INVENTORY OWNERSHIP AND PLACEMENT DECISIONS FOR AN EXTERNALLY SOURCED ITEM WITHIN A BUYER-SUPPLIER DYAD

by

Cynthia J. Wallin

A Dissertation Presented in Partial Fulfillment
of the Requirements for the Degree
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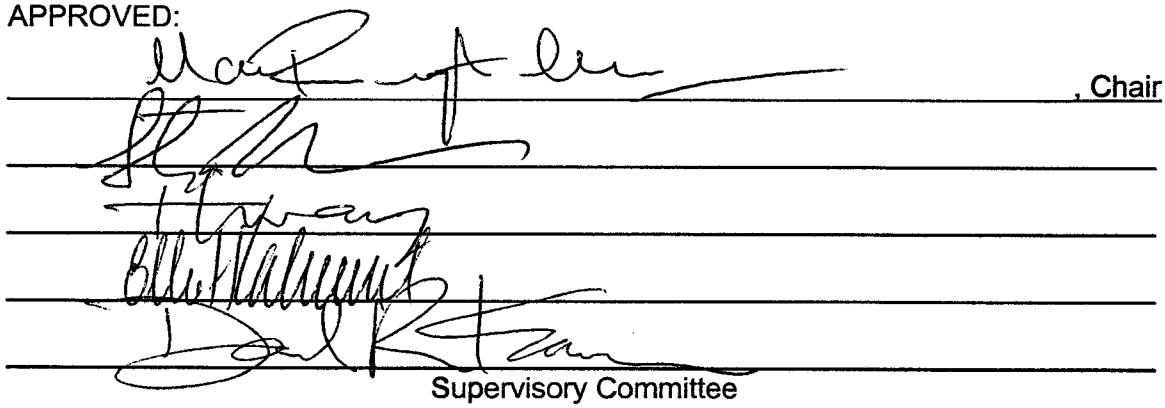

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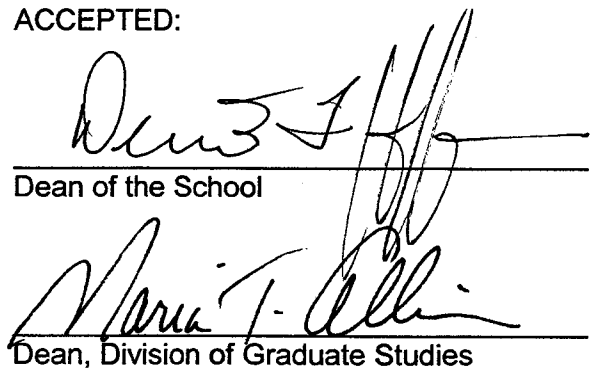

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ABSTRACT

This dissertation attempted to fill a gap in the literature by seeking to understand inventory ownership and inventory placement decisions for an externally sourced item in the buyer-supplier dyad. These two decisions, namely who (i.e., either the buying firm or the supplier) should own inventory of a sourced item and where (i.e., either in the buying or supplying firm's storage facilities) inventory of the sourced item should be placed, when decoupled, correspond to four potential inventory management approaches: *inventory speculation*, *inventory postponement*, inventory consignment, and *reverse inventory consignment*. Borrowing and applying classical Transaction Cost Economics, a set of propositions were developed relating the transaction specific attributes of asset specificity, uncertainty, and frequency to the two decisions of inventory ownership and inventory placement (and, by extension, the choice of inventory management approach) for a single externally-sourced item. The resulting conceptual framework not only fills a critical void in the literature, but also provides practical advice for firms to consider in a consistent manner every time an item is to be sourced externally.

Empirical data to test the conceptual framework were collected by means of a passive role-playing experiment in which subjects were asked to make inventory ownership and placement decisions for a particular externally sourced item in a given business scenario. The resulting stated preference data were then analyzed via several statistical tools, including contingency table analysis, binary logistic regression, non-parametric chi-square tests, and multicategory logistic regression to evaluate the theoretically derived propositions. Results of the analysis indicate moderate support for the predictive ability of two of the transaction attributes, asset specificity and uncertainty, and weak support for the third transaction attribute, frequency, as predictors of inventory

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ownership, inventory placement and the overall inventory management approach choice. The model was robust in predicting the placement of inventory in the buyer-supplier dyad, but an unexpected bias was exhibited by the subjects toward choosing the supplier, rather than the buyer, for inventory ownership.

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ACKNOWLEDGEMENTS

I am deeply indebted to so many people who have helped me through this process. It is impossible to list them all here but I would like to publicly acknowledge a few individuals.

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CHAPTER 1

OVERVIEW OF THE RESEARCH

INTRODUCTION

Decisions that firms make can a have significant impact on their ability to create a competitive advantage in the marketplace (Porter, 1991). For firms involved in manufacturing, these decisions generally pertain to process choice and improvement, capacity management, inventory management and quality management (Hayes & Wheelwright, 1984). While all the aforementioned decisions are strategic in nature, inventory management decisions – i.e., what to order, how much to order, when to order, where to store materials, when to transfer inventory title, and how much (if any) of the inventory management activities should be outsourced (Ballou, 1992) – have become even more critical in recent years with the focus on becoming lean and agile in supply chains.

Research and commentaries pertaining to decisions in inventory management can be found in just about every business discipline. For example, in the accounting and finance literature, there is interest in how inventory levels and reorder points are set as these decisions affect holding costs (e.g., Hadley, 2004; Kennedy & Brewer, 2005; Wen, 2005). In logistics and marketing, the focus is on how inventory levels and the placement of inventory within a network impacts customer service (e.g., Myers, Daugherty, & Autry, 2000; Trunick, 2005; Rabinovich, 2005; Croxton & Zinn, 2005), as well as who should make inventory quantity and timing decisions (Waller, Johnson, & Davis, 1999: Pohlen & Goldsby, 2003). Within operations and supply chain management, there are a plethora of optimization studies, investigating and focusing on decisions pertaining to inventory reorder points, inventory timing, inventory placement, and even inventory ownership (e.g., Lee, Padmanabhan, & Whang, 1997; Lee & Whang,

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1999; Song, Yano & Lerssisuriya, 2000; Corbett, 2001; Chopra, Reinhardt, & Dada, 2004; Chiang & Monahan, 2005).

Two reasons can, in fact, be offered to explain the broad, multidisciplinary fascination with this topic. First, decisions regarding how much to order, when to order, and where inventory is placed can have a significant negative impact for a firm. Too much inventory, on one hand, can translate into relatively higher holding costs (Silver, Pyke & Peterson, 1998). Too little inventory in a particular location, on the other hand, can translate into lost sales to competitors (Corsten & Gruen, 2004), either because the firm does not have units of a product on the shelves or because the production process is being interrupted due to a lack of available parts. In both cases, the bottom line for the firm is negatively impacted.

Second, inventory management decisions are made on an ongoing basis in almost all firms. As such, consistency is imperative in how these decisions should be made. Indeed, when the "right" decisions are being made, consistency should ideally optimize both the decision itself and the corresponding use of the resources affected by the decision.

Given the significance and prevalence of decisions pertaining to inventory management, one should, therefore, not be too surprised to learn that many tools have been tendered to assist in the decision-making process. Examples of these tools would include EOQ-based models (e.g., Lieberman, Helper & Demeester, 1999; Balakrishnan, Pangburn & Stavrulaki, 2004; Zinn & Charnes, 2005), the square root law (e.g., Maister, 1976; Zinn, Levy & Bowersox, 1989; Evers & Beier, 1993), MRP/ERP systems (e.g., Schroeder, Anderson, Tupy, & White, 1981; Aggarwal, 1985; Rabinovich & Evers, 2002), models for designing inventory storage networks (e.g., Croxton & Zinn, 2005; Lee & Elsayed, 2005), and even frameworks for selecting vendors from whom items should be

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sourced (e.g., Dickson, 1966; Choi & Hartley, 1996; Verma & Pullman, 1998). In general, these tools help in making decisions regarding how many units of an item to order, when to place orders for an item, where to place inventory of the ordered item within a firm's own storage facilities, and from whom to buy the item.

However, besides these decisions, a buying firm must make at least two other important decisions that reside specifically at the buyer-supplier interface, namely who should legally own the inventory of an item that is to be sourced externally (i.e., the inventory *ownership* decision) and where should the inventory of the item, once sourced, be placed within the buyer-supplier dyad (i.e., inventory *placement* decision). Unfortunately, the majority of research in inventory management (with the exception of literature related to consignment) has implicitly assumed, particularly for an externally sourced item, that the *ownership* of inventory of the item matches its *placement* in the buyer-supplier dyad – that is, either the buyer owns and, at the same time, holds the inventory of an item or, conversely, the supplier owns and, at the same time, holds the inventory of an item.

With respect to the consignment literature, while explicitly decoupling the two inventory *ownership* and *placement* decisions, the tendency in this literature stream has been to advocate one specific pairing of these decisions as optimal, namely that the supplier should own the inventory of an item to be located physically within the buying firm. In fact, until recently (see Wallin, Rungtusanatham, & Rabinovich, 2006), the insight that decoupling the inventory *ownership* and *placement* decisions would allow consideration of an alternative and reverse option (i.e., the buying firm owns inventory of an item that is physically located with the supplier) has generally been ignored and overlooked in both the consignment, as well as the broader, inventory management literature.

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RESEARCH OBJECTIVES

In order to complete this literature, more research is needed on the different inventory management approaches for an externally sourced item, particularly for the option wherein the buying firm owns inventory of an item that is physically located with the supplier. More importantly, a unifying framework based on a common set of decision determinants is needed to provide insights into how a buyer should and currently does make decisions with respect to inventory *ownership* and *placement*.

Thus, the purpose of this dissertation is to fill this gap in the literature. In order to accomplish this objective, the researcher will first determine, based on the application of a proven theoretical lens, how a buying firm should make inventory *ownership* and *placement* decisions for an externally sourced item in the buyer-supplier dyad. The combination of an inventory *ownership* and an inventory *placement* decision implies an overall inventory management approach about which conclusions may be drawn, resulting in a set of propositions.

Then, with the understanding of what buying firms should pursue in terms of inventory *ownership* and *placement* decisions pertaining to a particular sourced item, the model is tested empirically to determine what a buyer would actually choose to do in a given circumstance.

THEORETICAL LENS

Achieving the research objectives requires i) an understanding of the potential choices that result when inventory *ownership* is decoupled from inventory *placement*; and, ii) an understanding of the determinants that should and do drive a buying firm's choice of inventory *ownership* and inventory *placement*, which then imply one of four inventory management approaches: *inventory speculation*, *inventory postponement, inventory consignment and reverse inventory consignment*. By examining the inventory

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ownership and *placement* decisions and resulting inventory management approaches through a single theoretical lens, the decision-making process to pursue each of these approaches can be studied concurrently.

To that end, this dissertation applies classical Transaction Cost Economics to identify a common set of decision factors that can be used to predict the appropriate inventory *ownership*, *placement*, and overall inventory management approach that a buying firm should pursue with respect to a particular externally sourced item. While TCE theory has not yet been applied to studying the choice of an inventory management approach, its use is appropriate in this context as this decision requires an understanding of inter-firm relationships. It also involves determining whether to 'outsource' or 'insource' the activities related to inventory management, which is a familiar application for this theoretical lens (Rindfliesch & Heide, 1997; David & Han, 2004).

CONTRIBUTION OF THE RESEARCH

The research described here will expand the understanding of what should and does drive a buyer's choice of inventory *ownership,* inventory *placement*, and the overall inventory management approach for an externally sourced item. From an academic perspective, this research contributes to the study of distribution channels by concurrently studying when a buying firm should choose *inventory speculation, inventory postponement, inventory consignment,* or *reverse inventory consignment* in a single framework. Then, through the use of a stated preference methodology, the theoretically-based model is tested empirically.

This research is unique in that it applies a theoretical perspective from economics (Transaction Cost Economics Theory) to the study of inventory management. By doing so, this study answers the call to expand the study of operations related topics

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by borrowing theoretical lenses from other fields (Amundson, 1998; Grover & Malhotra, 2003).

From a managerial perspective this research will explicitly inform managers of their inventory management approach choices for an externally sourced item and illustrate under which conditions each is preferable. This will not only allow managers to make the best inventory *ownership* and *placement* decisions for a particular item based on current conditions, but also provide guidance on how conditions must change in order for a more favorable approach to become available.

OVERVIEW OF THE STUDY

Chapter 1 provided an introduction and overview of the dissertation. The next chapter consists of a review of the literature related to inventory *ownership* and *placement* decisions. Chapter 3 presents an overview of classical TCE and an application of that theory to the questions at hand, resulting in a theoretical framework and propositions. This is followed by an explanation of the research design and methodology in Chapter 4. Chapter 5 contains the results of this empirical study, followed by a discussion of these results, as well as the limitations and the opportunities for future research. Concluding thoughts regarding this dissertation are presented in Chapter 6.

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CHAPTER 2

LITERATURE REVIEW

INTRODUCTION

Prior research regarding the choice of an inventory management approach for a particular purchased item has focused on deciding between *inventory speculation* or *inventory postponement*, or on the benefits of an *inventory consignment* approach. This literature is reviewed following a treatment of the definition and practical application of each of the inventory management approaches considered in this dissertation.

TRADITIONAL INVENTORY MANAGEMENT APPROACHES

Inventory Speculation

Historically the most common inventory management approach adopted in practice for incoming inventory is that of *inventory speculation* (Zinn & Bowersox, 1988; Pagh & Cooper, 1998). As the name implies, speculating incoming inventory means that stock is purchased and held by the buying firm before demand is known with certainty (Bucklin, 1965). In its most basic form, this approach is executed by purchasing inventory based on a forecast, and holding that material within the organizational boundaries of the buying firm.

The choice of an *inventory speculation* approach comes with many benefits, not the least of which is the buying firm's ability to respond quickly to demand or usage needs, thus reducing the risk of stock-outs and customer dissatisfaction. In addition, with this approach, a buying firm can also protect itself against fluctuations in prices, and avail itself of the volume discounts and reduced inbound transportation costs that typically result from buying in bulk (Bucklin, 1965; Zinn & Bowersox, 1988; Pagh & Cooper, 1998).

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Unfortunately, a speculative inventory approach may also lead to higher costs for the buying firm, especially in environments with uncertainty demand. In addition to the opportunity cost and financial burden of having cash tied up in physical inventory, there is also the incurrence of high inventory holding costs, given the need for storage, material handling and tracking. When material is purchased and held in stock before demand is known, the buying firm also faces potential costs associated with obsolescence and an inability to recover inventory investment (Bucklin, 1965; Zinn & Bowersox, 1988; Pagh & Cooper, 1998).

IKON Office Solutions provides an example of this inventory management approach in practice. IKON is a well-known company in the office equipment and services industry and an important part of IKON's success comes from delivering and servicing office equipment, such as printers and copiers. The particular spare parts needed to perform that service are the focus of this example. IKON's 7,000 service technicians each carry a parts kit with them in the hope that they will be able to complete their service requests on the first visit. Therefore, in order to meet customer service goals while also minimizing inventory levels in what are essentially 7,000 stocking locations, IKON has invested heavily in forecasting and planning tools (Albright, 2002).

Inventory Postponement

The traditional alternative to *inventory speculation* is *inventory postponement.* With this inventory management approach the buying firm deliberately delays the purchase and the physical possession of inventory items until demand or usage requirements are known with certainty (Bucklin, 1965). By doing so, a firm can effectively negate the risk of inventory obsolescence, reduce the opportunity cost of having capital tied up in such items, and avoid incurring inventory storage and tracking expenses since these items are physically located with the supplier.

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However, a successful *inventory postponement* approach must also be able to meet demand within a customer's expectations (Van Hoek, 2001). In an industrial setting, this means inventory must be available to the factory promptly enough so that production is not interrupted. In a retail setting, a product must be available within what a customer perceives as a reasonable lead-time or that customer may be lost to a competitor. Therefore, one of the risks associated with *inventory postponement* is that of lost sales and customer dissatisfaction when demand exceeds a supplier's capacity to produce within a given lead-time, or when a competitor's decision to speculate on incoming inventory is more attractive to customers (Van Hoek, 2001). Additionally, the costs of transportation and material handling activities may increase with smaller order batches with an *inventory postponement* approach (Xu, Windle, Grimm, & Corsi, 1994), as would the risk of increasing prices in the future. Regardless of the risks and trade-offs, an *inventory postponement* approach does have the potential to reduce costs in the supply chain (Bucklin, 1965; Zinn & Bowersox, 1988; Pagh & Cooper, 1998).

An example of the use of *inventory postponement* in practice comes from Dell Computer, a company that has successfully removed the majority incoming inventory from its factories, virtually eliminating the need for warehousing, materials handling, and inventory investment. In an industry that typically makes products to stock, Dell instead employs a make-to-order approach, receiving orders steadily throughout the day (over 50% of orders from on-line transactions) and scheduling production lines every 2 hours. With respect to the particular components needed to assemble computers, once orders are received from customers and scheduled for production, Dell passes the request for component parts on to its suppliers, who then deliver the needed material within 90 minutes (Jacobs, 2003; Murphy, 2003).

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BEYOND TRADITIONAL INVENTORY MANAGEMENT APPROACHES

While Bucklin's seminal research regarding *inventory speculation* and *inventory postponement* explicitly deals with the location of material (where it appears in the supply chain), research related to these decisions typically ties inventory *ownership* implicitly to inventory *placement*. By doing so, not only are inventory *placement* and inventory *ownership* presumed to be inseparable dimensions, but the choice of inventory management strategy essentially is constrained to one of the two traditional inventory management approaches—either the *supplier* internally holds and, by default, owns the inventory (i.e., *inventory postponement*) or the *buyer* internally holds and, by default, owns the inventory (i.e., *inventory speculation*). However, it is not necessary to tie inventory *ownership* to inventory *placement*. A consignment approach effectively decouples these two dimensions of inventory management by allowing one firm to hold inventory while allowing another firm to retain *ownership*. Because the firm that owns the stock is not in physical possession of the material, this approach requires a certain level of cooperation and information sharing between supply chain members. There is evidence that the overall inventory cost structure for the supply chain improves with the use of *inventory consignment* (Hackett, 1993; Aggarwal & Jaggi, 1995; Hung, Fun, & Li, 1995; Kandel, 1996; Lee & Whang, 1999; Corbett, 2001; Boyaci & Gallego, 2002; Valentini & Zavanella, 2003), as information sharing leads to lower inventories, and responsibilities for owning and holding inventory can be assigned to the most efficient supply chain member.

Inventory Consignment

There are two basic approaches to establishing a consignment arrangement between a buying firm and a supplying firm. The most common form of this approach is typically referred to as "consignment" in the academic and practitioner literature and

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occurs when materials owned by a supplying firm are in the physical possession of a buying firm (e.g., Ballard, 1987; Donovan, 1987; Fenton & Sanborn, 1987; Keener, 1987; Khermouch, 1994; Andel, 1996; Harrington, 1996; Ukens, 1996; Beam, 1998; Lee & Whang, 1999; Roos, 2000; Simchi-Levi, Kaminsky, & Simchi-Levi, 2000; Williams, 2000; Corbett, 2001; Coughlan, Anderson, Stern, & El-Ansary, 2001; Valentini & Zavenella, 2003). Only after an item has been either used in production or sold to customers would the buying firm then make payment to the supplying firm.

This form of *consignment* yields obvious benefits to the buying firm in a supply chain because it allows the buying firm to have inventory available without investing precious capital and risking potential obsolescence expense. The continual replenishment process protects the buying firm against fluctuations in demand and the costs of stockouts may be offset by contractual penalties when the supplying firm does not have stock available (Valentini & Zavanella, 2003). *Inventory consignment* also affords advantages to a supplying firm, as this contractual arrangement allows it to tap into information on real-time consumption patterns that can be made available by vertically coordinating inventory management processes. In turn, this data availability translates into a more accurate perception of customer demand and savings in inventory-holding costs (Kandel, 1996; Valentini & Zavanella, 2003).

As with any inventory management approach, there are also potential disadvantages to a buying firm when employing an *inventory consignment* approach. In addition to the expense of storing, handling and tracking a consignment item, a firm could also be subject to price fluctuations, with the price of the item on hand increasing between the time when it was physically received and when it was put to use or sold.

Examples of *inventory consignment* arrangements can be found in electronics manufacturing (Hung et al., 1995; Carbone, 2000; Roos, 2000), health care (Benefield,

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1985; Ackerman, 1986; Fenton & Sanborn, 1987; Ballard, 1987; Schenarts & Rodrigues, 1987; Louviere, 1987; Bledsoe, 1987; Donovan, 1987; Benefield, 1987; Gerber, 1987; North, 1987; Keener, 1987; Barlow, 1992; Ukens, 1996; Williams, 2000; Drickhamer, 2002), and book publishing (Kandel, 1996; Andel, 1996; Beam, 1998). *Inventory consignment* contracts can also be found for retail products like journals, newspapers, music records and compact discs, jewelry, dairy products, cigarettes, and office equipment industries (Kandel, 1996), and in the auto and auto part industries (Kandel, 1996; Corbett, 2001; Valentini & Zavanella, 2003). Distributors selling from manufacturers' catalogues and manufacturers who rent space in department stores are also effectively using *inventory consignment* contracts (Kandel, 1996).

AutoZone is one of the many companies employing an *inventory consignment* approach. AutoZone implemented a pay-on-scan program to work more closely with suppliers and reduce inventory investment and expense related to parts stocked in their retail locations (AutoZone Annual Report 2003). Pay-on-scan means that parts that are stocked in AutoZone stores are owned by the suppliers until they are sold to a customer. At the time of purchase (i.e. 'scan') AutoZone then pays the supplier for the item per the payment terms, up to 90 days after the sale (Boorstin, 2003; Fahey, 2003). Without a doubt, an initiative of this type has a significant impact on a firm that reportedly carried $1.5 billion worth of inventory on its shelves as recently as 2003 (Fahey, 2003).

Inventory consignment is often confused with vendor-managed-inventory (VMI), and while they share many characteristics and benefits, the terms are not synonymous. VMI may include the use of *inventory consignment*, but the focus of VMI is that the supplier is responsible for making decisions about what quantity is ordered, where material is stored, and when material arrives at the buyer location (Waller, et al., 1999; Cetinkaya & Lee, 2000). The APICS dictionary (10th Edition) defines VMI as

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> "A means of optimizing supply chain performance in which the supplier has access to the customer's inventory data and is responsible for maintaining the inventory level required by the customer. Resupply is performed by the vendor through regularly scheduled reviews of the on-site inventory. The on-site inventory is counted, damaged or outdated goods are removed, and the inventory is restocked to predefined levels."

Under VMI, inventory *ownership* and/or *placement* may or may not be transferred to the supplier with the inventory management responsibility.

Reverse Inventory Consignment

The second consignment approach, *reverse inventory consignment*, is less commonly found in practice. In this case the buying firm would pay for and own, but would not take physical possession, of inventory of the particular purchased item. Rather, the item would reside physically within the supplying firm's network of storage facilities. At the buying firm's request, the purchased item would be transferred either into the buying firm's production facilities or directly to the buying firm's customer.

Not surprisingly, the majority of the benefits of a *reverse inventory consignment* approach mirror the drawbacks of an *inventory consignment* approach, and vice versa. With *reverse inventory consignment*, not only is the risk of future price increases fully mitigated, but the storage and storage-related costs also become trivialized. The disadvantages with this approach are the opportunity cost of capital tied up in physical inventory and the risk and expense of inventory obsolescence.

In summary, both consignment approaches provide the buying firm access to the purchased item, one through inventory *placement* (*inventory consignment*) and the other through inventory *ownership* (*reverse inventory consignment*). In addition, the *reverse inventory consignment* approach to consigning incoming inventory also yields benefits related to information sharing and cooperation between supply chain members. This approach can lead to a more efficient supply chain overall when a buying firm is best

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suited to support the capital investment but the supplying firm is the most capable supply chain member to provide material handling services.

An example of *reverse inventory consignment* can be found in the textiles industry. A firm in the fashion-ski-apparel business placed buyer-owned raw materials near the fabricators' premises in anticipation of future demand. In exchange for assuming the risk of supplying the correct raw materials, the fabricators allowed the firm to make production commitments later than would otherwise have been required. This was one of several actions taken to address uncertainty in a volatile supply chain (Fisher, Hammond, Obermeyer, & Raman, 1994).

Another example of *reverse inventory consignment* involves the use of electronic inventory. The W. P. Carey School of Business at Arizona State University has made the decision to manage its inventory of course packs by allowing the supplier to hold the electronic inventory it has already paid for. The school chose this inventory management approach following years of frustrating delays in receiving copyright permissions and a logistical nightmare when course packs began to stack up in the MBA office hallways at the beginning of each semester.

Table 1 provides an overview of the advantages and disadvantages of each of these inventory management approaches.

DIFFERENTIATING INVENTORY MANGAEMENT APPROACHES

In comparing and contrasting the inventory management approaches described above, two factors differentiate among the choices: inventory *ownership* and inventory positioning (*placement*). Inventory *ownership* is defined by the action of transferring title of the purchased item from the supplying firm to the buying firm. Inventory positioning, or *placement*, refers to the physical location of material in the supplier-buyer dyad. In both *inventory speculation* and *inventory postponement* approaches, inventory

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Table 1: Inventory management approaches overview

Inventory Management Approach	*Advantages/Disadvantages*
Inventory Speculation	Advantages • Inventory on-hand to fill customer orders • Protection against future price increases • Volume discounts and reduced in-bound transportation expense Disadvantages • Inventory investment opportunity cost • Inventory storage, handling and tracking expense • Inventory obsolescence expense
Inventory Postponement	Advantages • No inventory obsolescence expense • No inventory investment opportunity cost • No inventory storage, handling and tracking expense Disadvantages • Lost sales when inventory is not available in time to meet customer demand • Higher in-bound transportation expense • Subject to future price increases
Inventory Consignment	Advantages • Inventory on-hand to fill customer orders • No inventory investment opportunity cost • No inventory obsolescence expense Disadvantages • Subject to future price increases • Inventory storage, handling and tracking expense
Reverse Inventory Consignment	Advantages • Inventory on-hand at supplier location • Protection against future price increases • No inventory storage, handling and tracking expense Disadvantages • Inventory investment opportunity cost • Inventory obsolescence expense

ownership has traditionally been tied to *placement*, so as the inventory changes physical location, the assumption was made that the title moves from supplier to buyer (Bucklin, 1965; Zinn & Bowersox, 1988; Pagh & Cooper, 1998). In an *inventory consignment* or *reverse inventory consignment* approach, *ownership* and *placement* decisions are

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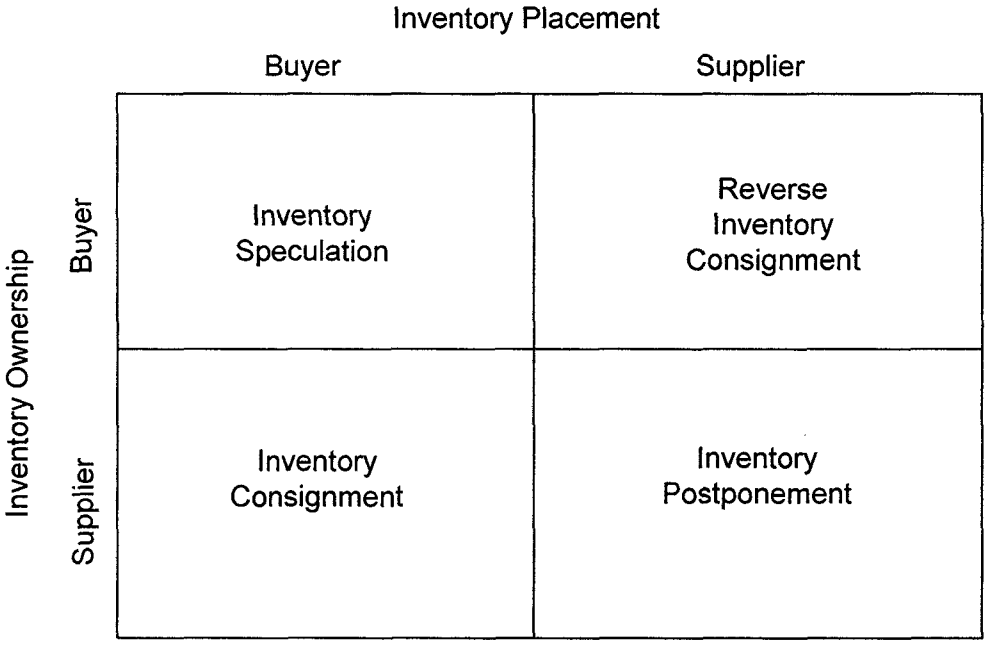
decoupled and treated separately, with one supply chain member responsible for physically holding inventory while the other is responsible for the financial investment in the stock (Simchi-Levi et al., 2000; Coughlan et al., 2001). The matrix in Figure 1 represents the approaches for managing incoming inventory in terms of these factors that differentiate them.

Figure 1: Inventory management approaches



CHOOSING AMONG INVENTORY MANAGEMENT APPROACHES

Postponement vs. Speculation

Although the literature draws no conclusions regarding choosing among all four inventory management approaches identified above, the distribution channels literature does provide some insights into the choice between the two inventory management approaches wherein *ownership* and *placement* are assumed to go together, namely *inventory speculation* and *inventory postponement*. Bucklin (1965) laid much of the

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groundwork with respect to this choice, suggesting that the decision between *inventory speculation* and *inventory postponement* is contingent on total channel cost. More specifically, in articulating his principle of speculation-postponement, Bucklin (1965: p. 28) stated that "A speculative inventory will appear at each point in a distribution channel whenever its costs are less than the net savings to both buyer and seller from postponement." By inference, within the buyer-supplier dyad, a buying firm should therefore choose to own and hold inventory of a sourced item (i.e., *inventory speculation)* when the total channel costs of doing so are less than not speculating (i.e. *inventory postponement*).

Zinn and Bowersox (1988) provide a well known extension of Bucklin's work. They identified five types of postponement, one of which is time postponement, defined as moving products from one location to another only after firm orders have been received (Zinn & Bowersox, 1988, p. 118). Consistent with Bucklin's principle of speculation-postponement, Zinn and Bowersox identified four physical distribution cost related to time postponement – transportation, inventory carrying, warehousing, and lost sales; how these costs would counteract one another would determine whether or not to pursue time postponement. For example, if the cost of lost of sales were to increase relative to inventory carrying costs, the advice would then be to not pursue time postponement. By implication, for a buyer-supplier dyad this would mean that *inventory speculation* should be chosen over *inventory postponement* given the aforementioned cost tradeoff.

Pagh and Cooper (1998), taking essentially a supplier perspective, defined four supply chain P/S (i.e., postponement/ speculation) strategies, one of which, labeled "the logistics postponement strategy," pertains to movement and implied ownership of units of an item between a firm and its customer. According to this strategy, the

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manufacturing function would engage in speculation (i.e., make to inventory) while the logistics function would hold inventory centrally and ship directly to retailer or customer upon receipt of a confirmed order. Such a strategy would be expected to result in low production costs, low-to-mid inventory costs, high distribution costs, and low-to-mid customer service (Pagh & Cooper, 1998). Within the buyer-supplier dyad, these insights imply when the supplier, as opposed to the buying firm, should engage in *inventory postponement* to the buying firm.

Van Hoek's (2001) literature review includes the following postponement determinants relevant to the inventory management approach decision: high product variety, high value density/unit value, product size and weight, short product life cycles, high sales fluctuations, short and reliable lead-times, price competition.

Yang et al. (2004a) provide a more recently published framework regarding a postponement strategy. They determined that uncertain demand, a wide expected range of variability, and the chance that more information will become available during the delay are all preconditions for postponement.

Since Bucklin's seminal work, researchers in this field have examined the use of postponement as compared to speculation across several functional areas within the firm and across the supply chain (see Figure 2). Most of the postponement literature deals with operational decisions from fabrication to the customer, with very little work done in the area of sourcing or purchasing postponement. In a literature review of the postponement research, Van Hoek (2001) found that only 2 of the 19 articles examined looked at postponement in the complete chain, the other 17 articles being categorized as either mid-to-down stream or down-steam postponement studies.

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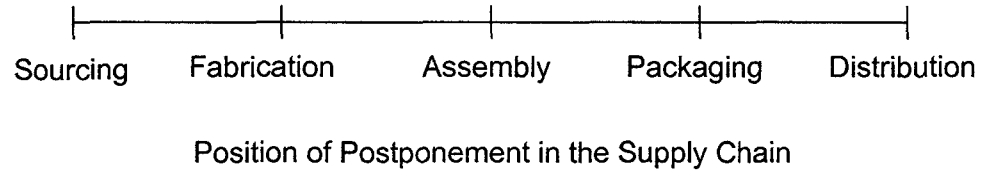
Figure 2: The application of postponement



Source: adapted from Van Hoek, 2001, p. 162

However, recently, Yang et al. (2004b) extended the concept of postponement to include not only product postponement and logistics postponement but also product development postponement and purchasing postponement. By purchasing postponement, they mean ". . . purchasing components as close to the point of manufacture as possible" (p. 1055) and, as such, would equate to *inventory postponement* as defined in Wallin et al. (2006). Moreover, when a firm is facing a high level of demand uncertainty, the advice offered is for the firm to postpone the purchase of assets that may become obsolete quickly. Purchasing postponement, accordingly, would be most appropriate for raw materials and components that are expensive, fragile, and come in many different sizes and shapes. Additionally, how successful purchasing postponement is would depend on collaboration between supply chain members and on whether or not the buying firm holds power within the supply chain.

Table 2 provides a summary of the decision determinants identified in the distribution channels literature related to *inventory postponement* and *inventory speculation*.

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Table 2: Postponement decision determinants reported in the literature

Author(s)	Relevant Determinants Identified
Bucklin (1965)	Total channel cost
Zinn and Bowersox (1988)	Cost trade offs related to • Inventory investment • Transportation and distribution • Customer service High unit value products High sales fluctuations
Pagh and Cooper (1998)	Product lifecycle maturity Product range Product type (standard or custom) Monetary density Relative delivery time Delivery frequency Demand uncertainty
Van Hoek (2001)	Product variety High value density/unit value of products Product life cycle High sales fluctuations Short, reliable lead-times Price competition
Yang, Burns, and Blackhouse (2004a)	Demand uncertainty Range of variability Potential for more available information in the future
Yang, Burns, and Blackhouse (2004b)	Demand Uncertainty Product price Product fragility Product variety (shapes and sizes) Degree of collaboration Power position of buying firm

Consignment

Aside from analytical studies regarding optimum stocking and ordering policies (Aggarwal & Jaggi, 1995; Hung et al, 1995), prior operations management research regarding the *inventory consignment* approach has focused on the potential benefits of *inventory consignment*, rather than a comparison between *inventory consignment* and

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the other three inventory management approaches. However, when comparisons are made in this research stream, *inventory consignment* is typically compared, via modeling, to *inventory speculation*. These modeling-based investigations indicate that *inventory consignment* has both economic and operational implications for a firm (Lee & Whang 1999).

Interestingly, these benefits are most commonly attributed to increased coordination, cooperation, or information flow inherent in *inventory consignment*. For example, Lee and Whang (1999) demonstrated that *inventory consignment* could affect inventory cost structures through inter-firm or intra-firm coordination as this inventory management approach motivates information sharing. Likewise, Boyaci and Gallego (2002) found that *inventory consignment* promotes channel cooperation that, in turn, maximizes channel profits. Corbett (2001) used *inventory consignment* stock to model the impact of shared incentives and information flow and proposed a framework for how incentives should be structured to reduce inventory. That study demonstrated that an *inventory consignment* policy is effective in reducing information asymmetry between a buyer and a supplier and led to a reduction in the supplier's cycle stock. However, the policy also gave the buyer an incentive to increase the level of safety stock. Valentini and Zavanella (2003) found that an *inventory consignment* stock policy could outperform traditional inventory models, with evidence that total supply chain cost savings increase as overall holding costs decrease with the use of this approach. A summary of this literature is found in Table 3.

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Table 3: Benefits of inventory consignment reported in the literature

Author(s)	Benefits Identified
Lee and Whang (1999)	- Motivate information sharing - Improve coordination - Reduce supply chain costs
Cobett (2001)	- Reduces the impact of information asymmetry - Reduce cycle stock for supplier
Boyaci and Gallego (2002)	- Improve channel cooperation - Maximize supply chain profits
Valentini and Zavanella (2003)	- Reduce holding costs - Reduce supply chain costs

CRITIQUE OF THE LITERATURE

Since prior research related to *inventory speculation* and *inventory postponement* implicitly assumes ownership is tied to location (Bucklin, 1965; Zinn & Bowersox, 1988; Pagh & Cooper, 1998; Van Hoek, 2001), and only two inventory management approaches have been analyzed in the distribution channels literature with regard to the decision determinants published to date (see Table 2), it is impossible to predict a buying firm's behavior with respect to a full compliment of approach choices based solely on this literature.

On the other hand, the *inventory consignment* literature infers that this inventory management approach is better than other alternatives. While the mathematical models presented do indicate a number of benefits are possible with the use of *inventory consignment* (see Table 3), contingency theory suggests that no one approach is best suited to all circumstances and it is practically irresponsible to perpetuate the view that *inventory consignment* is always a better choice.

Therefore, a rigorous, theoretically-based model of inventory management approach choice is needed to explain and predict a buying firm's optimal selection of inventory management approach in varied contexts. Additionally, by studying all four

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inventory management approaches in a single model, both researchers and managers will be able to identify the common factors that drive this choice. With that in mind, the conceptual model presented in Chapter 3 is intended to address this gap in the literature by proposing a TCE-based model of inventory *ownership*, *placement*, and overall approach choice for a particular externally sourced item.

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CHAPTER 3

RESEARCH MODEL

Chapter 3, as currently written, was taken in its entirety from an article currently under review at Production and Operations Management Journal.

CLASSICAL TRANSACTION COST ECONOMICS

Classical Transaction Cost Economics (TCE) is a macro-level theory that seeks to define what the boundaries of a firm are by distinguishing between the activities that should take place within the firm and those that should not. The fundamental tenets of TCE can be traced back to Coase (1937), who defined the functional boundaries of a firm in terms of (1) the coordination costs associated with information exchange and functional knowledge creation by the transacting parties and (2) the transaction risks resulting from the unforeseen evasion of agreed upon terms and responsibilities by one of the parties in the transaction (Coase, 1937). Transaction costs, therefore, would determine what a firm's decision would be regarding where and how a particular activity should be managed – internally or by an external party.

Behavioral Attributes and Transaction Attributes

Building on the work by Coase (1937), Williamson (1975, 1985) proposed that these transaction costs result from two classes of attributes – behavioral attributes and transaction attributes. Foremost are behavioral attributes reflected in the individuals involved in the transaction and include bounded rationality and opportunism. Whereas opportunism represents the risk that one of the parties in the transaction would take advantage of the other when the opportunity presents itself, bounded rationality refers to the fact that there would always be elements of the circumstances surrounding the transaction that are unknown. More importantly, the two behavioral attributes are

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presumed to be inherent to the transacting parties and are, therefore, omnipresent in any and all transactions (Williamson, 1985).

In addition, each transaction also varies based on three attributes that are specific to the transaction itself (i.e., asset specificity, uncertainty, and frequency). The first transaction attribute, asset specificity, is defined as the usefulness of the asset beyond the transaction in question (Williamson, 1985), with the presence of specialized investments increasing the likelihood and risk of opportunistic behavior (Pilling et al., 1994). The second transaction attribute, uncertainty, is defined as unexpected changes in the circumstances surrounding the transaction (Willliamson, 1985), with lack of knowledge regarding the environment and lack of knowledge regarding the behavior of the other participants in the transaction being the primary sources of uncertainty (Sutcliffe & Zaheer, 1998). The third and last transaction attribute is frequency, defined as the volume of transactions processed through a given governance structure (Williamson, 1985), with such volume justifying a particular governance structure in terms of cost and economies of scale (Williamson, 1985).

