion of the make-or-buy factors for logistics activities (Capgemini 2005 ; R C Lieb 1992; R. L. Lieb et al. 1993; Rao and Young 1994; Van Damme and Van Amstel 1996; Wilding and Juriado 2004), despite that a great body of research have been done on information technology or production activities (Aubert et al. 2004; MaCarthy and Anagnostou 2004; Madhok 2002; Poppo and Zenger 1998; Robertson and Gatignon 1998).

In this research, the logistics process is analysed in detail at four basic levels. These levels show outsourcing sequences and their dependable relationships. This means that when the later level of activities is outsourced, the previous levels must be outsourced as well. These four levels in sequence are- *1^{st} level:* The first level of logistics refers to the execution level of activities, such as transportation and warehousing activity. *2^{nd} level:* It refers to the value-added activities, such as packaging and labelling, assembly, sizing, blending and mixing etc. *3^{rd} level*: The third level means the planning and control level of logistics activities. Examples of activities are inventory management, transportation management. Sub-activities of

inventory management are sale forecasting, stock control and event control. Sub-activities of transportation management include route planning and scheduling, road carriers' selection, mode selection, delivery time window negotiation, and event control. *4th level:* At the top level is the distribution network design. This belongs to the strategic planning and control level. Functions of distribution network design are location and site analysis and logistics network management. Within the present study, we explicitly select one or two activities out of each level. These activities are transportation (1st), packaging (2nd), transportation management, inventory management (3rd) and distribution network design (4th). The empirical portion of this study is based upon an analysis of five different logistics activities in the food processing industry.

2. Theories

Transaction cost economics: asset specificity and performance measuring uncertainty

Neo-classical economics describes the firm as a production function, which is a technological construction, transaction cost economics (TCE) describes the firm as a governance structure, which is an organization construction (Williamson 1998). In TCE, firms and markets are alternative modes of governance. Rather than view the efficient boundaries of the firm in terms of technology (economies of scale and scope), the efficient boundaries can be derived by aligning different transactions with governance structures (firm or market) in a discriminating way (Williamson 1998). Thus, transaction cost economics begins with an archetypal problem-vertical integration-or, in more mundane terms, the make-or-buy decision (firm-or-markets) (Williamson 1998).

Transaction cost economics invokes the discriminating alignment hypothesis, according to which transactions, which differ in their attributes, are aligned with governance structures, which differ in their cost and competence, so as to affect a (mainly) transaction cost economizing results (Williamson, 1998). Asset specificity, uncertainty are two major attributes (determinants) discussed in literatures (David and Han 2004; Williamson 1975).

Asset specificity takes a variety of forms-physical assets; human assets, site specificity, dedicated assets, brand name capital, and temporal specificity-to that individuated governance structure responses accrue (Williamson 1998). Transaction-specific assets involve investments in human and physical capital that cannot be redeployed without losing productive value. These assets may be the specific knowledge or expertise that can carry out a certain activity or serve a particular customer through collective learning or accumulated experience in a certain time (human asset specificity); or these assets may be in plat and equipment that dedicated in producing a specific product or services (physical asset specificity) (Robertson and Gatignon 1998). In our research, these activity-specific assets refer to the current assets that have been existed before transactions. Empirical research has provided strong and consistent support for the theorized relationships between transaction-specific investment and governance form. Robertson and Gatingnon (1998) proved a negative relationship between asset specificity and decision to use R&D alliances in the development of a technology. Poppo (1998) finds that the presence of firm-specific assets encourages internalisation. Based on these statements, we formulate the first hypothesis. When the specificity of existing assets is high, the governance costs of alliances render them inferior to internal modes (Williamson 1991).

H1: The higher the asset specificity of a specific logistics activity, the more likely that a food firm will keep this activity in-house rather than outsource it.

Transaction uncertainty is a very broad concept. It can be distinguished into three categories (David and Han 2004): market condition uncertainty; technology uncertainty; and behavioural uncertainty. Here we focus on behavioural uncertainty because it is the most often discussed in make-or-buy decision. Furthermore, including all behavior uncertainties (performance measurement uncertainty and technological uncertainty) seems unnecessary in this study since we focus on perception of service buyer (food companies). And the performance measurement uncertainty is much more concerned by service buyers, while service providers concern more on technological performance especially in contracting process. Performance measurement uncertainty is one of behavior uncertainties (David and Han 2004) as the difficulty in evaluating performance (Poppo and Zenger 1998). Thus we would suggest the prior importance of performance measurement uncertainty in our study. Empirical studies have provided a negative relationship between the measurement uncertainty and outsourcing (buy) decisions (Anderson 1985; Poppo and Zenger 1998; Robertson and Gatignon 1998). In brief, when performances cannot be easily assessed, using markets can be "inefficient" (i.e. less profitable than in-house), the contracting costs are high when writing an incentive compatible contract under a complex performance assessment. Thus we formulate another hypothesis:

H2: The higher the performance measuring uncertainty when outsourcing a logistics activity, the more likely that a food firm will keep this activity in-house rather than outsource it.

Resource-based view: core business closeness

Literatures have suggested that core activity won't be outsourced, because it allows firms to leverage their unique competencies (Insinga and Werle 2000; Leiblein and Miller 2003) and offers long-term competitive advantage (Quinn and Hilmer 1994). Core activity, or called core competencies, distinctive competencies, core business, is central to the company successfully serving the needs of potential customers in each market (Mclvor et al. 1997). Insinga and Werle (2000) further distinguish business activities into four different types according to their potential to yield competitive advantage. These activities are commodity activity (readily available), basic activity (needed to be in the business), emerging activity (has the potential to become a competitive differentiator) and key activity (a competitive differentiator). In this paper, we focus not on the core business because the core business to a food firm usually refers to processing activities or product development and design, but not logistics activities. Instead, we measure a logistics activity's closeness to core business for food companies, as a decisive criterion.

The question here is how to assess the closeness of the five logistics activities to the core business? We use similar criteria that assess a core activity to assess a core business close activity in this research. The resource based view of strategic management examines the resources and capabilities of firms that enable them to generate above-normal rates of return and a sustainable competitive advantage (Barney 1991). The logic suggests that business processes that exploit valuable but common resources can only be a source of competitive parity, business processes that exploit valuable and rare resources can be a source of temporary competitive advantage; and business processes that exploit valuable, rare, and costly-to-imitate resources can be a source of sustained competitive advantage (Barney 1991). In brief, a core activity is usually measured by its value, rareness and uniqueness, thus can be a source of sustained competitive advantage; however here we focus on core business. And it is measured only by value, which can only be a source of competitive advantage.

