Determinants of Sourcing During Technology Growth and Maturity: An Empirical Study of e-Commerce Sourcing

RAJIV KISHORE, MANISH AGRAWAL, AND H. RAGHAV RAO

RAJIV KISHORE is an Assistant Professor in the School of Management at the State University of New York at Buffalo. His research interest is in understanding how organizations can improve their IT services delivery capability through IT outsourcing, adoption of IT innovations, and software process improvement. His papers have been published or accepted for publication in Communications of the ACM, Decision Support Systems, Information Systems Frontiers, and Journal of Healthcare Information Management. Dr. Kishore has presented his research at ICIS, AMCIS, SIM, and other national and international conferences. He received a best paper award at AMCIS 2001 and was nominated for a best paper award at AMCIS 2003. He is also the recipient of a multiyear National Science Foundation research grant as a coprincipal investigator in the area of IT outsourcing. He has consulted with a number of large companies including BellSouth, Blue Cross Blue Shield of Minnesota, IBM, and Pioneer Standard Electronics.

MANISH AGRAWAL is an Assistant Professor in the Department of Information Systems and Decision Sciences at the University of South Florida in Tampa. He completed his Ph.D. at SUNY Buffalo. His research interests include information systems outsourcing, electronic intermediaries, and software quality. His articles have appeared or have been accepted for publication in Decision Support Systems, Journal of Organizational Computing and Electronic Commerce, and Communications of the ACM. His work received the best paper award at the proceedings of the Americas Conference on Information Systems, 2001.

H. RAGHAV RAO is a Professor of MIS and an Adjunct Professor of Computer Systems Engineering at SUNY Buffalo. He is also co-Editor-in-Chief of Information Systems Frontiers and Associate Editor of Decision Support Systems, IEEE Transactions on Systems, Man, and Cybernetics, and Information Systems Research. He has published over 100 papers, of which over 60 are in archival journals such as Journal of Management Information Systems, Information Systems Research, Decision Support Systems, IEEE Transactions on Systems, Man, and Cybernetics, MIS Quarterly, Management Science, and others. His research has been supported by the NSF, the Canadian Embassy, and the Department of Defense. He is the recipient of a University (Lily) teaching grant.

ABSTRACT: This paper conducts a two-period dynamic analysis of sourcing mode choices for e-commerce projects implemented by large firms during 1999–2002. We
differentiate e-commerce assets that are the focus of a sourcing decision in terms of whether they are in the growth or maturity stages. We also consider hybrid governance mechanisms, such as minority equity arrangements, as a potential sourcing mode in addition to the conventional distinction between insourcing (i.e., hierarchical governance) and outsourcing (i.e., market governance). The rapid evolution in e-commerce technologies and their markets during this period allows us to test whether asset maturity plays any role in sourcing decisions. Results indicate that when the strategic intent of an e-commerce project is more business focused during the growth phase, hybrid governance is preferred over hierarchical governance for sourcing of e-commerce assets. Strategic intent is found not to influence sourcing mode choices during the technology/market maturity phase. Hierarchical governance is the preferred sourcing mode during the growth phase, when task complexity is high. For managing task complexity, as technologies and their markets mature, both hierarchical and hybrid governance modes become preferable to the market governance mode.

KEY WORDS AND PHRASES: asset life cycle, content analysis, e-commerce projects, e-commerce sourcing, governance forms, project strategic intent, project task complexity, sourcing determinants, sourcing modes, technology growth phase.

E-COMMERCE HAS GROWN RAPIDLY IN THE RECENT PAST. The U.S. Commerce Department stated that U.S. retail sales over the Internet grew 6.6 percent in the third quarter of 2003 to $13.29 billion, representing a growth of 27 percent compared to 2002 [7, 29, 102]. Although e-commerce technology has often been considered a subset of information technology (IT), there are significant differences in terms of the technical and managerial issues encountered. Traditional IT applications mainly focused on relatively mature functions such as desktop support, and functions such as data center and network operations that help a company run its own business [68]. On the other hand, e-commerce systems (e.g., Internet-based applications) often provide an interface between a firm and its customers and suppliers, and provide another channel to market products or services. The real strength of e-commerce (and e-business) is that the Internet makes it fast and easy to get information to clients and customers, wherever they are located. E-commerce implementations also depend more extensively on the development and use of standards than traditional IT systems. Thus, in contrast to traditional electronic data interchange (EDI), where each retailer can impose its own standard, in the Internet version of EDI (EDIINT) for the retail industry, for example, a single standard, AS2, is used to connect to all retailers [105].