Transaction Costs

Together, the two classes of attributes interact in a complex manner to drive different types of costs. Therefore, given opportunism and given a transaction with a high level of asset specificity, a firm would experience safeguarding costs should it make the decision to outsource the transaction, these being the costs of protecting itself from being held captive by the other entity in the exchange (Williamson & Ouchi, 1981; Rindfleisch & Heide, 1997; Grover & Malhotra, 2003). Similarly, the firm would incur adaptation costs when outsourcing a transaction that has a high level of environmental uncertainty as the firm, itself, has bounded rationality. Adaptation costs are then the costs incurred in fully specifying all aspects of the exchange in advance and continually

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modifying the conditions surrounding the exchange (Williamson & Ouchi, 1981; Rindfleisch & Heide, 1997; Grover & Malhotra, 2003). In addition, when a transaction has a high level of behavioral uncertainty while the firm faces bounded rationality, the firm would incur performance evaluation costs for monitoring and evaluating the performance of exchange partners (Rindfleisch & Heide, 1997). Finally, when the level of frequency in a transaction is low-to-moderate relative to the firm's marginal cost structure, the firm would incur inefficiency costs if it were choose to internalize the transaction.

Governance Structure

The existence of transaction costs (i.e., safeguarding, adaptation, performance evaluation, inefficiency), in turn, would influence a firm's decision in terms of the appropriate governance structure for a particular transaction. Williamson (1985) identified three potential governance structures – hierarchy, market, or hybrid. At one end of the spectrum is a hierarchical governance structure. Under this governance structure, a transaction is vertically integrated and managed within the firm's boundaries. At the opposite end, in a market governance structure, the firm would rely on arms-length transactions with organizations outside its boundaries. Lastly, a hybrid governance structure would include all governance mechanisms falling between the two extremes of market and hierarchy. Accordingly, whereas excessive safeguarding costs, excessive adaptation costs, and excessive performance evaluation costs, and low inefficiency costs should influence a firm to internalize a transaction (i.e., hierarchy), the converse would suggest that the firm pursue a market governance structure.

Since transaction costs result from the interactions between the omnipresent behavioral attributes and the varying levels of transaction attributes, the governance structure decision by transitory property is, therefore, determined primarily by the direct

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and combined affects of the transaction attributes (asset specificity, uncertainty and frequency). Indeed, when the levels of these transaction attributes are high, TCE argues that a firm should seek to internalize the transaction using a hierarchical type governance structure. Conversely, when the levels of all transaction attributes are low, a firm would be expected to transact through a market governance structure. By deploying the appropriate governance structure relative to the levels of the three transaction attributes, a firm would, as a consequence, be able to maximize profitability. Figure 3 depicts a summative pictorial representation of the relationships among the behavioral attributes, the transaction attributes, the transaction costs, and the choice of governance structure.

Relevance to Present Context

The fact that TCE has been used to understand inter-firm relationships and determine the appropriate allocation of activities, whether internal or external, to the firm, makes TCE an ideal theoretical lens to apply to the study of inventory *ownership* and *placement* decisions within the buyer-supplier dyad. To appreciate this logic, it is important to view the inventory *ownership* decision and the inventory *placement* decision as connoting two separate activities – i.e., between the buyer and the supplier, who should perform the activity of owning this inventory and who should perform the activity of physically having possession of this inventory? Hence, the governance structure decision that must be made is whether to internalize or outsource each of these two separate activities, as reflected in the decisions themselves. By examining the decisions relative to the separate activities (i.e., inventory *ownership* or inventory *placement*), we can then infer what the appropriate governance structure in this context would be – a hierarchy corresponding to the *inventory speculation* approach, a market corresponding

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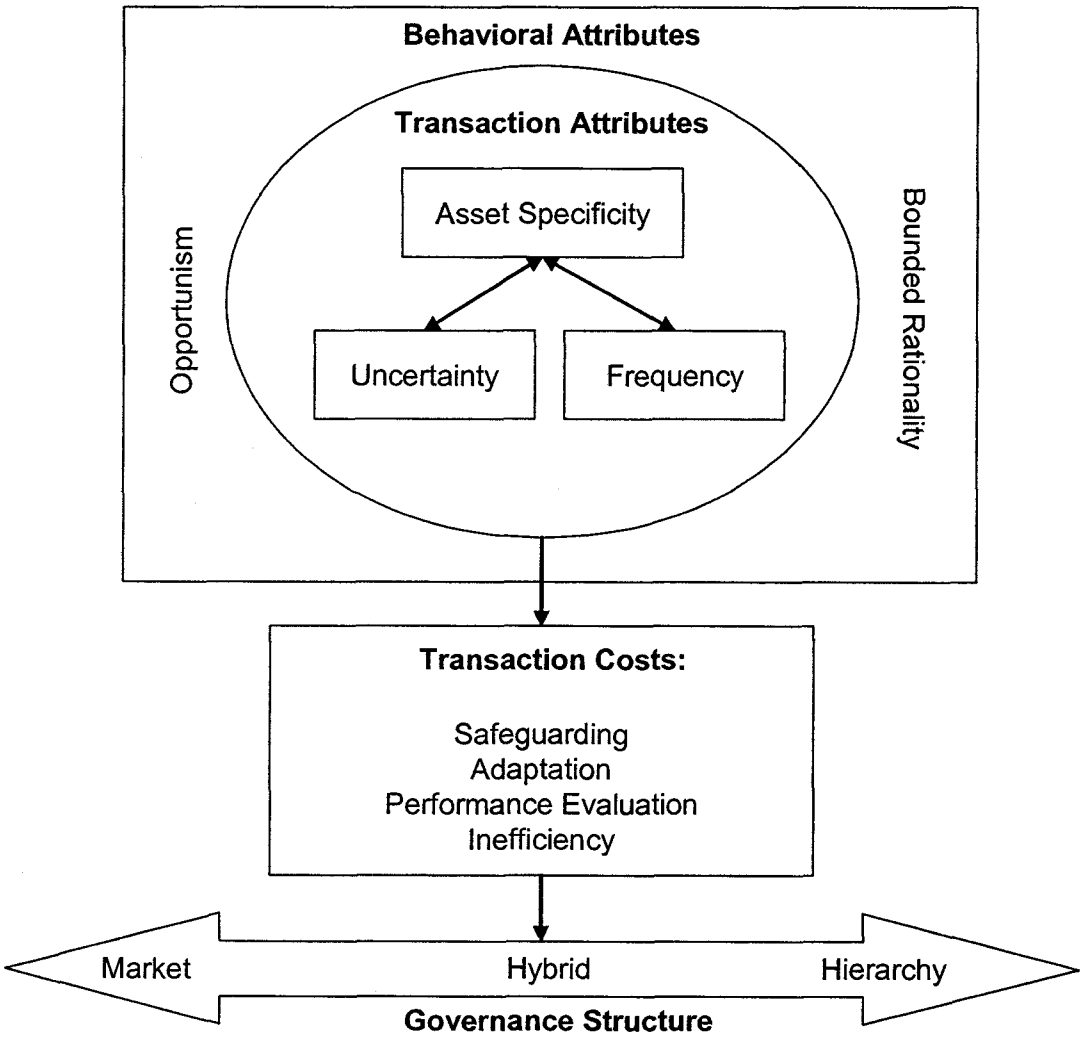
to the *inventory postponement* approach, or a hybrid corresponding to the *inventory consignment* and *reverse inventory consignment* approaches.

Figure 3: A pictorial representation of Transaction Cost Economics



In addition, TCE brings a missing perspective, namely a behavioral angle via the inherent behavioral attributes, to the question of how a buying firm should make decisions pertaining to inventory *ownership* and *placement*. Such a behavioral perspective would augment the primarily cost-driven focus in the distribution channels

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literature and would be more consistent with current understanding of buyer-supplier relationships.

MAKING INVENTORY OWNERSHIP AND PLACEMENT DECISIONS

Assumptions

Before proceeding with the application of TCE to the context of inventory *ownership* and *placement* decisions within the buyer-supplier dyad, several assumptions should be clearly articulated as they constrain the theorizing task that we undertake. First, in our theoretical development, we assume the perspective of the buying firm which, as a matter of fact, is consistent with previous research in supply chain management (Cox et al., 2001; Watson, 2001). Second, we assume that other than the two inventory *ownership* and *placement* decisions, all other decisions concerning the item being sourced externally have already been taken (e.g., supplier selection, order quantity, etc.). Third, we further assume that these two decisions of inventory *ownership* and *placement* are being taken in advance of demand, whether from the external market or in terms of internal usage. Fourth and last, we assume that the externally sourced item is of a critical nature to the buying firm, without being concerned with how criticality is pragmatically defined.

Asset Specificity

Whereas previous studies applying a TCE theoretical lens often point to customized capital equipment or uniquely trained employees as the specific assets involved in a transaction (David and Han, 2004 p. 49), the specific asset underlying this research is the item to be sourced and, therefore, its inventory. The inventory of an item with a high level of asset specificity, consistent with the definition by Williamson (1985), would have little use beyond the immediate transaction and, in this context, would correspond to units of an externally sourced item that has been highly customized to

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meet the particular needs of the buying firm. Such a highly customized item also implies that the buying firm would typically face high switching costs associated with changing the supplier. The supplier, as a result, has the advantage when setting the price for the item being sourced.

Hence, when the level of asset specificity is high, the buying firm should protect itself against the risk of opportunistic behavior on the part of the supplier. This can be accomplished by making the decisions to internalize both the *ownership and* the *placement* of inventory of the item (i.e., *inventory speculation*), thereby avoiding safeguarding costs that would result from having the supplier perform these activities. By taking *ownership* of the inventory of the sourced item before demand is known, the buying firm would be able to lock in its price, removing the risk of the supplier taking advantage of the buying firm's high switching costs and lack of readily available alternative sources to change pricing. Internalizing the *placement* of the item before demand is known would, in turn, ensure that the item is available when needed and the supplier would not be able to hold the item "hostage".

On the other hand, if the item in question were to have a common design with many potential sources of supply (i.e., a low level of asset specificity and, therefore, a low level of transaction cost), the buying firm should choose, instead, a market governance structure – one wherein *ownership* and *placement* of inventory of the sourced item would reside with the supplier (i.e., *inventory postponement*). Such reliance of the supplier would allow the buying firm to avoid the costs associated with these activities.

Hence:

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Proposition	IF THE LEVEL OF	THEN IDEALLY		
	Asset Specificity	Inventory Ownership	Inventory Placement	Therefore
1A	HIGH	Buyer	Buyer	Inventory speculation
1B	LOW	Supplier	Supplier	Inventory postponement

Uncertainty

Uncertainty, in the current context of an externally sourced item and consistent with Williamson's (1985) definition, refers to unexpected events which affect the availability of an item being sourced. As such, the nature of the supply environment and the performance of a chosen supplier are two critical factors to consider in terms of supply uncertainty. The level of supply uncertainty, for example, would be determined by the availability of raw materials or components comprising the item being sourced, as well as the on-time-delivery or quality performance of the supplier for the particular item.

Consistent with TCE, a high level of supply uncertainty should encourage a buying firm to internalize both inventory *ownership* and inventory *placement* activities and to adopt *inventory speculation* for the externally sourced item in question. By owning the inventory of this particular item before demand is known, the buying firm would ensure itself of a reliable supply; by locating the inventory of the sourced item within its own storage facilities, the buying firm would protect itself against potential performance failure on the part of the supplying firm (implying an *inventory speculation* approach). Alternatively, when the level of supply uncertainty for an externally sourced item is low, the buying firm should rely on the supplier to perform both inventory *ownership* and inventory *placement* activities (i.e., *inventory postponement*) and, thereby, avoid the costs of owning and physically handling such inventory.

Hence:

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Proposition	IF THE LEVEL OF	THEN IDEALLY		
	Uncertainty	Inventory Ownership	Inventory Placement	Therefore
2A	HIGH	Buyer	Buyer	Inventory speculation
2B	LOW	Supplier	Supplier	Inventory postponement

Frequency

Frequency, referring to the volume of transactions processed though the governance structure (Williamson, 1985), equates, in the current context, to the volume of the item being sourced by the buying firm and can be more specifically described in terms of consistency or the length of time between usage of the item (Pilling et al., 1994). Therefore, when frequency of use is high and consistent, to rationalize economies of scale effects, the buying firm should internalize inventory *ownership* and *placement* of a sourced item (i.e., *inventory speculation*). Conversely, with a low level of frequency, the buying firm would not likely be able to argue for economies of scale necessary to justify internalizing the inventory *ownership* and inventory *placement* activities and, as such, should rely on the supplier to perform these activities (i.e., *inventory postponement*).

Hence:

Proposition	IF THE LEVEL OF	THEN IDEALLY		
	Frequency	Inventory Ownership	Inventory Placement	Therefore
3A	HIGH	Buyer	Buyer	Inventory speculation
3B	LOW	Supplier	Supplier	Inventory postponement

Asset Specificity, Uncertainty, and Frequency

While each transaction attribute, considered individually as a decision driver, does provide useful theoretical insights pertaining to the choice between *inventory*

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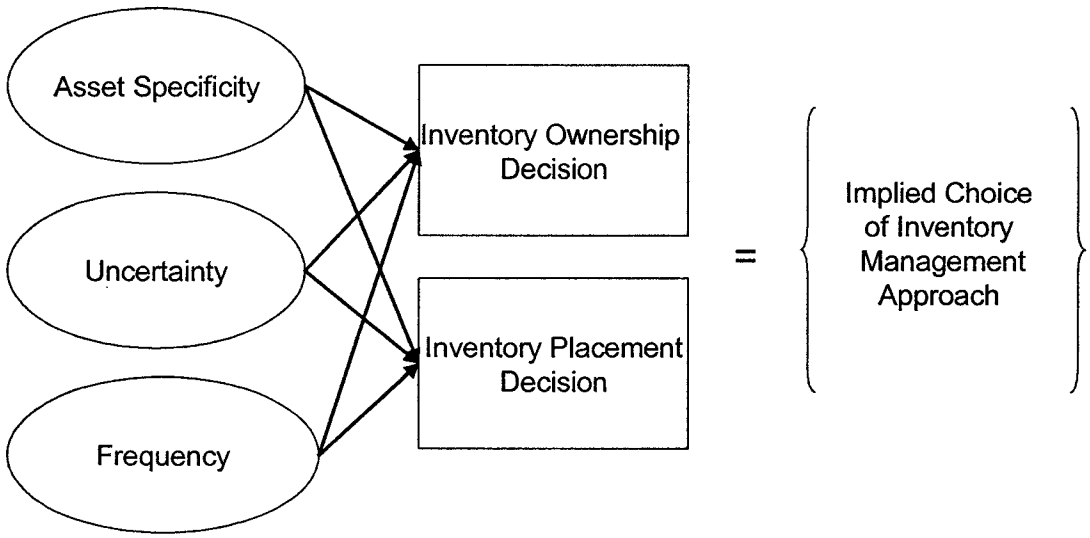
speculation and *inventory postponement*, a more realistic and pragmatic context would be to decipher the implications for inventory *ownership* and *placement* decisions, while considering the simultaneous implications of all three transaction attributes on the inventory *ownership* and *placement* decisions for an item being sourced externally by a buying firm (see Figure 4). Indeed, considering asset specificity, uncertainty, and frequency simultaneously, with each transaction attribute specified at two levels (high or low), leads to eight potential scenarios.

Figure 4: Research model of combined effects



The ideal inventory *ownership* and *placement* decisions, and implied overall inventory management approach, for two of the eight possible scenarios are quite evident. For these two scenarios, the levels of the three transaction attributes are all specified in the same direction – that is, all have high levels or all have low levels. Moreover, the ideal decision outcomes with respect to inventory *ownership* and inventory *placement* are also consistent for all three transaction attributes with the same level specification. Hence:

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Proposition	IF THE LEVEL OF			THEN IDEALLY		
	Asset Specificity	Uncertainty	Frequency	Inventory Ownership	Inventory Placement	Therefore
4A	HIGH	HIGH	HIGH	Buyer	Buyer	Inventory speculation
4B	LOW	LOW	LOW	Supplier	Supplier	Inventory postponement

The more intriguing question, of course, is how the interactions of the three transaction attributes would drive the inventory *ownership* and inventory *placement* decisions when the attribute levels are not all high or all low. In order to derive the joint impact of the three transaction attributes, we proceeded to examine each transaction attribute in terms of the primary risk that needs to be mitigated per transaction attribute. Since asset specificity has been described as the "the big locomotive to which transaction cost economics owes much of its predictive content" (Williamson, 1985 p. 56) and as the transaction attribute that most consistently predicts the governance structure (Rindfleisch & Heide, 1997; David & Han, 2004) and that affects directly the choice of governance structure (Williamson, 1985), we begin this theoretical examination looking first at asset specificity.

With respect to the current context, the primary concern when the level of asset specificity is high is the vulnerable position in which a buying firm finds itself. Because the asset in question is specialized and customized, the buying firm essentially faces high switching costs and must acknowledge the risk that the chosen supplier may act opportunistically, either in refusing to sell units of the item or in raising the price of the item unexpectedly. Mitigating this risk effectively would require the buying firm to pursue inventory *ownership* in advance of demand, since doing so would protect against such opportunistic behavior; the price would have been agreed to, payments would have been

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made, and the chosen supplier would not be able to refuse shipment to the buying firm. Pursuing inventory *placement* (i.e., have inventory of the item placed within the buying firm) alone would not protect a buying firm from the risk of increasing prices and, therefore, irrespective of what the levels of other transaction attributes are, when the level of asset specificity is high, the ideal inventory *ownership* decision should be biased in favor of the buying firm in the buyer-supplier dyad.

Compared to asset specificity, the transaction attributes of uncertainty and frequency are more closely associated with the availability of an externally sourced item. Issues of uncertainty in terms of supply line availability and supplier performance all but disappear for a buying firm when the inventory of the sourced item is located within its own storage facilities. In fact, if availability is of primary concern, pursuing inventory *ownership* alone does not resolve completely the risks associated with a high level of uncertainty, as there is still a risk of delivery performance failure or item unavailability. If an item is frequently used, its availability is even more important to the buying firm and the structure to be used to handle and store inventory of the item within the buying firm would then be justified from an economies of scale perspective. Therefore, high levels of supply uncertainty and frequency should bias the inventory *placement* decision in favor of the buyer in the buyer-supplier dyad.

With this understanding, we can now decipher two additional scenarios in terms of how the three transaction attributes simultaneously affect the inventory *ownership* and *placement* decisions and, therefore, the choice of inventory management approach. In one scenario, the level of asset specificity is high while the levels of supply uncertainty and frequency are both low. These conditions essentially reflect a context that can be described as (a) a buying firm is engaged in sourcing a customized item from a chosen supplier, (b) there are high switching costs to change suppliers, (c) the chosen supplier

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can deliver in a consistent and accurate manner, (d) the constituent raw materials and components for the item are readily available, and (e) the item is used infrequently. Under these conditions, the buying firm should take ownership of the inventory of the item before demand is known (i.e., inventory *ownership* = buyer) to protect against potentially escalating pricing but leave such inventory with the supplier (i.e., inventory *placement* = supplier) to avoid the additional costs of having to physically handle the inventory. As a result, the ideal inventory management approach for this particular externally sourced item would, therefore, be *reverse inventory consignment*.

In the converse scenario, when the opposite conditions exist (i.e., a low level of asset specificity and high levels of both uncertainty and frequency), the buying firm would essentially be sourcing a common item and can easily switch to another supplier, but there are uncertainties either with the supply line for raw materials and components or with the supplier's ability to deliver accurately and consistently and the item is used frequently by the buying firm. Under these conditions, the buying firm should choose, before demand is known, to delay inventory *ownership*, leaving the ownership (and associated costs) of inventory of the item with the supplier (i.e., inventory *ownership* = supplier), but locate the inventory of the item in its own storage facilities in order to protect against unavailability and cost inefficiencies. As such, *inventory consignment* would, therefore, be the ideal inventory management approach for the externally sourced item given the levels of the three transaction attributes.

Hence:

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Proposition	IF THE LEVEL OF			THEN IDEALLY		
	Asset Specificity	Uncertainty	Frequency	Inventory Ownership	Inventory Placement	Therefore
5A	HIGH	LOW	LOW	Buyer	Supplier	Reverse inventory consignment
5B	LOW	HIGH	HIGH	Supplier	Buyer	Inventory consignment

For the last four scenarios, TCE allows us to narrow down but not definitively predict a specific and unique inventory management approach. In each of these four scenarios, while the inventory *ownership* decision can be predicted based on the level of asset specificity, the different levels of uncertainty and frequency confound the inventory *placement* choice. Therefore, within the buyer-supplier dyad, with the level of asset specificity being high and the levels of uncertainty and frequency differing, the inventory *ownership* would be biased in favor of the buying firm but whether the inventory *placement* decision favors the buying firm or the supplier would be unclear. As such, both *inventory speculation* and *reverse inventory consignment* would, therefore, be plausible options. Hence:

Proposition	IF THE LEVEL OF			THEN IDEALLY		
	Asset Specificity	Uncertainty	Frequency	Inventory Ownership	Inventory Placement	Therefore
6A	HIGH	HIGH	LOW	Buyer	Either	Inventory speculation or Reverse inventory consignment
6B	HIGH	LOW	HIGH	Buyer	Either	

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Finally, when the level of asset specificity is low but the levels of uncertainty and frequency differ, the inventory *ownership* decision would favor the supplier (i.e., supplier retains ownership of the inventory of an item) while the inventory *placement* decision would be ambiguous (i.e., locating the inventory of the item either within the buying firm or at the supplier are both equally viable). Therefore, both *inventory postponement* and *inventory consignment* are plausible options. Hence:

Proposition	IF THE LEVEL OF			THEN IDEALLY		
	Asset Specificity	Uncertainty	Frequency	Inventory Ownership	Inventory Placement	Therefore
7A	LOW	HIGH	LOW	Supplier	Either	Inventory postponement or Inventory consignment
7B	LOW	LOW	HIGH	Supplier	Either	

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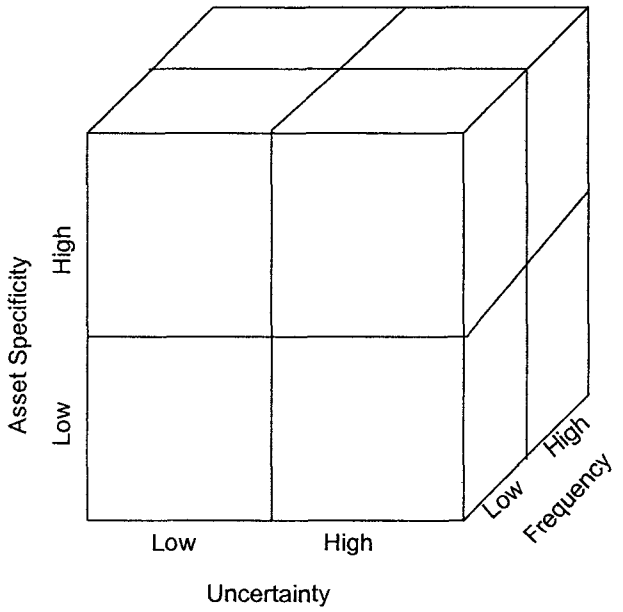
CHAPTER 4

RESEARCH METHODOLOGY

RESEARCH DESIGN

The propositions developed in Chapter 3 were tested with data collected by means of a passive role playing experiment in a 2 x 2 x 2 full factorial design resulting in eight treatment cells (see Figure 5). This permitted the examination of two levels of asset specificity, two levels of uncertainty, and two levels of frequency on the preferred inventory *ownership*, inventory *placement*, and implied overall inventory management approach choices for a particular externally sourced item. The proposed research design comes from stated preference theory, an economics-based methodology that evaluates a consumer's preference for a particular product based on price (or other conditions) and expected utility (Louviere, Hensher, & Swait, 2000).

Figure 5: Experimental design, 2 X 2 X 2 between groups factorial



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There are several reasons why researchers should consider using stated preference data rather than revealed preference information. A stated preference approach is applicable when there is a need to estimate demand for new products with new attributes or features, when there is a lack of variability of the variables in question in the marketplace, when it is too costly and time consuming to collect observational data, and in cases where the product is not traded in the real market (Louviere, et al., 2000). Furthermore, researchers have found that models estimated from stated preference data yield valid and reliable predictions of real market behavior (for examples of studies that compare stated preference and revealed preference data see Ben-Akiva & Morikawa, 1990; Hensher & Bradley, 1993; Louviere, Fox, & Moore, 1993; Adamowicz, Louviere, & Williams, 1994; Swait, Louviere, & Williams, 1994; Adamowicz, Swait, Boxall, Louviere, & Williams, 1997). Table 4 provides an overview of the differences between revealed and stated preference data.

The use of passive role-playing as a specific form of stated preference methodology is an approach to data collection that is commonly used in the marketing field (e.g. Cardozo & Cagley, 1971; Bearden & Shimp, 1982; Churchill & Suprenant, 1982; Jackson, Keith, & Burdick, 1984; Mowen, Keith, Brown, & Jackson, 1984; Puto, Wesley, & King, 1985; Pilling, Crosby, & Jackson, 1994), and is justified for situations which cannot be replicated easily in a traditional experiment (Pilling, et al., 1994).

Relative to the study at hand, the use of a stated preference methodology in the form of a passive role-playing experiment enabled the researcher to isolate the TCE-based variables in question and conduct an analysis of all possible combinations of the variables in question, an analysis that would not have been possible with a traditional survey. Furthermore, the stated preference method allowed for the examination of an

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inventory management approach that is not commonly found in practice, *reverse inventory consignment.*

Table 4: Characteristics of revealed and stated preference data

Revealed Preference Data	Stated Preference Data
• Depict the world as it is now	• Describe hypothetical or virtual decision contexts
• Possess inherent relationships between attributes	• Control relationships between attributes
• Have only existing alternatives as observables	• Can include existing, proposed or generic choice alternatives
• Embody market and personal constraints on the decision maker	• Cannot easily represent changes in market and personal constraints effectively
• Have high reliability and face validity	• Reliable when subjects understand, are committed to and can respond to tasks
• Yield one observation per respondent at each observation point	• Usually yield multiple observations per respondent at each observation point

Source: Louviere, et al., 2000, p. 24

Experimental Task

The subjects in this study were invited to participate in a passive role-playing experiment during a presentation at a local meeting of the National Association of Purchasing Managers (NAPM, also known as the Institute of Supply Management (ISM) in some locations). The presentation began with an overview of the importance of making appropriate inventory management decisions, using the 2 x 2 classification matrix presented in Chapter 2 (Figure 1) to discuss the four inventory management approaches that result when the inventory *ownership* decision is decoupled from the inventory *placement* decision for a particular externally sourced item. The meeting attendees were then invited to participate in an exercise, putting themselves in the role

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of a buyer, with two decisions to make: who should own the inventory of the item described (either the buyer or supplier), and where the inventory of that item should be placed in the buyer/supplier dyad. In addition to making these two decisions, the subjects were also asked to answer a short series of questions regarding the degree to which they perceived each transaction attribute being present in the scenario, and the extent to which each attribute was important in their decisions. The passive role playing experiment concluded with a set of questions regarding the realism of the scenario presented, the extent to which the subject was familiar with the topic, the extent to which the person took his or her role seriously, and demographic information.

The same researcher conducted all of the data collection sessions using the same script to minimize variance in the data collection process. Once the exercises were completed and returned to the researcher, the subsequent discussion was allowed to flow based on the comments and interests of the audience and the amount of time remaining in the meeting.

The full factorial design for this passive-role playing experiment study consisted of 8 different profiles ($2^3 = 8$), corresponding to the conditions outlined in Propositions 4 through 7 (see Table 5). In order to test each of these potential combinations of the three TCE-based attributes, a scenario was written to represent each profile, and each subject was randomly assigned to only one of the eight cells in the experiment. The complete research instrument, comprising all eight versions of the exercises used to collect data, is included in Appendix A. Each version of the exercise was assigned an alphabetic designation (E, F, G, H, J, K, L, and M) to enable a post exercise discussion wherein the participants were invited to compare their responses to what was predicted in the theoretical model. The first four letters of the alphabet were not used to lessen the potential artifact effect that might result should a participant anticipate that the exercises

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were labeled in the same order in which the inventory management approaches were introduced in the presentation.

Table 5: Full factorial design matrix

Treatment Cell (Proposition)	LEVEL OF		
	Asset Specificity	Uncertainty	Frequency
1 (4A)	HIGH	HIGH	HIGH
2 (4B)	LOW	LOW	LOW
3 (5A)	HIGH	LOW	LOW
4 (5B)	LOW	HIGH	HIGH
5 (6A)	HIGH	HIGH	LOW
6 (6B)	HIGH	LOW	HIGH
7 (7A)	LOW	HIGH	LOW
8 (7B)	LOW	LOW	HIGH

SUBJECTS FOR THE EXPERIMENT

Data Collection Sites

As noted above, the participants in this passive role-playing experience were attendees at a local NAPM/ISM meeting. All those present at the meeting were invited to complete the exercise as part of the presentation that was given by the researcher. These presentations were held at 12 NAPM/ISM locations, primarily in the western half of the United States, over a 7 month period of time (see Table 6). Access to the participants was a result of contact made via email with the NAPM/ISM chapter Presidents and/or Education Directors wherein the researcher offered to provide a free seminar titled "What is the "right" approach to Inventory Management" during a normally scheduled meeting. The first round of invitations was sent to NAPM/ISM Chapters in the

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western United States that hold monthly meetings in which speakers are invited to give presentations (predominately in medium to large sized cities). The choice to concentrate on this particular region was based solely on a desire to minimize travel time and expenses. A subsequent second round of invitations was sent to chapters in the eastern part of the United States.

Table 6: Data collection sessions

NAPM/ISM Location	Date	# of Participants
San Antonio, Texas	July 28, 2005	16
Oklahoma City, Oklahoma	August 9, 2005	39
Austin, Texas	September 15, 2005	19
Tulsa, Oklahoma	September 20, 2005	7
Tucson, Arizona	October 12, 2005	6
Salt Lake City, Utah	October 13, 2005	46
Spokane, Washington	October 18, 2005	31
Phoenix, Arizona	October 20, 2005	55
Colorado Springs, Colorado	October 27, 2005	28
San Diego, California	November 8, 2005	35
Knoxville, Tennessee	November 17, 2005	22
Provo, Utah	January 11, 2006	43
Total		347

Selection of Subjects

Over the course of the twelve sessions conducted, 347 people agreed to participate in the passive-role playing experiment by completing one of the exercises. However, since the purpose of this study is to determine how purchasing professionals make decisions with regard to the *ownership* and *placement* of inventory, only those participants with either a job description indicating he or she currently works in a purchasing related job (see Appendix A, Question E.1.), or an answer of greater than zero to the question of how many years of experience that person possessed in a purchasing role (see Appendix A, Question E. 2) were included as subjects in the study. Furthermore, any exercises that were missing data related to the items that measured the perceived level of transaction attributes (see Appendix A, Part A), the inventory *ownership* and inventory *placement* decisions (see Appendix A, Part B), or the

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importance of the transaction attributes (see Appendix A, Part C) were removed. Lastly, participants that indicated they did not take the exercise seriously were not included as subjects in the study (an answer of < 3 on Question D.2., Appendix A), as stated preference methodology is only reliable when subjects understand, are committed to and can respond to tasks (Louviere et al., 2000). Based on these criteria, of the 347 exercises returns, 256 were used in the analysis (see Table 7). With approximately 30 subjects per cell the researcher can reasonably assume normality in the data.

Table 7: Number of usable exercises

# of Exercises	Version of the Scenario							
	E	F	G	H	J	K	L	M
Total Returned	47	41	42	43	42	44	44	44
Total Usable	39	28	28	35	29	32	32	33

Profile of Subjects

Several questions were included in the exercise to gather demographic information about the participants (see Appendix A). Based on those self reports, the 256 experimental subjects held a variety of purchasing positions, had an average of 14 years experience in a purchasing role, were responsible for an overage of $45 million in annual spending, and came from many different industries (see Table 8).

Table 8: Profile of subjects

Job Title	# of Subjects	Years Experience in Purchasing Function			# of Subjects
Agent	18	.15	-	.9	2
Buyer	65	1	-	2.9	20
Senior Buyer	30	3	-	4.9	13
Analyst/Specialist	19	5	-	9.9	44
Subcontract Administrator	6	10	-	14.9	51
Commodity/Product/Supplier Mgr	20	15	-	19.9	49
Team Leader/Supervisor	6	20	or	more	71
Materials/Purchasing/Sourcing Mgr	55				
Director	13				
VP/CPO	3				
Other	13				

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Table 8: Profile of subjects (cont'd)

Annual Purchasing Responsibility Dollars			# of Subjects
0	-	499,999	8
500,000	-	999,999	9
1,000,000	-	1,499,999	14
1,500,000	-	2,499,999	14
2,500,000	-	4,999,999	19
5,000,000	-	9,999,999	23
10,000,000	-	14,999,999	26
15,000,000	-	24,999,999	25
25,000,000	-	49,999,999	19
50,000,000	-	99,999,999	18
100,000,000	-	249,999,999	14
250,000,000	or	more	11
Average = 45,093,535			

Industries Represented	# of Subjects
Aerospace/Aviation/Defense	20
Automotive	4
Bio-Med/Pharmaceutical	18
Chemical/Oil/Gas	8
Construction	5
Contract Manufacturing	14
Education	4
Electronics/Semiconductor	17
Financial Services	9
Food and Nutrition	12
Government	18
Health Care	9
Manufacturing (other)	58
Mining	2
Non-profit	4
Software Development	3
Services (other)	13
Telecommunications	4
Tooling/Mfg Supplies	5
Transportation/Distribution	5
Utilities	13

OPERATIONALIZATION OF VARIABLES

Independent Variables

The independent variables of asset specificity, uncertainty, and frequency were operationalized through the use of written scenarios or vignettes. Each variable was

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presented in a scenario at one of two levels, either high or low, resulting in the eight treatment cells presented in Table 5. The decision to test each variable at only two levels is consistent with the nature of the propositions and served to limit the number of profiles that must be created for testing.

The purpose of the scenarios is to put the subject into to the role of a buyer making inventory *ownership* and *placement* decisions for a particular externally sourced item in a specific context. By using this approach, the researcher was able to isolate the effects of the TCE-based transaction attributes in a way that would not be possible in a non-experimental setting.

Asset Specificity

In accordance with the theoretical model developed in Chapter 3, asset specificity was represented in a way that distinguishes the degree of customization in the externally sourced item and the difficulty and cost the buying firm faces should it desire to change suppliers. A low level of asset specificity was presented as a purchased item that is a commodity, readily available from many different supplying firms. Alternatively, a high level of asset specificity was indicated by describing an externally sourced item that has been customized for the buying firm and therefore could not be purchased from a different supplying firm without considerable effort and cost on the part of the buying firm. This operationalization is consistent with a TCE-based passive role-playing study conducted by Pilling et al. (1994). A three item measurement scale was created to represent the asset specificity construct (see Table 9)

Uncertainty

The level of uncertainty was communicated to the subjects in terms of the availability of supply and the past performance of the supplying firm. Past shortages in supply and issues with the supplying firm's performance, operationalized as component

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availability issues, quality defects, inability to deliver within the required lead-time, and a poor on-time-delivery record, represented a high level of uncertainty. Conversely, readily available components, a low defect rate, the ability to deliver within the buying firm's required lead-time, and a favorable history of on-time-delivery performance represent a low level of uncertainty. The four items related to the uncertainty construct can be found in Table 9.

Frequency

Lastly, the level of frequency was described as either occasional or high in the scenarios. Operationalizing this variable as occasional, rather than low, is consistent with Williamson (1985, p. 79) and Pilling, et al. (1994). If the occurrence of the activity is perceived to be extremely infrequent no governance decision is needed at all, and the choice among inventory management approaches is moot. For that reason, a high level of frequency was represented by an on-going, recurrent use of the item, and a low level of frequency was be represented by an occasional use of the item. The three item measurement scale related to frequency is found in Table 9.

Contextual Variables

In addition to the three transaction attributes, the context of the scenarios includes several variables which were included based on interviews with purchasing professionals. In these interviews the practitioners were asked to describe what is important to them in making inventory ownership and placement decisions. Based on the data collected in these interviews, information regarding the size of the firm, the cost of the item, the impact of not having the externally sourced item available, and the current status of the supplier relationship were also included in the scenarios. This information did not vary throughout the different scenarios.

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Table 9: Transaction attribute measurement items

Transaction Attribute	Measurement Item
Asset Specificity	Q1a. How unique is the design of the motor supplied by XYZ for your firm's conveyor system? Q1b. How difficult would it be for you to switch motor suppliers? Q1c. How costly would it be for you to switch motor suppliers?
Uncertainty[a]	Q2a. How would your rate XYZ's level of quality compared to other suppliers in the industry? Q2b. How confident are you that XYZ will be able to delivery motor to you on-time? Q2c. How confident are you that XYZ will be able to obtain part X? Q2d. What is the likelihood that XYZ will be able to deliver motors within the time between a warning signal and when the motor is needed?
Frequency	Q3a. How would you rate the volume of motors purchased for the conveyor system compared to other purchased items? Q3b. How would you rate the replacement frequency of motors used in the conveyor system compared to other motors used in your factories? Q3c. How easy would it be for you to forecast the annual used of motors?

[a] Responses were reverse coded for purposes of the data analysis

Dependent variables

The dependent variables in this study are discrete, namely the choice of inventory *ownership* (owned by either the buying or supplying firm) and the choice of inventory *placement* (at either the buying or supplying firm's physical location), which together imply an overall choice of inventory management approach: *inventory speculation*, *inventory postponement*, *inventory consignment*, or *reverse inventory consignment* (see classification matrix in Figure 1). Therefore, the questions in Part B of the exercise (see Appendix A) ask the subject to choose either buyer or supplier *ownership* for the inventory of the externally sourced item in question; and to make a choice with regard to the *placement* of that item, either at the buyer or supplier's physical location. While the subjects were also asked for an overall choice of inventory

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management approach, for purposes of the data analysis the overall choice of inventory management approach was implied based on the subject's responses to the questions of who should own the inventory and where that inventory should be placed. This assured alignment between the inventory *ownership*, inventory *placement*, and overall inventory management approach decisions.

Pilot Tests

Several pilot tests were conducted prior to initiating the formal data collection process to ensure the levels of each independent variable were adequately communicated to, and discerned by the subjects in the scenarios presented. Following the interviews with purchasing professionals to establish the appropriate context for the scenario, a limited pre-test was conducted with fellow PhD students upon which several changes were made to both the statements in the scenarios and the perception based items.

A second pre-test was held with a group of 81 students at the Instituto de Empresa in Spain. That pre-test included the use of two dichotomous scenarios, a scenario representing high levels of each of the TCE attributes and a scenario representing low levels of each of the attributes (Treatment cells 1 and 2 using an earlier version of the exercises labeled E and F in Appendix A). Once again, several changes were made with respect to both the cues and the related perception based items. Additional minor changes were made to the data collection instrument based on feedback received during the dissertation proposal defense and from Arizona State University's Human Subjects Institutional Review Board.