What does “value” mean? Resources are said to be valuable when they enable a firm to conceive of or implement strategies that improve its efficiency and effectiveness (Barney 1991). Logistical resources include tangible assets and intangible assets. Trucks or warehouses are examples of tangible assets; and logistical capability (intangible assets) is the capacity for a team of logistical resources to perform some task. It is a complex bundles of individual skills, accumulated knowledge exercised through organizational process that enable firms to co-ordinate activities and make use of their resources (Olavarrieta and Ellinger 1997) and it could be developed experientially at the firm or plant level (Leiblein and Miller 2003). A logistics activity is executed or translated by employee’s sills or knowledge through use of tangible assets. For example, transportation activity is executed by truck driver’s driving skills; inventory management activity is executed by employees’ ability to predict stock levels through use of software. In brief, the logistic activity is close to core business (valuable) when this activity could improve logistical efficiency and effectiveness.

To conclude, the likelihood that a firm choose a make decision also depends on the core closeness of an activity to firm. In this regard, a core business closeness activity is more likely to be kept in-house because it is valuable to firm, in other word; this activity is executed more efficiently and effectively than competitors.

H3: The closer a logistics activity to the core business, the less likely that a food firm will outsource that activity.

Supply chain management: supply chain complexity

It is still new that supply chain management approach is used to evaluate a make-or-buy decision. In 1994, Rao and Young conceptually mentioned that logistics outsourcing decisions might be related to a certain supply chain characteristic, such as product complexity (perishability, size, density), process complexity (time sensitivity, manufacturing cycle), and network complexity (number of trading companies, countries and continents) (Rao and Young 1994). Milgate (2001) further mentions that an increase in supply chain complexity could deteriorate delivery performance, so we add supply chain complexity as one of considerations in make-or-buy decision, since we study a logistical chain.

What is the concept of supply chain complexity? Supply chain (network) refers to “all interconnected companies that exist upstream and downstream to any one company in the value system.” In this paper, the system we considered includes the supply, production, distribution and demand bases. And the complexity is viewed from the perspective of the focal company. Supply base refers to a portion of the supply chain network that is actively managed by the focal company through contracts and purchasing of parts, materials and services, and production base is a portion managed through manufacturing and processing of parts and materials into final products or semi-finished products. Distribution and demand base is the portion where selling of semi-products, final products and services.

Complexity refers to the level and type of interactions present in the system (Milgate 2001). Complexity is viewed as a deterministic component more related to the numerousness and variety in the system. Building on the conceptual definitions of complexity used by Milgate (2001) and Choi (2006), we regard complexity is associated with the “number of elements” within the system and the degree to which these elements are “differentiated”. In this regard, *supply chain (network) complexity* means the number of elements within the focal company’s supply, production, distribution and demand, and the degree to which these elements are differentiated.

Followed from previous statements, there are two dimensions of chain complexity: number and degree of differentiation. In this research, we then use these two dimension and four portions along a chain: supply, production, distribution and demand to describe supply chain complexity. Number of elements refers to the number of current supplier, product, production, customers with enduring business relations; and differentiation means the degree of different characteristics (variety, and uncertainty) along the supply, production, distribution and demand. However, due to our interest on the later part of the supply chain, we omit the supply base. Thus, in this paper, to describe the complexity of a food supply chain, we developed seventeen items (Goor et al. 2003; Milgate 2001; Rao and Young 1994; Stadtler 2005). There are four in product characteristics: perishability; number of stock keeping units, number of product groups, storage variety; three in production portion: number of packaging lines; production uncertainty; production volumes; two in demand portion: demand uncertainty; demand fluctuation; and eight in distribution portion: number of clients, number of international clients, number of warehouses, distribution channel varieties, delivery frequency, lead time requirement, distribution size, distribution uncertainty.

The level of supply chain complexity affects the level of effort, or operational load, required to manage a system (Choi and Krause 2006). Simply put, large number of clients increases the level of coordination needed to improve efficiency of operations. With fewer clients, the focal company can implement a more efficient buyer-supplier interface through more cost-effective inventory control. To summarize, supply chain complexity is higher for a focal company if its supply, production, distribution and demand portions are in great number or varying to a large degree. Then focal company requires high level of effort or operational load to manage this system. To ease or transfer such complexity, the focal company might seek forming a logistic alliance with logistics companies.

H4: The more complex the supply chain setting, the more likely a higher level of logistics activity is outsourced.

Logistics strategy

Another construct to identify characteristics of a firm for a certain outsourcing decision is by their logistics strategy. Generally, strategy is used to describe activities that involve a long-term time horizon, both with regard to the time it takes to accomplish such activities and the time it takes to observe their impact (Wheelwright 1984). Besides, strategy also denotes actions or patterns of actions intended for the attainment of goals, and sequence of decisions (Swamidass and Newell 1987).

The hierarchical view of strategy visualizes three primary levels of strategy (Wheelwright 1984): corporate strategy, business strategy and functional strategy. Corporate strategy specifies the definition of the business (such as products or markets) in which the corporation will participate, and the acquisition of resources and their commitment to each of those businesses. Second level, each business unit specifies the scope or boundaries of each business in a way that operationally links the business strategy to the corporate strategy; and also specifies the basis on which that business unit will achieve and maintain a competitive advantage. Third, functional strategy forms a part of a cluster of functional area strategies such as marketing strategy, financial strategy, logistics strategy etc., which support the desired competitive advantage (business strategy) and how it will complement the other functional strategies.

Unlike manufacturing strategy, not much literatures study specificity on logistics strategy. In recent strategy or manufacturing strategy literature there is a tendency to mention the dimensions of manufacturing strategy. They are (1) cost, (2) quality (3) flexibility, and (4) dependability (on time delivery or reliability) (Wheelwright 1984). These competitive dimensions are referred to as competitive priorities. These lists are closely related to the idea of generic strategies from the business strategy literature (Porter 1980). Cost, as a competitive priority, would correspond to cost leadership, while the others (quality, flexibility, reliability etc.) would correspond to differentiation. Adopt from these concept, in this research, we discuss three types of logistics strategy: cost strategy, flexibility strategy and food quality strategy.

-*low cost strategy*: It refers that companies seek to design, product, and market a comparable product more efficiently than its competitors (Porter 1980). At perspective of logistics, companies may compete through lower cost than competitors at distribution cost (transportation and handling costs), manufacturing cost, inventory cost etc.

-*flexibility strategy*: Aspects of flexibility can be many. Here we use volume flexibility and delivery flexibility (Beamon 1999). A business that competes on the basis of volume and delivery flexibility emphasizes its ability to accelerate or decelerate production very quickly. Other companies compete through delivery flexibility, emphasizing its ability to handle unexpected orders.

-*food quality strategy*: quality has wide concept, such as actual quality and perceived quality. The perceived quality is often more a function of selling and advertising approaches. Here we focus on the actual quality, specifically, the number of the shelf-life days. A business that competes on product shelf-life emphasizes its ability to extend length of time before consumption than its competitors.

To be effective, each type of logistics strategy must support through a consistent pattern of decisions and trade-offs on competitive priorities. In other word, logistics-related decisions should reflect the goals and strategies of the business, and enables the logistics function to contribute to the long-term competitiveness and performance of the business. For instance, decisions in such area as distribution, transportation, inventory, outsourcing, selection of carriers-all subparts of the logistics strategy-should be very different if the desired competitive priorities are low cost than it if are flexibility. With regarding with outsourcing decisions, not many empirical evidences are found on the relationship between logistics strategy and outsourcing choice. Bolumole (2001) conceptually mentions that outsourcing for operational and cost based reasons will tend to restrict LSPs' involvement to the basic logistics functions (Bolumole 2001). Elaborated from his statements and arguments discussed above, we formulate another hypothesis.

H5: A food manufacturer with a low cost supply chain strategy is likely to outsource only execution activities; a food manufacturer with a flexibility differentiation strategy is likely to outsource higher level of activities

Other variables

Three variables are considered as controlled variables: *size of firm, changes of sales growth rate* and *geographic region*. Size of firm could possibly influence an outsourcing decision. However, we don't set an expectation on the relationship between size of firm and the outsourcing decision. Even with available funding for internal logistics activities, larger firms could also favor external alliances because they may have greater bargaining power (Robertson, 1998). Thus, in this research, size of firm is regarded as a control variable.

3. Data

The research is tested using Dutch and Taiwanese data. The sample frame consists of a mailing list of food manufacturing firms from membership lists of Dutch Chamber of Commerce (www.ksv.nl) and Taiwan's Industry & Technology Intelligence Service (www.itis.org.tw). Surveys were mailed to logistics managers in firms with least forty employees. Following Groves et al's (2004) survey methodology, initial mailings were followed by phone calls after two weeks. If necessary, second mailings were preceded. Data was gathered from September 2006 to February 2007. Of the 890 surveys mailed (NL: 385; TW: 505), 66 had incorrect contact information (NL: 57; TW: 9) and were returned by the postal service. A total of 138 responses received (NL: 76; TW: 62), of which 24 had missing data and were judged unusable, thus yielding a sample size of 114 (NL: 69; TW: 45) with a response rate of 14.25% (114/800). The response numbers to the studied variables is close to the recommended rule of thumb for binary logistic regression (Hair 2005).

Measures

Make or buy choices

The constructs for testing are shown in the appendix 1. It also indicates the actual questionnaire items and reliability coefficients. Five logistics activities are identified: transportation, packaging and labeling, transportation management inventory management distribution network design. The scope of the operation for each activity was assessed using a three-point scale with three anchors (have outsourced, intend to outsource, and won't outsource). In order to measure the boundary choice more correctly, we coded the status of "had outsourced," "planning to outsource" as a "buy" choice for the studied activities.

Asset specificity

Logistics-specific assets were measured using an instrument adapted from Poppo and Zenger (1998) and Roberson and Gatignon (1998). The instruments comprise three-item scales. The scales assess the extent to which the firm commits the investments for each logistics activity. Items are measured using 10-point scales anchored by "strongly disagree" and "strongly agree."

Performance measuring uncertainty

Performance measuring uncertainty was measured using an instrument adapted from Robertson and Gatignon (1998). In their research, three-item scales were used, with alpha=0.68. In our research, two items scales were used. This scale assesses the extent to which the firm evaluates the performance of logistics service provider. Items are measured using 10-point scales anchored by "strongly disagree" and "strongly agree."

Core business closeness

Core business closeness refers to potential of an activity to be a source of competitive advantage. This construct is estimated by three measures-the value of this activity. *Value* is measured by contribution to improving the firm's performance (Hafeez et al. 2002), specificity, the efficiency and effectiveness (Barney 1991). Three-item scales are created and designed with alpha=0.75 to measure the core closeness of a logistics activity to firms. Items are measured using 10-point scales anchored by "strongly disagree" and "strongly agree."

Supply chain complexity

A new scale was developed to measure supply chain complexity. Two dimensions measures are assessed in product, production, demand and distribution parts: uncertainty/variety-related complexity and number-related complexity. Literature reviews and interviews with logistics

manager were used to identify the measures. In total this results in seventeen items of supply chain complexity: perishability; number of stock keeping units, number of product groups, storage variety; number of packaging lines, production uncertainty; production volumes; two in demand portion: demand uncertainty; demand fluctuation, number of clients, number of international clients, number of warehouses, distribution channel varieties, delivery frequency, lead time requirement, distribution size, distribution uncertainty. Respondents were then asked to rate the degree to which the item complicates logistics management in their organization on a seven-point Likert scale ranging from (1) extremely low to (7) extremely high. After factor analysis the item "perishability," "number of stock keeping units," "number of product groups," "storage variety," "production uncertainty," and "number of international clients" were dropped due to the differences in the distributions of the scores for the Taiwan and the Netherlands and also due to unacceptable loading factor. This then results in three new meaningful variables, naming general complexity (number of packaging lines, number of clients, delivery frequency, lead-time requirement), distribution complexity (storage variety, number of warehouse, distribution channel variety, distribution uncertainty) and demand complexity (production volumes, demand uncertainty and demand fluctuation). Overall reliability results show that the minimum Cronbrach's α of the three measures is 0.782, indicating that these variables are reliable.

Logistics strategy
Logistics competitive strategy was measured using an instrument adapted from Sum and Teo (1999) and Beamon (1999). This variable is a dummy variable. The instrument consists of three-item scales to measure operations objectives that are used to classify different type of companies. Items are measured using scales anchored by "cost, flexibility and food quality." Respondents were asked to rank each of objectives its importance in percentage with overall sum of 100. Thus three indicator variables were created to specify whether the logistics strategy if cost, flexibility or food quality, the reference is the equivalence of the three items.

Control variables
Firm size This measure is used as a control variable. In this research, firm size is measured by number of employees in national scale. *Sales growth rate changes between 2003 to 2008*Respondents are asked to provide sales growth rate changes of their division for the last three years (from 2003-2005) and expect sales growth changes level for the next three years (2005 to 2008). Thus two indicator variables were created to specify whether the sales growth rate is increasing or decreasing, the reference is non-change. *Geographic region* This measure is also used as a control variable. One indicator variable was created to specify whether the focal firm is headquartered in the Netherlands or Taiwan.