Finally, a preliminary manipulation check was conducted after the first two data collection sessions were held (see Table 6, 55 responses from San Antonio, Texas and Oklahoma City, Oklahoma). The purpose of manipulation testing was to determine

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whether the subjects perceived the intended level, either high or low, of the independent variables. This was accomplished by comparing the responses to the items that measure the perceived level of the TCE attribute (see Table 9) using univariate analysis of variance. For example, the subjects who were assigned to a scenario with a high level of asset specificity (i.e., treatment cells 1, 3, 5, 6) should have perceived a higher level on the items related to that attribute than subjects who were exposed to scenarios intended to communicate a low level of asset specificity (treatment cells 2, 4, 7, 8), with a statistically significant difference between the mean responses. At that point in time all but one of the TCE-based items (see Table 9) exhibited an *F* test statistic with a *p* value <.001, and the remaining item had a *p* value of .029. Based on that result, the data collection continued with no further changes to the passive role-playing experimental instrument.

Validation of Experimental Manipulations

Once the data collection was completed the manipulation check was repeated with all the usable responses. The results of this analysis were consistent with the initial manipulation check conducted with the exercises obtained in the first two data collection sessions. See Table 10 for the details of these ANOVA tests.

Based on the results of the ANOVA tests (presented in Table 10), the manipulations presented in the scenarios were successful. The subjects did in fact perceive a difference in the items related to each transaction attribute as intended, and that difference was statistically significant at the .001 level for all but one of the frequency items. The third frequency item had a *p* value of .053.

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Table 10: Results of manipulation check for attribute perception items

Asset Specificity Items	High (N = 135)		Low (N = 121)		F (1, 254)	p	Adj R^2
	μ	σ	μ	Σ			
Uniqueness of design	4.38	.818	1.80	.691	731.828	<.001	.741
Ability to switch suppliers	4.18	.809	2.02	.979	370.705	<.001	.592
Cost of switching suppliers	4.21	1.018	2.00	.966	317.038	<.001	.553
Uncertainty Items	**High (N = 128)**		**Low (N = 128)**		**F (1, 254)**	**p**	**Adj R^2**
	μ	σ	μ	Σ			
Level of quality	3.95	.719	1.44	.572	959.477	<.001	.790
Ability to delivery as committed	3.77	.776	1.44	.514	809.903	<.001	.760
Ability to obtain component	3.56	.858	1.52	.575	499.069	<.001	.661
Ability to deliver w/in warning signal lead-time	4.11	.825	1.52	.546	873.846	<.001	.774
Frequency Items	**High (N = 132)**		**Low (N = 124)**		**F (1, 254)**	**p**	**Adj R^2**
	μ	σ	μ	Σ			
Relative volume	3.73	.925	2.00	.765	263.066	<.001	.507
Relative replacement frequency	3.86	.898	2.31	.828	207.369	<.001	.447
Ability to forecast future usage	4.01	.726	3.81	.859	3.790	.053	.011

Factor Analysis

Factor analysis of the perception items was conducted to determine whether the items represented multiple constructs. More specifically, an exploratory factor analysis approach was deemed appropriate as these items constitute a new scale in the application of TCE to this unique context.

An initial principle components analysis revealed 3 components with eigenvalues >1, a preliminary indication of a three factor structure (Tabachnick & Fidell, 2001; Green & Salkind, 2003). Subsequent factor analysis was then conducted using a maximum likelihood method and a Varimax rotation to extract three factors, resulting in the factor loadings presented in Table 11.

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Table 11: Exploratory factor analysis, all items

Item	Factor		
	1	2	3
Uniqueness of design	.845		
Ability to switch suppliers	.956		
Cost of switching suppliers	.876		
Level of quality		.927	
Ability to deliver as committed		.972	
Ability to obtain components		.894	
Ability to deliver w/in warning signal lead-time		.920	
Relative volume			.999
Relative replacement frequency			.687
Ability to forecast future usage	-.204		

Loadings <.20 suppressed for ease of interpretation
Extraction Method: Maximum Likelihood
Rotation: Varimax with Kaiser Normalization

All items loaded well on the expected factor except the third item related to frequency. Since, as a rule of thumb, only loadings with .32 or greater should be interpreted (Tabachnick & Fidell, 2001), this item was removed and the factor analysis was then repeated, once again based on maximum likelihood extraction and a Varimax rotation. The revised factor loadings can be found in Table 12.

Table 12: Revised exploratory factor analysis

Item	Factor		
	1	2	3
Uniqueness of design	.846		
Ability to switch suppliers	.954		
Cost of switching suppliers	.877		
Level of quality		.928	
Ability to deliver as committed		.973	
Ability to obtain components		.895	
Ability to deliver w/in warning signal lead-time		.920	
Relative volume			.999
Relative replacement frequency			.687

Loadings <.20 suppressed for ease of interpretation
Extraction Method: Maximum Likelihood
Rotation: Varimax with Kaiser Normalization

To ensure that the use of orthogonal factors was appropriate, an additional factor analysis was conducted on the nine remaining items using Direct Oblimin, an oblique

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rotation. The resulting factor correlation matrix (see Table 13) with no factor to factor correlation >.32 supports the use of orthogonal factors (Tabachnick & Fidell, 2001).

Table 13: Factor correlation matrix

	Factor	1	2	3
Asset Specificity	1	1.000	.029	.036
Uncertainty	2	.029	1.000	-.046
Frequency	3	.036	-.046	1.000

Extraction Method: Maximum Likelihood
Rotation: Direct Oblimin

Convergent and Discriminant Validity

The reliability of the factor structure was evaluated by first analyzing each item's correlation with its own scale, with the item-to-total correlations presented in Table 14. All items exhibit strong correlations to their own scales, with coefficient alphas of .81 or greater, indicating convergent validity for the three factor structure (Green & Salkind, 2003).

Table 14: Analysis of convergent validity

Items	Item-to-Total Correlations		
	Asset Specificity	Uncertainty	Frequency
Uniqueness of design	.807		
Ability to switch suppliers	.881		
Cost of switching suppliers	.828		
Level of quality		.905	
Ability to deliver as committed		.943	
Ability to obtain components		.871	
Ability to deliver w/in warning signal lead-time		.902	
Relative volume			.687
Relative replacement frequency			.687
Alpha	.92	.96	.81

A second correlation analysis was then conducted to evaluate the discriminant validity of the three factor structure by correlating each item with the other scales. None of the correlations between an item and another scale (see Table 15) were larger than

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the correlation between an item and its own scale (see Table 14), indicating disciminant validity for the factors (Green & Salkind, 2003).

Table 15: Analysis of discriminant validity

Items	Correlations to other Scales		
	Asset Specificity	Uncertainty	Frequency
Uniqueness of design		-.021	.012
Ability to switch suppliers		-.041	-.001
Cost of switching suppliers		-.058	.068
Level of quality	-.044		.046
Ability to deliver as committed	-.021		.012
Ability to obtain components	-.083		.032
Ability to deliver w/in warning signal lead-time	-.019		.024
Relative volume	.022	.038	
Relative replacement frequency	.031	.017	

REALISM OF THE EXPERIMENT

A stated preference methodology is only reliable when subjects understand, are committed to and can respond to tasks (Louviere et al. 2000). Therefore, a scale was included in the research instrument to evaluate the perceived realism of the scenarios presented and the commitment of the subjects participating in the exercise. The items used in the realism scale were taken from a similar passive role-playing experiment conducted by Pilling (1988).

The inclusion of this scale provided for two types of analysis related to the realism of the experiment. First, the scale means were computed and tested (see Table 16), finding that, on a 5 point scale with 1 as strongly disagree and 5 as strongly agree, the subjects viewed the scenarios as realistic ($\mu = 4.06$), took their roles seriously ($\mu = 4.51$), do encounter the issues discussed ($\mu = 3.35$), and are aware of the issues raised in the study ($\mu = 3.95$). These results validate the realism of the purchasing situation

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described, the ability of the subjects to address the questions presented, and confirm a commitment to the task.

Table 16: Realism scale item means

Items	Mean	S.D.	*t*	*p*
D1. The purchasing situation described in the study was realistic	4.06	.82	79.27	<.001
D2. I took my role seriously	4.51	.61	118.55	<.001
D3. In my work, I seldom encounter the issues discussed in this study[a]	3.35	1.40	38.21	<.001
D4. I am highly aware of the issues raised in this study	3.95	1.03	51.44	<.001

[a] Responses reverse coded for purposes of analysis

As a second test related to the realism of the experimental scenarios, the average value on the realism scale was analyzed in an ANOVA model with the designed levels of asset specificity, uncertainty, and frequency as independent variables to determine whether the treatment design had an impact on the perceived realism of the experiment. The results of this analysis can be found in Table 17. The overall explanatory power of this model was poor ($F = 1.338$, $p = .233$) suggesting that the experimental treatments did not have a significant impact on the perceived level of realism (though uncertainty was significant in the model, $F = 4.428$, $p = .036$). This analysis indicates that the realism of the experiments was no different across all treatment cells.

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Table 17: Realism scale ANOVA results

Treatment Cell	Level of Asset Specificity	Level of Uncertainty	Level of Frequency	Realism Scale Mean
1	High	High	High	3.99
2	Low	Low	Low	3.80
3	High	Low	Low	3.89
4	Low	High	High	4.15
5	High	High	Low	4.19
6	High	Low	High	3.98
7	Low	High	Low	3.90
8	Low	Low	High	3.88

Main Effects	F	df	p
Asset Specificity	1.079	1	.300
Uncertainty	4.428	1	.036
Frequency	.448	1	.504

Interactions	F	df	p
Asset Specificity * Uncertainty	.057	1	.812
Asset Specificity * Frequency	1.856	1	.174
Uncertainty * Frequency	.149	1	.700
Asset Specificity * Uncertainty * Frequency	.2.071	1	.151
Overall Model	1.338	7	.233

Dependent Variable: Average score on realism scale

STATISTICAL ANALYSES

This section outlines the testable hypotheses and statistical analysis tools that were employed to test the propositions developed in Chapter 3. SPSS 13 was used to perform all the statistical analysis related to this research. Please note that all hypotheses are written in the alternative, rather than null form.

Propositions 1 through 3

The first three propositions state that a high level of the transaction attribute (i.e., asset specificity, uncertainty and frequency) should lead a buyer to choose the buyer for both the inventory *ownership* and the inventory *placement* of a particular externally sourced item; with a low level of the transaction attribute leading a buyer to the opposite choices, namely the supplier for inventory *ownership* and inventory *placement.*

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Proposition	IF THE LEVEL OF			THEN IDEALLY		
	Asset Specificity	Uncertainty	Frequency	Inventory Ownership	Inventory Placement	Therefore
1A	HIGH			Buyer	Buyer	Inventory speculation
1B	LOW			Supplier	Supplier	Inventory postponement
2A		HIGH		Buyer	Buyer	Inventory speculation
2B		LOW		Supplier	Supplier	Inventory postponement
3A			HIGH	Buyer	Buyer	Inventory speculation
3B			LOW	Supplier	Supplier	Inventory postponement

These propositions were tested in two ways: via a contingency table analysis and through the use of binary logistic regression analysis.

Contingency table analyses

A two-way contingency table analysis was conducted to determine if a statistical relationship existed between each transaction attribute at either a high or low level and each possible choice related to the dependent variables (*inventory ownership* or *inventory placement*). In order to conduct the analysis, the factor scores for each transaction attribute were coded as either high (code = 1) or low (code = 0) based on the relationship to the standardized mean of 0. The results of the 2x2 contingency table analyses include a χ^2 test to indicate whether a statistically significant relationship exists between the two levels of the transaction attribute in question and the two levels of the dependent variable in question. The testable hypotheses related to Propositions 1 through 3 and the contingency table analyses are as follows:

$H_1 1$: A significant relationship exists between asset specificity and inventory ownership

$H_1 2$: A significant relationship exists between asset specificity and inventory placement

$H_2 1$: A significant relationship exists between uncertainty and inventory ownership

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$H_2$2: A significant relationship exists between uncertainty and inventory placement

$H_3$1: A significant relationship exists between frequency and inventory ownership

$H_3$2: A significant relationship exists between frequency and inventory placement

Binary logistic regression

As a second direct effects test, the probability that a buyer would chose either the buyer or the supplier for inventory *ownership* and inventory *placement* was evaluated in two binary logistic regression equations, one for each choice. Logistics regression is a categorical data analysis technique in which a nonlinear relationship between binary or continuous independent variables and a binary dependent variable can be tested (Agresti, 1996). The dependent variable in the model is the *inventory ownership* or *inventory placement* choice (either the buyer or the supplier) and the independent variable is the factor scores for the perceived level of the transaction attributes (asset specificitiy, uncertainty, or frequency) In a functional form, the equation for these models is:

$$Y_i = f(x), \text{ where } x \in (\text{Asset Specificity, Uncertainty, Frequency}); \quad (1)$$

where Y_i =

Ownership Decision	Y_i	Placement Decision	Y_i
Buyer	*1*	*Buyer*	*1*
Supplier	*2*	*Supplier*	*2*

And the testable hypotheses related to each proposition can be articulated as follows:

$H_1$3: A significant, positive relationship exists between asset specificity and choosing the buyer for inventory ownership and a significant, negative relationship exists between asset specificity and choosing the supplier for inventory ownership

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H_14: *A significant, positive relationship exists between asset specificity and choosing the buyer for inventory placement and a significant, negative relationship exists between asset specificity and choosing the supplier for inventory placement*

H_23: *A significant, positive relationship exists between uncertainty and choosing the buyer for inventory ownership and a significant, negative relationship exists between uncertainty and choosing the supplier for inventory ownership*

H_24: *A significant, positive relationship exists between uncertainty and choosing the buyer for inventory placement and a significant, negative relationship exists between uncertainty and choosing the supplier for inventory placement*

H_33: *A significant, positive relationship exists between frequency and choosing the buyer for inventory ownership and a significant, negative relationship exists between frequency and choosing the supplier for inventory ownership*

H_34: *A significant, positive relationship exists between frequency and choosing the buyer for inventory placement and a significant, negative relationship exists between frequency and choosing the supplier for inventory placement*

Propositions 4 through 7

The other four propositions developed in Chapter 3 address the combined effects of the three transaction attributes on a buyer's choice of inventory *ownership*, inventory *placement*, and the resulting overall inventory management approach. Three statistical techniques were used to evaluate the hypotheses relating to Propositions 4 through 7: non-parametric chi-square tests, binary logistic regression, and multicategory logistic regression.

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Proposition	IF THE LEVEL OF			THEN IDEALLY		
	Asset Specificity	Uncertainty	Frequency	Inventory Ownership	Inventory Placement	Therefore
4A	HIGH	HIGH	HIGH	Buyer	Buyer	Inventory speculation
4B	LOW	LOW	LOW	Supplier	Supplier	Inventory postponement
5A	HIGH	LOW	LOW	Buyer	Supplier	Reverse inventory consignment
5B	LOW	HIGH	HIGH	Supplier	Buyer	Inventory consignment
6A	HIGH	HIGH	LOW	Buyer	Either	Inventory speculation or Reverse inventory consignment
6B	HIGH	LOW	HIGH	Buyer	Either	
7A	LOW	HIGH	LOW	Supplier	Either	Inventory postponement or Inventory consignment
7B	LOW	LOW	HIGH	Supplier	Either	

Non-parametric chi-square tests

One sample non-parametric chi-square tests were used to assess whether the purchasing situations communicated in the scenarios, each of which represents a unique combination of the two levels of the three transaction attributes, led buyers to make the predicted inventory *ownership*, inventory *placement* and resulting inventory management approach decisions. For example, a scenario was written to coincide with the combined effects set out in Proposition 4A (treatment cell #1 in Table 5, Version E in Appendix A), representing the conditions of a high level of asset specificity, a high level of uncertainty, and a high level of frequency, with the expectation that the levels of the independent variables would have an effect on the inventory management decisions in question (i.e., the dependent variables). The null hypotheses for each treatment condition is that there is an equal likelihood of choosing either the buyer or the supplier for inventory

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ownership, either the buyer or the supplier for inventory *placement*, and any one of the four resulting overall inventory management approaches. A significant chi-square result is an indication that the expectation of equal frequencies is not met, and in those cases the researcher rejected the null hypothesis and accepted the alternative hypothesis (as given below) when the majority of subjects make the predicted decision. The testable hypotheses related to Propositions 4 through 7 (treatment cells 1 through 8 in Table 5) and this analysis are as follows:

$H_{4A}1$: *When the level of asset specificity is HIGH, the level of uncertainty is HIGH, and the level of frequency is HIGH, the majority of subjects will likely choose the buyer for inventory ownership*

$H_{4A}2$: *When the level of asset specificity is HIGH, the level of uncertainty is HIGH, and the level of frequency is HIGH, the majority of subjects will likely choose the buyer for inventory placement*

$H_{4A}3$: *When the level of asset specificity is HIGH, the level of uncertainty is HIGH, and the level of frequency is HIGH, the majority of subjects will likely choose inventory speculation*

$H_{4B}1$: *When the level of asset specificity is LOW, the level of uncertainty is LOW, and the level of frequency is LOW, the majority of subjects will likely choose the supplier for inventory ownership*

$H_{4B}2$: *When the level of asset specificity is LOW, the level of uncertainty is LOW, and the level of frequency is LOW, the majority of subjects will likely choose the supplier for inventory placement*

$H_{4B}3$: *When the level of asset specificity is LOW, the level of uncertainty is LOW, and the level of frequency is LOW, the majority of subjects will likely choose inventory postponement*

$H_{5A}1$: *When the level of asset specificity is HIGH, the level of uncertainty is LOW, and the level of frequency is LOW, the majority of subjects will likely choose the buyer for inventory ownership*

$H_{5A}2$: *When the level of asset specificity is HIGH, the level of uncertainty is LOW, and the level of frequency is LOW, the majority of subjects will likely choose the supplier for inventory placement*

$H_{5A}3$: *When the level of asset specificity is HIGH, the level of uncertainty is LOW, and the level of frequency is LOW, the majority of subjects will likely choose reverse inventory consignment*

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$H_{5B}1$: *When the level of asset specificity is LOW, the level of uncertainty is HIGH, and the level of frequency is HIGH, the majority of subjects will likely choose the supplier for inventory ownership*

$H_{5B}2$: *When the level of asset specificity is LOW, the level of uncertainty is HIGH, and the level of frequency is HIGH, the majority of subjects will likely choose the buyer for inventory placement*

$H_{5B}3$: *When the level of asset specificity is LOW, the level of uncertainty is HIGH, and the level of frequency is HIGH, the majority of subjects will likely choose inventory consignment*

$H_{6A}1$: *When the level of asset specificity is HIGH, the level of uncertainty is HIGH, and the level of frequency is LOW, the majority of subjects will likely choose the buyer for inventory ownership*

$H_{6A}2$: *When the level of asset specificity is HIGH, the level of uncertainty is HIGH, and the level of frequency is LOW, the subjects will likely chose the buyer and the supplier with equal frequencies for inventory placement*

$H_{6A}3$: *When the level of asset specificity is HIGH, the level of uncertainty is HIGH, and the level of frequency is LOW, the majority of subjects will likely choose either inventory speculation or reverse inventory consignment*

$H_{6B}1$: *When the level of asset specificity is HIGH, the level of uncertainty is LOW, and the level of frequency is HIGH, the majority of subjects will likely choose the buyer for inventory ownership*

$H_{6B}2$: *When the level of asset specificity is HIGH, the level of uncertainty is LOW, and the level of frequency is HIGH, the subjects will likely chose the buyer and the supplier with equal frequencies for inventory placement*

$H_{6B}3$: *When the level of asset specificity is HIGH, the level of uncertainty is LOW, and the level of frequency is HIGH, the majority of subjects will likely choose either inventory speculation or reverse inventory consignment*

$H_{7A}1$: *When the level of asset specificity is LOW, the level of uncertainty is HIGH, and the level of frequency is LOW, the majority of subjects will likely choose the supplier for inventory ownership*

$H_{7A}2$: *When the level of asset specificity is LOW, the level of uncertainty is HIGH, and the level of frequency is LOW, the subjects will likely chose the buyer and the supplier with equal frequencies for inventory placement*

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$H_{7A}3$: *When the level of asset specificity is LOW, the level of uncertainty is HIGH, and the level of frequency is LOW, the majority of subjects will likely choose either inventory postponement or inventory consignment*

$H_{7B}1$: *When the level of asset specificity is LOW, the level of uncertainty is LOW, and the level of frequency is HIGH, the majority of subjects will likely choose the supplier for inventory ownership*

$H_{7B}2$: *When the level of asset specificity is LOW, the level of uncertainty is LOW, and the level of frequency is HIGH, the subjects will likely chose the buyer and the supplier with equal frequencies for inventory placement*

$H_{7B}3$: *When the level of asset specificity is LOW, the level of uncertainty is LOW, and the level of frequency is HIGH, the majority of subjects will likely choose either inventory postponement or inventory consignment*

Binary Logistic Regression

Non-parametric chi-square testing directly addresses the TCE-based propositions for combined effects of the three transaction based attributes (Propositions 4 through 7). Through the use of this statistical tool the researcher was able to determine whether a buyer faced with a particular combination of the transaction attributes (one of eight treatment cells) would behave as expected with regard to the choice of inventory *ownership* and inventory *placement*, and thus the overall implied inventory approach.

However, another way to look at the combined effects of the transaction attributes is to examine what role these independent variables played from the perspective of the stated choice of inventory management approach. In other words, regardless of what treatment cell the subject was assigned to, what characterized the implied choice of a particular inventory management approach? This alternative approach to testing the propositions was accomplished by simultaneously examining the relationships between each of the transaction attributes (independent variables) and the

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choice of one particular implied inventory management approach. For example, by comparing all cases in which a buyer made inventory *ownership* and *placement* decisions that implied *inventory speculation* as the preferred inventory management approach (i.e., the buyer for inventory *ownership* and the buyer for inventory *placement*), regardless of the scenario that buyer was presented with, the logistic regression model indicates whether the levels of asset specificity, uncertainty, and frequency were significantly related to that choice and in the direction expected. The functional form of the model is:

$$Y_i = f(\text{Asset Specificity, Uncertainty, Frequency}); \quad (2)$$

where Y_i =

Implied Inventory Management Approach	Y_i
Approach(es) in question	*1*
All Other Approaches	*0*

The following hypotheses were tested with these binary logistic regression models:

$H_{4A}4$: *A significant, positive relationship exists between inventory speculation and the levels of asset specificity, uncertainty, and frequency*

$H_{4B}4$: *A significant, negative relationship exists between inventory postponement and the levels of asset specificity, uncertainty, and frequency*

$H_{5A}4$: *A significant, positive relationship exists between reverse inventory consignment and the level of asset specificity, and a significant, negative relationship exists between reverse inventory consignment and the levels of uncertainty and frequency*

$H_{5B}4$: *A significant, negative relationship exists between inventory consignment and the level of asset specificity, and a significant, positive relationship exists between reverse inventory consignment and the levels of uncertainty and frequency*

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H_64: *A significant, positive relationship exists between inventory speculation or reverse inventory consignment and the level of asset specificity, and no significant relationship exists between inventory speculation or reverse inventory consignment and the levels of uncertainty and frequency*

H_74: *A significant, negative relationship exists between inventory postponement or inventory consignment and the level of asset specificity, and no significant relationship exists between inventory postponement or inventory consignment and the levels of uncertainty and frequency*

Multicategory logistic regression

The binary logistic regression models analyzed the combined effects of the transaction attributes in terms of choosing one inventory management approach as opposed to all others. A multicategory logistic regression model was then used to evaluate the impact of each transaction attribute on the probability of choosing one inventory management approach compared individually to each of the other approaches available, thus adding an additional layer of depth to the data analysis (beta weights from the binary logistic regression models cannot be directly compared to one another because each is based on a different covariance matrix). Rather than categorizing one inventory management approach as 1 and all others as 0 as with the binary logistic regression approach, a multicategory logistic regression model simultaneously refers to all possible pairs of categories and describes the odds of response in one category instead of another (Agresti, 1996). As such, multicategory logistic regression allows for the evaluation of what drives a buyer to choose *inventory speculation* over *inventory postponement*, *inventory speculation* over *inventory consignment*, or *inventory speculation* over *reverse inventory consignment* (as well as all other comparisons) in terms of the independent variables. The functional form of this model is as follows:

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Y_i = *f(Asset Specificity, Uncertainty, Frequency)*; (3)

where Y_i =

Approach Chosen	Y_i
Speculation	*1*
Postponement	*2*
Consignment	*3*
Reverse Consignment	*4*

The testable hypotheses related to this model are derived from the expected relationships of the transaction attributes with respect to the four inventory management approaches (based on Propositions 4 and 5; Propositions 6 and 7 are not included in this analysis because they involve comparisons between more than one inventory management approach). For example, looking at Propositions 4A and 4B, one would expect the probability of a making an *inventory speculation* choice to increase relative to making an *inventory postponement* choice as the levels of all three of the transaction attributes increase (at a statistically significant level), because *inventory speculation* is the predicted choice when the levels of the transaction attributes are high, and *inventory postponement* is the predicted choice when the levels of the transaction attributes are low. On the other hand, when two inventory management approaches have the same expected level of a particular transaction attribute, as in the case of a high level of uncertainty related to both *inventory speculation* and *inventory consignment*, the expected relationship between those two inventory management approaches with respect to that transaction attribute is expected to be non-significant. In the hypotheses listed below the predicted beta sign is written from the perspective of the first approach listed, using the second inventory management approach mentioned as the reference category (meaning the first approach listed is preferred to the second (reference

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category) approach when the beta has the sign indicated for the specified transaction attribute):

H_{4A_4B}: *Inventory speculation is preferred to inventory postponement when there is a significant, positive relationship between the levels of asset specificity, uncertainty, and frequency*

H_{4A_5A}: *Inventory speculation is preferred to reverse inventory consignment when there is no significant relationship between the levels of asset specificity and a significant, positive relationship between the levels of uncertainty and frequency*

H_{4A_5B}: *Inventory speculation is preferred to inventory consignment when there is a significant, positive relationship between the levels of asset specificity and no significant relationship between the levels of uncertainty and frequency*

H_{4B_5A}: *Inventory postponement is preferred to reverse inventory consignment when there is a significant, negative relationship between the levels of asset specificity and no significant relationship between the levels of uncertainty and frequency*

H_{4B_5B}: *Inventory postponement is preferred to inventory consignment when there is no significant relationship between the levels of asset specificity and a significant, negative relationship between the levels of uncertainty and frequency*

H_{5B_5A}: *Inventory consignment is preferred to reverse inventory consignment when there is a significant, negative relationship between the levels of asset specificity and significant, positive relationships between the levels of uncertainty and frequency*

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CHAPTER 5

RESULTS

This chapter contains the results of the statistical procedures outlined in Chapter 4. In addition, the potential impact of the subject demographic information collected in the exercise is also analyzed.

RESULTS OF SUBJECT DEMOGRAPHICS ANALYSIS

The subjects in this passive role-playing experiment were asked to provide information regarding their job titles, number of years of purchasing experience, the approximate annual purchasing dollars for which they have responsibility, and the industry worked in. In order to determine whether the demographic profile, rather than the independent variables, drove the decisions related to the dependent variables, three logistic regression models were run. The first two models tested the relationship between the demographic profile items and the inventory *ownership* and inventory *placement* decisions using binary logistic regression. The third model, a multicategorical logistic regression, tested the relationship between these variables and the overall inventory management approach choice.

Both the number of years of experience and purchasing dollars were treated as continuous variables in the models, whereas job title and industry were treated as categorical variables. Regarding the categorical items, unexpected singularities in the Hessian matrix indicated that the number of categories reported in Table 8 should be reduced. Therefore, job titles were collapsed into three categories: individual contributor (e.g. agent, buyer, specialist), a supervisor/manager, or other; and the number of industry categories was also collapsed, in this case into two categories based on the product type, either a discrete product or a service. The results of these regression models are presented in Table 18, with all statistical results presented at the model level.

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Table 18: Logistic regression analysis of demographic items

Independent Variable	Dependent Variable	χ^2	*df*	*p*
Years Experience	Inventory Ownership	2.382	1	.123
Years Experience	Inventory Placement	1.163	1	.281
Years Experience	Inventory Management Approach	4.798	3	.187
Purchasing Dollars	Inventory Ownership	.525	1	.469
Purchasing Dollars	Inventory Placement	1.121	1	.290
Purchasing Dollars	Inventory Management Approach	3.545	3	.315
Job Title	Inventory Ownership	.817	2	.665
Job Title	Inventory Placement	3.765	2	.152
Job Title	Inventory Management Approach	3.992	6	.678
Industry	Inventory Ownership	.122	1	.727
Industry	Inventory Placement	.235	1	.628
Industry	Inventory Management Approach	4.303	3	.231

This analysis indicates that the subjects' demographic profile did not significantly impact the inventory management decisions (i.e., dependent variables) under study in this research as none of the relationships had a significant *p* value.

RESULTS OF DIRECT EFFECTS ANALYSIS

The purpose of the direct effects analysis is to determine whether each transaction attribute, irrespective of other TCE attributes, impacted the decisions related to inventory *ownership* and inventory *placement*. This analysis was conducted by means of both contingency tables and a binary logistics regression model.

Contingency Table Analysis

Hypotheses $H_1 1$ and $H_1 2$

The contingency table analysis and testable hypotheses related to Proposition 1 evaluate whether or not the level of asset specificity has a direct effect on the inventory *ownership* and inventory *placement* decisions a buyer makes. Based on TCE, a high level of asset specificity is expected to drive a firm to internalize the *ownership* and

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placement of inventory of a particular externally sourced item. Conversely, a low level of asset specificity should lead to a supplier choice for the inventory *ownership* and *placement* decisions.

Hypothesis $H_1 1$, which tests for a significant relationship between asset specificity and inventory ownership, was supported in this analysis with a *p* value of .022 related to the χ^2 test (see Table 19). From the contingency table counts it is clear that the significant χ^2 results from the difference in the number of subjects whose chose the buyer for inventory *ownership* depended on the level of asset specificity. When the level of asset specificity was low, 25 out of 118 buyers chose the buyer for inventory *ownership*, whereas, when asset specificity was high 47 out of 138 buyers chose the buyer for inventory *ownership*. The choice of the supplier for inventory *ownership* does not appear to be similarly impacted by the level of asset specificity.

Table 19: Contingency table analysis of asset specificity and inventory ownership

		Inventory Ownership		
		1	*2*	*Total*
Level of Asset Specificity	0	25	93	118
	1	47	91	138
	Total	72	184	256
χ^2=5.213, *df*=1, *p*=.022				

Key: Inventory Ownership: 1 = Buyer; 2 = Supplier
Level of Asset Specificity: 0 = Low; 1 = High

However, the relationship between the level of asset specificity and the inventory *placement* choice, $H_1 2$, was not supported in the contingency table analysis (see Table 20). Not only is the *p* value non-significant, but the cell counts in the contingency table indicate that choosing the buyer and the supplier for inventory *placement* increase as a result of a high level of asset specificity.

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Table 20: Contingency table analysis of asset specificity and inventory placement

		Inventory Placement 1	2	*Total*
Level of Asset Specificity	0	60	58	118
	1	73	65	138
	Total	133	123	256

χ^2=.107, *df*=1, *p*=.743

Key: Inventory Placement: 1 = Buyer; 2 = Supplier
Level of Asset Specificity: 0 = Low; 1 = High

Hypotheses $H_2$1 and $H_2$2

Hypotheses $H_2$1 and $H_2$2 test Proposition 2, which states that a high level of uncertainty should drive a buyer to internalize the *ownership* and *placement* of inventory of a particular externally sourced item. A low level of uncertainty should have the opposite effect, driving the subject to choose the supplier for both inventory *ownership* and *placement* decisions.

Table 21: Contingency table analysis of uncertainty and inventory ownership

		Inventory Ownership 1	2	*Total*
Level of Uncertainty	0	33	106	139
	1	39	78	117
	Total	72	184	256

χ^2=2.892, *df*=1, *p*=.089

Key: Inventory Ownership: 1 = Buyer; 2 = Supplier
Level of Uncertainty: 0 = Low; 1 = High

Table 21 summarizes the results of the contingency table analysis related to hypothesis $H_2$1, the relationship between the level of uncertainty and the inventory *ownership* decision, finding weak support with a *p* value of .089 for the χ^2 test. In examining the cell counts in Table 21, this result seems to be primarily driven by the change in the number of subjects who chose the supplier for inventory *ownership* when

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the level of uncertainty was low as opposed to high. On the other hand, there is little change in the number of subjects that chose the buyer for inventory ownership as the level of uncertainty varied from low to high.

$H_2$2, which tests the relationship between the level of uncertainty and the inventory *placement* decision, was also supported in the contingency table analysis, with a *p* value of <.001. In this case, based on the cell counts presented in Table 22, both the choices of buyer or supplier for inventory *placement* appear to be affected by the change in the level of uncertainty, and in the directions predicted. When the level of uncertainty is low, the more subjects choose the supplier for inventory placement and when the level of uncertainty was high most subjects chose the buyer for inventory placement

Table 22: Contingency table analysis of uncertainty and inventory placement

		Inventory Placement		
		1	*2*	*Total*
Level of Uncertainty	0	51	88	139
	1	82	35	117
	Total	133	123	256
χ^2=28.382, *df*=1, *p*=<.001				

Key: Inventory Placement: 1 = Buyer; 2 = Supplier
Level of Uncertainty: 0 = Low; 1 = High

Hypotheses $H_3$1 and $H_3$2

Hypotheses $H_3$1 and $H_3$2 test for the relationships between the level of frequency and the inventory *ownership* and inventory *placement* decisions predicted in Proposition 3; namely, that the *ownership* and *placement* of inventory would be internalized (i.e., with the buyer) when the level of frequency is high, and alternatively left with the supplier when the level of frequency is low.

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When the choice of inventory *ownership* is compared to the level of frequency (see Table 23), the cell counts change as expected with the level of the transaction attribute but the change is not significant based on a *p* value of .266. Thus hypothesis $H_3 1$ is not supported.

Table 23: Contingency table analysis of frequency and inventory ownership

		Inventory Ownership		
		1	*2*	*Total*
Level of Frequency	0	32	96	128
	1	40	88	128
	Total	72	184	256
χ^2=1.237, *df*=1, *p*=.266				

Key: Inventory Ownership: 1 = Buyer; 2 = Supplier
Level of Frequency: 0 = Low; 1 = High

Hypothesis $H_3 2$, which tests the relationship between the level of frequency and the inventory *placement* decision, is also not supported due a non-significant *p* value (.169), as found in Table 24, though once again the cell counts do follow the pattern expected.

Table 24: Contingency table analysis of frequency and inventory placement

		Inventory Placement		
		1	*2*	*Total*
Level of Frequency	0	61	67	128
	1	72	56	128
	Total	133	123	256
χ^2=1.894, *df*=1, *p*=.169				

Key: Inventory Placement: 1 = Buyer; 2 = Supplier
Level of Frequency: 0 = Low; 1 = High

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Contingency table analysis findings

Based on the results of the contingency table analysis and the hypotheses specific to Propositions 1 through 3 (see Table 25), Proposition 1 is partially supported with only inventory *ownership* demonstrating a significant relationship to asset specificity. Proposition 2 is supported with respect to both inventory *ownership* and inventory *placement*. And Proposition 3 is not supported in this analysis.

Table 25: Summary of contingency table analysis results

Proposition	Hypothesis	Result	Explanation
1	**$H_1$1:** A significant relationship exists between asset specificity and inventory ownership	Supported**	Subjects are more likely to choose the buyer for inventory ownership with a high level of asset specificity
	$H_1$2: A significant relationship exists between asset specificity and inventory placement	Not Supported	No significant relationship found
2	**$H_2$1:** A significant relationship exists between uncertainty and inventory ownership	Supported*	Subjects are more likely to choose the supplier for inventory ownership with a low level of uncertainty
	$H_2$2: A significant relationship exists between uncertainty and inventory placement	Supported***	Subjects are more likely to choose the buyer for inventory placement with a high level of uncertainty and the supplier for inventory placement when the level of uncertainty is low
3	**$H_3$1:** A significant relationship exists between frequency and inventory ownership	Not Supported	No significant relationship found
	$H_3$2: A significant relationship exists between frequency and inventory placement	Not Supported	No significant relationship found

***p < .01, **p < .05, *p < .10

Binary Logistic Regression

The second set of statistical tests performed to evaluate the direct effects of the transaction attributes on the inventory management decisions in question utilized binary logistic regression. In this case, the discrete dependent variables of either the buyer or the supplier for inventory *ownership* and inventory *placement* were studied in terms of the factor scores for three transaction attributes.

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Once again, the question of whether or not a particular transaction attribute is related to the choices of inventory *ownership* and inventory *placement* was addressed, but this time rather than determining only if a statistical relationship exists and inferring the direction of that relationship from cell counts, the resulting logistic regression equation and associated χ^2 test indicate how the probability of a particular choice is impacted as the level of the transaction attribute either increases or decreases. As the dependent variable is discrete, the binary logistic model uses one value of the dependent variable as a reference with the equation presented in terms of the other value. Take, for example, a binary regression model for the inventory *ownership* decision. The dependent variable (inventory *ownership*) has been coded as 1 if the subject chose the buyer and a 2 if the subject chose the supplier. Then the binary model was executed such that the supplier (code = 2) was used as the reference and the equation should be interpreted in terms of choosing the buyer for inventory *ownership*. This means that a positive, significant beta weight in the regression equation should be interpreted as follows: the probability of choosing the buyer for inventory *ownership* increases as the level of the transaction attribute increases. To interpret the equation from the perspective of the reference category, that is choosing the supplier for inventory *ownership*, simply change the sign of the beta weight, meaning, assuming the same example, the probability of choosing the supplier for inventory *ownership* decreases as the level of the transaction attribute increases. It would also be accurate to state that as the level of the transaction attribute decreases, the probability of choosing the supplier for inventory *ownership* increases.

Hypotheses $H_1$3 and $H_1$4

Two additional hypotheses were tested related to Proposition 1, one to evaluate the relationship between inventory *ownership* and asset specificity and the other regarding

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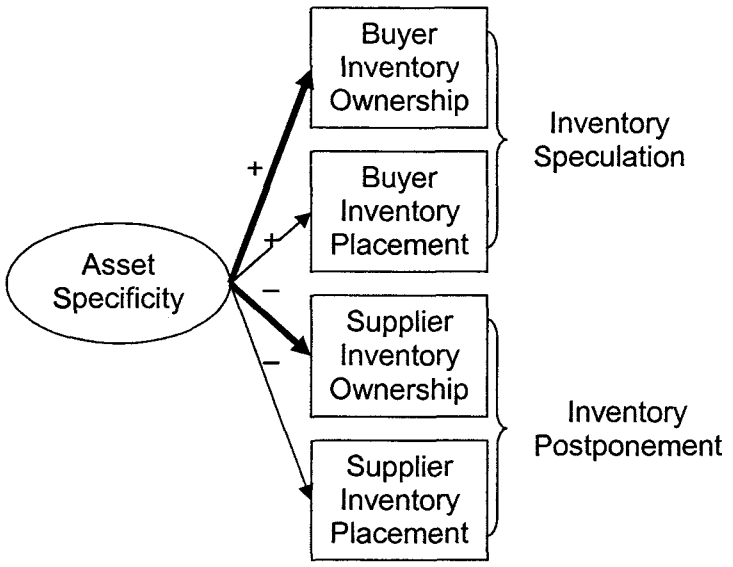
the relationship between inventory *placement* and this transaction attribute (see Figure 6). Based on the results of these analyses (Table 26), there is support for hypothesis $H_1$3, as the significant positive beta indicates that the probability choosing the buyer for inventory *ownership* increases as the level of asset specificity increases (thus the probability of choosing the supplier for inventory *ownership* increases as the level of uncertainty decreases). Hypothesis $H_1$4, however, is not supported in the model (p = .925).