Make or buy model
Objective in this research is to determine the relationship between the firms' transaction and intra-firm's characteristics and levels of outsourcing decision. A great body of literatures has suggested binomial (or binary) choice models to evaluate the relationship between the make-or-buy decision and a set of covariates. Thus, we use binary logistic regression to predict a categorical dependent variable and to determine the percent of variance in the dependent variable explained by the independents; to rank the relative importance of independents; to assess interaction effects; and to understand the impact of covariate control variables. The resulting multivariate statistical model takes the following basic form:

$$\text{Buy (outsourcing)} = \beta 0 + \beta 1\text{–}3\ \text{Controls} + \beta 4\ \text{Asset specificity} + \beta 5\ \text{Measuring uncertainty} + \beta 6\ \text{Logistics strategy} + \beta 7\ \text{General complexity} + \beta 8\ \text{Distribution complexity} + \beta 9\ \text{Demand complexity} + \varepsilon \quad (1)$$

Analysis

The likelihood ratio test was used to test the significance of the coefficients. “Likelihood" is a probability, specifically the probability that the observed values of the dependent may be predicted from the observed values of the independents. Like any probability, the likelihood varies from 0 to 1. The log likelihood (LL) is its log and varies from 0 to minus infinity (it is negative because the log of any number less than 1 is negative). The principle of likelihood ratio test is to compare observed values of the response variable (dependent variable) to predicted values obtained from models with and without the variable. (Hosmer and Lemeshow 1989).

Sample description

The food processor companies represented in the sample range widely in terms of number of employees. The majority is distributed in the “less than 50 employees” group (27.2%), and “less then 100 and larger than 50 employees” (23.7%). Besides, these companies also widely range in terms of processor types. A large number of respondents is in the “others” group (28.9 %), these comprises processor of bread, biscuits, sugar, cocoa, macaroni, coffee etc. Other processors are distributed in is in the group of meat (16.7 %), dairy products (10.5%), prepared animal feeds (9.6%), fruit and vegetables (8.8%), beverages (7 %), grain mill products (5.3%), fish products (4.4%), lunch box (4.4%) and oil and fats (1.8%).

4. Results

Table 1 presents test results of hypothesis for the selection of outsourcing model of the five activities. Model I is a baseline model. Model II introduces measures of derived from transaction cost theory, resource based view, and supply chain management theories. Model III adds an interaction term between uncertainty and asset specificity. Likelihood statistics and measures of overall model fit are included at the bottom of the table. Correlation tables are presented in the Appendix 2.

The goodness of fit of the model is assessed with full samples. For each activity, samples number of the make and buy choices was different, which showed below the tables. The best model is assessed by the improvement of the likelihood ratio (-2LL), which reflects the significance of the unexplained variances. For example, the best model for the transportation activity is the Model II because adding the five variables can significantly improved the model, X^2 (9, N=114)=71.696, p<0.001. Given the stability of our results across specifications, we focus Model II for the packaging activity, Model II for transportation management, Model II for inventory management, Model III for distribution network design.

Asset specificity

The firm’s investment in specific logistics asset is a significant predicator of whether to buy or make decision of transportation, packaging, transportation management and inventory management activities. As hypothesized, the lower the current investment by the firm in transportation (β= −0.886; p <0.001), packaging (β= −0.864; p <0.01), inventory management (β= −0.875; p <0.05) and transportation management activity (β= −0.289; p <0.10), the greater the likelihood that these activities are carried out by logistics companies rather than internally. Hence, the hypothesis 1 is supported in most of the studied activities.

Performance measuring uncertainty

As measuring uncertainty increases, the likelihood of forming an alliance with logistics companies to carry out distribution network design (β= 1.249; p <0.05) activities increases as well. This result contrasts to our hypothesis. Thus, the hypothesis 2 is rejected in this activity.

Core business closeness

Decision to outsource transportation management is negatively related to the core business closeness (β= −0.424; p <0.05), just as hypothesized. However, core business closeness is positively associated with an increased incidence of forming alliances for transportation (β=0.631; p <0.001), and packaging (β=0.688; p <0.05). Thus, the hypothesis 3 is partly supported.

Our data show that a firm regards transportation and packaging as core business closeness activities. Why transportation and packaging activities are still outsourced despite its critical importance? This could be interpreted by two reasons: one is that maybe the service market of transportation is highly saturated, thus outsourcing of transportation is a preferred choice. In such instance, using long term contracts or cooperating with familiar logistics companies would be a balance solution. As the reasons for packaging activities, a firm who operates under a great number of packaging lines will require flexibility from logistics service providers if they change packaging lines very often. Such food firm requires high flexible packaging system if it changes products or product design very often. Thus complementary with outside sources becomes important.

Supply chain complexity

Prior to binary logistic regression, we carry out factor analysis on this construct to reduce the data. This results in three variables, named general complexity, distribution complexity and demand complexity. Our data show that decision to outsource packaging and distribution network design depends on degree of supply chain complexity. In particular, as general complexity increases (many packaging lines, many clients, high delivery frequency, strict lead-time), the likelihood of outsourcing packaging activity increases as well (β= 0.864; p <0.05). Besides, the probability to outsource distribution network design increases when a firm confronts with higher demand complexity (large production volume, high demand uncertainty and high demand fluctuation) (β= 1.085; p <0.10). Thus the hypothesis 4 is supported here.

General complexity and packaging. General complexity is a combination of the number of packaging lines, number of clients, delivery frequency and lead-time requirement. Our data show that a firm who produces large number of product varieties and deliveries under high frequency and strict lead-time requirements to a large amount of clients is likely to outsource packaging activities. We noticed that most of these items in the general complexity are time-related; this may explain its relationship with outsourcing of packaging activity. Choi (2006) proposes a negative relationship between complexity and (supplier) responsiveness. Van Hoek (1999) also mentioned the relationship between postponement and some supply chain settings. For instance, by working with a limited number of clients, the focal company can be more effective in communicating its needs and can better respond to clients' needs. Thus, this can better induce the focal company to be more responsive to clients' immediate needs.

Demand complexity and distribution network design. A firm under great demand complexity (production volume, demand uncertainty and demand fluctuation) is more likely to outsource distribution network design activity. This means that decisions to locate a new factory or warehouse, and to control inventory level or to plan the delivery schedule are transferred to a logistics company. Operating under the condition of large production volume and high demand uncertainty and great demand fluctuation, it might be difficult for a firm to manage its distribution system or production system, thus delivery performance may be damaged. By

transferring such problems to a logistics service provider, this service provider can effectuate a great degree of efficiency by exploiting economies of scale among others. Thus in such cases and for a long term, capacity can be better utilized because the peaks and drops in transport quantities offered by different clients can be counterbalanced, and backhauls are often available to maintain or improve the service level.