Figure 6: Direct effect of asset specificity on inventory ownership and placement



Note: bold lines indicate support for the predicted relationship

Table 26: Binary logistic regression analysis of the asset specificity factor

Independent Variable	Dependent Variable	β	Wald χ^2	*df*	*p*
Asset Specificity Factor	Inventory Ownership	.259	3.125	1	.077
Asset Specificity Factor	Inventory Placement	.012	.009	1	.925

Reference Category = 2 (Supplier Ownership; Supplier Placement)

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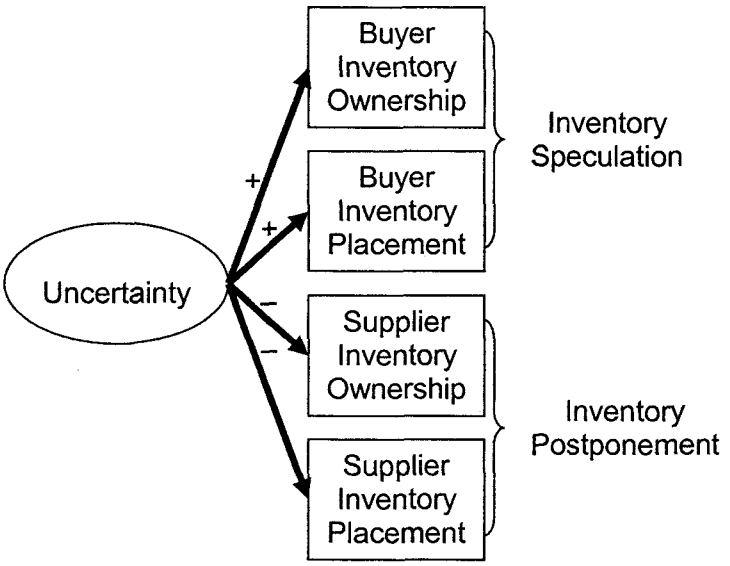
Hypotheses $H_2$3 and $H_2$4

Hypotheses $H_2$3 and $H_2$4 test the impact of uncertainty on the inventory *ownership* and inventory *placement* decisions (see Figure 7). In this case, both binary regression models resulted in a significant, positive beta (see Table 27). Thus, the probability of choosing the buyer for inventory *ownership* increases as the perceived level of uncertainty increases, and conversely, the probability of choosing the supplier for inventory *ownership* increases as the perceived level of uncertainty decreases. Furthermore, the probability of choosing the buyer for inventory *placement* increases as the perceived level of uncertainty increases, and conversely, the probability of choosing the supplier for inventory *placement* increases as the perceived level of uncertainty decreases. Thus $H_2$3 and $H_2$4 are both supported.

Figure 7: Direct effect of uncertainty on inventory ownership and placement



Note: bold lines indicate support for the predicted relationship

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Table 27: Binary logistic regression analysis of the uncertainty factor

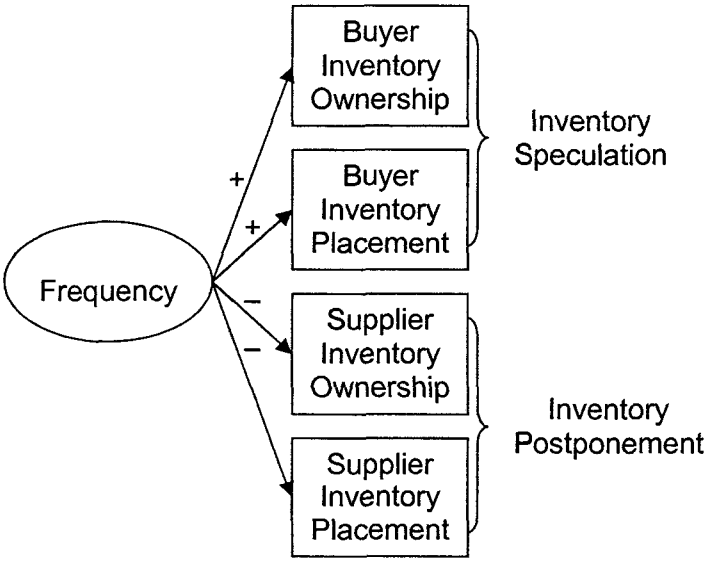
Independent Variable	Dependent Variable	β	Wald χ^2	*df*	*p*
Uncertainty Factor	Inventory Ownership	.280	3.858	1	.050
Uncertainty Factor	Inventory Placement	.692	25.208	1	<.001

Reference Category = 2 (Supplier Ownership; Supplier Placement)

Hypotheses $H_3$3 and $H_3$4

The final binary logistic regression models related to the direct effects of the transaction attributes were used to test hypotheses $H_3$3 and $H_3$4, the relationship between frequency and the inventory *ownership* and inventory *placement* decisions (see Figure 8). In this case, neither model produced a significant result (see Table 28), thus finding no support for a relationship between frequency and inventory *ownership*, nor between frequency and inventory *placement*.

Figure 8: Direct effect of frequency on inventory ownership and placement



Note: bold lines indicate support for the predicted relationship

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Table 28: Binary logistic regression analysis of the frequency Factor

Independent Variable	Dependent Variable	β	Wald χ^2	*df*	*p*
Frequency Factor	Inventory Ownership	.134	.920	1	.338
Frequency Factor	Inventory Placement	.199	2.485	1	.115

Reference Category = 2 (Supplier Ownership; Supplier Placement)

Summary of binary logistic regression findings

The summary results of the binary logistic regression models undertaken to evaluate the direct effects of the three transaction attributes are presented in Table 29. Based on these tests alone, there is partial support for Proposition 1, full support for Proposition 2, and no support for Proposition 3.

Summary of Direct Effects Analyses

Table 30 provides a summary of all the statistical tests conducted to determine whether asset specificity, uncertainty and frequency, each in and of itself, had a direct impact on the two inventory management decisions the subjects in the study were asked to make, namely who should own the inventory of the externally sourced item, and where that inventory should be placed in the buyer/supplier dyad.

The two sets of tests produced consistent results. Proposition 1, related to asset specificity, was supported with regard to the inventory *ownership* decision only. Proposition 2, related to uncertainty, was supported with regard to both decisions. And no support was found for Proposition 3, related to frequency.

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Table 29: Summary of binary logistic regression analysis results

Proposition	Hypothesis	Result	Explanation
1	**$H_1$3:** A significant, positive relationship exists between asset specificity and choosing the buyer for inventory ownership and a significant, negative relationship exists between asset specificity and choosing the supplier for inventory ownership	Supported*	The probability of choosing the buyer for inventory ownership increases as the level of asset specificity increases and the probability of choosing the supplier for inventory ownership increases as the level of asset specificity decreases
	$H_1$4: A significant, positive relationship exists between asset specificity and choosing the buyer for inventory placement and a significant, negative relationship exists between asset specificity and choosing the supplier for inventory placement	Not Supported	No significant relationship found
2	**$H_2$3:** A significant, positive relationship exists between uncertainty and choosing the buyer for inventory ownership and a significant, positive relationship exists between uncertainty and choosing the supplier for inventory ownership	Supported**	The probability of choosing the buyer for inventory ownership increases as the level of uncertainty increases and the probability of choosing the supplier for inventory ownership increases as the level of uncertainty decreases
	$H_2$4: A significant, positive relationship exists between uncertainty and choosing the buyer for inventory placement and a significant, negative relationship exists between uncertainty and choosing the supplier for inventory placement	Supported***	The probability of choosing the buyer for inventory placement increases as the level of uncertainty increases and the probability of choosing the supplier for inventory placement increases as the level of uncertainty decreases
3	**$H_3$3:** A significant, positive relationship exists between frequency and choosing the buyer for inventory ownership and a significant, positive relationship exists between frequency and choosing the supplier for inventory ownership	Not Supported	No significant relationship found
	$H_3$4: A significant, positive relationship exists between frequency and choosing the buyer for inventory placement and a significant, negative relationship exists between frequency and choosing the supplier for inventory placement	Not Supported	No significant relationship found

***p < .01, **p < .05, *p < .10

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Table 30: Summary of direct effects analysis

Proposition	Abbreviated Hypotheses	Result (Test Procedure)	Explanation
1 Partially Supported	**H_11 & H_13:** Relationship between asset specificity and inventory ownership	H_11: Supported** (Contingency Table)	Subjects are more likely to choose the buyer for inventory ownership with a high level of asset specificity
		H_13: Supported* (Binary Logistic Regression)	The probability of choosing the buyer (supplier) for inventory ownership increases as the level of asset specificity increases (decreases)
	H_12 & H_14: Relationship between asset specificity and inventory placement	H_12: Not Supported (Contingency Table)	No significant relationship found
		H_14: Not Supported (Binary Logistic Regression)	No significant relationship found
2 Supported	**H_21 & H_23:** Relationship between uncertainty and inventory ownership	H_21: Supported* (Contingency Table)	Subjects are more likely to choose the supplier for inventory ownership with a low level of uncertainty
		H_23: Supported** (Binary Logistic Regression)	The probability of choosing the buyer (supplier) for inventory ownership increases as the level of uncertainty increases (decreases)
	H_22 & H_24: Relationship between uncertainty and inventory placement	H_22: Supported*** (Contingency Table)	Subjects are more likely to choose the buyer (supplier) for inventory placement when the level of uncertainty low (high)
		H_24: Supported*** (Binary Logistic Regression)	The probability of choosing the buyer (supplier) for inventory placement increases as the level of uncertainty increases (decreases)
3 Not Supported	**H_31 & H_33** Relationship between frequency and inventory ownership	H_31: Not Supported (Contingency Table)	No significant relationship found
		H_33: Not Supported (Binary Logistic Regression)	No significant relationship found
	H_32 & H_34 Relationship between frequency and inventory placement	H_32: Not Supported (Contingency Table)	No significant relationship found
		H_34: Not Supported (Binary Logistic Regression)	No significant relationship found

[a] ***p < .01, **p < .05, *p < .10

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RESULTS OF COMBINED EFFECTS ANALYSIS

The remaining hypotheses test the combined, rather than isolated, effects of the transaction attributes on the two inventory management decisions of *ownership* and *placement*, as well as the impact on the resulting implied inventory management approach choice. Three statistical tools were used, non-parametric chi-square tests, binary logistic regression, and multicategory logistic regression.

Non-Parametric Chi-Square Tests

The first step in conducting non-parametric chi-square analysis was to calculate the cell counts for each of the treatment cells. Therefore, a contingency table analysis was conducted to compare the treatment cell categories with the inventory *ownership* decision (Table 31), the inventory *placement* decision (Table 32), and the implied inventory management approach (Table 33).

Table 31: Contingency table analysis of inventory ownership by treatment cell

		Inventory Ownership 1	2	Total
Treatment Cell	1	15	24	39
	2	4	24	28
	3	9	26	35
	4	9	19	28
	5	11	18	29
	6	9	23	32
	7	9	23	32
	8	6	27	33
Total		72	184	256

χ^2=8.032, *df*=7, *p*=.330

Key: Inventory Ownership: 1 = Buyer; 2 = Supplier

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Table 32: Contingency table analysis of inventory placement by treatment cell

		Inventory Placement		
		1	2	Total
Treatment Cell	1	27	12	39
	2	11	17	28
	3	7	28	35
	4	21	7	28
	5	18	11	29
	6	16	16	32
	7	21	11	32
	8	12	21	33
Total		133	123	256

χ^2=33.585, *df*=7, *p*=<.001

Key: Inventory Placement: 1 = Buyer; 2 = Supplier

Table 33: Contingency table analysis of implied inventory management approach by treatment cell

		Implied Inventory Management Approach				
		1	2	3	4	Total
Treatment Cell	1	9	6	18	6	39
	2	4	17	7	0	28
	3	3	22	4	6	35
	4	7	5	14	2	28
	5	6	6	12	5	29
	6	6	13	10	3	32
	7	8	10	13	1	32
	8	4	19	8	2	33
Total		47	98	86	25	256

χ^2=49.820, *df*=21, *p*=<.001

Key: Implied Inventory Management Approach: 1 = Inventory Speculation
2 = Inventory Postponement;
3 = Inventory Consignment
4 = Reverse Inventory Consignment

Non-parametric chi-square tests were then performed to determine if the differences in the counts related to each of the three choices were significant and in the direction expected within each particular treatment cell.

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Hypotheses $H_{4A}1$, $H_{4A}2$, $H_{4A}3$

Hypotheses $H_{4A}1$, $H_{4A}2$ and $H_{4A}3$ test whether the subjects assigned to treatment cell #1 (see Table 5), a scenario representing high levels of all three transaction attributes, chose the buyer for inventory *ownership*, the buyer for inventory *placement*, and an *inventory speculation* approach. The results of the chi-square tests are found in Table 34.

Hypothesis $H_{4A}1$, related to the inventory *ownership* choice, was not supported for this treatment cell. In fact, the majority of subjects chose the supplier rather than the buyer for inventory *ownership*, though the difference was not significant. $H_{4A}2$, on the other hand, was supported, with a statistically significant majority of subjects choosing the buyer for inventory *placement* for this scenario. As for the overall inventory management approach ($H_{4A}3$), the result was statistically significant but the majority chose *inventory consignment*, rather than *inventory speculation*, the predicted approach. Therefore, $H_{4A}3$ was not supported.

Table 34: Non-parametric chi-square tests for treatment cell #1

Treatment Cell #1	Inventory Ownership		Inventory Placement		Implied Inventory Management Approach				Total
	1	2	1	2	1	2	3	4	
Observed	15	24	27	12	9	6	18	6	39
	$\chi^2 = 2.077$ $df = 1$ $p = .15$		$\chi^2 = 5.769$ $df = 1$ $p = .016$		$\chi^2 = 9.923$ $df = 3$ $p = .019$				

Key: Inventory Ownership and Inventory Plaement: 1 = Buyer;2 = Supplier
Implied Inventory Management Approach: 1 = Inventory Speculation
2 = Inventory Postponement
3 = Inventory Consignment
4 = Reverse Inventory Consignment

Hypotheses $H_{4B}1$, $H_{4B}2$, $H_{4B}3$

The hypotheses related to Proposition 4B evaluate the choices made by subjects assigned to treatment cell #2 (see Table 5), a condition of low levels of all three of the

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transaction attributes. For this scenario, the subjects were expected to choose the supplier for inventory *ownership*, the supplier for inventory *placement*, and an *inventory postponement* approach.

The chi-square tests related to $H_{4B}1$ (see Table 35) provide strong support for this hypothesis, with the majority of subjects choosing the supplier for inventory *ownership* at a statistically significant level. However, the inventory *placement* hypothesis, $H_{4B}2$, was not supported; while the majority of subjects chose the supplier for inventory *placement* as predicted, the difference was not statistically significant. The final test did support hypothesis $H_{4B}3$, with a statistically significant majority of subjects implying *inventory postponement* for the overall inventory management choice.

Table 35: Non-parametric chi-square tests for treatment cell #2

Treatment Cell #2	Inventory Ownership		Inventory Placement		Implied Inventory Management Approach				Total
	1	2	1	2	1	2	3	4	
Observed	4	24	11	17	4	17	7	0	28
	$\chi^2 = 14.286$ $df = 1$ $p = .000$		$\chi^2 = 1.286$ $df = 1$ $p = .257$		$\chi^2 = 9.929$ $df = 2$ $p = .007$				

Key: Inventory Ownership and Inventory Placement: 1 = Buyer; 2 = Supplier
Implied Inventory Management Approach: 1 = Inventory Speculation
2 = Inventory Postponement;
3 = Inventory Consignment
4 = Reverse Inventory Consignment

Hypotheses $H_{5A}1$, $H_{5A}2$, $H_{5A}3$

Hypotheses $H_{5A}1$, $H_{5A}2$, and $H_{5A}3$ test the outcome of treatment cell #3 (see Table 5), the condition of a high level of asset specificity and low levels of both uncertainty and frequency. The expected outcome is a preference for the buyer for inventory *ownership*, the supplier for inventory *placement*, and *reverse inventory consignment* approach.

The results from the chi-square tests related to this treatment cell indicate that only one of the hypotheses, $H_{5A}2$, was supported (see Table 36). While the chi-square tests

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performed for the inventory *ownership* and implied inventory management approach were both statistically significant, neither produced the predicted result. Instead of choosing the buyer for inventory *ownership* as expected ($H_{5A}1$), the majority of subjects chose the supplier for inventory *ownership*. And instead of a reverse consignment approach ($H_{5A}3$), the *ownership* and *placement* decisions made by the majority of subjects implied an *inventory postponement* approach. Thus $H_{5A}2$, choosing the supplier for inventory *placement*, is the only hypothesis supported for this treatment cell.

Table 36: Non-parametric chi-square tests for treatment cell #3

Treatment Cell #3	Inventory Ownership		Inventory Placement		Implied Inventory Management Approach				Total
	1	2	1	2	1	2	3	4	
Observed	9	26	7	28	3	22	4	6	35
	$\chi^2 = 8.257$ $df = 1$ $p = .004$		$\chi^2 = 12.600$ $df = 1$ $p = <.001$		$\chi^2 = 27.286$ $df = 3$ $p = <.001$				

Key: Inventory Ownership and Inventory Placement: 1 = Buyer; 2 = Supplier
Implied Inventory Management Approach: 1 = Inventory Speculation
2 = Inventory Postponement
3 = Inventory Consignment
4 = Reverse Inventory Consignment

Hypotheses $H_{5B}1$, $H_{5B}2$, $H_{5B}3$

Proposition 5B is associated with treatment cell #4 (see Table 5), wherein the subjects were presented with a scenario representing a low level of asset specificity and high levels of both uncertainty and frequency. The related hypotheses, $H_{5B}1$, $H_{5B}2$, and $H_{5B}3$ indicate that the subjects are expected to choose the supplier for inventory *ownership*, the buyer for inventory *placement*, and an *inventory consignment* approach.

In this case, all three hypotheses were supported (see Table 37), with the majority of subjects choosing the supplier for inventory *ownership* ($H_{5B}1$), the buyer for inventory *placement* ($H_{5B}2$) and implying an overall inventory management choice of *inventory consignment* ($H_{5B}3$), all at a statistically significant level.

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Table 37: Non-parametric chi-square tests for treatment cell #4

Treatment Cell #4	Inventory Ownership		Inventory Placement		Implied Inventory Management Approach				Total
	1	2	1	2	1	2	3	4	
Observed	9	19	21	7	7	5	14	2	28
	$\chi^2 = 3.571$ *df* = 1 *p* = .059		$\chi^2 = 7.000$ *df* = 1 *p* = .008		$\chi^2 = 11.143$ *df* = 3 *p* = .011				

Key: Inventory Ownership and Inventory Placement: 1 = Buyer; 2 = Supplier
Implied Inventory Management Approach: 1 = Inventory Speculation
2 = Inventory Postponement
3 = Inventory Consignment
4 = Reverse Inventory Consignment

Hypotheses $H_{6A}1$, $H_{6A}2$, $H_{6A}3$

Hypotheses $H_{6A}1$, $H_{6A}2$, and $H_{6A}3$ test the conditions set out in treatment cell #5 (see Table 5), that is a high level of asset specificity, a high level of uncertainty and a low level of frequency. What is unique in this and the other three remaining treatment cells is that the predicted overall inventory management approach choice has not been uniquely determined, but only narrowed down. Based on the application of TCE, the expected inventory *ownership* choice is clear, but the predicted inventory *placement* choice is not because the levels of uncertainty and frequency confound that decision. Therefore, in order to support the propositions and related hypotheses, the chi-square test related to inventory *ownership* ($H_{6A}1$) should be significant with the majority of subjects selecting the buyer, there should not be a significant difference in the inventory *placement* choices made (a non-significant chi-square test), and the majority of subjects should have implied either an *inventory speculation* or *reverse inventory consignment* approach.

The results of this analysis are found in Table 38. For treatment cell #5 hypothesis $H_{6A}1$ is not supported; not only is the χ^2 test not significant, but the majority of subjects also chose the supplier rather than the buyer for inventory *ownership*. Hypothesis $H_{6A}2$

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was supported for this combination of transaction attributes as no significant difference was found in the inventory *placement* decisions. And finally, $H_{6A}3$ was not supported as there was not a significant difference among the four implied inventory management approaches, and even if the difference had been significant, the hypothesis still would not have been supported as the majority implied *inventory consignment* as the preferred overall approach.

Table 38: Non-parametric chi-square tests for treatment cell #5

Treatment Cell #5	Inventory Ownership		Inventory Placement		Implied Inventory Management Approach				Total
	1	2	1	2	1	2	3	4	
Observed	11	18	18	11	6	6	12	5	29
	$\chi^2 = 1.690$ $df = 1$ $p = .194$		$\chi^2 = 1.690$ $df = 1$ $p = .194$		$\chi^2 = 4.241$ $df = 3$ $p = .237$				

Key: Inventory Ownership and Inventory Placement: 1 = Buyer; 2 = Supplier
Implied Inventory Management Approach: 1 = Inventory Speculation
2 = Inventory Postponement
3 = Inventory Consignment
4 = Reverse Inventory Consignment

Hypotheses $H_{6B}1$, $H_{6B}2$, $H_{6B}3$

The expected decisions, and therefore hypotheses, related to treatment cell #6 (see Table 5) are identical to treatment cell #5. This treatment cell, related to Proposition 6B, represents the condition of a high level of asset specificity, a low level of uncertainty, and a high level of frequency. Once again, based on the theoretical development of the propositions, subjects are expected to choose the buyer for inventory *ownership*, the inventory *placement* decision is expected to be confounded by the varying levels of uncertainty and frequency, and the implied inventory management approach is expected to be either *inventory speculation* or *reverse inventory consignment.*

The results of the chi-square tests, while not identical to treatment cell #5, were similar (see Table 39). In this case the chi-square test associated with the inventory

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ownership decision was significant, though, like treatment cell #5, in the wrong direction, with the majority of subjects choosing the supplier for inventory *ownership*, thus $H_{6B}1$ was not supported. The inventory *placement* hypothesis, $H_{6B}2$, was supported for treatment cell #6 with an equal number of subjects choosing each alternative, and the two treatment cells shared similar results related to the overall inventory management choice in that the majority implied choices other than the expected, though this time at a significant level, hence $H_{6B}3$ was also not supported.

Table 39: Non-parametric chi-square tests for treatment cell #6

Treatment Cell #6	Inventory Ownership		Inventory Placement		Implied Inventory Management Approach				Total
	1	2	1	2	1	2	3	4	
Observed	9	23	16	16	6	13	10	3	32
	$\chi^2 = 6.125$ $df = 1$ $p = .013$		$\chi^2 = .000$ $df = 1$ $p = 1.000$		$\chi^2 = 7.250$ $df = 3$ $p = .064$				

Key: Inventory Ownership and Inventory Placement: 1 = Buyer; 2 = Supplier
Implied Inventory Management Approach: 1 = Inventory Speculation
2 = Inventory Postponement;
3 = Inventory Consignment
4 = Reverse Inventory Consignment

Hypotheses $H_{7A}1$, $H_{7A}2$, $H_{7A}3$

Hypotheses $H_{7A}1$, $H_{7A}2$, and $H_{7A}3$ are related to treatment cell #7 (see Table 5), the scenario representing a low level of asset specificity, a high level of uncertainty, and a low level of frequency. Based on proposition 7A, the majority of subjects are expected to choose the supplier for inventory *ownership*, the inventory *placement* decision is expected to be confounded by the varying levels of uncertainty and frequency, and the overall implied inventory management approach is expected to be either *inventory postponement* or *inventory consignment*.

The chi-square tests indicate support for two of the three hypotheses related to this treatment cell (see Table 40). The majority of subjects chose the supplier for inventory

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ownership as expected ($H_{7A}1$), and the most common implied inventory management approaches were *inventory postponement* and *inventory consignment*, with a statistically significant χ^2 test, thus supporting $H_{7A}3$. However, the inventory *placement* decision was not expected to be significant, but was at the $p<.10$ level, thus $H_{7A}2$ was not supported.

Table 40: Non-parametric chi-square tests for treatment cell #7

Treatment Cell #7	Inventory Ownership		Inventory Placement		Implied Inventory Management Approach				Total
	1	2	1	2	1	2	3	4	
Observed	9	23	21	11	8	10	13	1	32
	$\chi^2 = 6.125$ $df = 1$ $p = .013$		$\chi^2 = 3.125$ $df = 1$ $p = .077$		$\chi^2 = 9.750$ $df = 3$ $p = .021$				

Key: Inventory Ownership and Inventory Placement: 1 = Buyer; 2 = Supplier
Implied Inventory Management Approach: 1 = Inventory Speculation
2 = Inventory Postponement;
3 = Inventory Consignment
4 = Reverse Inventory Consignment

Hypotheses $H_{7B}1$, $H_{7B}2$, $H_{7B}3$

The last set of non-parametric chi-square tests relate to treatment cell #8 (see Table 5), the condition of a low level of asset specificity, a low level of uncertainty, and a high level of frequency. Like the relationship of treatment cells 5 and 6, treatment cells 7 and 8 share identical hypotheses, predicting a preference for the supplier for inventory *ownership*, a confounded inventory *placement* decision, and either *inventory postponement* or *inventory consignment* as the overall implied inventory management choice.

The difference, in this case, is that all three hypotheses were supported (see Table 41). A statistically significant majority of subjects chose the supplier for inventory *ownership* ($H_{7B}1$) and the most common implied inventory management approach was *inventory postponement* ($H_{7B}3$). The inventory *placement* decision was unclear, with a non-significant χ^2 test, as predicted ($H_{7B}2$).

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Table 41: Non-parametric chi-square tests for treatment cell #8

Treatment Cell #8	Inventory Ownership		Inventory Placement		Implied Inventory Management Approach				Total
	1	2	1	2	1	2	3	4	
Observed	6	27	12	21	4	19	8	2	33
	$\chi^2 = 13.364$ $df = 1$ $p = <.001$		$\chi^2 = 2.455$ $df = 1$ $p = .117$		$\chi^2 = 20.939$ $df = 3$ $p = <.001$				

Key: Inventory Ownership and Inventory Placement: 1 = Buyer; 2 = Supplier
Implied Inventory Management Approach: 1 = Inventory Speculation
2 = Inventory Postponement
3 = Inventory Consignment
4 = Reverse Inventory Consignment

Summary of non-parametric chi-square analysis findings

The summary results presented in Table 42 represent the most common decision made related to each treatment cell and whether or not the majority decision was statistically significant. However, not all the statistically significant results supported the related hypothesis (see Table 43). This is particularly obvious in the case of the inventory *ownership* decision, where, in every case, the majority of subjects chose the supplier for inventory *ownership*, regardless of the level of asset specificity, and thus none of the hypotheses ($H_{4A}1$, $H_{5B}1$, $H_{7A}1$, and $H_{7B}1$) related to buyer inventory *ownership* were supported. It is interesting to note, however, that in cases where both asset specificity and uncertainty were high, the choice of the supplier for inventory *ownership* was not statistically significant.

The hypotheses related to inventory *placement* ($H_{4A}2$, $H_{4B}2$, $H_{5A}2$, $H_{5B}2$, $H_{6A}2$, $H_{6B}2$, $H_{7A}2$, and $H_{7B}2$) faired much better, with six of the eight supported (see Table 43). The theoretical propositions that posit a confounding of the inventory *placement* decision when the levels of uncertainty and frequency vary (Propositions 6 and 7) also appear to be justified, as in only one case out of four where there are differing levels of these two

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transaction attributes ($H_{6A}2$, $H_{6B}2$, $H_{7A}2$, and $H_{7B}2$) was the *placement* decision statistically significant.

Table 42: Summary of non-parametric chi-square results

Treatment Cell (Proposition)	LEVEL OF			EXPECTED			FOUND		
	Asset Specificity	Uncertainty	Frequency	Inventory Ownership	Inventory Placement	Inventory Management Approach	Inventory Ownership	Inventory Placement	Inventory Management Approach
1 (4A)	HIGH	HIGH	HIGH	Buyer	Buyer	Inventory speculation	Supplier	Buyer**	Inventory consignment**
2 (4B)	LOW	LOW	LOW	Supplier	Supplier	Inventory postponement	Supplier***	Supplier	Inventory postponement***
3 (5A)	HIGH	LOW	LOW	Buyer	Supplier	Reverse inventory consignment	Supplier***	Supplier***	Inventory postponement***
4 (5B)	LOW	HIGH	HIGH	Supplier	Buyer	Inventory consignment	Supplier*	Buyer***	Inventory consignment**
5 (6A)	HIGH	HIGH	LOW	Buyer	Either	Inventory speculation or Reverse inventory consignment	Supplier	Buyer	Inventory consignment
6 (6B)	HIGH	LOW	HIGH	Buyer	Either		Supplier**	No preference	Inventory postponement*
7 (7A)	LOW	HIGH	LOW	Supplier	Either	Inventory postponement or Inventory consignment	Supplier**	Buyer*	Inventory consignment**
8 (7B)	LOW	LOW	HIGH	Supplier	Either		Supplier***	Supplier	Inventory postponement***

***p < .01, **p < .05, *p < .10

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Table 43: Summary of non-parametric chi-square hypotheses testing of combined effects

Proposition	Hypothesis	Result	Explanation
4A	**$H_{4A}1$:** When the level of asset specificity is HIGH, the level of uncertainty is HIGH, and the level of frequency is HIGH, the majority of subjects will likely choose the buyer for inventory ownership	Not Supported	There is no statistically significant difference between the number of subjects who chose the buyer for inventory ownership and the number of subjects who chose the supplier for inventory ownership for this treatment cell
	$H_{4A}2$: When the level of asset specificity is HIGH, the level of uncertainty is HIGH, and the level of frequency is HIGH, the majority of subjects will likely choose the buyer for inventory placement	Supported**	A statistically significant majority of subjects chose the buyer for inventory placement for this treatment cell as hypothesized
	$H_{4A}3$: When the level of asset specificity is HIGH, the level of uncertainty is HIGH, and the level of frequency is HIGH, the majority of subjects will likely choose inventory speculation	Not Supported	A statistically significant majority of subjects chose inventory consignment for this treatment cell rather than inventory speculation as hypothesized
4B	**$H_{4B}1$:** When the level of asset specificity is LOW, the level of uncertainty is LOW, and the level of frequency is LOW, the majority of subjects will likely choose the supplier for inventory ownership	Supported***	A statistically significant majority of subjects chose the supplier for inventory ownership for this treatment cell as hypothesized
	$H_{4B}2$: When the level of asset specificity is LOW, the level of uncertainty is LOW, and the level of frequency is LOW, the majority of subjects will likely choose the supplier for inventory placement	Not Supported	There is no statistically significant difference between the number of subjects who chose the buyer for inventory placement and the number of subjects who chose the supplier for inventory placement for this treatment cell
	$H_{4B}3$: When the level of asset specificity is LOW, the level of uncertainty is LOW, and the level of frequency is LOW, the majority of subjects will likely choose inventory postponement	Supported***	A statistically significant majority of subjects chose inventory postponement for this treatment cell as hypothesized

***p < .01, **p < .05, *p < .10, NS = Non-significant

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Table 43: Summary of non-parametric chi-square hypotheses testing of combined effects (cont'd)

Proposition	*Hypothesis*	*Result*	*Explanation*
5A	**$H_{5A}1$:** When the level of asset specificity is HIGH, the level of uncertainty is LOW, and the level of frequency is LOW, the majority of subjects will likely choose the buyer for inventory ownership	Not Supported	A statistically significant majority of subjects chose the supplier for inventory ownership for this treatment cell rather than choosing the buyer as hypothesized
	$H_{5A}2$: When the level of asset specificity is HIGH, the level of uncertainty is LOW, and the level of frequency is LOW, the majority of subjects will likely choose the supplier for inventory placement	Supported***	A statistically significant majority of subjects chose the supplier for inventory placement for this treatment cell as hypothesized
	$H_{5A}3$: When the level of asset specificity is HIGH, the level of uncertainty is LOW, and the level of frequency is LOW, the majority of subjects will likely choose reverse inventory consignment	Not Supported	A statistically significant majority of subjects chose inventory postponement for this treatment cell rather than reverse inventory consignment as hypothesized
5B	**$H_{5B}1$:** When the level of asset specificity is LOW, the level of uncertainty is HIGH, and the level of frequency is HIGH, the majority of subjects will likely choose the supplier for inventory ownership	Supported*	A statistically significant majority of subjects chose the supplier for inventory ownership for this treatment cell as hypothesized
	$H_{5B}2$: When the level of asset specificity is LOW, the level of uncertainty is HIGH, and the level of frequency is HIGH, the majority of subjects will likely choose the buyer for inventory placement	Supported***	A statistically significant majority of subjects chose the buyer for inventory placement for this treatment cell as hypothesized
	$H_{5B}3$: When the level of asset specificity is LOW, the level of uncertainty is HIGH, and the level of frequency is HIGH, the majority of subjects will likely choose inventory consignment	Supported**	A statistically significant majority of subjects chose inventory consignment for this treatment cell as hypothesized

***p < .01, **p < .05, *p < .10, NS = Non-significant

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Table 43: Summary of non-parametric chi-square hypotheses testing of combined effects (cont'd)

Proposition	*Hypothesis*	*Result*	*Explanation*
6A	**$H_{6A}1$:** When the level of asset specificity is HIGH, the level of uncertainty is HIGH, and the level of frequency is LOW, the majority of subjects will likely choose the buyer for inventory ownership	Not Supported	There is no statistically significant difference between the number of subjects who chose the buyer for inventory ownership and the number of subjects who chose the supplier for inventory ownership for this treatment cell
	$H_{6A}2$: When the level of asset specificity is HIGH, the level of uncertainty is HIGH, and the level of frequency is LOW, the subjects will likely chose the buyer and the supplier with equal frequencies for inventory placement	Supported^{NS}	There is no statistically significant difference between the number of subjects who chose the buyer for inventory placement and the number of subjects who chose the supplier for inventory placement for this treatment cell as hypothesized
	$H_{6A}3$: When the level of asset specificity is HIGH, the level of uncertainty is HIGH, and the level of frequency is LOW, the majority of subjects will likely choose either inventory speculation or reverse inventory consignment	Not Supported	There is no statistically significant difference between the number of subjects who chose one approach versus another
6B	**$H_{6B}1$:** When the level of asset specificity is HIGH, the level of uncertainty is LOW, and the level of frequency is HIGH, the majority of subjects will likely choose the buyer for inventory ownership	Not Supported	A statistically significant majority of subjects chose the supplier for inventory ownership for this treatment cell rather than choosing the supplier as hypothesized
	$H_{6B}2$: When the level of asset specificity is HIGH, the level of uncertainty is LOW, and the level of frequency is HIGH, the subjects will likely chose the buyer and the supplier with equal frequencies for inventory placement	Supported^{NS}	There is no difference between the number of subjects who chose the buyer for inventory placement and the number of subjects who chose the supplier for inventory placement for this treatment cell as hypothesized
	$H_{6B}3$: When the level of asset specificity is HIGH, the level of uncertainty is LOW, and the level of frequency is HIGH, the majority of subjects will likely choose either inventory speculation or reverse inventory consignment	Not Supported	A statistically significant majority of subjects chose either inventory postponement or inventory consignment for this treatment cell rather than inventory speculation or reverse inventory consignment as hypothesized

***p < .01, **p < .05, *p < .10, NS = Non-significant

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Table 43: Summary of non-parametric chi-square hypotheses testing of combined effects (cont'd)

Proposition	*Hypothesis*	*Result*	*Explanation*
7A	**$H_{7A}1$:** When the level of asset specificity is LOW, the level of uncertainty is HIGH, and the level of frequency is LOW, the majority of subjects will likely choose the supplier for inventory ownership	Supported**	A statistically significant majority of subjects chose the supplier for inventory ownership for this treatment cell as hypothesized
	$H_{7A}2$: When the level of asset specificity is LOW, the level of uncertainty is HIGH, and the level of frequency is LOW, the subjects will likely chose the buyer and the supplier with equal frequencies for inventory placement	Not Supported	A statistically significant majority of subjects chose the buyer for inventory placement for this treatment cell, rather than the hypothesized condition where neither choice is preferred
	$H_{7A}3$: When the level of asset specificity is LOW, the level of uncertainty is HIGH, and the level of frequency is LOW, the majority of subjects will likely choose either inventory postponement or inventory consignment	Supported**	A statistically significant majority of subjects chose either inventory postponement or inventory consignment for this treatment cell as hypothesized
7B	**$H_{7B}1$:** When the level of asset specificity is LOW, the level of uncertainty is LOW, and the level of frequency is HIGH, the majority of subjects will likely choose the supplier for inventory ownership	Supported***	A statistically significant majority of subjects chose the supplier for inventory ownership for this treatment cell as hypothesized
	$H_{7B}2$: When the level of asset specificity is LOW, the level of uncertainty is LOW, and the level of frequency is HIGH, the subjects will likely chose the buyer and the supplier with equal frequencies for inventory placement	Supported^{NS}	There is no difference between the number of subjects who chose the buyer for inventory placement and the number of subjects who chose the supplier for inventory placement for this treatment cell as hypothesized
	$H_{7B}3$: When the level of asset specificity is LOW, the level of uncertainty is LOW, and the level of frequency is HIGH, the majority of subjects will likely choose either inventory postponement or inventory consignment	Supported***	A statistically significant majority of subjects chose either inventory postponement or inventory consignment for this treatment cell as hypothesized

***p < .01, **p < .05, *p < .10, NS = Non-significant

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The final inventory management decision tested was the overall inventory management approach choice that was implied by the individual inventory *ownership* and *placement* decisions made ($H_{4A}3$, $H_{4B}3$, $H_{5A}3$, $H_{5B}3$, $H_{6A}3$, $H_{6B}3$, $H_{7A}3$, and $H_{7B}3$). Half, four of eight, of these hypotheses were supported. These are logical results given the preference toward choosing the supplier for inventory *ownership* demonstrated by the subjects in the study. So, while the majority of inventory *placement* decisions were made as expected, the bias toward choosing the supplier for inventory *ownership* led to a preponderance of *inventory postponement* and *inventory consignment* decisions as the overall implied inventory management approach.

In looking at the hypotheses in relation to their respective propositions, only two of the propositions are fully supported (Propositions 5B and 7B), with the inventory *ownership*, inventory *placement*, and implied inventory management approach related hypotheses all having the results expected. Partial support was found for the other six treatment cells.

Binary Logistic Regression

The binary logistic regression models used to test the combined effects of the transaction attributes should be interpreted in the same manner as those used to test the direct effects of these independent variables. The difference, in this case, is that rather than having a dependent variable that is of a binary origin, the dependent variable has been made binary by giving the approach of interest a code of 1 and all other approaches a code of 0. In these models, the approaches coded 0 were assigned as the reference category so all results should be interpreted in terms of the approach coded 1 (the approach of interest for the particular hypothesis). Additionally, all three transaction attributes are included in the same model rather than each being examined separately.

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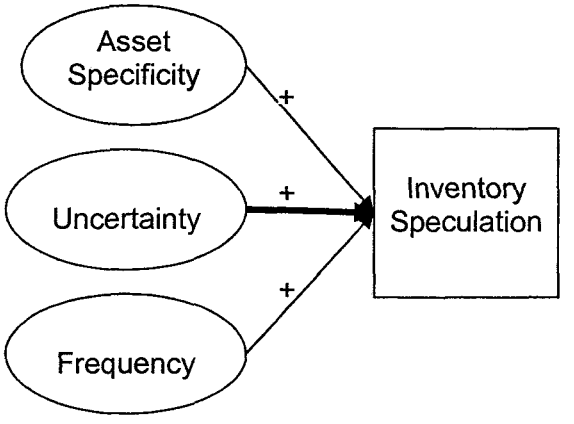
Hypothesis $H_{4A}4$

Hypothesis $H_{4A}4$ tests the relationship of asset specificity, uncertainty and frequency to the implied choice of *inventory speculation*. As illustrated in Figure 9, the proposition related to this hypothesis predicts a positive relationship between this inventory management approach and each of the transaction attributes.