Formatted
Formatted
Formatted

Logistics strategy

A firm who does not pursue low cost strategy is likely to outsource transportation management activity (β= −1.518; p <0.10). In other word, a firm outsources transportation management activity not because of cost reduction reason, could be to increase flexibility, and also could be to increase food quality. As for this outsources either for flexibility or food quality reason in particular, our data did not show any significant difference.

Table 1. Results of logistics regression analysis for outsourcing choice model for transportation, packaging, transportation management, inventory management and distribution network design [a,b,c,d]

Activity	Transportation			Packaging		
Independent variables	Model I	Model II	Model III	Model I	Model II	Model III
Intercept	-1.602(.961)	-3.329(2.123)	-5.230(2.580)*	-3.532(1.297)**	-6.644(2.927)*	-10.069(4.331)*
Dutch firm	1.257(.536)*	1.991(.858)*	1.790(.843)*	.323(.644)	.425(.879)	.152(.896)
Firm size	.374(.172)*	.619(.237)**	.587(.238)*	.446(227)*	.359(.302)	.434(.322)
Sales growth (increasing)	.331(.581)	.647(.768)	.687(.775)	-.095(.741)	-.193(.994)	-.069(1.031)
Sales growth (Decreasing)	.384(.652)	.315(.841)	.311(.844)	-.914(.982)	-1.624(1.399)	-1.388(1.430)
Cost strategy		-.238(.838)	.067(.891)		1.127(1.022)	1.466(1.132)
Flexibility strategy		-.391(1.028)	-.286(1.037)		.507(1.287)	.992(1.365)
Food quality strategy		-.496 (.744)	-.405(.766)		-1.365(1.137)	-.865(1.244)
General complexity		-.229(.281)	-.097(297)		.864(.403)*	.975(.456)*
Distribution complexity		.095(.258)	-.017(272)		.167(.285)	.212(.295)
Demand complexity		.084(223)	.032(.225)		-.212(.328)	-.269(.346)
Core business closeness		.631(.210)**	.570(.210)**		.688(.299)*	.680(.319)*
Asset specificity		-.866(.222)***	-.386(.404)		-.864(.316)**	-.440(.431)
Measuring uncertainty		.187(.136)	.670(.397) ψ		.039(150)	.719(.543)
Asset specificity* measuring uncertainty			-.088(.066)			-.121(.092)
Log likelihood	-125.316	-89.468	-87.532	-79.993	-53.223	-51.344
-2 [L(β)- L(model I)]	-15.402(4)***			-12.876(4)**		
-2 [L(model I)- L(model II)]		-71.696(9)***			-53.54(9)***	
-2[L(model II)- L(model III)]			-3.871(1)*			-3.758(1)*
Correctly classified (%)	71.7	78.1	79	85.8	89.3	87.4
Cox & Snell R Square	.07	.335	.347	.059	.269	.282

[a] Positive coefficients indicate a greater probability of external governance (i.e., outsource or buy)
[b] For each variable, the estimated coefficient is given, and standard errors are in parenthesis
[c] ψp<0.10; *p<0.05; ** p <0.01; *** p <0.001
[d] N=114; For Transportation : $N_{outsource}$=79;$N_{not\ outsource}$=35 and Log likelihood for null model was 133.017
For Packaging: $N_{outsource}$=18;$N_{not\ outsource}$=96 and Log likelihood for null model was 86.431
For Transportation management: $N_{outsource}$=42;$N_{not\ outsource}$=72 and Log likelihood for null model was 139.462
For Inventory management: $N_{outsource}$=6;$N_{not\ outsource}$=108 and Log likelihood for null model was 40.300
For Distribution network design: $N_{outsource}$=12;$N_{not\ outsource}$=102 and Log likelihood for null model was 61.605
Appropriate degrees of freedom are reported in parentheses

Table 1. (Continued)

Activity	Transportation management			Inventory management			Distribution network design		
Independent variables	Model I	Model II	Model III	Model I	Model II	Model III	Model I	Model II	Model III
Intercept	-1.547(.906) ψ	.594(1.482)	-2.239(1.890)	-3.888(2.118) ψ	-19.185(7588.091)	-20.444(7492.673)	-1.576(1.624)	-5.239 (3.053) ψ	-10.675(4.682)*
Dutch firm	.636(487)	.585(574)	.538(.581)	-.424(1.092)	-.136(1.311)	-.159(1.285)	-.665(.852)	-.952(.972)	-.497(1.013)
Firm size	.131(.152)	.356(.195) ψ	.372(.205) ψ	.315(.378)	.460(.499)	.469(.514)	-.251(.276)	-.211(.329)	-.017(.402)
Sales growth (increasing)	.213(.572)	.594(.685)	.927(.743)	-.589(1.274)	-1.987(1.878)	-2.088(1.870)	.487(1.135)	.475(1.477)	-.685(1.633)
Sales growth (Decreasing)	.046(.642)	.876(.789)	1.403(.871)	.349(1.277)	-1.329(1.932)	-1.583(2.018)	.646(1.206)	.690(1.458)	-.211(1.602)
Cost strategy		-1.518(.817) ψ	-1.643(.833)*		19.692(7588.090)	19.681(7492.672)		1.271(1.253)	2.032(1.655)
Flexibility strategy		-.374(.882)	-.786(.937)		17.917(7588.090)	18.027(7492.672)		.646(1.744)	.969(2.174)
Food quality strategy		-.434(613)	-.502(.648)		16.643(7588.091)	16.790(7492.672)		-.282(1.354)	.612(1.737)
General complexity		-.102(.223)	-.199(.236)		.121(.525)	.032(.544)		.366(.348)	-.054(419)
Distribution complexity		.034(.203)	-.043(.211)		.632(.525)	.572(.551)		-.401(.329)	-.553 (.388)
Demand complexity		.081(.182)	.199(.195)		-.649(.538)	-.519(.553)		.536(.361)	1.085(559) ψ
Core business closeness		-.424(.205)*	-.674(.258)**		.359(.434)	.181(.467)		.285(.273)	.043(.357)
Asset specificity		-.269(.142) ψ	.593(.347) ψ		-.875(.445)*	-.377(.729)		-.326(.264)	.832(.536)
Measuring uncertainty		.135(.111)	.839(.310)**		-.003(.234)	.579(.766)		.051(.204)	1.249(.536)*
Asset specificity*measuring uncertainty			-.149(.057)**			-.112(.140)			-.239(.096)
Log likelihood	137.379	108.957	100.964	38.067	26.079	25.406	60.272	47.140	38.701
-2 [L(β)- L(model I)]	-4.166(4)			-44.466(4)			-2.666(4)		
-2 [L(model I)- L(model II)]		-56.844(9)***			-23.976(9)***			-26.264(9)***	
-2[L(model II)- L(model III)]			-15.986(1)***			-1.346(1)			-16.878(1)***
Correctly classified (%)	62.3	73.5	73.5	95.3	95.0	96.0	91.5	92.9	93.9
Cox & Snell R Square	.019	.223	.282	.021	.127	.133	.012	.125	.196

Control variable

Firm size The likelihood of outsourcing transportation (β= 0.619; p <0.01) and transportation management (β= 0.356; p <0.10) increases if firm's size is larger. *Change of sales growth rate* Change of sales growth rate is a controlled variable. As expected, none of activities is found to be related with the change of sales growth rate. *Geographic region* Among the five activities, only the transportation's outsourcing decision is influenced by geographic region. Firms in the Netherlands are more likely to outsource transportation than firms in Taiwan (β= 1.991; p <0.05).