Figure 9: Combined effects of the transaction attributes on inventory speculation



Note: bold lines indicate support for the predicted relationship

Table 44: Binary logistic regression analysis of the combined effects on inventory speculation

Independent Variable	*β*	*Wald* χ^2	*df*	*p*
Asset Specificity Factor	-.019	.013	1	.910
Uncertainty Factor	.349	4.358	1	.037
Frequency Factor	.085	.268	1	.605

Dependent Variable = Inventory Speculation (1) versus all other approaches (0)
Reference Category = 0 (Inventory Postponement, Inventory Consignment, Reverse Inventory Consignment)

However the binary logistic regression model indicates that only one of the transaction attributes, uncertainty, is significantly related to the *inventory speculation* approach (p = .037, see Table 44). Therefore, this hypothesis is partially supported, with

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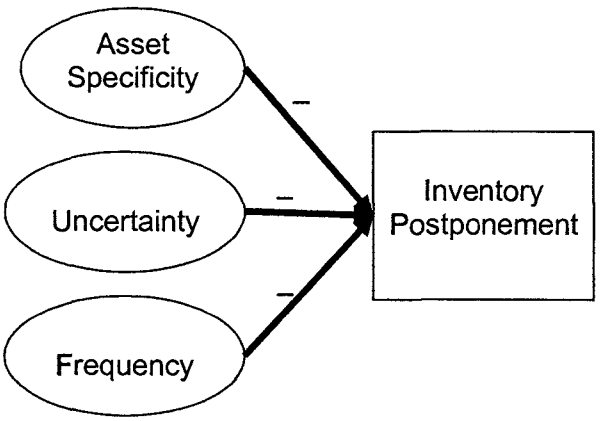
the probability of choosing *inventory speculation* increasing as the perceived level of uncertainty increases

Hypothesis $H_{4B}4$

Hypothesis $H_{4B}4$ tests the combined effects of the three transaction attributes when the inventory *ownership* and *placement* decisions made by the subjects imply an *inventory postponement* approach. Based on Proposition 4B, all three transaction attributes are expected to have a negative relationship with the *inventory postponement* approach (see Figure 10).

Figure 10: Combined effects of the transaction attributes on inventory postponement



Note: bold lines indicate support for the predicted relationship

Table 45: Binary logistic regression analysis of the combined effects on inventory postponement

Independent Variable	*β*	*Wald* χ^2	*df*	*p*
Asset Specificity Factor	-.285	3.863	1	.049
Uncertainty Factor	-.799	28.198	1	<.001
Frequency Factor	-.317	5.008	1	.025

Dependent Variable = Postponement (1) versus all other approaches (0)
Reference Category = 0 (Inventory Speculation, Inventory Consignment, Reverse Inventory Consignment)

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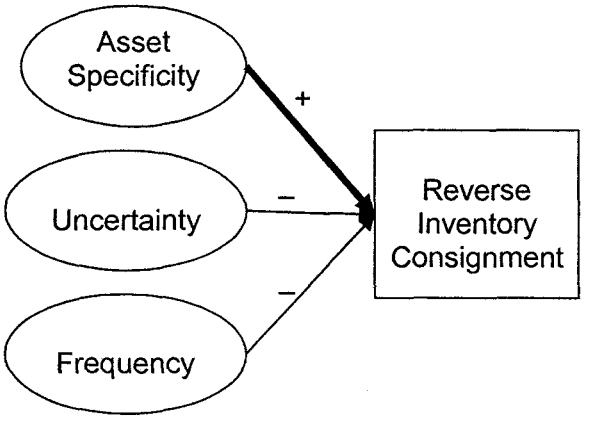
In this case there is full support for the hypothesis in the binary logistic model. Per the sign and significance of the *p* value related to the beta weights (see Table 45), the probability of choosing *inventory postponement* decreases as the perceived level of asset specificity increases, the perceived level of uncertainty increases, and the perceived level of frequency increases. The results can also be interpreted as follows: the probability of an *inventory postponement* choice increases as the levels of each of the transaction attributes decrease.

Hypothesis $H_{5A}4$

Related to Proposition 5A, hypothesis $H_{5A}4$ tests the combined effects of the transaction attributes on the choice of *reverse inventory consignment*, with the expectation that asset specificity will be positively related, while uncertainty and frequency have a negative relationship (see Figure 11).

Figure 11: Combined effects of the transaction attributes on reverse inventory consignment



Note: bold lines indicate support for the predicted relationship

This hypothesis was only supported in terms of the asset specificity relationship (see Table 46), meaning that the probability of choosing *reverse inventory consignment* increases as the perceived level of asset specificity increases.

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Table 46: Binary logistic regression analysis of the combined effects on reverse inventory consignment

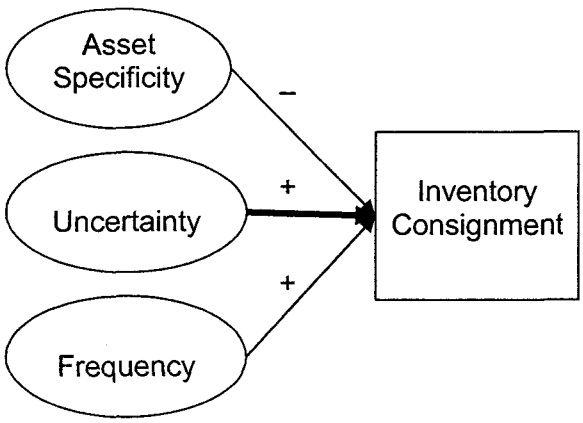
Independent Variable	*β*	*Wald* χ^2	*df*	*P*
Asset Specificity Factor	.703	7.369	1	.007
Uncertainty Factor	.066	.090	1	.764
Frequency Factor	.169	.611	1	.434

Dependent Variable = Reverse Inventory Consignment (1) versus all other approaches (0)
Reference Category = 0 (Inventory Speculation, Inventory Postponement, Inventory Consignment)

Hypothesis $H_{5B}4$

Hypothesis $H_{5B}4$ tests the combined effects of the transaction attributes on the choice of *inventory consignment.* In its related proposition (Proposition 5B), *inventory consignment* is predicted to be negatively related to asset specificity and positively related to both uncertainty and frequency (see Figure 12).

Figure 12: Combined effects of the transaction attributes on inventory consignment



Note: bold lines indicate support for the predicted relationship

But this model found only partial support for the hypothesis (see Table 47), with a positive, significant relationship between an *inventory consignment* choice and the level of uncertainty. Therefore, the probability of choosing *inventory consignment* increases as the perceived level of uncertainty increases.

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Table 47: Binary logistic regression analysis of the combined effects on inventory consignment

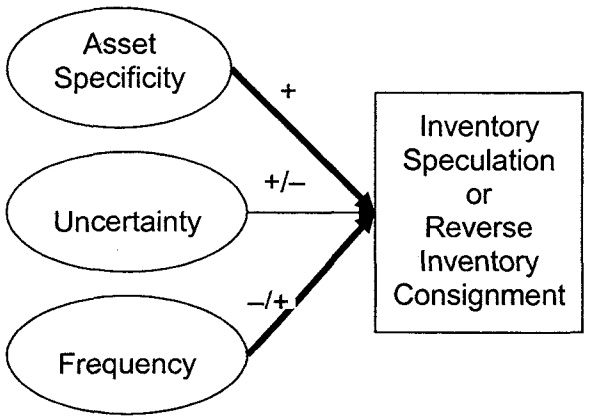
Independent Variable	*β*	*Wald* χ^2	*df*	*p*
Asset Specificity Factor	.031	.048	1	.827
Uncertainty Factor	.519	13.563	1	<.001
Frequency Factor	.182	1.732	1	.188

Dependent Variable = Inventory Consignment (1) versus all other approaches (0)
Reference Category = 0 (Inventory Speculation, Inventory Postponement, Reverse Inventory Consignment)

Hypothesis $H_6$4

Hypothesis $H_6$4 and its associated binary regression model address both Propositions 6A and 6B because these two propositions similarly predict that a buyer will choose either *inventory speculation* or *reverse inventory consignment* when the level asset specificity is high (a positive relationship) and when the levels of uncertainty and frequency vary with one high and one low (a non-significant relationship predicted), as illustrated in Figure 13.

Figure 13: Combined effects of the transaction attributes on either inventory speculation or reverse inventory consignment



Note: bold lines indicate support for the predicted relationship

Based on the results of the model (see Table 48), $H_6$4 is partially supported, with the probability of choosing *inventory speculation* or *reverse inventory consignment*

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increasing as the perceived level of asset specificity increases, and a non-significant relationship found between frequency and these approaches.

Table 48: Binary logistic regression analysis of the combined effects on either inventory speculation or reverse inventory consignment

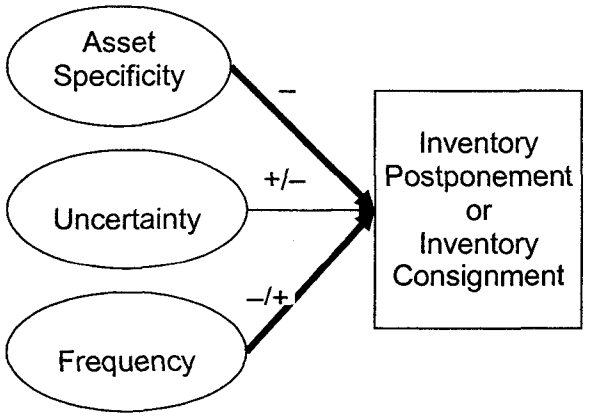
Independent Variable	*β*	*Wald* χ^2	*df*	*p*
Asset Specificity Factor	.267	3.220	1	.073
Uncertainty Factor	.288	3.982	1	.046
Frequency Factor	.139	.948	1	.330

Dependent Variable = Inventory Speculation or Reverse Inventory Consignment (1) versus all other approaches (0)
Reference Category = 0 (Inventory Postponement, Inventory Consignment)

Hypothesis $H_7$4

Hypothesis $H_7$4 is testing the mirror of $H_6$4, based on Propositions 7A and 7B, which indicate that a low level of asset specificity (negative relationship) and varying levels of uncertainty and frequency (either high/low or low/high leading to a non-significant relationship) will be related to the choice of either *inventory postponement* or *inventory consignment* (see Figure 14).

Figure 14: Combined effects of the transaction attributes on either inventory postponement or inventory consignment



Note: bold lines indicate support for the predicted relationship

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The binary logistic model is also a mirror image of the results related to $H_6$4 because what was previous coded as a 1 (*inventory speculation* and *reverse inventory consignment*) is now coded as a 0 and vice versa. Thus, the signs of the betas have simply changed (see Table 49), with the probability of choosing *inventory postponement* or *inventory consignment* increasing as the perceived level of asset specificity decreases, and a non-significant relationship found between frequency and the choice of *inventory postponement* or *inventory consignment*.

Table 49: Binary logistic regression analysis of the combined effects on either inventory postponement or inventory consignment

Independent Variable	*β*	*Wald* χ^2	*df*	*p*
Asset Specificity Factor	-.267	3.220	1	.073
Uncertainty Factor	-.288	3.982	1	.046
Frequency Factor	-.139	.948	1	.330

Dependent Variable = Inventory Postponement and Inventory Consignment (1) versus all other approaches (0)
Reference Category = 0 (Inventory Speculation, Reverse Inventory Consignment)

Summary of binary logistic regression analysis findings

Table 50 provides a summary of the binary logistic regression combined effects models. Based on these results there is partial support for all three of the transaction attributes in terms of an impact on the overall inventory management choice. Asset specificity impacted the choice as expected in four out of the six hypotheses, uncertainty in three of the six, and frequency in three of the six. Only one of the hypotheses was fully supported, H_{4B}2, the hypothesis related to *inventory postponement*. The other hypotheses were partially supported.

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Table 50: Summary of binary regression analysis of combined effects on the implied inventory management approach choice

Proposition	Hypothesis	Result	Explanation
4A	**$H_{4A}4$:** A significant, positive relationship exists between inventory speculation and the levels of asset specificity, uncertainty, and frequency	Partially Supported: Uncertainty**	The probability of choosing inventory speculation increases as the perceived level of uncertainty increases
4B	**$H_{4B}4$:** A significant, negative relationship exists between inventory postponement and the levels of asset specificity, uncertainty, and frequency	Supported: Asset Specificity** Uncertainty*** Frequency**	The probability of choosing inventory postponement increases as the perceived level of asset specificity decreases, the perceived level of uncertainty decreases, and the perceived level of frequency decreases
5A	**$H_{5A}4$:** A significant, positive relationship exists between reverse inventory consignment and the level of asset specificity, and a significant, negative relationship exists between reverse inventory consignment and the levels of uncertainty and frequency	Partially Supported: Asset Specificity***	The probability of choosing reverse inventory consignment increases as the perceived level of asset specificity increases
5B	**$H_{5B}4$:** A significant, negative relationship exists between inventory consignment and the level of asset specificity, and a significant, positive relationship exists between reverse inventory consignment and the levels of uncertainty and frequency	Partially Supported: Uncertainty***	The probability of choosing inventory consignment increases as the perceived level of uncertainty increases
6	**$H_6 4$:** A significant, positive relationship exists between inventory speculation or reverse inventory consignment and the level of asset specificity, and no significant relationship exists between inventory speculation or reverse inventory consignment and the levels of uncertainty and frequency	Partially Supported: Asset Specificity* Frequency^{NS}	The probability of choosing inventory speculation or reverse inventory consignment increases as the perceived level of asset specificity increases, and a non-significant relationship found between frequency and the choice of inventory speculation or reverse inventory consignment
7	**$H_7 4$:** A significant, negative relationship exists between inventory postponement or inventory consignment and the level of asset specificity, and no significant relationship exists between inventory postponement or inventory consignment and the levels of uncertainty and frequency	Partially Supported: Asset Specificity* Frequency^{NS}	The probability of choosing inventory postponement or inventory consignment increases as the perceived level of asset specificity decreases, and a non-significant relationship found between frequency and the choice of inventory postponement or inventory consignment

***p < .01, **p < .05, *p < .10, NS = Non significant

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Multicategory Logistic Regression

The final combined effects tests involved the application of multicategory logistic regression, which allows for the comparison of more than two categories of responses. These tests enabled a more thorough examination of how the level of each transaction attribute affects the probability that one inventory management approach would be selected over each of the others. So instead of coding one inventory management approach as a 1 and all others as 0, each of the four inventory management approaches were assigned a code: 1 – *inventory speculation*, 2 – *inventory postponement*, 3 – *inventory consignment*, 4 – *reverse inventory consignment.*

The results of the multicategory logistic regression model are given in Table 51. Once again, in interpreting the results of the logistic regression model, it is necessary to evaluate the beta weights in terms of the reference category. For example, the first result given for asset specificity (β = -.164, χ^2 = .723, p = .395), is an indication of the probability that approach 2 (*inventory postponement*) would be chosen over approach 1 (*inventory speculation*), the reference category. A negative, significant beta weight would be interpreted as follows: the probability of a buyer choosing *inventory postponement* over *inventory speculation* decreases as the level of asset specificity increases, which is also to say that the probability increases as the level of asset specificity decreases. The results can be interpreted in terms of the reference category by reversing the sign associated with the beta, such that, using the same example, the negative, significant beta weight would now be interpreted as a positive beta when *inventory speculation* is chosen over *inventory postponement.* In this case, however, based on the p value of .395, while the sign of the beta is in the direction expected, asset specificity is not statistically significant in the comparison of *inventory speculation* and *inventory postponement.*

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Table 51: Multicategory logistic regression model results

Dependent Variable = Approach	Model Fit		
	χ^2	*df*	*p*
Final -2 Log Likelihood	47.933	9	<.001
Pearson Goodness of Fit	705.728	702	.453
Asset Specificity	10.329	3	.016
Uncertainty	33.252	3	<.001
Frequency	5.226	3	.156

	Pseudo R^2
Cox and Snell	.171
Nagelkerke	.185
McFadden	.074

Approach	Code	Definition
Inventory Speculation	1	Buyer ownership, buyer placement
Inventory Postponement	2	Supplier ownership, supplier placement
Inventory Consignment	3	Supplier ownership, buyer placement
Reverse Inventory Consignment	4	Buyer ownership, supplier placement

	Approach	Ref[a]	β	Wald χ^2	P value	Expected Significance (S/NS)	Expected β Sign (+/-)	Met Expectation (Y/N)
Intercept	2	1	.641	11.278	.001			
Intercept	3	1	.582	9.307	.002			
Intercept	4	1	-.783	7.519	.006			
Intercept	3	2	-.059	.132	.716			
Intercept	4	2	-1.424	28.341	<.001			
Intercept	4	3	-1.365	26.038	<.001			
Asset Spec	2	1	-.164	.723	.395	S	-	N
Asset Spec	3	1	.039	.041	.839	S	-	N
Asset Spec	4	1	.656	4.978	.026	NS		N
Asset Spec	3	2	.202	1.505	.220	NS		Y
Asset Spec	4	2	.820	8.817	.003	S	+	Y
Asset Spec	4	3	.618	5.021	.025	S	+	Y
Uncertainty	2	1	-.799	16.473	<.001	S	-	Y
Uncertainty	3	1	-.060	.097	.755	NS		Y
Uncertainty	4	1	-.209	.642	.423	S	-	N
Uncertainty	3	2	.859	25.607	<.001	S	+	Y
Uncertainty	4	2	.590	5.769	.016	NS		N
Uncertainty	4	3	-.269	1.255	.263	S	-	N
Frequency	2	1	-.277	2.167	.141	S	-	N
Frequency	3	1	.051	.076	.783	NS		Y
Frequency	4	1	.077	.092	.762	S	-	N
Frequency	3	2	.328	4.136	.042	S	+	Y
Frequency	4	2	.355	2.261	.133	NS		Y
Frequency	4	3	.026	.013	.911	S	-	N

Maximum likelihood estimates
[a] Reference category

Along with the results of the regression model, Table 51 also provides a prediction regarding the relationship between the transaction attributes specific to each comparison. Taking again the example of comparing *inventory speculation* and *inventory postponement* with regard to asset specificity, since the level of asset

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specificity is predicted to be high for the former and low for the latter, the expected difference is expected to be significant, with a negative beta when *inventory speculation* is the reference category, and a significant beta when *inventory postponement* is the reference. If, on the other hand, the two approaches in question share the same expected level of a particular transaction attribute, as in the case of a high level of uncertainty for both *inventory speculation* and *inventory consignment*, the probability that one approach would be selected over the other would not depend on that transaction attribute, and therefore, in that case, there is no significant difference expected in the comparison.

Inventory Speculation vs. Inventory Postponement (Hypothesis H_{4A_4B})

Hypothesis H_{4A_4B} evaluates how the combined impact of the three transaction attributes effect the probability that a buyer would choose *inventory speculation* versus *inventory postponement*. Since *inventory speculation* and *inventory postponement* are mirror images in terms of the expected levels of each of the transaction attributes, the predicted relationships between the two inventory management approaches are all expected to be significant, and should be positive from the perspective of choosing *inventory speculation* over *inventory postponement*, and negative from the perspective of choosing *inventory postponement* over *inventory speculation* (see Figure 15).

The results of the multicategory logistic regression model related to this specific comparison are found in Table 51 (all instances where Approach = 2, Reference Category = 1). For this comparison, only the difference in the uncertainty variable was statistically significant, finding partial support for H_{4A_4B}. Thus, the probability of making an *inventory speculation* choice over an *inventory postponement* choice increases as the level of uncertainty increases, which is also to say that the probability of making an

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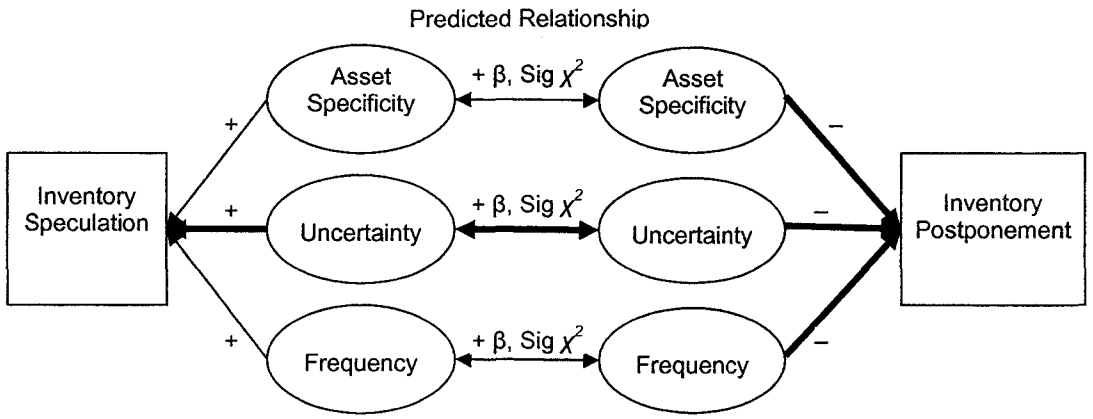
inventory postponement choice over an *inventory speculation* choice increases as the level of uncertainty decreases.

Figure 15: Multicategory logistic regression comparison of inventory speculation and inventory postponement



Note: bold lines indicate support for the predicted relationship

Inventory Speculation vs. Inventory Consignment (Hypothesis H_{4A_5B})

Hypothesis H_{4A_5B} tests the relationship between transaction attribute variables when comparing *inventory speculation* and *inventory consignment*. In this case the two approaches are not mirror images of each other in terms of the expected levels of the transaction attributes and thus only one of the predicted relationships, asset specificity, is anticipated to be significant while the other relationships (uncertainty and frequency) are expected to be non-significant (see Figure 16).

The results of the logistic regression model (see Table 51, all instances where Approach = 3, Reference category = 1) indicate that the relationship between the levels of uncertainty and the levels of frequency are not significant, as was expected. However the relationship between the levels of asset specificity, while in the direction expected, was also not statistically significant. Therefore, the probability of making an *inventory*

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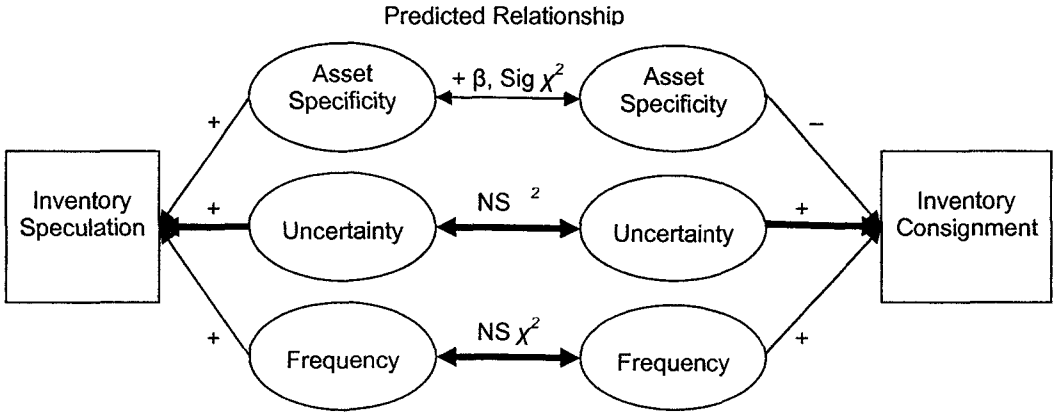
speculation choice over an *inventory consignment* choice does not differ as a result of the level of uncertainty or the level of frequency, providing partial support for H_{4A_5B}.

Figure 16: Multicategory logistic regression comparison of inventory speculation and inventory consignment



Note: bold lines indicate support for the predicted relationship

Inventory Speculation vs. Reverse Inventory Consignment (Hypothesis H_{4A_5A})

In hypothesis H_{4A_5B} the probability of an *inventory speculation* decision was compared to a *reverse inventory consignment* choice, with the expectation of a non-significant asset specificity relationship and significant uncertainty and frequency relationships (see Figure 17).

In this case none of the expected relationships (see Table 51, all instances where Approach = 4, Reference category = 1) were supported in the logistic regression model, and thus hypothesis H_{4A_5A} was not supported.

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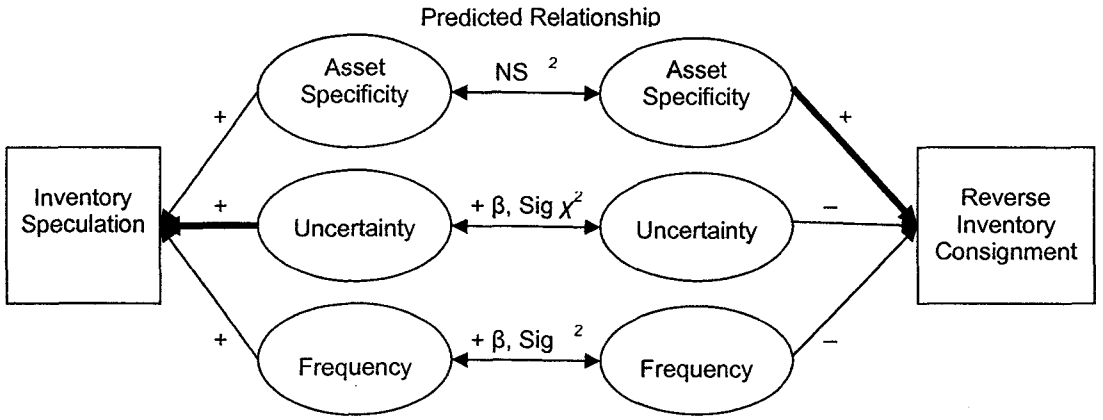
Figure 17: Multicategory logistic regression comparison of inventory speculation and reverse inventory consignment

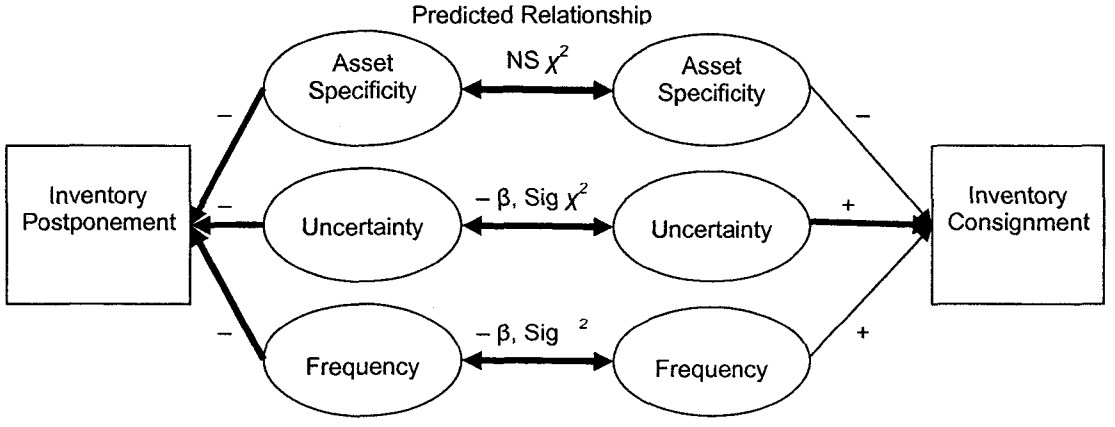


Note: bold lines indicate support for the predicted relationship

Inventory Postponement vs. Inventory Consignment (Hypothesis H_{4B_5B})

Hypothesis H_{4B_5B} tests the relationships between transaction attributes when comparing *inventory postponement* and *inventory consignment* (predicted relationships shown in Figure 18).

Figure 18: Multicategory logistic regression comparison of inventory postponement and inventory consignment



Note: bold lines indicate support for the predicted relationship

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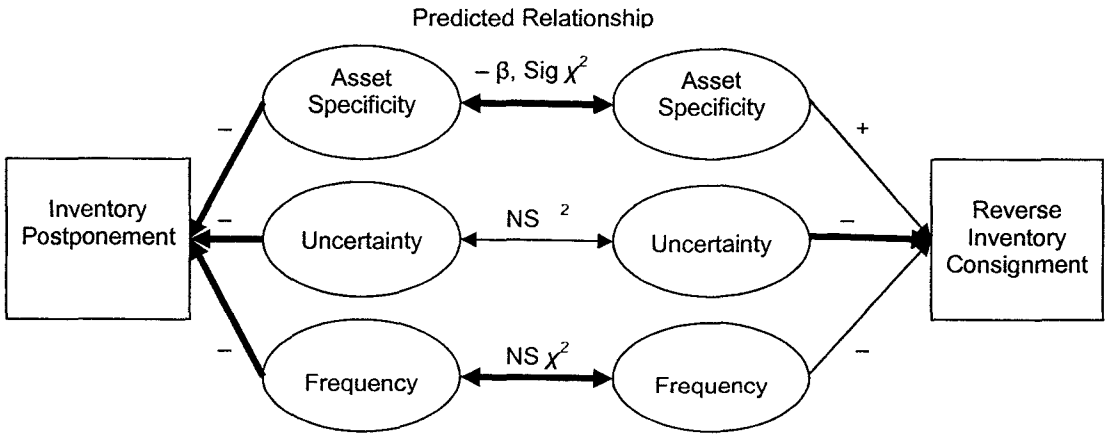
The hypothesis was fully supported in the comparison (see Table 51, all instances were Approach = 3, Reference = 2). Thus, the probability that *inventory postponement* is chosen over *inventory consignment* is not affected by the level of asset specificity, decreases as the level of uncertainty increases, and decreases as the level of frequency increases. From the perspective of choosing *inventory consignment* over *inventory postponement*, it can also be said that the probability that *inventory consignment* is chosen is once again not affected by the level of asset specificity, increases as the level of uncertainty increases, and increases as the level of frequency increases.

Inventory Postponement vs. Reverse Inventory Consignment (Hypothesis H_{4B_5A})

When the choice of *inventory postponement* is compared to the choice of *reverse inventory consignment*, only the difference in the asset specificity level is expected to be significant, with non-significant differences in the other two variables (see Figure 19).

Figure 19: Multicategory logistic regression comparison of inventory postponement and reverse inventory consignment



Note: bold lines indicate support for the predicted relationship

This hypothesis (H_{4B_5A}) is partially supported in the model (see Table 51, Approach = 4, Ref = 2), as the relationship between the levels of asset specificity was

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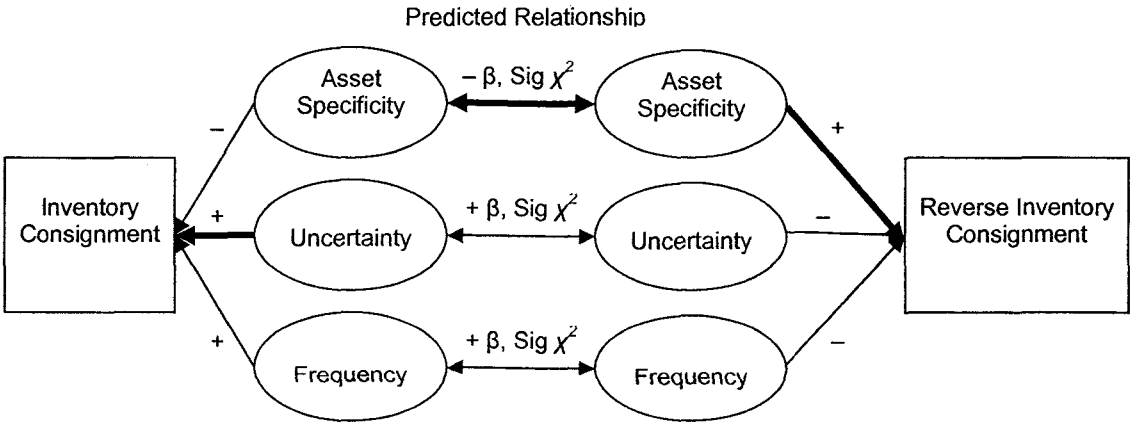
significant and in the direction expected, and the differences in the levels of frequency were not significant. Therefore, the probability of making an *inventory postponement* choice over an *inventory consignment* choice decreases as the level of asset specificity increases, and is not affected by the level of frequency; which is also to say that the probability of making an *inventory consignment* over an *inventory postponement* choice increases as the level of asset specificity decreases, and is not affected by the level of frequency.

Inventory Consignment vs. Reverse Inventory Consignment (Hypothesis H_{5B_5A})

The final hypothesis compares the relationship between an *inventory consignment* decision and the choice of *reverse inventory consignment*. Like the comparison of *inventory speculation* and *inventory postponement*, the difference in levels of the transaction attributes are all expected to be significant in this pairing (see Figure 20).

Figure 20: Multicategory logistic regression comparison of inventory consignment and reverse inventory consignment



Note: bold lines indicate support for the predicted relationship

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However, the multicategory logistic regression model found a significant difference for only one of the relationships, asset specificity, partially supporting hypothesis H_{5B_5A} (see Table 51, Approach = 4, Ref = 3)). Hence, the probability of making an *inventory consignment* choice as opposed to a *reverse inventory consignment* choice decreases as the level of asset specificity increases. And thus the converse is also true, the probability of making a *reverse inventory consignment* choice over an *inventory consignment* choice increases as the level of asset specificity increases.

Summary multicategory logistic analysis findings

Table 52 provides a summary of the findings related to these final six hypotheses (H_{4A_4B}, H_{4A_5A}, H_{4A_5B}, H_{4B_5A}, H_{4B_5B}, H_{5B_5A}). Four of the hypotheses were partially supported, one was not supported, and only one, the comparison of *inventory postponement* and *inventory consignment*, was fully supported. All three transaction attributes faired equally well (or equally poorly), with the predicted relationships supported in three out of the six hypotheses.

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Table 52: Summary of multicategory logisitic regression analysis of the combined effects on the implied inventory management choice

Propositions	Hypothesis	Result	Explanation
4A & 4B	H_{4A_4B}: Inventory speculation is preferred to inventory postponement when there is a significant, positive relationship between the levels of asset specificity, uncertainty, and frequency	Partially Supported: Uncertainty***	The probability of choosing inventory speculation over inventory postponement increases as the perceived level of uncertainty increases
4A & 5A	H_{4A_5A}: Inventory speculation is preferred to reverse inventory consignment when there is no significant relationship between the levels of asset specificity and a significant, positive relationship between the levels of uncertainty and frequency	Not Supported	None of the expected relationships were found in the probability of choosing inventory speculation over reverse inventory consignment
4A & 5B	H_{4A_5B}: Inventory speculation is preferred to inventory consignment when there is a significant, positive relationship between the levels of asset specificity and no significant relationship between the levels of uncertainty and frequency	Partially supported: Uncertainty^{NS} Frequency^{NS}	No significant difference was found in uncertainty or frequency when comparing the probability of choosing inventory speculation over inventory consignment
4B & 5B	H_{4B_5B}: Inventory postponement is preferred to inventory consignment when there is no significant relationship between the levels of asset specificity and a significant, negative relationship between the levels of uncertainty and frequency	Supported: Asset Specificity^{NS} Uncertainty*** Frequency**	The probability of choosing inventory postponement over inventory consignment increases as the perceived levels of uncertainty and frequency decrease, with no significant relationship between the levels of asset specificity
4B & 5A	H_{4B_5A}: Inventory postponement is preferred to reverse inventory Consignment when there is a significant, negative relationship between the levels of asset specificity and no significant relationship between the levels of Uncertainty and Frequency	Partially Supported: Asset Specificity*** Frequency^{NS}	The probability of choosing inventory postponement over reverse inventory consignment increases as the perceived level of asset specificity decreases, with no significant relationship between the levels of frequency
5B & 5A	H_{5B_5A}: Inventory consignment is preferred to reverse inventory consignment when there is a significant, negative relationship between the levels of asset specificity and significant, positive relationships between the levels of uncertainty and frequency	Partially Supported: Asset Specificity**	The probability of choosing inventory consignment over reverse inventory consignment increases as the perceived level of asset specificity decreases

[a] ***p < .01, **p < .05, *p < .10, NS = Non significant

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Summary of Combined Effects Analyses

The propositions and related hypotheses pertaining to the combined effects of the transaction attributes on the inventory management decisions of interest in this research were tested in three ways, through non-parametric chi-square tests, binary logistic regression, and multicategory logistic regression. Table 53 contains the consolidated results from these statistical analyses, which, in total were used to draw conclusions about the level of support found for Propositions 4 through 7.

Proposition 4A

Proposition 4A predicted that high levels of asset specificity, uncertainty and frequency should lead a buyer to choose the buyer for inventory *ownership*, the buyer for inventory *placement*, and therefore *inventory speculation* as the overall inventory management approach. As the summary results in Table 53 indicate, there was support for the inventory *placement* decision in the chi-square analysis of treatment cell #1 ($H_{4A}2$), and support for three of the four hypotheses related to the relationship between the level of uncertainty and the *inventory speculation* choice ($H_{4A}4$, H_{4A_4B}, H_{4A_5B}).

However, there was no support for the hypotheses testing the inventory *ownership* and overall inventory approach choices ($H_{4A}1$ and $H_{4A}3$), nor the relationship between the level of asset specificity and the choice of *inventory speculation* ($H_{4A}4$, H_{4A_4B}, H_{4A_5B}, H_{4A_5A}), and only one of four hypotheses related to the level of frequency and *inventory speculation* was supported ($H_{4A}4$, H_{4A_4B}, H_{4A_5B}, H_{4A_5A}). These finding indicate partial support for Proposition 4A, specifically with respect to the inventory *placement* decision and the relationship between *inventory speculation* and the level of uncertainty.

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Proposition 4B

Proposition 4B, on the other hand, predicting a preference for the supplier for inventory *ownership*, the supplier for inventory *placement*, and an *inventory postponement* approach when the levels of the transaction attributes are low, was generally supported (see Table 53). Two of the three hypotheses testing the decisions made by subjects responding to treatment cell #2 were supported ($H_{4B}1$ and $H_{4B}3$). Furthermore, three of the four hypotheses testing the relationship between the levels of each of the transaction attributes and the choice of *inventory postponement* were also supported ($H_{4B}4$, H_{4A_4B}, H_{4B_5A}, H_{4B_5B}). These results support Proposition 4B.

Proposition 5A

Proposition 5A states that when the level of asset specificity is high and the levels of uncertainty and frequency are low (treatment cell #3) a buyer should choose the buyer for inventory *ownership*, the supplier for inventory *placement*, and therefore *reverse inventory consignment* for the overall inventory management approach. The hypotheses related to Proposition 5A found only partial support in the model, similar to what was found for Proposition 4A (see Table 53). Once again, there was support for the inventory *placement* decision ($H_{5A}2$), and three of the four hypotheses testing the relationship between the levels of one of the transaction attributes (this time asset specificity rather than uncertainty) and the inventory management approach. There was no support for the hypotheses testing the inventory *ownership* and overall inventory approach choices ($H_{4A}1$ and $H_{4A}3$), nor the relationship between the level of uncertainty and the choice of *reverse inventory consignment* ($H_{5A}4$, H_{4A_5A}, H_{4B_5A}, H_{5B_5A}), and only one of four hypotheses related to the level of frequency and *reverse inventory consignment* was supported ($H_{5A}4$, H_{4A_5A}, H_{4B_5A}, H_{5B_5A}). These findings indicate partial

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support for Proposition 5A with respect to the inventory *placement* decision and the relationship between *reverse inventory consignment* and the level of asset specificity.

Proposition 5B

Proposition 5B predicts that a low level of asset specificity, a high level of uncertainty and a high level of frequency should motivate a buyer to choose the supplier for inventory *ownership*, the buyer for inventory *placement*, and therefore *inventory consignment* as the overall inventory management approach. This proposition was supported in terms of the chi-square tests, with a statistically significant majority of subjects making the predicted choices for treatment cell #4 ($H_{5B}1$, $H_{5B}2$, $H_{5B}3$). However, support for this proposition was not quite as clear in the analysis of the combined effects of the transaction attributes on the choice of *inventory consignment*. While three of the four hypotheses testing the uncertainty relationship were supported, only two of four of the hypotheses testing the asset specificity and frequency attributes were supported ($H_{5B}4$, H_{4A_5B}, H_{4B_5B}, H_{5B_5A}). Therefore, Proposition 5B is partially supported, with support for the inventory *ownership*, inventory *placement* and overall inventory management approach choices, and the relationship between uncertainty and *inventory consignment* (see Table 53).

Propositions 6A and 6B

Propositions 6A and 6B, related to treatment cells #5 and #6, predict that a high level of asset specificity and varied levels of uncertainty and frequency should lead buyers to an inventory management approach choice that includes the buyer for inventory *ownership*, either *inventory speculation* or *reverse inventory consignment*. While the scenarios are different, the results for these two treatment cells were identical (see Table 53). In both cases only the chi-square test for inventory *placement* was supported ($H_{6A}2$ and $H_{6B}2$) and support was found for asset specificity and frequency

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with regard to choice of either of these inventory management approaches ($H_6$4). Therefore, there is partial support for Proposition 6 with regard to inventory *placement*, and the asset specificity and frequency attributes.

Proposition 7A and 7B

The final set of propositions, related to treatment cells 7 and 8, predict that a low level of asset specificity and varied levels of uncertainty and frequency should lead to an inventory management approach that includes the supplier for inventory *ownership*, either *inventory postponement* or *inventory consignment*. In this case the results of the two related propositions are similar but not identical (see Table 53). Only inventory *ownership* and the overall inventory management approach choice were supported for treatment cell #7 (H_{7A}1, H_{7A}3), while the chi-square tests for all three decisions were supported for treatment cell #8 (H_{7B}1, H_{7B}2, H_{7B}3). Hypothesis $H_7$4 applies to both versions of Proposition 7 by examining how the combined impact of all three transaction attributes relate to the choice of either *inventory postponement* or *inventory consignment*, finding support for both the asset specificity and frequency relationships. Therefore, Proposition 7A was partially supported with respect to inventory *ownership*, overall inventory management approach, asset specificity and frequency; and Proposition 7B was partially supported for all but the uncertainty relationship.

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Table 53: Summary of combined effects analyses

Proposition	Abbreviated Hypotheses	Result (Test Procedure)		Explanation
4A Partially Supported	**$H_{4A}1$, $H_{4A}2$, $H_{4A}3$:** Expect the subjects to choose the buyer for inventory ownership, the buyer for inventory placement, and an inventory speculation approach	Inventory Ownership	$H_{4A}1$: Not Supported (Non-Parametric χ^2)	Non-significant majority chose the supplier for inventory ownership
		Inventory Placement	$H_{4A}2$: Supported** (Non-Parametric χ^2)	Significant majority chose the buyer for inventory placement
		Overall Approach	$H_{4A}3$: Not Supported (Non-Parametric χ^2)	Significant majority chose an inventory consignment approach
	$H_{4A}4$, H_{4A_4B} H_{4A_5B}, H_{4A_5A}: Asset specificity, uncertainty and frequency are all positively related to the inventory speculation choice	Asset Specificity	$H_{4A}4$: Not Supported (BLR)	No significant relationship between asset specificity and inventory speculation
			H_{4A_4B}: Not Supported (MLR)	Asset specificity was not significant in the choice between inventory speculation and inventory postponement
			H_{4A_5B}: Not Supported (MLR)	Asset specificity was not significant in the choice between inventory speculation and inventory consignment
			H_{4A_5A}: Not Supported (MLR)	Asset specificity was significant in the choice between inventory speculation and reverse inventory consignment
		Uncertainty	$H_{4A}4$: Supported** (BLR)	Found a significant relationship between uncertainty and inventory speculation
			H_{4A_4B}: Supported*** (MLR)	Uncertainty was significant in the choice between inventory speculation and inventory postponement
			H_{4A_5B}: Supported^{NS} (MLR)	Uncertainty was not significant in the choice between inventory speculation and inventory consignment
			H_{4A_5A}: Not Supported (MLR)	Uncertainty was not significant in the choice between inventory speculation and reverse inventory consignment
		Frequency	$H_{4A}4$: Not Supported (BLR)	No significant relationship between frequency and inventory speculation
			H_{4A_4B}: Not Supported (MLR)	Frequency was not significant in the choice between inventory speculation and inventory postponement
			H_{4A_5B}: Supported^{NS} (MLR)	Frequency was not significant in the choice between inventory speculation and inventory consignment
			H_{4A_5A}: Not Supported (MLR)	Frequency was not significant in the choice between inventory speculation and reverse inventory consignment

***p < .01, **p < .05, *p < .10, NS = Non significant, BLR = Binary Logistic Regression, MLR = Multicategory Logistic Regression

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Table 53: Summary of combined effects analyses, cont'd

Proposition	*Abbreviated Hypotheses*	*Result (Test Procedure)*		*Explanation*
4B Supported	**$H_{4B}1$, $H_{4B}1$, $H_{4B}3$:** Expect the subjects to choose the supplier for inventory ownership, the supplier for inventory placement, and an inventory postponement approach	Inventory Ownership	$H_{4B}1$: Supported*** (Non-Parametric χ^2)	Significant majority chose the supplier for inventory ownership
		Inventory Placement	$H_{4B}2$: Not Supported (Non-Parametric χ^2)	Non-significant majority chose the supplier for inventory placement
		Overall Approach	$H_{4B}3$: Supported*** (Non-Parametric χ^2)	Significant majority chose an inventory postponement approach
	$H_{4B}4$, H_{4A_4B}, H_{4B_5B}, H_{4B_5A}: Asset specificity, uncertainty and frequency are all negatively related to the inventory postponement choice	Asset Specificity	$H_{4B}4$: Supported** (BLR)	Found a significant relationship between asset specificity and inventory postponement
			H_{4A_4B}: Not Supported (MLR)	Asset specificity was not significant in the choice between inventory speculation and inventory postponement
			H_{4B_5B}: Supported^{NS} (MLR)	Asset specificity was not significant in the choice between inventory postponement and inventory consignment
			H_{4B_5A}: Supported*** (MLR)	Asset specificity was significant in the choice between inventory postponement and reverse inventory consignment
		Uncertainty	$H_{4B}4$: Supported*** (BLR)	Found a significant relationship between uncertainty and inventory postponement
			H_{4A_4B}: Supported*** (MLR)	Uncertainty was significant in the choice between inventory speculation and inventory postponement
			H_{4B_5B}: Supported*** (MLR)	Uncertainty was significant in the choice between inventory postponement and inventory consignment
			H_{4B_5A}: Not Supported (MLR)	Uncertainty was significant in the choice between inventory postponement and reverse inventory consignment
		Frequency	$H_{4B}4$: Supported** (BLR)	Found a significant relationship between frequency and inventory postponement
			H_{4A_4B}: Not Supported (MLR)	Frequency was not significant in the choice between inventory speculation and inventory postponement
			H_{4B_5B}: Supported** (MLR)	Frequency was significant in the choice between inventory postponement and inventory consignment
			H_{4B_5A}: Supported^{NS} (MLR)	Frequency was not significant in the choice between inventory postponement and reverse inventory consignment

***p < .01, **p < .05, *p < .10, NS = Non significant, BLR = Binary Logistic Regression, MLR = Multicategory Logistic Regression

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Table 53: Summary of combined effects analyses, cont'd

Proposition	*Abbreviated Hypothesis*	*Result (Test Procedure)*		*Explanation*
5A Partially Supported	**$H_{5A}1$ $H_{5A}2$ $H_{5A}3$:** Expect the subjects to choose the buyer for inventory ownership, the supplier for inventory placement, and a reverse inventory consignment approach	Inventory Ownership	$H_{5A}1$: Not Supported (Non-Parametric χ^2)	Significant majority chose the supplier for inventory ownership
		Inventory Placement	$H_{5A}2$: Supported*** (Non-Parametric χ^2)	Significant majority chose the supplier for inventory placement
		Overall Approach	$H_{5A}3$: Not Supported (Non-Parametric χ^2)	Significant majority chose an inventory postponement approach
	$H_{5A}4$, H_{4A_5A}, H_{4B_5A}, H_{5B_5A}: Asset specificity is positively related, and uncertainty and frequency are negatively related to the reverse inventory consignment choice	Asset Specificity	$H_{5A}4$: Supported*** (BLR)	Found a significant relationship between asset specificity and reverse inventory consignment
			H_{4A_5A}: Not Supported (MLR)	Asset specificity was significant in the choice between inventory speculation and reverse inventory consignment
			H_{4B_5A}: Supported*** (MLR)	Asset specificity was significant in the choice between inventory postponement and reverse inventory consignment
			H_{5B_5A}: Supported** (MLR)	Asset specificity was significant in the choice between inventory consignment and reverse inventory consignment
		Uncertainty	$H_{5A}4$: Not Supported (BLR)	No significant relationship between uncertainty and reverse inventory consignment
			H_{4A_5A}: Not Supported (MLR)	Uncertainty was not significant in the choice between inventory speculation and reverse inventory consignment
			H_{4B_5A}: Not Supported (MLR)	Uncertainty was significant in the choice between inventory postponement and reverse inventory postponement
			H_{5B_5A}: Not Supported (MLR)	Uncertainty was not significant in the choice between inventory consignment and reverse inventory consignment
		Frequency	$H_{5A}4$: Not Supported (BLR)	No significant relationship between frequency and reverse inventory consignment
			H_{4A_5A}: Not Supported (MLR)	Frequency was not significant in the choice between inventory speculation and reverse inventory consignment
			H_{4B_5A}: Supported^{NS} (MLR)	Frequency was not significant in the choice between inventory postponement and reverse inventory consignment
			H_{5B_5A}: Not Supported (MLR)	Frequency was not significant in the choice between inventory consignment and reverse inventory consignment

***p < .01, **p < .05, *p < .10, NS = Non significant, BLR = Binary Logistic Regression, MLR = Multicategory Logistic Regression

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Table 53: Summary of combined effects analyses, cont'd

Proposition	*Abbreviated Hypothesis*	*Result (Test Procedure)*		*Explanation*
5B Supported	**$H_{5B}1$, $H_{5B}2$, $H_{5B}3$:** Expect the subjects to choose the supplier for inventory ownership, the buyer for inventory placement, and an inventory consignment approach	Inventory Ownership	$H_{5B}1$: Supported* (Non-Parametric χ^2)	Significant majority chose the supplier for inventory ownership
		Inventory Placement	$H_{5B}2$: Supported*** (Non-Parametric χ^2)	Significant majority chose the buyer for inventory placement
		Overall Approach	$H_{5B}3$: Supported** (Non-Parametric χ^2)	Significant majority chose an inventory consignment approach
	$H_{5B}4$, H_{4A_5B}, H_{4B_5B}, H_{5B_5A}: Asset specificity is negatively related, and uncertainty and frequency are positively related to the inventory consignment choice	Asset Specificity	$H_{5B}4$: Not Supported (BLR)	No significant relationship between asset specificity and inventory consignment
			H_{4A_5B}: Not Supported (MLR)	Asset specificity was not significant in the choice between inventory speculation and inventory consignment
			H_{4B_5B}: Supported^{NS} (MLR)	Asset specificity was not significant in the choice between inventory postponement and inventory consignment
			H_{5B_5A}: Supported** (MLR)	Asset specificity was significant in the choice between inventory consignment and reverse inventory consignment
		Uncertainty	$H_{5B}4$: Supported*** (BLR)	Found significant relationship between uncertainty and inventory consignment
			H_{4A_5B}: Supported^{NS} (MLR)	Uncertainty was not significant in the choice between inventory speculation and inventory consignment
			H_{4B_5B}: Supported*** (MLR)	Uncertainty was significant in the choice between inventory postponement and inventory consignment
			H_{5B_5A}: Not Supported (MLR)	Uncertainty was not significant in the choice between inventory consignment and reverse inventory consignment
		Frequency	$H_{5B}4$: Not Supported (BLR)	No significant relationship between frequency and inventory consignment
			H_{4A_5B}: Supported^{NS} (MLR)	Frequency was not significant in the choice between inventory speculation and inventory consignment
			H_{4B_5B}: Supported** (MLR)	Frequency was significant in the choice between inventory postponement and inventory consignment
			H_{5B_5A}: Not Supported (MLR)	Frequency was not significant in the choice between inventory consignment and reverse inventory consignment

***p < .01, **p < .05, *p < .10, NS = Non significant, BLR = Binary Logistic Regression, MLR = Multicategory Logistic Regression

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Table 53: Summary of combined effects analyses, cont'd

Proposition	*Abbreviated Hypothesis*	*Result (Test Procedure)*		*Explanation*
6A Partially Supported	**$H_{6A}1$, $H_{6A}2$, $H_{6A}3$:** Expect the subjects to choose the buyer for inventory ownership, either the buyer or supplier for inventory placement, and either an inventory speculation or reverse inventory consignment approach	Inventory Ownership	$H_{6A}1$: Not Supported (Non-Parametric χ^2)	Non-significant majority chose the supplier for inventory ownership
		Inventory Placement	$H_{6A}2$: Supported^{NS} (Non-Parametric χ^2)	Non-significant majority chose the buyer for inventory placement
		Overall Approach	$H_{6A}3$: Not Supported (Non-Parametric χ^2)	Non-significant majority chose an inventory consignment approach
	$H_6$4: Asset specificity is positively related, and uncertainty and frequency are non-significantly related to the choice of either inventory speculation or reverse inventory consignment	Asset Specificity	$H_6$4: Supported* (BLR)	Found significant relationship between asset specificity and either inventory speculation or reverse inventory consignment
		Uncertainty	$H_6$4: Not Supported (BLR)	Found significant relationship between uncertainty and either inventory speculation or reverse inventory consignment
		Frequency	$H_6$4: Supported^{NS} (BLR)	No significant relationship between frequency and either inventory speculation or reverse inventory consignment
6B Partially Supported	**$H_{6B}1$, $H_{6B}2$, $H_{6B}3$:** Expect the subjects to choose the buyer for inventory ownership, either the buyer or supplier for inventory placement, and either an inventory speculation or reverse inventory consignment approach	Inventory Ownership	$H_{6B}1$: Not Supported (Non-Parametric χ^2)	Significant majority chose the supplier for inventory ownership
		Inventory Placement	$H_{6B}2$: Supported^{NS} (Non-Parametric χ^2)	No difference in the inventory placement choice
		Overall Approach	$H_{6B}3$: Not Supported (Non-Parametric χ^2)	Significant majority chose an inventory postponement approach
	$H_6$4: Asset specificity is positively related, and uncertainty and frequency are non-significantly related to the choice of either inventory speculation or reverse inventory consignment	Asset Specificity	$H_6$4: Supported* (BLR)	Found significant relationship between asset specificity and either inventory speculation or reverse inventory consignment
		Uncertainty	$H_6$4: Not Supported (BLR)	Found significant relationship between uncertainty and either inventory speculation or reverse inventory consignment
		Frequency	$H_6$4: Supported^{NS} (BLR)	No significant relationship between frequency and either inventory speculation or reverse inventory consignment

***p < .01, **p < .05, *p < .10, NS = Non significant, BLR = Binary Logistic Regression, MLR = Multicategory Logistic Regression

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Table 53: Summary of combined effects analyses, cont'd

Proposition	*Abbreviated Hypothesis*	*Result (Test Procedure)*		*Explanation*
7A Partially Supported	**$H_{7A}1$, $H_{7A}2$, $H_{7A}3$:** Expect subjects to choose the supplier for inventory ownership, either the buyer or supplier for inventory placement, and either an inventory postponement or inventory consignment approach	Inventory Ownership	$H_{7A}1$: Supported** (Non-Parametric χ^2)	Significant majority chose the supplier for inventory ownership
		Inventory Placement	$H_{7A}2$: Not Supported (Non-Parametric χ^2)	Significant majority chose the buyer for inventory placement
		Overall Approach	$H_{7A}3$: Supported** (Non-Parametric χ^2)	Significant majority chose an inventory consignment approach
	H_74: Asset specificity is positively related, and uncertainty and frequency are non-significantly related to the choice of either inventory speculation or reverse inventory consignment	Asset Specificity	H_74: Supported* (BLR)	Found significant relationship between asset specificity and either inventory postponement or inventory consignment
		Uncertainty	H_74: Not Supported (BLR)	Found significant relationship between uncertainty and either inventory postponement or inventory consignment
		Frequency	H_74: Supported^{NS} (BLR)	No significant relationship between frequency and either inventory postponement or inventory consignment
7B Partially Supported	**$H_{7B}1$, $H_{7B}2$, $H_{7B}3$:** Expect subjects to choose the supplier for inventory ownership, either the buyer or supplier for inventory placement, and either an inventory postponement or inventory consignment approach	Inventory Ownership	$H_{7B}1$: Supported*** (Non-Parametric χ^2)	Significant majority chose the supplier for inventory ownership
		Inventory Placement	$H_{7B}2$: Supported^{NS} (Non-Parametric χ^2)	Non-significant majority chose the supplier for inventory placement
		Overall Approach	$H_{7B}3$: Supported*** (Non-Parametric χ^2)	Significant majority chose an inventory postponement approach
	H_74: Asset specificity is positively related, and uncertainty and frequency are non-significantly related to the choice of either inventory speculation or reverse inventory consignment	Asset Specificity	H_74: Supported*** (BLR)	Found significant relationship between asset specificity and either inventory postponement or inventory consignment
		Uncertainty	H_74: Not Supported (BLR)	Found significant relationship between uncertainty and either inventory postponement or inventory consignment
		Frequency	H_74: Supported^{NS} (BLR)	No significant relationship between frequency and either inventory postponement or inventory consignment

***p < .01, **p < .05, *p < .10, NS = Non significant, BLR = Binary Logistic Regression, MLR = Multicategory Logistic Regression

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SUMMARY RESULTS

Table 54 provides a summary of the findings. The statistical tests performed suggest full support for Propositions 2 and 4B, partial support for Propositions 1, 4A, 5A, 5B, 6A, 6B, 7A, and 7B, and no support for Proposition 2.

Table 54: Summary results for all propositions

Proposition	Condition			Hypotheses	Result
	AS	UN	FR		
1	H/L			$H_1 1$, $H_1 2$, $H_1 3$, $H_1 4$	**Partially Supported:** Inventory Ownership
2		H/L		$H_2 1$, $H_2 2$, $H_2 3$, $H_2 4$	**Supported**
3			H/L	$H_3 1$, $H_3 2$, $H_3 3$, $H_3 4$	**Not Supported**
4A	H	H	H	$H_{4A} 1$, $H_{4A} 2$, $H_{4A} 3$ $H_{4A} 4$, H_{4A_4B}, H_{4A_5B}, H_{4A_5A}	**Partially Supported:** Inventory Placement Uncertainty
4B	L	L	L	$H_{4B} 1$, $H_{4B} 2$, $H_{4B} 3$ $H_{4B} 4$, H_{4A_4B}, H_{4B_5B}, H_{4B_5A}	**Supported**
5A	H	L	L	$H_{5A} 1$, $H_{5A} 2$, $H_{5A} 3$ $H_{5A} 4$, H_{4A_5A}, H_{4B_5A}, H_{4B_5A}	**Partially Supported:** Inventory Placement Asset Specificity
5B	L	H	H	$H_{5B} 1$, $H_{5B} 2$, $H_{5B} 3$ $H_{5B} 4$, H_{4A_5B}, H_{4B_5B}, H_{5B_5A}	**Partially Supported:** Inventory Ownership Inventory Placement Overall Approach Uncertainty
6A	H	H	L	$H_{6A} 1$, $H_{6A} 2$, $H_{6A} 3$, $H_6 4$	**Partially Supported:** Inventory Placement Asset Specificity Frequency
6B	H	L	H	$H_{6B} 1$, $H_{6B} 2$, $H_{6B} 3$, $H_6 4$	**Partially Supported:** Inventory Placement Asset Specificity Frequency
7A	L	H	L	$H_{7A} 1$, $H_{7A} 2$, $H_{7A} 3$, $H_7 4$	**Partially Supported:** Inventory Ownership Overall Approach Asset Specificity Frequency
7B	L	L	H	$H_{7B} 1$, $H_{7B} 2$, $H_{7B} 3$, $H_7 4$	**Partially Supported:** Inventory Ownership Inventory Placement Overall Approach Asset Specificity Frequency

Key: AS = Asset Specificity; UN = Uncertainty; FR = Frequency; H = High; L = Low

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CHAPTER 6

DISCUSSION, LIMITATIONS, FUTURE RESEARCH, AND CONCLUSION

DISCUSSION

The results reported in Chapter 5 have implications for both the distribution channels literature (reviewed in Chapter 2) and the TCE foundation upon which the conceptual model was developed (Chapter 3).

Distribution Channels Literature

It is clear from the results of the passive role-playing experiment that inventory *ownership* and inventory *placement* are viewed as decisions that can, and in some cases should, be decoupled. In this study, buyers (the subjects) were asked to make inventory *ownership* and *placement* decisions for a particular externally sourced item in a given context, with no restriction in how they chose to assign those responsibilities within the buyer-supplier dyad – except that only one member of the supply chain could be assigned to each activity (see classification matrix in Figure 1). Of the 256 subjects, based on the cell counts presented in Table 33, 47 subjects (18%) implied *inventory speculation* as their preferred overall inventory management approach, 98 implied *inventory postponement* (38%), 86 implied *inventory consignment* (34%) and 25 implied *reverse inventory consignment* (10%). These results suggest that the concept of decoupling inventory *ownership* and *placement* decisions is either already familiar to at least half of those participating in the study, or if it is a new concept, that it is attractive in a given context.

Buyers participating in the experiment were also asked to report on their general preference for one of the four inventory management approaches in their firms, with the results, categorized by industry, presented in Table 55. Where the subject reported a

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preference for more than one approach, all were included in the counts recorded in the table.

Table 55: Inventory management approach preference within a subject's organization

	A	B	C	D	E
Aerospace/Aviation/Defense	6	5	1	2	6
Automotive	1	1			2
Bio-Med/Pharmaceutical	6	3	2	4	3
Chemical/Oil/Gas	5	1	1	1	1
Construction	3				2
Contract Manufacturing		3	1		
Education	3	6			3
Electronics/Semiconductor	1	4	6		4
Financial Services	1	2		3	3
Food and Nutrition	4	5			2
Government	3	7	1	1	5
Health Care	2		5	2	2
Manufacturing (other)	19	22	11	1	14
Mining	1				1
Non-profit	3	1			
Software Development		1			1
Services (other)	3	5	4		2
Telecommunications	1	1	1		1
Tooling/Mfg Supplies	3	1	1		1
Transportation/Distribution	3	2			1
Utilities	8	2		1	4
Total	76	72	34	15	58

Key: A = Inventory Speculation
B = Inventory Postponement
C = Inventory Consignment
D = Reverse Inventory Consignment
E = No preference

These results align quite well with what was expected from a review of the literature. First, that *inventory speculation* (reportedly used by 39%) and *inventory postponement* (reportedly used by 37%), the traditional inventory management approaches, are most commonly chosen in practice. Second, that *inventory consignment* is the most commonly chosen form of an approach that decouples inventory *ownership* and inventory *placement* decisions (used by 17%). And third, that

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reverse inventory consignment is an approach that is not as commonly found in practice (8%).

But these results also support the notion that a more comprehensive approach to making inventory management decisions is needed, one that explicitly recognizes the need to simultaneously consider both the *ownership* and *placement* of inventory in a way that includes all possible combinations of these critical decisions in a single, robust, decision-making framework.

Transaction Cost Economics

In addition to the fact that this is the first study to decouple inventory *ownership* and *placement* decisions and concurrently examine four approaches to inventory management, it is also the first to apply TCE to the choice of inventory management approach, answering the call to expand the study of operations related topics by borrowing theoretical lenses from other fields (Amundson 1998, Grover and Malhotra, 2003). In applying this theoretical lens, not only have all three transaction attributes been included, but the combined effects of asset specificity, uncertainty, and frequency, have also been accounted for. This is significant because the level of frequency has been omitted from most TCE-based studies (Rindfliesch and Heide, 1997; David and Han, 2004), as have the combined effects of all three transaction attributes (David and Han, 2004).

Asset Specificity

While the hypotheses related to the level of asset specificity were supported for the majority of the propositions in the various statistical tests performed, asset specificity was expected to have an even more predominant effect in the model as the "locomotive" that drives transaction cost theory (Williamson, 1985) and based on the support this attribute has received in previous studies (Rindfliesch and Heide, 1997; David and Han,

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2004),. The results of tests related to Proposition 1 (see Table 30) provided the first indication that asset specificity may not have performed to the extent expected. This proposition posited a direct effect on both the inventory *ownership* and *placement* decisions, but support was only found for the relationship between the level of asset specificity and the inventory *ownership* decision.

Although Proposition 1 was not fully supported, finding support for the inventory *ownership* relationship does align with the theoretical model for the combined effects, as Propositions 4 through 7 are based on the prediction that the inventory *ownership* decision is directly related to the level of asset specificity, whereas the inventory *placement* decision is more closely tied to the levels of uncertainty and frequency. However, the chi-square tests of the eight treatment cells that represent the conditions outlined in the combined effects propositions (see Table 5) revealed that the relationship between asset specificity and inventory *ownership* was not strong enough to overcome an unexpected bias in the buyers toward the supplier for inventory *ownership* (see Table 42). Therefore, while the buyers perceived a difference in the level of asset specificity as defined in the scenarios (see Table 10), and the level of the transaction attribute had a significant effect on the inventory *ownership* decision (see Tables 19 and 26), this did not result in a majority of subjects choosing the buyer for *ownership* decision in any of the scenarios presented (see Table 42).

In spite of this bias, there was still strong support for the impact of the level of asset specificity in the combined effects analysis. In fact, of the eight combined effects related propositions (4A through 7B), six found support for the asset specificity attribute (see Table 54). In each case, where the asset specificity related beta was expected to be significant, the sign of the beta was in the direction expected; an indication that the transaction attribute was performing as predicted, but perhaps not to the degree

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necessary to motivate a buyer to choose the buyer for inventory *ownership* in the contexts provided.

Uncertainty

The level of uncertainty also played a strong role in this research, particularly in light of the inventory *placement* and overall inventory management choices made by the subjects in the experiment. Beginning with the direct effects tests (Proposition 2), the relationships between the level of uncertainty and both of the inventory management decisions were significant, with a particularly strong relationship between the level of uncertainty and the inventory *placement* decision (see Table 27, $\chi^2 = 25.208$, $p = <.001$). This relationship is also evident in the chi-square tests regarding the implied inventory management approach for each treatment cell, as in every case, even when the levels of uncertainty and frequency differed, the implied inventory management approach choice was directly related to the level of uncertainty (see Table 42). When the level of uncertainty was high the majority of subjects implied *inventory consignment* as the preferred choice (at a significant level in all but one case), and when the level of uncertainty was low the majority of subjects implied *inventory postponement* as the preferred approach (at a significant level in all cases).

In the logistic regression tests of combined effects uncertainty performed similarly to the other transaction attributes in terms of how many times hypotheses were supported, but differed in effect size. The largest χ^2 values across all tests were found in the uncertainty relationships (e.g., see Tables 45, 47, 51), an indication of intensity with which this variable influenced the inventory management decisions in certain situations. It is also worth noting that the role of uncertainty was important in all but one of the four propositions that correspond to the four inventory management choices (see Propositions 4A, 4B and 5B in Table 54), *reverse inventory consignment* being the only

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one of the four without support for this transaction attribute. Hypotheses related to the level of uncertainty were not supported for the last four propositions (6A-7B) because the relationship between the level of this transaction attribute and the choice of either of two inventory management approaches was significant when a non-significant result was expected due to the varying levels of uncertainty and frequency.

And finally, it appears that uncertainty may have a moderating effect with respect to both asset specificity and frequency. Even though a multicategory logistic regression model that included interaction terms for the transaction attributes did not produce significant results, it is interesting to note in the non-parametric chi-square analysis that the only instances where a supplier *ownership* choice was not significant was when a high level of asset specificity was accompanied by a high level of uncertainty (see treatment cells 1 and 3 in Table 42). Additionally, in treatment cells where both uncertainty and frequency levels were the same (see treatment cells 1-4 in Table 42), the statistical significance associated with both the inventory *placement* and the implied inventory management approach is higher, in general, than in the treatment cells where the levels of those transaction attributes differ.

It is somewhat unusual to see the uncertainty attribute play such a strong role in a TCE-based model. In past research, uncertainty has proven to be inconsistent in predicting governance choices, with support well below 50% in terms of the number of times support was found for these relationships (David & Han, 2004). The successful application of uncertainty in this research study is likely due to the narrow definition of the construct as referring to supply and supplier uncertainty only.

Frequency

The level of frequency proved to be the weakest predictor in the model, with no supported direct effects (see Table 25). There was, however, some support for the

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impact of frequency in the logistic regression analysis of combined effects. In these tests, the hypotheses relating the frequency attribute to the inventory management choice were supported for four of the eight propositions (see Propositions 4A through 7B in Table 54). It should be noted that in three of the four cases the frequency related hypotheses were supported based on finding an expected non-significant result, rather than because a predicted significant relationship was found.

A weak finding regarding the frequency transaction attribute is not particularly surprising when compared with previous TCE-based research. According to Rindfleisch and Heide (1997), researchers have been largely unsuccessful in finding support for this transaction attribute (e.g. Anderson & Schmittlein, 1984; Anderson, 1985; Maltz, 1994).

LIMITATIONS

Context

As with any research study, the results from this research may be limited in their application. A manufacturing setting was chosen for the scenarios used in the passive role-playing experiment so the results may be limited to that context. The research also focuses on only one critical item, the criticality of which may have overshadowed the impacts of the transaction attributes in driving a conservative decision on the part of the subjects. For example, the frequency with which the item was used may not have played a strong role in the decision making process because the subjects were less concerned about that level of frequency than they were about the risk of running out of an item that might interrupt production in the factory.

TCE application in the inventory management context

Asset specificity

There are at least two possible reasons for the unexpected asset specificity-related results that may have been limitations in this research. First, and perhaps the

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most likely reason, is that the TCE assumption of risk neutral transaction participants (Rindfleisch and Heide, 1997) does not hold in this context. Instead, the subjects in this experiment appear to be risk-averse when it comes to owning inventory, possibly a result of policies within firms that emphasize delaying the *ownership* of inventory to minimize carrying costs. Therefore, measuring the subjects' attitude toward risk may be a useful control variable in future research.

Another reason for the unexpected inventory *ownership* results may stem from the unique application of the transaction attribute in this context. Asset specificity has been used in many studies to represent the level of dependence in a dyadic relationship. For example, Joshi and Stump (1999) found that a supplying firm may be motivated to behave opportunistically and take advantage of its position of power, Heide and John (1992) found that high levels of buyer asset specificity led to low levels of buyer control, and Sriram, Krapfel, and Speckman (1992) concluded that supplier-specific investments are negatively related to perceived buying dependence. Therefore, utilizing the level of asset specificity to test for power or dependence in buyer/supplier relationships is not novel, but the operationalization is typically in the form of the assets used to produce the product or service that is to be transferred between the parties in the transaction (Nooteboom, 1993; Rindfleisch & Heide, 1997; David & Han, 2004), rather than operationalizing asset specificity in terms of the product itself, as was the application here. Since the context of this research regards making inventory management decisions for an externally sourced item from the perspective of the buying firm, there are no production assets, specific or otherwise, to consider without broadening the research perspective to include the supplying firm. Hence, the degree to which the item itself is in a customized or common form represented the core aspects of asset specificity, that is being "locked in" due to the cost and difficulty of switching suppliers

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and thereby becoming vulnerable to opportunistic behavior on the part of the supplier, and was thus used to operationalize this transaction attribute from a buyer's perspective.

An alternative approach would have been to operationalize this variable in a more traditional manner by doing so in terms of the investment the buyer makes in the supplier relationship when an item is customized, an investment that is not easily transferred to another supplier. However, it is not clear that this alteration in the theoretical application would have changed the results of the experiment, as the cues in the scenario would still have indicated a customized item with high switching costs to represent a high level of asset specificity, and a common item with low switching costs to represent a low level.

Uncertainty and Frequency

The level of uncertainty was operationalized in terms of supply uncertainty only, as the level of demand uncertainty would have confounded the impact of this variable, a narrow definition that may also be viewed as a limitation in this study. Walker and Weber (1984) were the first to uncover the mulitidimensionality of the uncertainty construct (Rindfleisch & Heide, 1997), finding that the aspect of uncertainty being studied may have opposing effects on the governance decision. This was clearly a potential issue with regard to supply and demand uncertainty as demand uncertainty has been found to have the opposite impact as supply uncertainty in the postponement literature (see Table 2), with supply uncertainty leading to a decision to speculate with regard to the activity, and demand uncertainty motivating the opposite decision, that is to postpone the activity to the latest possible moment.

For that reason, the definition of the uncertainty construct was limited to supply uncertainty to improve its potential predictive power. And as frequency has been used as proxy for the forecasted demand of the item in previous research (Pilling, et al.,

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1994), the impact of demand uncertainty was intended to be communicated in the frequency related cues, in that demand is more certain when a product is used frequently, and less certain when the product is used less frequently. However, the question in the research instrument that most closely ties frequency to demand uncertainty (the ability to forecast future usage) did not load on the frequency factor (nor did it load well on any factor) and as such was removed from the analysis. Therefore, future research should include both demand and supply uncertainty, along with frequency, as independent variables.

Data Analysis Approach

The data analysis approach taken in this research examined each of the propositions from at least two perspectives with multiple sets of hypotheses. This may be seen as a limitation or a contribution. The potential limitation is that the researcher may be seen as blindly trying a myriad of tests until finding one that produces the desired results, rather than methodically choosing the best tool to test a particular proposition with a single set of hypotheses. On the other hand, the potential contribution of using multiple tests is to provide a preponderance of evidence that either point to support or non-support for a single proposition based on all related hypotheses.

In the case of this research, the multiple tests conducted related to a single proposition generally pointed to the same conclusion, meaning that regardless of the perspective taken the researcher could be confident in the results reported. However, some of the tests do not provide the between cell type of analysis that is typically seen in an experimental design. For example, the non-parametric chi-square tests conducted examine only the within-cell variance of each individual experimental cell, limiting the usefulness of these results for theoretical purposes but providing interesting practical insights on how subjects are making these decisions. However, the logistic regression

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models conducted do reflect between-cell analyses of the data collected and should therefore be the focus related to testing the theoretical model.

FUTURE RESEARCH

Additional perspectives

While TCE served to augment the previous research which considered only channel costs in making inventory *placement* and *ownership* decisions, a single ideal inventory *placement* decision was not derived for all of the scenarios considered in the conceptual framework with this theoretical lens. Additional theoretical lenses may help to more concisely discern the preferred overall inventory management approach choice for these scenarios (i.e. Propositions 6 and 7). For example, the application of Resource-Based-View (RBV) of the firm, which has been used in previous research to determine what should be kept within the boundaries of a firm versus what should be sought from an outside entity based on the core competencies of the supply chain members, may be useful lens (Barney, 1991). Resource Dependence theory may also contribute to the study of inventory *ownership* and *placement* choice as a buying firm's ability to choose a particular inventory management approach may be impacted in part by the degree to which it is either dependent on or has power over the supplier (Pfeffer & Salancik, 1978), and asset specificity factor alone did not seem to adequately represent the level of buyer power or buyer dependence in the scenarios.

In addition to the possible inclusion of supplementary theoretical lenses to determine the single ideal inventory management approach for all scenarios, future research could also apply a contingency perspective (Miles, Snow, Meyer, & Coleman, 1978; Miller, 1986; Miller, 1996). Contingency theory posits that when a firm chooses the 'right' strategy or approach to address its particular circumstance, optimal performance follows (Miles et al., 1978; Miller, 1987; Vorhies & Morgan, 2003; Ebben &

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Johnson, 2005). For example, applied to this context, does a buying firm faced with high levels of asset specificity, uncertainty, and frequency that chooses the buyer for inventory *ownership* and the buyer for inventory *placement* (*inventory speculation*) perform better in terms of inventory related performance metrics (e.g. purchase price, order fill rate, return on assets, inventory holding cost, etc.) than a buying firm that chooses the supplier for inventory *ownership* and the buyer for inventory *placement* (*inventory consignment*) when sourcing the same type of item in a similar circumstance?

Relaxing assumptions

Pure forms of the inventory management approaches

The subjects in the experiment were asked to choose only one member of the buyer-supplier dyad for each of the inventory management responsibilities of owning and physically handling the inventory. Through discussions during the data collection sessions (after the exercise had been completed) the researcher was made aware of many instances where hybrid forms of the four inventory management approaches were in use. In some cases the inventory was placed at the supplier location and not yet paid for by the buyer, but it wasn't a pure form of *inventory postponement* because the buyer was liable for the cost of the material if it wasn't all ordered within a particular timeframe. In another example, a firm used both *inventory speculation* and *inventory postponement*, with some items on hand for emergencies but most of the material being ordered after demand was known. These and other hybrid approaches currently in use provide opportunities for future research.

Criticality of the item

An assumption was made in this research regarding the criticality of the item being sourced. In so doing the framework presented in Chapter 3 represents the ideal inventory *ownership* and *placement* decisions for externally sourced items that represent

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the highest priority for most buyers. These are the items that will have the largest impact on a buying firm in terms of maximizing retail sales, or ensuring uninterrupted factory production or service delivery. While this research is focused on the type of item that has the potential to benefit most from the application of this conceptual framework, that is not to say that the decision drivers and ideal inventory *ownership* and *placement* decisions identified here will not apply equally well to non-critical items. It is possible that the framework is robust enough to support inventory *ownership* and *placement* decision making for non-critical items as well. However, it is also possible that the criticality of the item is a moderating factor in the model, or that the impact of making less than ideal or inconsistent inventory *ownership* and *placement* decisions for non-critical items is negligible, and therefore the time and effort required to apply this framework is not justified for that type of item.

Supplier point of view

This research was conducted from a buyer's point of view, a common approach in supply chain research. By representing what the buying firm should pursue in terms of inventory *ownership* and *placement* given the conditions outlined, a buying firm, who in its role as customer typically initiates the sourcing and receipt of incoming material, has been provided with a framework to be used in the initial stages of that decision-making process. Once the buying firm has determined which inventory *ownership* and *placement* approach is ideal for a particular sourced item, the next logical step is to communicate this decision to the other member in the buyer-supplier dyad, namely the supplier. In the event that the buying firm's ideal choice of inventory management approach requires some level of cooperation from the supplier, such as in the use of one of the forms of consignment, the supplier's ideal inventory *ownership* and *placement* decisions may come into play. Should the supplier's ideal choice of inventory *ownership*

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and *placement* not coincide with that of the buying firm, the supplier's ideal inventory *ownership* and *placement* decisions may be a moderating factor in the conceptual model.

Related research streams

One aspect of inventory management decision-making that was not addressed in this research is the question of who, either the buying firm or supplier, should make decisions regarding inventory reorder points and the timing of order delivery. These decisions are typically under the supplier's purview when a vendor-managed-inventory (VMI) or supplier-managed-inventory (SMI) arrangement is in place (Pohlen & Goldsby, 2003). While some have equated VMI or SMI to the use of *inventory consignment*, the decision of who should be responsible for inventory replenishment and the timing of deliveries is, in fact, a separate consideration in the buyer-supplier dyad. Either the buying firm or the supplier can perform that activity in conjunction with any of the inventory management approaches discussed here, and thus it deserves its own analysis of decision drivers.

As a final suggestion for future research, the lack of any modeling or empirical studies pertaining to the use of *reverse inventory consignment* has been identified as a gap in the literature. Future research in the same vein as has been previously conducted for *inventory consignment* could identify whether similar supply chain advantages exist with the use of the *reverse* form of this inventory management approach.