Determinants for levels of logistics outsourcing

Our survey results also reveal that value-added activities are outsourced less than transportation management activity. This contradicts to our prior assumptions. Perhaps it reflects the real phenomenon of food industry: value-added activities are more important than transportation management activity. In this regard, we reshuffle the activities based on our findings, see table 2. After such rearrangement, we found that key determinants for low and high levels of logistics outsourcing seem more vivid to identify. Asset specificity and core business closeness seem related with much lower level of outsourcing, while the supply chain complexity plays a key role in higher level of outsourcing. Such results imply that considerations of make or buy decision of different logistics activities should be varied. In particular, traditional outsourcing approach usually determines low level of outsourcing, while higher level of outsourcing consults supply chain management approach.

Table 2 Key determinants for levels of logistics outsourcing

Relationship between activities and determinants			Asset specificity	Measuring uncertainty	Core business closeness	Logistics Strategy	Supply chain complexity
Level of outsourcing	1st	Transportation	−		+		
	2nd	Transportation	−		−	−	
	3rd	Inventory management	−				
		Value-added activities	−		+		+
	4th	Distribution network		+			+

5. Discussion and conclusion

Our findings conclude two important points here:

1.Considerations on different types of logistics activities should be varied. Asset specificity and core business closeness determine lower level of logistics outsourcing; supply chain complexity determines higher level of logistics outsourcing.

Traditional make-or-buy approaches (transaction cost theory and resource-based view) play a major role on determinants for lower levels of outsourcing, such as on transportation or transportation management activities. More specificity, these outsourcing decisions is influenced by firms' asset specificity and core business closeness of these activities. These results are largely consistent with expectations and results published in the literature. Such outcome is not surprising because most of these literatures only focus on low levels of logistics activities. But, for higher levels of outsourcing (packaging or distribution network design), the decisions are influenced by the supply chain complexity degree, adopting from supply chain management approach. A firm's packaging lines numbers, client's numbers, delivery frequency and lead-time requirement positively influence outsourcing of packaging decision. While outsourcing of distribution network design is positively determined by a firm's production volume, demand uncertainty and demand fluctuation. According to our assumptions, when outsourcing of higher level of logistics activities, the lower level will be outsourced as well. It means that when a firm outsources distribution network design, it will

also consider asset specificity and core business closeness, but supply chain complexity is the major determinant.

2.Supply chain complexity is suggested to be included in make-or-buy considerations of logistics activities

System complexity could jeopardize performance. A number of authors had discussed impacts of system complexity on the performance. For example, Guimaraes (1999) investigates impacts of manufacturing system complexity (number of product types manufactured, the number of operation types involved, the number of operations involved, and the amount of maintenance required by the system) on performance (production costs, output, flexibility, cycle time, and product quality. They mentioned, for example, that execution of modern computerized manufacturing systems mostly relies on the performance of the technology, making relatively little use of human competence. Even a moderately complex system will show frequent stops when the system is operated by experts who designed it. To make matters worse, the experts usually leave the daily running to less competent operators. When a breakdown occurs these operators have little chance of identifying the source of the error, and can only wait for the experts to come and do the repair. Likewise, Mapes (2000) also observed that high-performing plants (productivity, quality consistency, customer lead times, delivery reliability) utilizes processes and procedures that have lower levels of variability and uncertainty than low-performance plants. The performance drivers (such as high adherence to schedule, low processes time variability, low variability in process output/scrap rate) are significantly higher for high-performing plants than for low-performing plants.

In brief, system complexity raises a great effort to manage the system (Choi and Krause 2006). In this regard, outsourcing of a certain logistics activity makes a great sense when a firm operates under great supply chain complexity-especially the general complexity (large number of packaging lines, clients, high delivery frequency, and strict lead-time) and demand complexity (large production volume, high demand uncertainty and high demand fluctuation). Because the levels of effort or operational load to manage such supply chain system increases. In term, the supply chain responsiveness could be damaged as well. Thus, relying on logistics service provider who has expertise and experiences could be an alternative of timesaving and risks avoiding.

To conclude, our logistics outsourcing framework proposes that an effective outsourcing depends on varied considerations on different logistics activities. Moreover, supply chain complexity is also suggested be considered as a decisive criteria, especially the general complexity (large number of packaging lines, clients, high delivery frequency, and strict lead-time) and demand complexity (large production volume, high demand uncertainty and high demand fluctuation). These are especially important for higher level of outsourcing.

Limitations and further research

This research provided a detail look at logistics outsourcing behavior of food processors, but it was limited in several ways that might be addressed in future research. First, some activities are not included in this research, such as warehousing and other value-added activities. Second, we focus only on outsourcing behavior of food processors. A food supply chain includes not only food processors, but also growers or retailers. Thus, we recommend including these food actors for further researches in order to achieve better generalization of the findings.

Appendix 1. Measures and coefficient alphas

Asset specificity (α=0.69)

- We have invested in special equipments to conduct this activity.
- We have acquired special knowledge and skills to perform this activity.
- It is very costly to outsource this activity.

Performance measuring uncertainty (α=0.30)

- We specify precise measures for evaluating the performance of this activity.
- It is difficult to measure the performance of logistics service providers for this activity.

Core business closeness (α=0.75)

- This activity contributes highly to our competitive advantage.
- This activity is essential to support our core activities.
- Compared to our rivals, this activity is performed efficiently.

Supply chain complexity

General complexity (α=0.82)

- Number of packaging lines
- Number of customers
- Delivery frequency
- Order lead time

Distribution complexity (α=079)

- Variety of product in storage conditions
- Number of warehouses
- Distribution channel variety
- Uncertainty of distribution time, quantity and quality

Demand complexity (α=0.83)

- Annual demand volume
- Demand uncertainty
- Demand fluctuation

Firm size

Full-time employees

Changes of sales growth rate

Development of total sales volume over the 2003-2005

Expected development of total sales volume over the 2005-2008

Appendix 2. Descriptive statistics and correlation[a] for transportation, packaging, transportation management, inventory management and distribution network design

Transportation		Mean	S.D.	1	2	3	4	5	6	7	8	9	10
1.	Make	.69	.463										
2.	Location	1.39	.491	-.163									
3.	Firm size	3.69	1.564	.101	.517(**)								
4.	Sales growth	1.61	.763	-.057	.006	-.063							
5.	Logistics strategy	2.62	1.092	-.126	-.099	-.151	.022						
6.	General complexity	4.1091	1.44664	-.063	-.116	.042	-.024	.114					
7.	Distribution complexity	3.4299	1.54249	.111	.036	.188(*)	-.078	-.037	.594(**)				
8.	Demand complexity	4.5929	1.56013	.128	-.028	.107	-.065	-.168	.432(**)	.436(**)			
9.	Core business closeness	7.0716	1.80052	.037	.245(**)	.217(*)	-.160	.006	-.059	-.047	-.082		
10.	Asset specificity	4.9181	2.15549	-.386(**)	.153	.147	-.145	.138	.129	-.152	-.137	.394(**)	
11.	Measuring uncertainty	5.9649	2.43474	.116	-.462(**)	-.240(*)	-.068	.161	.128	.046	-.009	-.057	.034

Packaging		Mean	S.D.	1	2	3	4	5	6	7	8	9	10
1.	Make	.16	.366										
2.	Location	1.39	.491	.093									
3.	Firm size	3.69	1.564	.255(**)	.517(**)								
4.	Sales growth	1.61	.763	-.043	.006	-.063							
5.	Logistics strategy	2.62	1.092	-.204(*)	-.099	-.151	.022						
6.	General complexity	4.1091	1.44664	.194(*)	-.116	.042	-.024	.114					
7.	Distribution complexity	3.4299	1.54249	.185(*)	.036	.188(*)	-.078	-.037	.594(**)				
8.	Demand complexity	4.5929	1.56013	.099	-.028	.107	-.065	-.168	.432(**)	.436(**)			
9.	Core business closeness	6.8143	2.11909	.034	-.025	.158	-.084	.015	-.087	.042	-.145		
10.	Asset specificity	6.2105	2.10422	-.208(*)	-.121	.015	-.027	.079	-.002	.076	-.051	.666(**)	
11.	Measuring uncertainty	4.7321	2.74759	.052	-.086	-.028	-.079	.160	.138	.171	.005	.164	.189(*)

Transportation management		Mean	S.D.	1	2	3	4	5	6	7	8	9	10
1.	Make	.37	.485										
2.	Location	1.39	.491	-.096									
3.	Firm size	3.69	1.564	.034	.517(**)								
4.	Sales growth	1.61	.763	-.049	.006	-.063							
5.	Logistics strategy	2.62	1.092	.114	-.099	-.151	.022						
6.	General complexity	4.1091	1.44664	.051	-.116	.042	-.024	.114					
7.	Distribution complexity	3.4299	1.54249	.055	.036	.188(*)	-.078	-.037	.594(**)				
8.	Demand complexity	4.5929	1.56013	.107	-.028	.107	-.065	-.168	.432(**)	.436(**)			
9.	Core business closeness	5.2865	1.52648	-.347(**)	.163	.221(*)	.009	.002	-.001	.044	-.154		
10.	Asset specificity	5.3494	2.17137	-.314(**)	.130	.231(*)	.007	-.004	.098	.002	-.074	.592(**)	
11.	Measuring uncertainty	5.3243	2.43893	.087	-.283(**)	-.062	-.032	.111	.212(*)	.120	.083	.045	.116

Inventory management		Mean	S.D.	1	2	3	4	5	6	7	8	9	10
1.	Make	.05	.224										
2.	Location	1.39	.491	.131									
3.	Firm size	3.69	1.564	.147	.517(**)								
4.	Sales growth	1.61	.763	.055	.006	-.063							
5.	Logistics strategy	2.62	1.092	-.243(**)	-.099	-.151	.022						
6.	General complexity	4.1091	1.44664	-.004	-.116	.042	-.024	.114					
7.	Distribution complexity	3.4299	1.54249	.049	.036	.188(*)	-.078	-.037	.594(**)				
8.	Demand complexity	4.5929	1.56013	-.065	-.028	.107	-.065	-.168	.432(**)	.436(**)			
9.	Core business closeness	7.0132	1.95426	.066	.030	.220(*)	-.019	-.040	.030	.065	.018		
10.	Asset specificity	6.0015	1.94384	-.075	.015	.236(*)	.046	.093	.107	.099	.020	.588(**)	
11.	Measuring uncertainty	4.6000	2.62381	-.071	-.124	-.014	-.047	.158	.004	-.009	-.073	.163	.243(*)

Distribution network design		Mean	S.D.	1	2	3	4	5	6	7	8	9	10
1.	Make	.11	.308										
2.	Location	1.39	.491	.015									
3.	Firm size	3.69	1.564	-.024	.517(**)								
4.	Sales growth	1.61	.763	-.023	.006	-.063							
5.	Logistics strategy	2.62	1.092	-.223(*)	-.099	-.151	.022						
6.	General complexity	4.1091	1.44664	.004	-.116	.042	-.024	.114					
7.	Distribution complexity	3.4299	1.54249	-.012	.036	.188(*)	-.078	-.037	.594(**)				
8.	Demand complexity	4.5929	1.56013	.170	-.028	.107	-.065	-.168	.432(**)	.436(**)			
9.	Core business closeness	6.3363	2.29396	-.038	-.041	.237(*)	-.019	.015	.026	.063	.036		
10.	Asset specificity	5.3799	2.29703	-.109	.067	.320(**)	.045	.057	.116	.064	.051	.641(**)	
11.	Measuring uncertainty	4.5185	2.50413	-.014	-.040	.082	.091	.081	-.005	-.176	-.077	.206(*)	.408(**)

Reference:

Anderson, E, 1985. The salesperson as outside agent or employee:a transaction cost analysis. Marketing Science. 4, 234-254.

Arroyo, P, Gaytan, J, and Boer, L de, 2006. A survey of third party logistics in Mexico and a comparison with reports on Europe and USA. International Journal of Operation & Production Management. 26, 639-667.

Aubert, B A, Rivard, S, and Patry, M, 2004. A transaction cost model of IT outsourcing. Information & Management. 41, 921-932.

Barney, J, 1991. Firm resources and sustained competitive advantage. Journal of Management. 17, 99-121.

Beamon, B M, 1999. Measuring supply chain performance. International Journal of Operation & Production Management. 19, 275-292.

Bolumole, Y A, 2001. The supply chain role of third-party logistics providers. International Journal of Logistics Management. 12, 87-102.

Burgess, K, Singh, P J, and Koroglu, R, 2006. Supply chain management:a structured literature review and implications for future research. International Journal of Operation & Production Management. 26, 703-729.