CONCLUSION

This dissertation expands the understanding of what motivates a buyer's choice of inventory *ownership*, inventory *placement* and the overall inventory management approach for a particular externally sourced item. From an academic perspective, this

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research contributes to existing literature by decoupling the inventory *ownership* and inventory *placement* decisions and concurrently examining the choice of *inventory speculation, inventory postponement, inventory consignment,* and *reverse inventory consignment* for incoming inventory of an externally sourced item in a single theoretically-based framework. In so doing, this research fills a gap noted in the distribution channels literature, namely the need for a framework for operations decision-making on the feasibility of various postponement applications in specific operating circumstances (Van Hoek, 2001). One such application is the study of inventory management approaches that consider the decoupling of *ownership* and *placement* responsibilities and address issues of upstream time and place postponement (Van Hoek, 2001).

The conceptual framework and propositions offered represent the ideal inventory *ownership* and *placement* decisions a buying firm should make for a particular externally sourced item when faced with the conditions described by the transaction attributes. Through the use of stated preference methodology, and specifically a passive role-playing experiment, the propositions and related hypotheses were empirically tested by means of chi-square and logistic regression analyses to determine what buyers actually would do in a given situation. Findings include general support for the roles of asset specificity and uncertainty as decision drivers, weak support for the frequency construct, and an unexpected bias exhibited by buyers, who, on the whole, chose the supplier for inventory *ownership* regardless of the buying firm's potential dependency on the supplier.

As a framework that provides the ideal conditions for each inventory management approach that results from disentangling inventory *ownership* and *placement* decisions, this conceptual framework has the potential to change the way

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managers are currently making these decisions. For many practitioners, considering inventory *ownership* and *placement* as distinct decisions may be a novel idea, and those who have limited their inventory *ownership* and *placement* options based on the implicit assumption that inventory *ownership* follows its *placement* may currently be using a less than ideal inventory management approach. For managers who have considered inventory *ownership* and *placement* as distinct decisions but have not yet been able to implement their preferred inventory management approach, this framework can serve to identify the conditions that need to change in order to employ the desired approach. Or alternatively, the framework can serve to validate that the buyer is already making the ideal inventory *ownership* and *placement* decisions based on his or her current circumstances.

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APPENDIX A

RESEARCH INSTRUMENT

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This appendix contains the exercises that were presented to the participants in the passive role-playing experiment. All exercises contain the same instructions, overview about the context of the decision the subject is asked to make, and the choices available. The portion of the exercise that varies pertains to the operationalization of each of the three independent variables (treatment cells 1 through 8). Each exercise was given an alphabetic label corresponding with a given treatment cell, as follows:

Treatment Cell	Asset Specificity	Uncertainty	Frequency	Version
1	High	High	High	E
2	Low	Low	Low	F
3	High	Low	Low	H
4	Low	High	High	G
5	High	High	Low	J
6	High	Low	High	K
7	Low	High	Low	L
8	Low	Low	High	M

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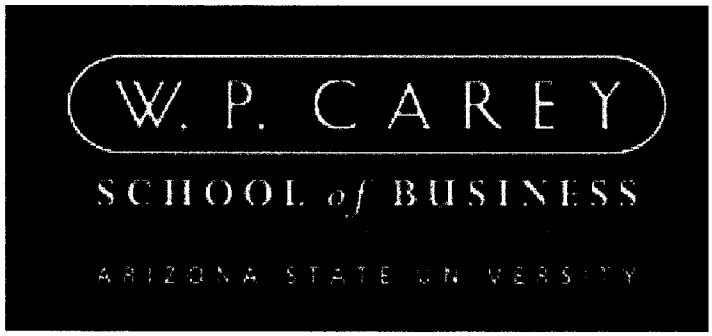

The "Inventory Management Decision" Exercise
VERSION E

Purchased goods inventory represents a significant direct and indirect investment for the average manufacturing firm. How inventory of any purchased item should be managed is, therefore, an important concern. Part of addressing this concern means asking where inventory of a purchased item (e.g., motors) should be stored (i.e., at a storage facility belonging to the supplier or at a storage facility belonging to the buying firm) and which firm legally owns the inventory of a purchased item (i.e., supplier or buying firm).

This exercise hopes to gain insights into how inventory storage and ownership decisions are determined by individuals familiar with the purchasing decision. It should take you about 15-20 minutes to complete the exercise, but you may withdraw at any time. Your participation is completely voluntary. Return of the exercise will be considered your consent to participate.

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INSTRUCTIONS: Please read the following scenario and then answer the questions related to this scenario and **your** choice of inventory management approach.

Scenario

You work for a global manufacturing firm with approximately 30 manufacturing plants around the world. The 30 manufacturing plants make a number of durable consumer goods (e.g., dishwashers, dryers, etc.) for various markets. Each manufacturing plant has at least 3 different conveyor systems, operating three shifts, 7 days a week. When a conveyor system fails, all materials and work-in-progress is moved manually on carts within the manufacturing plant; hence, slowing down production.

You are a corporate buyer responsible for motors (unit cost = $5,000) needed to operate the conveyor systems across all manufacturing plants for the firm. Three potential suppliers submitted bids for your conveyor system motor business and a single supplier, XYZ, was selected. The approach to managing inventory of these motors (i.e., storage and ownership decisions) has not yet been decided.

TASK: Choose the best inventory management approach for the inventory of motors.

Information about the Motor

- The motor used in the conveyor systems within the 30 manufacturing plants is built according to specifications that are unique to your firm's conveyor systems.
- The motor within each conveyor system is expected to be replaced approximately 4 times a year. The replacement frequency for other motors in your factories ranges from quarterly to once every 2 years.
- At this replacement frequency the number of motors purchased for the conveyor system is considered high compared to other purchased items.
- The motors contain an early warning signal that triggers 7 days before the motor experiences a catastrophic failure.
- The most important sub-component of the motor is PART X; there have been frequently reported shortages for PART X in the past two years.

Information about XYZ (the Selected Supplier)

- XYZ has quoted you a standard order-to-fulfillment (i.e., time between when an order for motors is placed and when you receive the order) lead-time of 2 weeks. After the business was awarded, you found out that XYZ frequently misses promised delivery times and has an on-time delivery of only 70%, compared to the industry average of 90%.
- XYZ has a historical quality defect rate of 8%, compared to the industry standard of 5%.
- Because of the unique motor specifications, switching to another supplier would be extremely costly in terms of time and money, especially now that XYZ has ramped up its capability and capacity to meet your firm's forecasted motor usage.

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Information about Available Inventory Management Approaches

The following inventory management choices are ALL available for you to consider implementing with respect to the motors; the advantages and disadvantages of each choice are also highlighted.

Inventory Storage Location

Inventory Ownership	*Buyer*	*Supplier*
Buyer	**Inventory Speculation** Purchase the motors and hold them in inventory at your firm's storage facilities in advance of actual replacement needs Advantages: • Motors on-hand when needed • Protection against future price increases Disadvantages: • Inventory investment opportunity cost • Inventory storage, handling and tracking expense • Inventory obsolescence expense	**Reverse Inventory Consignment** Pay for the motors in advance of actual replacement needs, but leave the motors in inventory at the supplier's storage facilities until a replacement motor is needed Advantages: • Motors on-hand at supplier location • Protection against future price increases • No inventory storage, handling and tracking expense Disadvantages: • Inventory investment opportunity cost • Inventory obsolescence expense
Supplier	**Inventory Consignment** Hold the motors in inventory at your firm's storage facilities in advance of actual replacement needs, but do not pay for a motor until it is used in the factory Advantages: • Motors on-hand when needed • No inventory investment opportunity cost • No inventory obsolescence expense Disadvantages: • Subject to future price increases • Inventory storage, handling and tracking expense	**Inventory Postponement** Wait to purchase and take receipt of the motors until a replacement motor is needed in the factory Advantages: • No inventory obsolescence expense • No inventory investment opportunity cost • No inventory storage, handling and tracking expense Disadvantages: • Lost production when a motor is not available when needed • Subject to future price increases

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PART A. Please answer the following questions based on your perceptions of the scenario presented and in your role as the buyer. There are no "right or wrong" answers.

1a. How unique is the design of the motor supplied by XYZ for your firm's conveyor systems?

1	2	3	4	5	Don't
Very Common	Common	Neither	Unique	Very Unique	Know

1b. How difficult would it be for you to switch motor suppliers?

1	2	3	4	5	Don't
Very Easy	Easy	Neither	Difficult	Very Difficult	Know

1c. How costly would it be for you to switch motor suppliers?

1	2	3	4	5	Don't
Very Inexpensive	Inexpensive	Neither	Costly	Very Costly	Know

2a. How would you rate XYZ's level of quality compared to other suppliers in the industry?

1	2	3	4	5	Don't
Much Worse Than	Worse Than	Neither	Better Than	Much Better Than	Know

2b. How confident are you that XYZ will be able to deliver motors to you on-time?

1	2	3	4	5	Don't
Very Doubtful	Doubtful	Neither	Confident	Very Confident	Know

2c. How confident are you that XYZ will be able to obtain PART X?

1	2	3	4	5	Don't
Very Doubtful	Doubtful	Neither	Confident	Very Confident	Know

2d. What is the likelihood that XYZ will be able to deliver motors within the time between a warning signal and when the motor is needed?

1	2	3	4	5	Don't
Very Low	Low	Neither	High	Very high	Know

3a. How would you rate the volume of motors purchased for the conveyor system compared to other purchased items?

1	2	3	4	5	Don't
Very Low	Low	Neither	High	Very high	Know

3b. How would you rate the replacement frequency of motors used in the conveyor system compared to other motors used in your factories?

1	2	3	4	5	Don't
Very Low	Low	Neither	High	Very high	Know

3c. How easy would it be for you to forecast the annual usage of motors?

1	2	3	4	5	Don't
Very Difficult	Difficult	Neither	Easy	Very Easy	Know

PART B

As the buyer responsible for motors for the conveyor systems it is your responsibility to choose the ownership, storage and overall inventory management approach for this purchased item

1. In your opinion, who should own the inventory of motors?
   (Please check one and only one)

_____ Buyer (you)

_____ Supplier (XYZ)

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2. In your opinion, who should store (have physical possession) of the inventory of motors? (Please check one and only one)

_____ Buyer (you)

_____ Supplier (XYZ)

3. Which of the above four inventory management approaches would you choose to implement? (Please check one and only one)

_____Inventory Speculation

_____Inventory Postponement

_____Inventory Consignment

_____Reverse Inventory Consignment

PART C. Please indicate the degree to which each of these issues influenced your choice of inventory management approach.

	1	2	3	4	5	
1a. Common or unique motor design	No Influence		Some Influence		High Influence	Don't Know
1b. Difficulty or ease of switching suppliers	No Influence		Some Influence		High Influence	Don't Know
1c. Costs of switching suppliers	No Influence		Some Influence		High Influence	Don't Know
2a. XYZ's level of quality	No Influence		Some Influence		High Influence	Don't Know
2b. XYZ's ability (or inability) to deliver motors to you on-time	No Influence		Some Influence		High Influence	Don't Know
2c. XYZ's ability (or inability) to obtain PART X	No Influence		Some Influence		High Influence	Don't Know
2d. XYZ's ability (or inability) to deliver within the warning signal period	No Influence		Some Influence		High Influence	Don't Know
3a. Motor purchase volume	No Influence		Some Influence		High Influence	Don't Know
3b. Motor replacement frequency	No Influence		Some Influence		High Influence	Don't Know
3c. Difficulty or ease of forecasting the annual usage of motors	No Influence		Some Influence		High Influence	Don't Know

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PART D. Please answer the following questions concerning the situation described					
1. The purchasing situation described in the study was realistic					
1 Strongly Disagree	2	3	4	5 Strongly Agree	Don't Know
2. I took my role seriously					
1 Strongly Disagree	2	3	4	5 Strongly Agree	Don't Know
3. In my work, I seldom encounter the issues discussed in this study					
1 Strongly Disagree	2	3	4	5 Strongly Agree	Don't Know
4. I am highly aware of the issues raised in this study					
1 Strongly Disagree	2	3	4	5 Strongly Agree	Don't Know

PART E – Please tell us a little about your experience

1. What is your job title? _____

2. How many years experience do you have in a purchasing role? _____

3. What industry do you work in? _____

4. What approximate annual dollar volume of purchases are you responsible for? $_____

5. Is there a general preference within your firm for one of the inventory management practices studied here? If so, which one?
   a. Purchase the item now and hold it in stock until needed (inventory speculation)
   b. Wait to purchase and take receipt of the item until demand is known (inventory postponement)
   c. Hold the item in stock now but do not pay for it until it is used (inventory consignment)
   d. Purchase the item now but leave it in the suppliers storage facility until demand is known (reverse inventory consignment)
   e. There is no preference within my firm

THANK YOU FOR YOUR PARTICIPATION!!!

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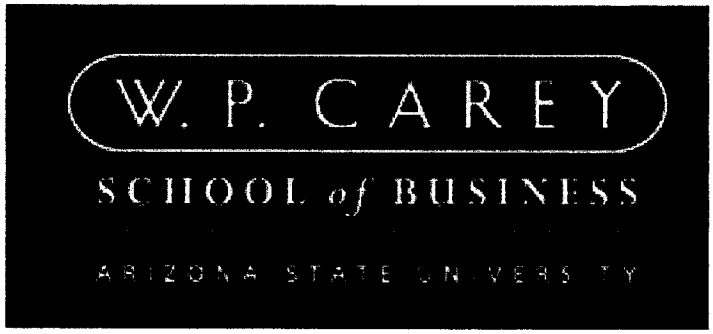

The "Inventory Management Decision" Exercise
VERSION F

Purchased goods inventory represents a significant direct and indirect investment for the average manufacturing firm. How inventory of any purchased item should be managed is, therefore, an important concern. Part of addressing this concern means asking where inventory of a purchased item (e.g., motors) should be stored (i.e., at a storage facility belonging to the supplier or at a storage facility belonging to the buying firm) and which firm legally owns the inventory of a purchased item (i.e., supplier or buying firm).

This exercise hopes to gain insights into how inventory storage and ownership decisions are determined by individuals familiar with the purchasing decision. It should take you about 15-20 minutes to complete the exercise, but you may withdraw at any time. Your participation is completely voluntary. Return of the exercise will be considered your consent to participate.

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INSTRUCTIONS: Please read the following scenario and then answer the questions related to this scenario and **your** choice of inventory management approach.

Scenario

You work for a global manufacturing firm with approximately 30 manufacturing plants around the world. The 30 manufacturing plants make a number of durable consumer goods (e.g., dishwashers, dryers, etc.) for various markets. Each manufacturing plant has at least 3 different conveyor systems, operating three shifts, 7 days a week. When a conveyor system fails, all materials and work-in-progress is moved manually on carts within the manufacturing plant; hence, slowing down production.

You are a corporate buyer responsible for motors (unit cost = $5,000) needed to operate the conveyor systems across all manufacturing plants for the firm. Three potential suppliers submitted bids for your conveyor system motor business and a single supplier, XYZ, was selected. The approach to managing inventory of these motors (i.e., storage and ownership decisions) has not yet been decided.

TASK: Choose the best inventory management approach for the inventory of motors.

Information about the Motor

- The motor used in the conveyor systems within the 30 manufacturing plants is built according to specifications that are common to conveyor systems used by many other firms around the world.
- The motor within each conveyor system is expected to be replaced upon failure, once every 1-2 years. The replacement frequency for other motors in your factories ranges from quarterly to once every 2 years.
- At this replacement frequency the number of motors purchased for the conveyor system is considered low compared to other purchased items.
- The motors contain an early warning signal that triggers 21 days before the motor experiences a catastrophic failure.
- The most important sub-component of the motor is PART X; there have been no reported shortages for PART X in the past two years.

Information about XYZ (the Selected Supplier)

- XYZ has quoted you a standard order-to-fulfillment (i.e., time between when an order for motors is placed and when you receive the order) lead-time of 2 weeks. After the business was awarded, you found out that XYZ consistently meets promised delivery times and has an on-time delivery of 99%, compared to the industry average of 90%.
- XYZ has a historical quality defect rate of 2%, compared to the industry standard of 5%.
- Because of the common motor specifications, switching to another supplier would be very inexpensive in terms of time and money, even though XYZ has ramped up its capability and capacity to meet your firm's forecasted motor usage.

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Information about Available Inventory Management Approaches

The following inventory management choices are ALL available for you to consider implementing with respect to the motors; the advantages and disadvantages of each choice are also highlighted.

Inventory Storage Location

Inventory Ownership	*Buyer*	*Supplier*
Buyer	**Inventory Speculation** Purchase the motors and hold them in inventory at your firm's storage facilities in advance of actual replacement needs Advantages • Motors on-hand when needed • Protection against future price increases Disadvantages • Inventory investment opportunity cost • Inventory storage, handling and tracking expense • Inventory obsolescence expense	**Reverse Inventory Consignment** Pay for the motors in advance of actual replacement needs, but leave the motors in inventory at the supplier's storage facilities until a replacement motor is needed Advantages • Motors on-hand at supplier location • Protection against future price increases • No inventory storage, handling and tracking expense Disadvantages • Inventory investment opportunity cost • Inventory obsolescence expense
Supplier	**Inventory Consignment** Hold the motors in inventory at your firm's storage facilities in advance of actual replacement needs, but do not pay for a motor until it is used in the factory Advantages • Motors on-hand when needed • No inventory investment opportunity cost • No inventory obsolescence expense Disadvantages • Subject to future price increases • Inventory storage, handling and tracking expense	**Inventory Postponement** Wait to purchase and take receipt of the motors until a replacement motor is needed in the factory Advantages • No inventory obsolescence expense • No inventory investment opportunity cost • No inventory storage, handling and tracking expense Disadvantages • Lost production when a motor is not available when needed • Subject to future price increases

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PART A. Please answer the following questions based on your perceptions of the scenario presented and in your role as the buyer. There are no "right or wrong" answers.					
1a. How unique is the design of the motor supplied by XYZ for your firm's conveyor systems?					
1 Very Common	2 Common	3 Neither	4 Unique	5 Very Unique	Don't Know
1b. How difficult would it be for you to switch motor suppliers?					
1 Very Easy	2 Easy	3 Neither	4 Difficult	5 Very Difficult	Don't Know
1c. How costly would it be for you to switch motor suppliers?					
1 Very Inexpensive	2 Inexpensive	3 Neither	4 Costly	5 Very Costly	Don't Know
2a. How would you rate XYZ's level of quality compared to other suppliers in the industry?					
1 Much Worse Than	2 Worse Than	3 Neither	4 Better Than	5 Much Better Than	Don't Know
2b. How confident are you that XYZ will be able to deliver motors to you on-time?					
1 Very Doubtful	2 Doubtful	3 Neither	4 Confident	5 Very Confident	Don't Know
2c. How confident are you that XYZ will be able to obtain PART X?					
1 Very Doubtful	2 Doubtful	3 Neither	4 Confident	5 Very Confident	Don't Know
2d. What is the likelihood that XYZ will be able to deliver motors within the time between a warning signal and when the motor is needed?					
1 Very Low	2 Low	3 Neither	4 High	5 Very high	Don't Know
3a. How would you rate the volume of motors purchased for the conveyor system compared to other purchased items?					
1 Very Low	2 Low	3 Neither	4 High	5 Very high	Don't Know
3b. How would you rate the replacement frequency of motors used in the conveyor system compared to other motors used in your factories?					
1 Very Low	2 Low	3 Neither	4 High	5 Very high	Don't Know
3c. How easy would it be for you to forecast the annual usage of motors?					
1 Very Difficult	2 Difficult	3 Neither	4 Easy	5 Very Easy	Don't Know

PART B

As the buyer responsible for motors for the conveyor systems it is your responsibility to choose the ownership, storage and overall inventory management approach for this purchased item

1. In your opinion, who should own the inventory of motors?
   (Please check one and only one)

_____ Buyer (you)

_____ Supplier (XYZ)

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2. In your opinion, who should store (have physical possession) of the inventory of motors? (Please check one and only one)

_____ Buyer (you)

_____ Supplier (XYZ)

3. Which of the above four inventory management approaches would you choose to implement? (Please check one and only one)

_____Inventory Speculation

_____Inventory Postponement

_____Inventory Consignment

_____Reverse Inventory Consignment

PART C. Please indicate the degree to which each of these issues influenced your choice of inventory management approach.

1a. Common or unique motor design					
1 No Influence	2	3 Some Influence	4	5 High Influence	Don't Know
1b. Difficulty or ease of switching suppliers					
1 No Influence	2	3 Some Influence	4	5 High Influence	Don't Know
1c. Costs of switching suppliers					
1 No Influence	2	3 Some Influence	4	5 High Influence	Don't Know
2a. XYZ's level of quality					
1 No Influence	2	3 Some Influence	4	5 High Influence	Don't Know
2b. XYZ's ability (or inability) to deliver motors to you on-time					
1 No Influence	2	3 Some Influence	4	5 High Influence	Don't Know
2c. XYZ's ability (or inability) to obtain PART X					
1 No Influence	2	3 Some Influence	4	5 High Influence	Don't Know
2d. XYZ's ability (or inability) to deliver within the warning signal period					
1 No Influence	2	3 Some Influence	4	5 High Influence	Don't Know
3a. Motor purchase volume					
1 No Influence	2	3 Some Influence	4	5 High Influence	Don't Know
3b. Motor replacement frequency					
1 No Influence	2	3 Some Influence	4	5 High Influence	Don't Know
3c. Difficulty or ease of forecasting the annual usage of motors					
1 No Influence	2	3 Some Influence	4	5 High Influence	Don't Know

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PART D. Please answer the following questions concerning the situation described					
1. The purchasing situation described in the study was realistic					
1 Strongly Disagree	2	3	4	5 Strongly Agree	Don't Know
2. I took my role seriously					
1 Strongly Disagree	2	3	4	5 Strongly Agree	Don't Know
3. In my work, I seldom encounter the issues discussed in this study					
1 Strongly Disagree	2	3	4	5 Strongly Agree	Don't Know
4. I am highly aware of the issues raised in this study					
1 Strongly Disagree	2	3	4	5 Strongly Agree	Don't Know

PART E – Please tell us a little about your experience

1. What is your job title? _____

2. How many years experience do you have in a purchasing role? _____

3. What industry do you work in? _____

4. What approximate annual dollar volume of purchases are you responsible for? $_____

5. Is there a general preference within your firm for one of the inventory management practices studied here? If so, which one?
   a. Purchase the item now and hold it in stock until needed (inventory speculation)
   b. Wait to purchase and take receipt of the item until demand is known (inventory postponement)
   c. Hold the item in stock now but do not pay for it until it is used (inventory consignment)
   d. Purchase the item now but leave it in the suppliers storage facility until demand is known (reverse inventory consignment)
   e. There is no preference within my firm

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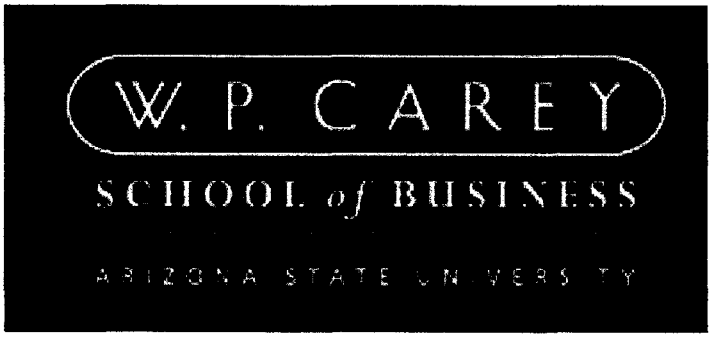

The "Inventory Management Decision" Exercise
VERSION G

Purchased goods inventory represents a significant direct and indirect investment for the average manufacturing firm. How inventory of any purchased item should be managed is, therefore, an important concern. Part of addressing this concern means asking where inventory of a purchased item (e.g., motors) should be stored (i.e., at a storage facility belonging to the supplier or at a storage facility belonging to the buying firm) and which firm legally owns the inventory of a purchased item (i.e., supplier or buying firm).

This exercise hopes to gain insights into how inventory storage and ownership decisions are determined by individuals familiar with the purchasing decision. It should take you about 15-20 minutes to complete the exercise, but you may withdraw at any time. Your participation is completely voluntary. Return of the exercise will be considered your consent to participate.

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INSTRUCTIONS: Please read the following scenario and then answer the questions related to this scenario and **your** choice of inventory management approach.

Scenario

You work for a global manufacturing firm with approximately 30 manufacturing plants around the world. The 30 manufacturing plants make a number of durable consumer goods (e.g., dishwashers, dryers, etc.) for various markets. Each manufacturing plant has at least 3 different conveyor systems, operating three shifts, 7 days a week. When a conveyor system fails, all materials and work-in-progress is moved manually on carts within the manufacturing plant; hence, slowing down production.

You are a corporate buyer responsible for motors (unit cost = $5,000) needed to operate the conveyor systems across all manufacturing plants for the firm. Three potential suppliers submitted bids for your conveyor system motor business and a single supplier, XYZ, was selected. The approach to managing inventory of these motors (i.e., storage and ownership decisions) has not yet been decided.

TASK: Choose the best inventory management approach for the inventory of motors.

Information about the Motor

- The motor used in the conveyor systems within the 30 manufacturing plants is built according to specifications that are common to conveyor systems used by many other firms around the world.
- The motor within each conveyor system is expected to be replaced approximately 4 times a year. The replacement frequency for other motors in your factories ranges from quarterly to once every 2 years.
- At this replacement frequency the number of motors purchased for the conveyor system is considered high compared to other purchased items.
- The motors contain an early warning signal that triggers 7 days before the motor experiences a catastrophic failure.
- The most important sub-component of the motor is PART X; there have been frequently reported shortages for PART X in the past two years.

Information about XYZ (the Selected Supplier)

- XYZ has quoted you a standard order-to-fulfillment (i.e., time between when an order for motors is placed and when you receive the order) lead-time of 2 weeks. After the business was awarded, you found out that XYZ frequently misses promised delivery times and has an on-time delivery of only 70%, compared to the industry average of 90%.
- XYZ has a historical quality defect rate of 8%, compared to the industry standard of 5%.
- Because of the common motor specifications, switching to another supplier would be very inexpensive in terms of time and money, even though XYZ has ramped up its capability and capacity to meet your firm's forecasted motor usage.

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Information about Available Inventory Management Approaches

The following inventory management choices are ALL available for you to consider implementing with respect to the motors; the advantages and disadvantages of each choice are also highlighted.

Inventory Storage Location

Inventory Ownership	*Buyer*	*Supplier*
Buyer	**Inventory Speculation** Purchase the motors and hold them in inventory at your firm's storage facilities in advance of actual replacement needs Advantages • Motors on-hand when needed • Protection against future price increases Disadvantages • Inventory investment opportunity cost • Inventory storage, handling and tracking expense • Inventory obsolescence expense	**Reverse Inventory Consignment** Pay for the motors in advance of actual replacement needs, but leave the motors in inventory at the supplier's storage facilities until a replacement motor is needed Advantages • Motors on-hand at supplier location • Protection against future price increases • No inventory storage, handling and tracking expense Disadvantages • Inventory investment opportunity cost • Inventory obsolescence expense
Supplier	**Inventory Consignment** Hold the motors in inventory at your firm's storage facilities in advance of actual replacement needs, but do not pay for a motor until it is used in the factory Advantages • Motors on-hand when needed • No inventory investment opportunity cost • No inventory obsolescence expense Disadvantages • Subject to future price increases • Inventory storage, handling and tracking expense	**Inventory Postponement** Wait to purchase and take receipt of the motors until a replacement motor is needed in the factory Advantages • No inventory obsolescence expense • No inventory investment opportunity cost • No inventory storage, handling and tracking expense Disadvantages • Lost production when a motor is not available when needed • Subject to future price increases

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PART A. Please answer the following questions based on your perceptions of the scenario presented and in your role as the buyer. There are no "right or wrong" answers.

1a. How unique is the design of the motor supplied by XYZ for your firm's conveyor systems?

1	2	3	4	5	
Very Common	Common	Neither	Unique	Very Unique	Don't Know

1b. How difficult would it be for you to switch motor suppliers?

1	2	3	4	5	
Very Easy	Easy	Neither	Difficult	Very Difficult	Don't Know

1c. How costly would it be for you to switch motor suppliers?

1	2	3	4	5	
Very Inexpensive	Inexpensive	Neither	Costly	Very Costly	Don't Know

2a. How would you rate XYZ's level of quality compared to other suppliers in the industry?

1	2	3	4	5	
Much Worse Than	Worse Than	Neither	Better Than	Much Better Than	Don't Know

2b. How confident are you that XYZ will be able to deliver motors to you on-time?

1	2	3	4	5	
Very Doubtful	Doubtful	Neither	Confident	Very Confident	Don't Know

2c. How confident are you that XYZ will be able to obtain PART X?

1	2	3	4	5	
Very Doubtful	Doubtful	Neither	Confident	Very Confident	Don't Know

2d. What is the likelihood that XYZ will be able to deliver motors within the time between a warning signal and when the motor is needed?

1	2	3	4	5	
Very Low	Low	Neither	High	Very high	Don't Know

3a. How would you rate the volume of motors purchased for the conveyor system compared to other purchased items?

1	2	3	4	5	
Very Low	Low	Neither	High	Very high	Don't Know

3b. How would you rate the replacement frequency of motors used in the conveyor system compared to other motors used in your factories?

1	2	3	4	5	
Very Low	Low	Neither	High	Very high	Don't Know

3c. How easy would it be for you to forecast the annual usage of motors?

1	2	3	4	5	
Very Difficult	Difficult	Neither	Easy	Very Easy	Don't Know

PART B

As the buyer responsible for motors for the conveyor systems it is your responsibility to choose the ownership, storage and overall inventory management approach for this purchased item

1. In your opinion, who should own the inventory of motors?
   (Please check one and only one)

_____ Buyer (you)

_____ Supplier (XYZ)

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2. In your opinion, who should store (have physical possession) of the inventory of motors? (Please check one and only one)

_____ Buyer (you)

_____ Supplier (XYZ)

3. Which of the above four inventory management approaches would you choose to implement? (Please check one and only one)

_____Inventory Speculation

_____Inventory Postponement

_____Inventory Consignment

_____Reverse Inventory Consignment

PART C. Please indicate the degree to which each of these issues influenced your choice of inventory management approach.

1a. Common or unique motor design					
1 No Influence	2	3 Some Influence	4	5 High Influence	Don't Know
1b. Difficulty or ease of switching suppliers					
1 No Influence	2	3 Some Influence	4	5 High Influence	Don't Know
1c. Costs of switching suppliers					
1 No Influence	2	3 Some Influence	4	5 High Influence	Don't Know
2a. XYZ's level of quality					
1 No Influence	2	3 Some Influence	4	5 High Influence	Don't Know
2b. XYZ's ability (or inability) to deliver motors to you on-time					
1 No Influence	2	3 Some Influence	4	5 High Influence	Don't Know
2c. XYZ's ability (or inability) to obtain PART X					
1 No Influence	2	3 Some Influence	4	5 High Influence	Don't Know
2d. XYZ's ability (or inability) to deliver within the warning signal period					
1 No Influence	2	3 Some Influence	4	5 High Influence	Don't Know
3a. Motor purchase volume					
1 No Influence	2	3 Some Influence	4	5 High Influence	Don't Know
3b. Motor replacement frequency					
1 No Influence	2	3 Some Influence	4	5 High Influence	Don't Know
3c. Difficulty or ease of forecasting the annual usage of motors					
1 No Influence	2	3 Some Influence	4	5 High Influence	Don't Know

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PART D. Please answer the following questions concerning the situation described					
1. The purchasing situation described in the study was realistic					
1 Strongly Disagree	2	3	4	5 Strongly Agree	Don't Know
2. I took my role seriously					
1 Strongly Disagree	2	3	4	5 Strongly Agree	Don't Know
3. In my work, I seldom encounter the issues discussed in this study					
1 Strongly Disagree	2	3	4	5 Strongly Agree	Don't Know
4. I am highly aware of the issues raised in this study					
1 Strongly Disagree	2	3	4	5 Strongly Agree	Don't Know

PART E – Please tell us a little about your experience

1. What is your job title? _____

2. How many years experience do you have in a purchasing role? _____

3. What industry do you work in? _____

4. What approximate annual dollar volume of purchases are you responsible for? $_____

5. Is there a general preference within your firm for one of the inventory management practices studied here? If so, which one?
   a. Purchase the item now and hold it in stock until needed (inventory speculation)
   b. Wait to purchase and take receipt of the item until demand is known (inventory postponement)
   c. Hold the item in stock now but do not pay for it until it is used (inventory consignment)
   d. Purchase the item now but leave it in the suppliers storage facility until demand is known (reverse inventory consignment)
   e. There is no preference within my firm

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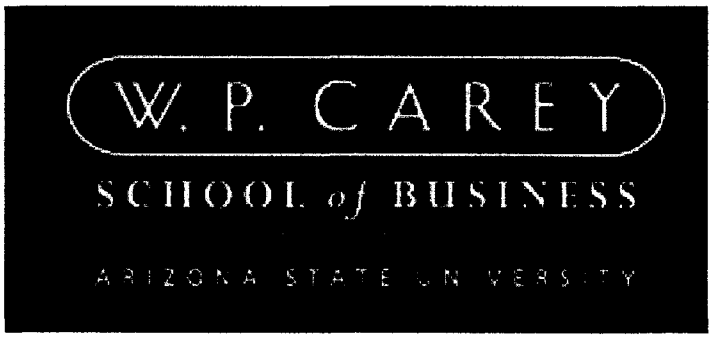

The "Inventory Management Decision" Exercise
VERSION H

Purchased goods inventory represents a significant direct and indirect investment for the average manufacturing firm. How inventory of any purchased item should be managed is, therefore, an important concern. Part of addressing this concern means asking where inventory of a purchased item (e.g., motors) should be stored (i.e., at a storage facility belonging to the supplier or at a storage facility belonging to the buying firm) and which firm legally owns the inventory of a purchased item (i.e., supplier or buying firm).

This exercise hopes to gain insights into how inventory storage and ownership decisions are determined by individuals familiar with the purchasing decision. It should take you about 15-20 minutes to complete the exercise, but you may withdraw at any time. Your participation is completely voluntary. Return of the exercise will be considered your consent to participate.

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INSTRUCTIONS: Please read the following scenario and then answer the questions related to this scenario and **your** choice of inventory management approach.

Scenario

You work for a global manufacturing firm with approximately 30 manufacturing plants around the world. The 30 manufacturing plants make a number of durable consumer goods (e.g., dishwashers, dryers, etc.) for various markets. Each manufacturing plant has at least 3 different conveyor systems, operating three shifts, 7 days a week. When a conveyor system fails, all materials and work-in-progress is moved manually on carts within the manufacturing plant; hence, slowing down production.

You are a corporate buyer responsible for motors (unit cost = $5,000) needed to operate the conveyor systems across all manufacturing plants for the firm. Three potential suppliers submitted bids for your conveyor system motor business and a single supplier, XYZ, was selected. The approach to managing inventory of these motors (i.e., storage and ownership decisions) has not yet been decided.

TASK: Choose the best inventory management approach for the inventory of motors.

Information about the Motor

- The motor used in the conveyor systems within the 30 manufacturing plants is built according to specifications that are unique to your firm's conveyor systems.
- The motor within each conveyor system is expected to be replaced upon failure, once every 1-2 years. The replacement frequency for other motors in your factories ranges from quarterly to once every 2 years.
- At this replacement frequency the number of motors purchased for the conveyor system is considered low compared to other purchased items.
- The motors contain an early warning signal that triggers 21 days before the motor experiences a catastrophic failure.
- The most important sub-component of the motor is **PART X**; there have been no reported shortages for **PART X** in the past two years.

Information about XYZ (the Selected Supplier)

- XYZ has quoted you a standard order-to-fulfillment (i.e., time between when an order for motors is placed and when you receive the order) lead-time of 2 weeks. After the business was awarded, you found out that XYZ consistently meets promised delivery times and has an on-time delivery of 99%, compared to the industry average of 90%.
- XYZ has a historical quality defect rate of 2%, compared to the industry standard of 5%.
- Because of the unique motor specifications, switching to another supplier would be extremely costly in terms of time and money, especially now that XYZ has ramped up its capability and capacity to meet your firm's forecasted motor usage.

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Information about Available Inventory Management Approaches

The following inventory management choices are ALL available for you to consider implementing with respect to the motors; the advantages and disadvantages of each choice are also highlighted.

Inventory Storage Location

Inventory Ownership	*Buyer*	*Supplier*
Buyer	**Inventory Speculation** Purchase the motors and hold them in inventory at your firm's storage facilities in advance of actual replacement needs Advantages • Motors on-hand when needed • Protection against future price increases Disadvantages • Inventory investment opportunity cost • Inventory storage, handling and tracking expense • Inventory obsolescence expense	**Reverse Inventory Consignment** Pay for the motors in advance of actual replacement needs, but leave the motors in inventory at the supplier's storage facilities until a replacement motor is needed Advantages • Motors on-hand at supplier location • Protection against future price increases • No inventory storage, handling and tracking expense Disadvantages • Inventory investment opportunity cost • Inventory obsolescence expense
Supplier	**Inventory Consignment** Hold the motors in inventory at your firm's storage facilities in advance of actual replacement needs, but do not pay for a motor until it is used in the factory Advantages • Motors on-hand when needed • No inventory investment opportunity cost • No inventory obsolescence expense Disadvantages • Subject to future price increases • Inventory storage, handling and tracking expense	**Inventory Postponement** Wait to purchase and take receipt of the motors until a replacement motor is needed in the factory Advantages • No inventory obsolescence expense • No inventory investment opportunity cost • No inventory storage, handling and tracking expense Disadvantages • Lost production when a motor is not available when needed • Subject to future price increases

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PART A. Please answer the following questions based on your perceptions of the scenario presented and in your role as the buyer. There are no "right or wrong" answers.

1a. How unique is the design of the motor supplied by XYZ for your firm's conveyor systems?

1	2	3	4	5	
Very Common	Common	Neither	Unique	Very Unique	Don't Know

1b. How difficult would it be for you to switch motor suppliers?

1	2	3	4	5	
Very Easy	Easy	Neither	Difficult	Very Difficult	Don't Know

1c. How costly would it be for you to switch motor suppliers?

1	2	3	4	5	
Very Inexpensive	Inexpensive	Neither	Costly	Very Costly	Don't Know

2a. How would you rate XYZ's level of quality compared to other suppliers in the industry?

1	2	3	4	5	
Much Worse Than	Worse Than	Neither	Better Than	Much Better Than	Don't Know

2b. How confident are you that XYZ will be able to deliver motors to you on-time?

1	2	3	4	5	
Very Doubtful	Doubtful	Neither	Confident	Very Confident	Don't Know

2c. How confident are you that XYZ will be able to obtain PART X?

1	2	3	4	5	
Very Doubtful	Doubtful	Neither	Confident	Very Confident	Don't Know

2d. What is the likelihood that XYZ will be able to deliver motors within the time between a warning signal and when the motor is needed?

1	2	3	4	5	
Very Low	Low	Neither	High	Very high	Don't Know

3a. How would you rate the volume of motors purchased for the conveyor system compared to other purchased items?

1	2	3	4	5	
Very Low	Low	Neither	High	Very high	Don't Know

3b. How would you rate the replacement frequency of motors used in the conveyor system compared to other motors used in your factories?

1	2	3	4	5	
Very Low	Low	Neither	High	Very high	Don't Know

3c. How easy would it be for you to forecast the annual usage of motors?

1	2	3	4	5	
Very Difficult	Difficult	Neither	Easy	Very Easy	Don't Know

PART B

As the buyer responsible for motors for the conveyor systems it is your responsibility to choose the ownership, storage and overall inventory management approach for this purchased item

1. In your opinion, who should own the inventory of motors?
   (Please check one and only one)

_____ Buyer (you)

_____ Supplier (XYZ)

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2. In your opinion, who should store (have physical possession) of the inventory of motors? (Please check one and only one)

_____ Buyer (you)

_____ Supplier (XYZ)

3. Which of the above four inventory management approaches would you choose to implement? (Please check one and only one)

_____Inventory Speculation

_____Inventory Postponement

_____Inventory Consignment

_____Reverse Inventory Consignment

PART C. Please indicate the degree to which each of these issues influenced your choice of inventory management approach.

	1	2	3	4	5	Don't Know
1a. Common or unique motor design	No Influence		Some Influence		High Influence	
1b. Difficulty or ease of switching suppliers	No Influence		Some Influence		High Influence	
1c. Costs of switching suppliers	No Influence		Some Influence		High Influence	
2a. XYZ's level of quality	No Influence		Some Influence		High Influence	
2b. XYZ's ability (or inability) to deliver motors to you on-time	No Influence		Some Influence		High Influence	
2c. XYZ's ability (or inability) to obtain PART X	No Influence		Some Influence		High Influence	
2d. XYZ's ability (or inability) to deliver within the warning signal period	No Influence		Some Influence		High Influence	
3a. Motor purchase volume	No Influence		Some Influence		High Influence	
3b. Motor replacement frequency	No Influence		Some Influence		High Influence	
3c. Difficulty or ease of forecasting the annual usage of motors	No Influence		Some Influence		High Influence	

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PART D. Please answer the following questions concerning the situation described					
1. The purchasing situation described in the study was realistic					
1 Strongly Disagree	2	3	4	5 Strongly Agree	Don't Know
2. I took my role seriously					
1 Strongly Disagree	2	3	4	5 Strongly Agree	Don't Know
3. In my work, I seldom encounter the issues discussed in this study					
1 Strongly Disagree	2	3	4	5 Strongly Agree	Don't Know
4. I am highly aware of the issues raised in this study					
1 Strongly Disagree	2	3	4	5 Strongly Agree	Don't Know

PART E – Please tell us a little about your experience

1. What is your job title? _____

2. How many years experience do you have in a purchasing role? _____

3. What industry do you work in? _____

4. What approximate annual dollar volume of purchases are you responsible for? $_____

5. Is there a general preference within your firm for one of the inventory management practices studied here? If so, which one?
   a. Purchase the item now and hold it in stock until needed (inventory speculation)
   b. Wait to purchase and take receipt of the item until demand is known (inventory postponement)
   c. Hold the item in stock now but do not pay for it until it is used (inventory consignment)
   d. Purchase the item now but leave it in the suppliers storage facility until demand is known (reverse inventory consignment)
   e. There is no preference within my firm

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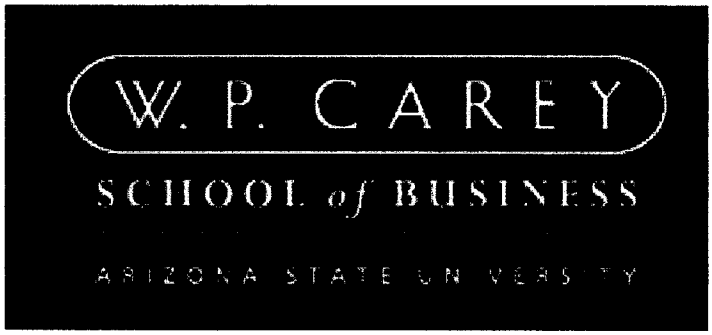

The "Inventory Management Decision" Exercise
VERSION J

Purchased goods inventory represents a significant direct and indirect investment for the average manufacturing firm. How inventory of any purchased item should be managed is, therefore, an important concern. Part of addressing this concern means asking where inventory of a purchased item (e.g., motors) should be stored (i.e., at a storage facility belonging to the supplier or at a storage facility belonging to the buying firm) and which firm legally owns the inventory of a purchased item (i.e., supplier or buying firm).

This exercise hopes to gain insights into how inventory storage and ownership decisions are determined by individuals familiar with the purchasing decision. It should take you about 15-20 minutes to complete the exercise, but you may withdraw at any time. Your participation is completely voluntary. Return of the exercise will be considered your consent to participate.

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INSTRUCTIONS: Please read the following scenario and then answer the questions related to this scenario and **your** choice of inventory management approach.

Scenario

You work for a global manufacturing firm with approximately 30 manufacturing plants around the world. The 30 manufacturing plants make a number of durable consumer goods (e.g., dishwashers, dryers, etc.) for various markets. Each manufacturing plant has at least 3 different conveyor systems, operating three shifts, 7 days a week. When a conveyor system fails, all materials and work-in-progress is moved manually on carts within the manufacturing plant; hence, slowing down production.

You are a corporate buyer responsible for motors (unit cost = $5,000) needed to operate the conveyor systems across all manufacturing plants for the firm. Three potential suppliers submitted bids for your conveyor system motor business and a single supplier, XYZ, was selected. The approach to managing inventory of these motors (i.e., storage and ownership decisions) has not yet been decided.

TASK: Choose the best inventory management approach for the inventory of motors.

Information about the Motor

- The motor used in the conveyor systems within the 30 manufacturing plants is built according to specifications that are unique to your firm's conveyor systems.
- The motor within each conveyor system is expected to be replaced upon failure, once every 1-2 years. The replacement frequency for other motors in your factories ranges from quarterly to once every 2 years.
- At this replacement frequency the number of motors purchased for the conveyor system is considered low compared to other purchased items.
- The motors contain an early warning signal that triggers 7 days before the motor experiences a catastrophic failure.
- The most important sub-component of the motor is PART X; there have been frequently reported shortages for PART X in the past two years.

Information about XYZ (the Selected Supplier)

- XYZ has quoted you a standard order-to-fulfillment (i.e., time between when an order for motors is placed and when you receive the order) lead-time of 2 weeks. After the business was awarded, you found out that XYZ frequently misses promised delivery times and has an on-time delivery of only 70%, compared to the industry average of 90%.
- XYZ has a historical quality defect rate of 8%, compared to the industry standard of 5%.
- Because of the unique motor specifications, switching to another supplier would be extremely costly in terms of time and money, especially now that XYZ has ramped up its capability and capacity to meet your firm's forecasted motor usage.

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Information about Available Inventory Management Approaches

The following inventory management choices are ALL available for you to consider implementing with respect to the motors; the advantages and disadvantages of each choice are also highlighted.

Inventory Storage Location

Inventory Ownership	*Buyer*	*Supplier*
Buyer	**Inventory Speculation** Purchase the motors and hold them in inventory at your firm's storage facilities in advance of actual replacement needs Advantages: • Motors on-hand when needed • Protection against future price increases Disadvantages: • Inventory investment opportunity cost • Inventory storage, handling and tracking expense • Inventory obsolescence expense	**Reverse Inventory Consignment** Pay for the motors in advance of actual replacement needs, but leave the motors in inventory at the supplier's storage facilities until a replacement motor is needed Advantages: • Motors on-hand at supplier location • Protection against future price increases • No inventory storage, handling and tracking expense Disadvantages: • Inventory investment opportunity cost • Inventory obsolescence expense
Supplier	**Inventory Consignment** Hold the motors in inventory at your firm's storage facilities in advance of actual replacement needs, but do not pay for a motor until it is used in the factory Advantages: • Motors on-hand when needed • No inventory investment opportunity cost • No inventory obsolescence expense Disadvantages: • Subject to future price increases • Inventory storage, handling and tracking expense	**Inventory Postponement** Wait to purchase and take receipt of the motors until a replacement motor is needed in the factory Advantages: • No inventory obsolescence expense • No inventory investment opportunity cost • No inventory storage, handling and tracking expense Disadvantages: • Lost production when a motor is not available when needed • Subject to future price increases

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PART A. Please answer the following questions based on your perceptions of the scenario presented and in your role as the buyer. There are no "right or wrong" answers.					
1a. How unique is the design of the motor supplied by XYZ for your firm's conveyor systems?					
1 Very Common	2 Common	3 Neither	4 Unique	5 Very Unique	Don't Know
1b. How difficult would it be for you to switch motor suppliers?					
1 Very Easy	2 Easy	3 Neither	4 Difficult	5 Very Difficult	Don't Know
1c. How costly would it be for you to switch motor suppliers?					
1 Very Inexpensive	2 Inexpensive	3 Neither	4 Costly	5 Very Costly	Don't Know
2a. How would you rate XYZ's level of quality compared to other suppliers in the industry?					
1 Much Worse Than	2 Worse Than	3 Neither	4 Better Than	5 Much Better Than	Don't Know
2b. How confident are you that XYZ will be able to deliver motors to you on-time?					
1 Very Doubtful	2 Doubtful	3 Neither	4 Confident	5 Very Confident	Don't Know
2c. How confident are you that XYZ will be able to obtain PART X?					
1 Very Doubtful	2 Doubtful	3 Neither	4 Confident	5 Very Confident	Don't Know
2d. What is the likelihood that XYZ will be able to deliver motors within the time between a warning signal and when the motor is needed?					
1 Very Low	2 Low	3 Neither	4 High	5 Very high	Don't Know
3a. How would you rate the volume of motors purchased for the conveyor system compared to other purchased items?					
1 Very Low	2 Low	3 Neither	4 High	5 Very high	Don't Know
3b. How would you rate the replacement frequency of motors used in the conveyor system compared to other motors used in your factories?					
1 Very Low	2 Low	3 Neither	4 High	5 Very high	Don't Know
3c. How easy would it be for you to forecast the annual usage of motors?					
1 Very Difficult	2 Difficult	3 Neither	4 Easy	5 Very Easy	Don't Know

PART B

As the buyer responsible for motors for the conveyor systems it is your responsibility to choose the ownership, storage and overall inventory management approach for this purchased item

1. In your opinion, who should own the inventory of motors?
   (Please check one and only one)

_____ Buyer (you)

_____ Supplier (XYZ)

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2. In your opinion, who should store (have physical possession) of the inventory of motors? (Please check one and only one)

_____ Buyer (you)

_____ Supplier (XYZ)

3. Which of the above four inventory management approaches would you choose to implement? (Please check one and only one)

_____Inventory Speculation

_____Inventory Postponement

_____Inventory Consignment

_____Reverse Inventory Consignment

PART C. Please indicate the degree to which each of these issues influenced your choice of inventory management approach.

	1	2	3	4	5	
1a. Common or unique motor design	No Influence		Some Influence		High Influence	Don't Know
1b. Difficulty or ease of switching suppliers	No Influence		Some Influence		High Influence	Don't Know
1c. Costs of switching suppliers	No Influence		Some Influence		High Influence	Don't Know
2a. XYZ's level of quality	No Influence		Some Influence		High Influence	Don't Know
2b. XYZ's ability (or inability) to deliver motors to you on-time	No Influence		Some Influence		High Influence	Don't Know
2c. XYZ's ability (or inability) to obtain PART X	No Influence		Some Influence		High Influence	Don't Know
2d. XYZ's ability (or inability) to deliver within the warning signal period	No Influence		Some Influence		High Influence	Don't Know
3a. Motor purchase volume	No Influence		Some Influence		High Influence	Don't Know
3b. Motor replacement frequency	No Influence		Some Influence		High Influence	Don't Know
3c. Difficulty or ease of forecasting the annual usage of motors	No Influence		Some Influence		High Influence	Don't Know

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PART D. Please answer the following questions concerning the situation described					
1. The purchasing situation described in the study was realistic					
1 Strongly Disagree	2	3	4	5 Strongly Agree	Don't Know
2. I took my role seriously					
1 Strongly Disagree	2	3	4	5 Strongly Agree	Don't Know
3. In my work, I seldom encounter the issues discussed in this study					
1 Strongly Disagree	2	3	4	5 Strongly Agree	Don't Know
4. I am highly aware of the issues raised in this study					
1 Strongly Disagree	2	3	4	5 Strongly Agree	Don't Know

PART E – Please tell us a little about your experience

1. What is your job title? _____

2. How many years experience do you have in a purchasing role? _____

3. What industry do you work in? _____

4. What approximate annual dollar volume of purchases are you responsible for? $_____

5. Is there a general preference within your firm for one of the inventory management practices studied here? If so, which one?
   a. Purchase the item now and hold it in stock until needed (inventory speculation)
   b. Wait to purchase and take receipt of the item until demand is known (inventory postponement)
   c. Hold the item in stock now but do not pay for it until it is used (inventory consignment)
   d. Purchase the item now but leave it in the suppliers storage facility until demand is known (reverse inventory consignment)
   e. There is no preference within my firm

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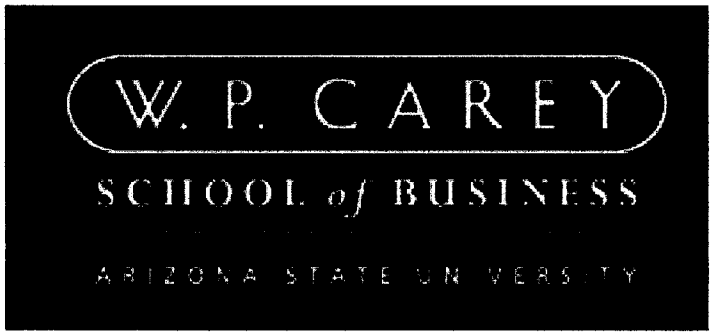

The "Inventory Management Decision" Exercise
VERSION K

Purchased goods inventory represents a significant direct and indirect investment for the average manufacturing firm. How inventory of any purchased item should be managed is, therefore, an important concern. Part of addressing this concern means asking where inventory of a purchased item (e.g., motors) should be stored (i.e., at a storage facility belonging to the supplier or at a storage facility belonging to the buying firm) and which firm legally owns the inventory of a purchased item (i.e., supplier or buying firm).

This exercise hopes to gain insights into how inventory storage and ownership decisions are determined by individuals familiar with the purchasing decision. It should take you about 15-20 minutes to complete the exercise, but you may withdraw at any time. Your participation is completely voluntary. Return of the exercise will be considered your consent to participate.

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INSTRUCTIONS: Please read the following scenario and then answer the questions related to this scenario and **your** choice of inventory management approach.

Scenario

You work for a global manufacturing firm with approximately 30 manufacturing plants around the world. The 30 manufacturing plants make a number of durable consumer goods (e.g., dishwashers, dryers, etc.) for various markets. Each manufacturing plant has at least 3 different conveyor systems, operating three shifts, 7 days a week. When a conveyor system fails, all materials and work-in-progress is moved manually on carts within the manufacturing plant; hence, slowing down production.

You are a corporate buyer responsible for motors (unit cost = $5,000) needed to operate the conveyor systems across all manufacturing plants for the firm. Three potential suppliers submitted bids for your conveyor system motor business and a single supplier, XYZ, was selected. The approach to managing inventory of these motors (i.e., storage and ownership decisions) has not yet been decided.

TASK: Choose the best inventory management approach for the inventory of motors.

Information about the Motor

- The motor used in the conveyor systems within the 30 manufacturing plants is built according to specifications that are unique to your firm's conveyor systems.
- The motor within each conveyor system is expected to be replaced approximately 4 times a year. The replacement frequency for other motors in your factories ranges from quarterly to once every 2 years.
- At this replacement frequency the number of motors purchased for the conveyor system is considered high compared to other purchased items.
- The motors contain an early warning signal that triggers 21 days before the motor experiences a catastrophic failure.
- The most important sub-component of the motor is PART X; there have been no reported shortages for PART X in the past two years.

Information about XYZ (the Selected Supplier)

- XYZ has quoted you a standard order-to-fulfillment (i.e., time between when an order for motors is placed and when you receive the order) lead-time of 2 weeks. After the business was awarded, you found out that XYZ consistently meets promised delivery times and has an on-time delivery of 99%, compared to the industry average of 90%.
- XYZ has a historical quality defect rate of 2%, compared to the industry standard of 5%.
- Because of the unique motor specifications, switching to another supplier would be extremely costly in terms of time and money, especially now that XYZ has ramped up its capability and capacity to meet your firm's forecasted motor usage.

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Information about Available Inventory Management Approaches

The following inventory management choices are ALL available for you to consider implementing with respect to the motors; the advantages and disadvantages of each choice are also highlighted.

Inventory Storage Location

Inventory Ownership	*Buyer*	*Supplier*
Buyer	**Inventory Speculation** Purchase the motors and hold them in inventory at your firm's storage facilities in advance of actual replacement needs Advantages: • Motors on-hand when needed • Protection against future price increases Disadvantages: • Inventory investment opportunity cost • Inventory storage, handling and tracking expense • Inventory obsolescence expense	**Reverse Inventory Consignment** Pay for the motors in advance of actual replacement needs, but leave the motors in inventory at the supplier's storage facilities until a replacement motor is needed Advantages: • Motors on-hand at supplier location • Protection against future price increases • No inventory storage, handling and tracking expense Disadvantages: • Inventory investment opportunity cost • Inventory obsolescence expense
Supplier	**Inventory Consignment** Hold the motors in inventory at your firm's storage facilities in advance of actual replacement needs, but do not pay for a motor until it is used in the factory Advantages: • Motors on-hand when needed • No inventory investment opportunity cost • No inventory obsolescence expense Disadvantages: • Subject to future price increases • Inventory storage, handling and tracking expense	**Inventory Postponement** Wait to purchase and take receipt of the motors until a replacement motor is needed in the factory Advantages: • No inventory obsolescence expense • No inventory investment opportunity cost • No inventory storage, handling and tracking expense Disadvantages: • Lost production when a motor is not available when needed • Subject to future price increases

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PART A. Please answer the following questions based on your perceptions of the scenario presented and in your role as the buyer. There are no "right or wrong" answers.

1a. How unique is the design of the motor supplied by XYZ for your firm's conveyor systems?

1	2	3	4	5	
Very Common	Common	Neither	Unique	Very Unique	Don't Know

1b. How difficult would it be for you to switch motor suppliers?

1	2	3	4	5	
Very Easy	Easy	Neither	Difficult	Very Difficult	Don't Know

1c. How costly would it be for you to switch motor suppliers?

1	2	3	4	5	
Very Inexpensive	Inexpensive	Neither	Costly	Very Costly	Don't Know

2a. How would you rate XYZ's level of quality compared to other suppliers in the industry?

1	2	3	4	5	
Much Worse Than	Worse Than	Neither	Better Than	Much Better Than	Don't Know

2b. How confident are you that XYZ will be able to deliver motors to you on-time?

1	2	3	4	5	
Very Doubtful	Doubtful	Neither	Confident	Very Confident	Don't Know

2c. How confident are you that XYZ will be able to obtain PART X?

1	2	3	4	5	
Very Doubtful	Doubtful	Neither	Confident	Very Confident	Don't Know

2d. What is the likelihood that XYZ will be able to deliver motors within the time between a warning signal and when the motor is needed?

1	2	3	4	5	
Very Low	Low	Neither	High	Very high	Don't Know

3a. How would you rate the volume of motors purchased for the conveyor system compared to other purchased items?

1	2	3	4	5	
Very Low	Low	Neither	High	Very high	Don't Know

3b. How would you rate the replacement frequency of motors used in the conveyor system compared to other motors used in your factories?

1	2	3	4	5	
Very Low	Low	Neither	High	Very high	Don't Know

3c. How easy would it be for you to forecast the annual usage of motors?

1	2	3	4	5	
Very Difficult	Difficult	Neither	Easy	Very Easy	Don't Know

PART B

As the buyer responsible for motors for the conveyor systems it is your responsibility to choose the ownership, storage and overall inventory management approach for this purchased item

1. In your opinion, who should own the inventory of motors?
   (Please check one and only one)

_____ Buyer (you)

_____ Supplier (XYZ)

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2. In your opinion, who should store (have physical possession) of the inventory of motors? (Please check one and only one)

_____ Buyer (you)

_____ Supplier (XYZ)

3. Which of the above four inventory management approaches would you choose to implement? (Please check one and only one)

_____Inventory Speculation

_____Inventory Postponement

_____Inventory Consignment

_____Reverse Inventory Consignment

PART C. Please indicate the degree to which each of these issues influenced your choice of inventory management approach.

	1	2	3	4	5	
1a. Common or unique motor design	No Influence		Some Influence		High Influence	Don't Know
1b. Difficulty or ease of switching suppliers	No Influence		Some Influence		High Influence	Don't Know
1c. Costs of switching suppliers	No Influence		Some Influence		High Influence	Don't Know
2a. XYZ's level of quality	No Influence		Some Influence		High Influence	Don't Know
2b. XYZ's ability (or inability) to deliver motors to you on-time	No Influence		Some Influence		High Influence	Don't Know
2c. XYZ's ability (or inability) to obtain PART X	No Influence		Some Influence		High Influence	Don't Know
2d. XYZ's ability (or inability) to deliver within the warning signal period	No Influence		Some Influence		High Influence	Don't Know
3a. Motor purchase volume	No Influence		Some Influence		High Influence	Don't Know
3b. Motor replacement frequency	No Influence		Some Influence		High Influence	Don't Know
3c. Difficulty or ease of forecasting the annual usage of motors	No Influence		Some Influence		High Influence	Don't Know

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PART D. Please answer the following questions concerning the situation described					
1. The purchasing situation described in the study was realistic					
1 Strongly Disagree	2	3	4	5 Strongly Agree	Don't Know
2. I took my role seriously					
1 Strongly Disagree	2	3	4	5 Strongly Agree	Don't Know
3. In my work, I seldom encounter the issues discussed in this study					
1 Strongly Disagree	2	3	4	5 Strongly Agree	Don't Know
4. I am highly aware of the issues raised in this study					
1 Strongly Disagree	2	3	4	5 Strongly Agree	Don't Know

PART E – Please tell us a little about your experience

1. What is your job title? _____

2. How many years experience do you have in a purchasing role? _____

3. What industry do you work in? _____

4. What approximate annual dollar volume of purchases are you responsible for? $_____

5. Is there a general preference within your firm for one of the inventory management practices studied here? If so, which one?
   a. Purchase the item now and hold it in stock until needed (inventory speculation)
   b. Wait to purchase and take receipt of the item until demand is known (inventory postponement)
   c. Hold the item in stock now but do not pay for it until it is used (inventory consignment)
   d. Purchase the item now but leave it in the suppliers storage facility until demand is known (reverse inventory consignment)
   e. There is no preference within my firm

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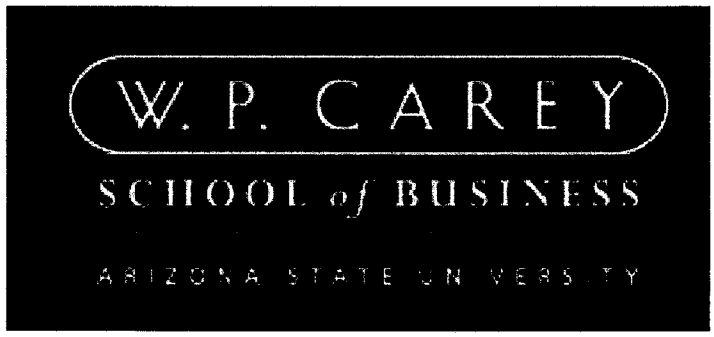

The "Inventory Management Decision" Exercise
VERSION L

Purchased goods inventory represents a significant direct and indirect investment for the average manufacturing firm. How inventory of any purchased item should be managed is, therefore, an important concern. Part of addressing this concern means asking where inventory of a purchased item (e.g., motors) should be stored (i.e., at a storage facility belonging to the supplier or at a storage facility belonging to the buying firm) and which firm legally owns the inventory of a purchased item (i.e., supplier or buying firm).

This exercise hopes to gain insights into how inventory storage and ownership decisions are determined by individuals familiar with the purchasing decision. It should take you about 15-20 minutes to complete the exercise, but you may withdraw at any time. Your participation is completely voluntary. Return of the exercise will be considered your consent to participate.

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INSTRUCTIONS: Please read the following scenario and then answer the questions related to this scenario and **your** choice of inventory management approach.

Scenario

You work for a global manufacturing firm with approximately 30 manufacturing plants around the world. The 30 manufacturing plants make a number of durable consumer goods (e.g., dishwashers, dryers, etc.) for various markets. Each manufacturing plant has at least 3 different conveyor systems, operating three shifts, 7 days a week. When a conveyor system fails, all materials and work-in-progress is moved manually on carts within the manufacturing plant; hence, slowing down production.

You are a corporate buyer responsible for motors (unit cost = $5,000) needed to operate the conveyor systems across all manufacturing plants for the firm. Three potential suppliers submitted bids for your conveyor system motor business and a single supplier, XYZ, was selected. The approach to managing inventory of these motors (i.e., storage and ownership decisions) has not yet been decided.

TASK: Choose the best inventory management approach for the inventory of motors.

Information about the Motor

- The motor used in the conveyor systems within the 30 manufacturing plants is built according to specifications that are common to conveyor systems used by many other firms around the world.
- The motor within each conveyor system is expected to be replaced upon failure, once every 1-2 years. The replacement frequency for other motors in your factories ranges from quarterly to once every 2 years.
- At this replacement frequency the number of motors purchased for the conveyor system is considered low compared to other purchased items.
- The motors contain an early warning signal that triggers 7 days before the motor experiences a catastrophic failure.
- The most important sub-component of the motor is PART X; there have been frequently reported shortages for PART X in the past two years.

Information about XYZ (the Selected Supplier)

- XYZ has quoted you a standard order-to-fulfillment (i.e., time between when an order for motors is placed and when you receive the order) lead-time of 2 weeks. After the business was awarded, you found out that XYZ frequently misses promised delivery times and has an on-time delivery of only 70%, compared to the industry average of 90%.
- XYZ has a historical quality defect rate of 8%, compared to the industry standard of 5%.
- Because of the common motor specifications, switching to another supplier would be very inexpensive in terms of time and money, even though XYZ has ramped up its capability and capacity to meet your firm's forecasted motor usage.

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Information about Available Inventory Management Approaches

The following inventory management choices are ALL available for you to consider implementing with respect to the motors; the advantages and disadvantages of each choice are also highlighted.

Inventory Storage Location

Inventory Ownership	*Buyer*	*Supplier*
Buyer	**Inventory Speculation** Purchase the motors and hold them in inventory at your firm's storage facilities in advance of actual replacement needs Advantages • Motors on-hand when needed • Protection against future price increases Disadvantages • Inventory investment opportunity cost • Inventory storage, handling and tracking expense • Inventory obsolescence expense	**Reverse Inventory Consignment** Pay for the motors in advance of actual replacement needs, but leave the motors in inventory at the supplier's storage facilities until a replacement motor is needed Advantages • Motors on-hand at supplier location • Protection against future price increases • No inventory storage, handling and tracking expense Disadvantages • Inventory investment opportunity cost • Inventory obsolescence expense
Supplier	**Inventory Consignment** Hold the motors in inventory at your firm's storage facilities in advance of actual replacement needs, but do not pay for a motor until it is used in the factory Advantages • Motors on-hand when needed • No inventory investment opportunity cost • No inventory obsolescence expense Disadvantages • Subject to future price increases • Inventory storage, handling and tracking expense	**Inventory Postponement** Wait to purchase and take receipt of the motors until a replacement motor is needed in the factory Advantages • No inventory obsolescence expense • No inventory investment opportunity cost • No inventory storage, handling and tracking expense Disadvantages • Lost production when a motor is not available when needed • Subject to future price increases

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PART A. Please answer the following questions based on your perceptions of the scenario presented and in your role as the buyer. There are no "right or wrong" answers.

1a. How unique is the design of the motor supplied by XYZ for your firm's conveyor systems?

1	2	3	4	5	
Very Common	Common	Neither	Unique	Very Unique	Don't Know

1b. How difficult would it be for you to switch motor suppliers?

1	2	3	4	5	
Very Easy	Easy	Neither	Difficult	Very Difficult	Don't Know

1c. How costly would it be for you to switch motor suppliers?

1	2	3	4	5	
Very Inexpensive	Inexpensive	Neither	Costly	Very Costly	Don't Know

2a. How would you rate XYZ's level of quality compared to other suppliers in the industry?

1	2	3	4	5	
Much Worse Than	Worse Than	Neither	Better Than	Much Better Than	Don't Know

2b. How confident are you that XYZ will be able to deliver motors to you on-time?

1	2	3	4	5	
Very Doubtful	Doubtful	Neither	Confident	Very Confident	Don't Know

2c. How confident are you that XYZ will be able to obtain PART X?

1	2	3	4	5	
Very Doubtful	Doubtful	Neither	Confident	Very Confident	Don't Know

2d. What is the likelihood that XYZ will be able to deliver motors within the time between a warning signal and when the motor is needed?

1	2	3	4	5	
Very Low	Low	Neither	High	Very high	Don't Know

3a. How would you rate the volume of motors purchased for the conveyor system compared to other purchased items?

1	2	3	4	5	
Very Low	Low	Neither	High	Very high	Don't Know

3b. How would you rate the replacement frequency of motors used in the conveyor system compared to other motors used in your factories?

1	2	3	4	5	
Very Low	Low	Neither	High	Very high	Don't Know

3c. How easy would it be for you to forecast the annual usage of motors?

1	2	3	4	5	
Very Difficult	Difficult	Neither	Easy	Very Easy	Don't Know

PART B

As the buyer responsible for motors for the conveyor systems it is your responsibility to choose the ownership, storage and overall inventory management approach for this purchased item

1. In your opinion, who should own the inventory of motors?
   (Please check one and only one)

_____ Buyer (you)

_____ Supplier (XYZ)

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2. In your opinion, who should store (have physical possession) of the inventory of motors? (Please check one and only one)

_____ Buyer (you)

_____ Supplier (XYZ)

3. Which of the above four inventory management approaches would you choose to implement? (Please check one and only one)

_____Inventory Speculation

_____Inventory Postponement

_____Inventory Consignment

_____Reverse Inventory Consignment

PART C. Please indicate the degree to which each of these issues influenced your choice of inventory management approach.

	1	2	3	4	5	
1a. Common or unique motor design	No Influence		Some Influence		High Influence	Don't Know
1b. Difficulty or ease of switching suppliers	No Influence		Some Influence		High Influence	Don't Know
1c. Costs of switching suppliers	No Influence		Some Influence		High Influence	Don't Know
2a. XYZ's level of quality	No Influence		Some Influence		High Influence	Don't Know
2b. XYZ's ability (or inability) to deliver motors to you on-time	No Influence		Some Influence		High Influence	Don't Know
2c. XYZ's ability (or inability) to obtain PART X	No Influence		Some Influence		High Influence	Don't Know
2d. XYZ's ability (or inability) to deliver within the warning signal period	No Influence		Some Influence		High Influence	Don't Know
3a. Motor purchase volume	No Influence		Some Influence		High Influence	Don't Know
3b. Motor replacement frequency	No Influence		Some Influence		High Influence	Don't Know
3c. Difficulty or ease of forecasting the annual usage of motors	No Influence		Some Influence		High Influence	Don't Know

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PART D. Please answer the following questions concerning the situation described					
1. The purchasing situation described in the study was realistic					
1 Strongly Disagree	2	3	4	5 Strongly Agree	Don't Know
2. I took my role seriously					
1 Strongly Disagree	2	3	4	5 Strongly Agree	Don't Know
3. In my work, I seldom encounter the issues discussed in this study					
1 Strongly Disagree	2	3	4	5 Strongly Agree	Don't Know
4. I am highly aware of the issues raised in this study					
1 Strongly Disagree	2	3	4	5 Strongly Agree	Don't Know

PART E – Please tell us a little about your experience

1. What is your job title? _____

2. How many years experience do you have in a purchasing role? _____

3. What industry do you work in? _____

4. What approximate annual dollar volume of purchases are you responsible for? $_____

5. Is there a general preference within your firm for one of the inventory management practices studied here? If so, which one?
   a. Purchase the item now and hold it in stock until needed (inventory speculation)
   b. Wait to purchase and take receipt of the item until demand is known (inventory postponement)
   c. Hold the item in stock now but do not pay for it until it is used (inventory consignment)
   d. Purchase the item now but leave it in the suppliers storage facility until demand is known (reverse inventory consignment)
   e. There is no preference within my firm

THANK YOU FOR YOUR PARTICIPATION!!!

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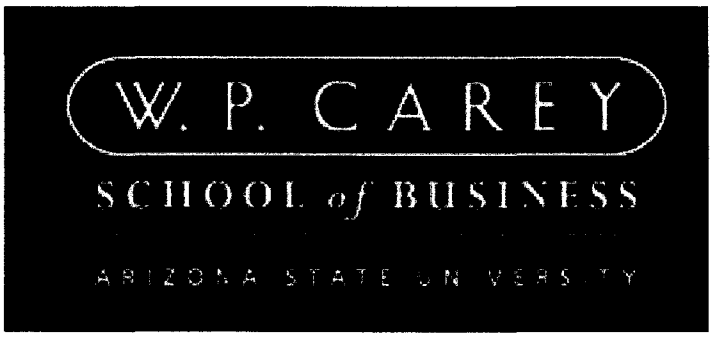

The "Inventory Management Decision" Exercise
VERSION M

Purchased goods inventory represents a significant direct and indirect investment for the average manufacturing firm. How inventory of any purchased item should be managed is, therefore, an important concern. Part of addressing this concern means asking where inventory of a purchased item (e.g., motors) should be stored (i.e., at a storage facility belonging to the supplier or at a storage facility belonging to the buying firm) and which firm legally owns the inventory of a purchased item (i.e., supplier or buying firm).

This exercise hopes to gain insights into how inventory storage and ownership decisions are determined by individuals familiar with the purchasing decision. It should take you about 15-20 minutes to complete the exercise, but you may withdraw at any time. Your participation is completely voluntary. Return of the exercise will be considered your consent to participate.

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INSTRUCTIONS: Please read the following scenario and then answer the questions related to this scenario and **your** choice of inventory management approach.

Scenario

You work for a global manufacturing firm with approximately 30 manufacturing plants around the world. The 30 manufacturing plants make a number of durable consumer goods (e.g., dishwashers, dryers, etc.) for various markets. Each manufacturing plant has at least 3 different conveyor systems, operating three shifts, 7 days a week. When a conveyor system fails, all materials and work-in-progress is moved manually on carts within the manufacturing plant; hence, slowing down production.

You are a corporate buyer responsible for motors (unit cost = $5,000) needed to operate the conveyor systems across all manufacturing plants for the firm. Three potential suppliers submitted bids for your conveyor system motor business and a single supplier, XYZ, was selected. The approach to managing inventory of these motors (i.e., storage and ownership decisions) has not yet been decided.

TASK: Choose the best inventory management approach for the inventory of motors.

Information about the Motor

- The motor used in the conveyor systems within the 30 manufacturing plants is built according to specifications that are common to conveyor systems used by many other firms around the world.
- The motor within each conveyor system is expected to be replaced approximately 4 times a year. The replacement frequency for other motors in your factories ranges from quarterly to once every 2 years.
- At this replacement frequency the number of motors purchased for the conveyor system is considered high compared to other purchased items.
- The motors contain an early warning signal that triggers 21 days before the motor experiences a catastrophic failure.
- The most important sub-component of the motor is **PART X**; there have been no reported shortages for **PART X** in the past two years.

Information about XYZ (the Selected Supplier)

- XYZ has quoted you a standard order-to-fulfillment (i.e., time between when an order for motors is placed and when you receive the order) lead-time of 2 weeks. After the business was awarded, you found out that XYZ consistently meets promised delivery times and has an on-time delivery of 99%, compared to the industry average of 90%.
- XYZ has a historical quality defect rate of 2%, compared to the industry standard of 5%.
- Because of the common motor specifications, switching to another supplier would be very inexpensive in terms of time and money, even though XYZ has ramped up its capability and capacity to meet your firm's forecasted motor usage.

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Information about Available Inventory Management Approaches

The following inventory management choices are ALL available for you to consider implementing with respect to the motors; the advantages and disadvantages of each choice are also highlighted.

Inventory Storage Location

Inventory Ownership	*Buyer*	*Supplier*
Buyer	**Inventory Speculation** Purchase the motors and hold them in inventory at your firm's storage facilities in advance of actual replacement needs Advantages: • Motors on-hand when needed • Protection against future price increases Disadvantages: • Inventory investment opportunity cost • Inventory storage, handling and tracking expense • Inventory obsolescence expense	**Reverse Inventory Consignment** Pay for the motors in advance of actual replacement needs, but leave the motors in inventory at the supplier's storage facilities until a replacement motor is needed Advantages: • Motors on-hand at supplier location • Protection against future price increases • No inventory storage, handling and tracking expense Disadvantages: • Inventory investment opportunity cost • Inventory obsolescence expense
Supplier	**Inventory Consignment** Hold the motors in inventory at your firm's storage facilities in advance of actual replacement needs, but do not pay for a motor until it is used in the factory Advantages: • Motors on-hand when needed • No inventory investment opportunity cost • No inventory obsolescence expense Disadvantages: • Subject to future price increases • Inventory storage, handling and tracking expense	**Inventory Postponement** Wait to purchase and take receipt of the motors until a replacement motor is needed in the factory Advantages: • No inventory obsolescence expense • No inventory investment opportunity cost • No inventory storage, handling and tracking expense Disadvantages: • Lost production when a motor is not available when needed • Subject to future price increases

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PART A. Please answer the following questions based on your perceptions of the scenario presented and in your role as the buyer. There are no "right or wrong" answers.

1a. How unique is the design of the motor supplied by XYZ for your firm's conveyor systems?

1	2	3	4	5	Don't
Very Common	Common	Neither	Unique	Very Unique	Know

1b. How difficult would it be for you to switch motor suppliers?

1	2	3	4	5	Don't
Very Easy	Easy	Neither	Difficult	Very Difficult	Know

1c. How costly would it be for you to switch motor suppliers?

1	2	3	4	5	Don't
Very Inexpensive	Inexpensive	Neither	Costly	Very Costly	Know

2a. How would you rate XYZ's level of quality compared to other suppliers in the industry?

1	2	3	4	5	Don't
Much Worse Than	Worse Than	Neither	Better Than	Much Better Than	Know

2b. How confident are you that XYZ will be able to deliver motors to you on-time?

1	2	3	4	5	Don't
Very Doubtful	Doubtful	Neither	Confident	Very Confident	Know

2c. How confident are you that XYZ will be able to obtain PART X?

1	2	3	4	5	Don't
Very Doubtful	Doubtful	Neither	Confident	Very Confident	Know

2d. What is the likelihood that XYZ will be able to deliver motors within the time between a warning signal and when the motor is needed?

1	2	3	4	5	Don't
Very Low	Low	Neither	High	Very high	Know

3a. How would you rate the volume of motors purchased for the conveyor system compared to other purchased items?

1	2	3	4	5	Don't
Very Low	Low	Neither	High	Very high	Know

3b. How would you rate the replacement frequency of motors used in the conveyor system compared to other motors used in your factories?

1	2	3	4	5	Don't
Very Low	Low	Neither	High	Very high	Know

3c. How easy would it be for you to forecast the annual usage of motors?

1	2	3	4	5	Don't
Very Difficult	Difficult	Neither	Easy	Very Easy	Know

PART B

As the buyer responsible for motors for the conveyor systems it is your responsibility to choose the ownership, storage and overall inventory management approach for this purchased item

1. In your opinion, who should own the inventory of motors?
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_____ Supplier (XYZ)

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2a. XYZ's level of quality						
2b. XYZ's ability (or inability) to deliver motors to you on-time						
2c. XYZ's ability (or inability) to obtain PART X						
2d. XYZ's ability (or inability) to deliver within the warning signal period						
3a. Motor purchase volume						
3b. Motor replacement frequency						
3c. Difficulty or ease of forecasting the annual usage of motors						

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