Capgemini, 2005 Third-party logistics: results and findings of the 10th annual study. http://www.capgemini.com/. Nov 2005.

Chen, I. J. and Paulraj, A., 2004a. Understanding supply chain management: critical research and a theoretical framework. International Journal of Production Research. 42, 131-163.

Chen, I. J. and Paulraj, A., 2004b. Towards a theory of supply chain management: the constructs and measurements. Journal of Operations Management. 22, 119-150.

Choi, T Y and Krause, D R, 2006. The supply base and its complexity:implications for transaction costs, risks, responsiveness, and innovation. Journal of Operation Management. 24, 637-652.

David, R J and Han, S K, 2004. A systematic assessment of the empirical support for transaction cost ecnonomics. Strategic Management Journal. 25, 39-58.

Goor, A R Van, Amstel, M J P Van, and Amstel, W P Van, 2003. European distribution and supply chain logistics, , Wolters-Noordhoff bv

Groves, R M, et al., 2004. Survey methodology, Wiley-Interscience.

Guimaraes, T, et al., 1999. Empirically testing the impact of manufacturing system complexity on performance. International Journal of Operation & Production Management. 19, 1254-1269.

Hafeez, K., Zhang, Y. B., and Malak, N., 2002. Core competence for sustainable competitive advantage: A structured methodology for identifying core competence. Ieee Transactions on Engineering Management. 49, 28-35.

Heikkila, J, 2002. From supply to demand chain management: efficienty and customer satisfaction. Journal of Operation Management. 20, 747-767.

Hennart, J F, 1993. Explaining the swollen middle;why most transactions are a mix of "market" and "hierarchy". Organization Science. 4, 529-547.

Hosmer, David W. and Lemeshow, Stanley, 1989. Applied logistic regression, John Wley & Sons, Inc.

Insinga, R C and Werle, M J, 2000. Linking outsourcing to business strategy. The Academy of Management Executive. 14, 58-70.

Koster, M B M de and Warffemius, P M J, 2005. American, Asian and third-party international warehouse operations in Europe. A performance comparison. International Journal of Operation & Production Management. 25, 762-780.

Leiblein, M J and Miller, D J, 2003. An empirical examination of transaction-and firm-level influences on the vertical boundaries of the firm. Strategic Management Journal. 24, 839-859.

Lieb, R C, 1992. The use of third-party logistics services by large American manufacturers. Journal of Business Logistics. 13, 29-42.

Lieb, R C and Randall, H L 1996. A comparision of the use of third-party logistics services by large American manufacturers, 1991, 1994, and 1995. Journal of Business Logistics. 17, 305-320.

Lieb, R L , Millen, R A , and Van Wassenhove, L N, 1993. Third party logistics services: a comparison of experienced American & European Manufactures International Journal of Physical Distribution & Logistics Management. 23, 35-44.

MaCarthy, I and Anagnostou, A, 2004. The impact of outsourcing on the transaction costs and boundaries of manufacturing. International Journal Of Production Economics. 88, 61-71.

Madhok, A, 2002. Reassessing the fundamentals and beyond: Ronald Coase: the transaction cost and resource-based theories of the firm and the institutional structure of production. Strategic Management Journal. 23, 535-550.

Mapes, J., Szwejczewski, M., and New, C., 2000. Process variability and its effect on plant performance. International Journal of Operations & Production Management. 20, 792-808.

Mason, S J and Cole, M H, 2002. Improving electronics manufacturing supply chain agility through outsourcing. International Journal of Physical Distribution & Material Management. 32, 610-620.

Mclvor, R T, 2000. Outsourcing Process. Supply Chain management:An International Journal. 5, 22-36.

Mclvor, R T, Humphrey, P K, and Mcaleer, W E, 1997. A strategic model for the formulation of an effective make or buy decision. Management Decision. 35, 169-178.

Milgate, M, 2001. Supply chain complexity and delivery performance: an international exploratory study. Supply chain management: An international Journal. 6, 106-118.
Millen, R, et al., 1997. Benchmarking Australian firms' usage of contract logistics services: a comparison with American and Western European practice Benchmarking for Quality Management & Technology. 4, 34-46.
Olavarrieta, S and Ellinger, A E, 1997. Resource-based theory and strategic logistics research International Journal of Physical Distribution & Logistics Management. 29, 559-587.
Pache, G, 1998. Logistics outsourcing in grocery distribution:a European perspective. Logistics Information Management. 11, 301-308.
Poppo, L. and Zenger, T., 1998. Testing alternative theories of the firm: Transaction cost, knowledge-based, and measurement explanations for make-or-buy decisions in information services. Strategic Management Journal. 19, 853-877.
Porter, M E, 1980. Competitive Strategy: Techniques for Analyzing Industries and Competitors, The Free Press.
Quinn, J B and Hilmer, F G, 1994. Strategic outsourcing. Sloan Management Review. 43-55.
Rao and Young, 1994. Global supply chains: factors influencing outsourcing of logistics functions. International Journal of Physical Distribution & Logistics Management. 24, 11-19.
Robertson, T S and Gatignon, H, 1998. Technology development mode: a transaction cost conceptualization Strategic Management Journal. 19, 515-531.
Stadtler, H., 2005. Supply chain management and advanced planning - basics, overview and challenges. European Journal of Operational Research. 163, 575-588.
Sum, C C and Teo, C B, 1999. Strategic posture of logistics service providers in Singapore. International Journal of Physical Distribution & Logistics Management. 29, 588-605.
Swamidass, P M and Newell, W T, 1987. Manufacturing strategy, environmental uncertainty and performance:a path analytic model. Management Science. 33, 509-524.
Van Damme, D E and Van Amstel, M J P, 1996. Outsourcing logistics management activities. International Journal of Logistics Management. 7, 85-95.
Wezel, W van, Donk, D P van, and Gaalman, G, 2006. The planning flexibility bottleneck in food processing industries. Journal of Operation Management. 24, 287-300.
Wheelwright, S C, 1984. Manufacturing strategy:defining the missing link. Strategic Management Journal. 5, 77-91.
Wilding, R and Juriado, R, 2004. Customer perceptions on logistics outsourcing in the European consumer goods industry. International Journal of Physical Distribution & Logistics Management. 34, 628-644.
Williamson, O E, 1975. Markets and Hierarchies: Analysis and Antitrust Implications, Free Press.
Williamson, O E, 1985. The economic Institutions of Capitalism, Free Press.
Williamson, O E, 1991. Comparative economic organization: the analysis of discrete structural alternatives. Administrative Science Quarterly. 36, 269-296.
Williamson, O E, 1998. Transaction cost economics; how it works;where it is headed. De Economist. 146, 23-58.