E-commerce technologies and applications are an exemplar of new IT assets that have rapidly progressed through growth and maturity phases in recent times, as predicted by Klepper [49], and the boundary between their growth and maturity phases is also quite clear. Along with the growth in e-commerce, outsourcing of e-commerce technologies has become increasingly important in recent years. The industry press abounds with stories of enterprises ranging from the large to the small and mid-sized that are involved with e-commerce outsourcing (www.gartner.com). A case in point is that of Walgreens, a firm that first outsourced its e-commerce Web site for processing digital photographs to Kodak and subsequently to Fuji [8].
This paper investigates the determinants of e-commerce sourcing during the technology growth and maturity phases. Three aspects differentiate this research from prior outsourcing studies. First, there are few published scholarly studies of e-commerce sourcing in the outsourcing literature—an important gap in outsourcing research, considering that e-commerce technologies are now mainstream, and there is hardly any business organization that does not use them. Our study is, in large part, informed by prior information systems (IS) research on outsourcing, which has used a variety of theoretical lenses to understand the motivations, drivers, contractual aspects, and consequences of this IT governance strategy [25, 35, 39, 53, 56, 65, 82]. In this paper, we scientifically extend it to the e-commerce sourcing area. Second, the outsourcing literature has not considered IT assets from the perspective of growth and maturity stages of the product life cycle. It has only performed a static analysis of outsourcing drivers without considering that outsourcing motivations/drivers may actually change over time as IT assets and their markets move from the growth phase to the maturity phase on the product or evolutionary life cycles [26, 49, 91]. This distinction is quite important, because previous research has shown that, as technological products pass through their life cycle stages, product demand, product and process innovations, user learning, adopter base, and market structures change [49, 61, 78, 91, 97]. We argue that product life cycle should be an important consideration of users’ e-commerce sourcing decisions to account for changes in market maturity and user learning commensurate with product life cycle stages [3, 20, 44, 93]. Third, the outsourcing literature has addressed only two polar governance modes—outsourcing and insourcing—and has ignored hybrid governance modes, such as minority equity alliances, which began to be utilized during the Internet boom in the 1990s and are now a common mode for sourcing e-commerce assets. We not only consider markets (outsourcing) and hierarchies (insourcing) but also include hybrid governance as potential sourcing modes. The paper thus contributes to outsourcing research in general (e.g., [2, 4, 5, 6, 45, 48, 53, 54, 59, 73, 84, 92, 98]), and e-commerce outsourcing research in particular.

This paper explores e-commerce sourcing via an empirical study and seeks to address the question: For e-commerce outsourcing, what influence does strategic intent behind sourcing decisions and project task complexity have on firms’ sourcing mode choices, including hybrid governance modes, during periods of technology/market growth and maturity? We consider e-commerce projects that were sourced both during the growth phase (1999–2000) and the maturity phase (2001–2002) of the e-commerce industry. We choose January 1, 2001, as the starting point for the growth period of the e-commerce industry based on general agreements in the trade press about the time when consolidation in this industry started, in the absence of hard data about the same.

Theory

Prior Literature

PRIOR RESEARCH IN IS OUTSOURCING has examined the outsourcing phenomenon from a number of perspectives. The highlights of the literature dealing with motivations


behind outsourcing suggest that outsourcing decisions are propelled by high IT cost structures [59, 84, 92], perceived production cost advantages [4, 5, 6], external influences [4, 45, 60], and environmental uncertainty [73]. Outsourcing has even been seen as a way to overcome internal organizational politics to achieve organizational outcomes [53, 54].

Two other drivers that have been considered in other areas of research are project task complexity and strategic intent. Task complexity has been considered in the software engineering literature [51, 85], and strategic intent has been discussed in the context of managing outsourcing contract relationships [27]. However, we know of few empirical studies on sourcing that consider project task complexity and that propose strategic intent to be a driver of outsourcing decisions. We are also not aware of any study that looks at the influence of evolutionary life cycles on sourcing decisions. We consider these important gaps in the context of e-commerce outsourcing in this research. (Note: We use the terms e-commerce and e-business interchangeably in this paper.)

Research Model

E-commerce Sourcing Modes

E-COMMERCE SOURCING MODE IS DEFINED in this research as the governance form that is utilized to manage the development of e-commerce goods and services (e-commerce assets hereafter). Transaction cost economics identifies three distinct economic institutions—firms (i.e., hierarchies), markets, and hybrid forms—for organizing productive economic activity [99]. These provide different governance forms for organizing economic transactions, and utilize the governance mechanisms of hierarchical control, classical arm’s-length contracting, and relational contracting, respectively, for managing those transactions [100, 101]. In our context, sourcing of new e-commerce assets is the economic transaction of interest and it can be conducted using either one of three governance forms. The governance forms, or sourcing modes, can be distinguished in terms of the extent to which firm managers have hierarchical control over the e-commerce assets sourcing transaction [6]. On one end of the spectrum of sourcing modes is the insourcing mode, which provides the hierarchy of firm managers with full control in the task of sourcing of an e-commerce project in terms of having complete authority and responsibility for the project. On the other end of the spectrum is the outsourcing mode, which uses market mechanisms governed by arm’s-length contractual arrangements for procurement of e-commerce assets and affords firm managers little, if any, hierarchical control over the project. The hybrid sourcing mode lies in the middle of this spectrum and includes a variety of governance forms, such as relational contracting, strategic alliances, minority equity investments, and vertical contracting [9, 62, 76, 99]. Hybrid forms provide some degree of hierarchical control to firm managers over their e-commerce projects through various governance mechanisms including board-level oversight, incentive design, joint decision-making, information sharing, and so on [43, 76, 86,
A typical example of hybrid governance in the form of a minority equity investment is provided below.

W.W. Grainger Inc. and Works.com [are creating] an online purchasing system and e-marketplace for small and midsize businesses. . . . Grainger said it will contribute more than $21 million cash to Works.com. In exchange, Grainger will receive a 40% stake in Austin-based Works.com, subject to certain voting and transfer restrictions. Grainger Group President . . . will hold one of seven seats on Works.com’s board. [28, p. 1]

As with most organizational decisions, no one particular sourcing mode is inherently superior to the others, and the choice is contingent upon organizational goals and contextual and project-specific factors. For e-commerce sourcing, this research investigates the role of a key organizational goal—project strategic intent—and a project-specific feature—project task complexity—and we develop hypotheses for their roles in selecting an appropriate sourcing mode for e-commerce projects during the technology growth and maturity phases.

E-Commerce Project Strategic Intent

Strategic intent [27, 42], in the context of investments in new e-commerce assets and capabilities (hereafter referred to as e-commerce project strategic intent), essentially captures a firm’s strategic goals for appropriating returns from these investments. DiRomualdo and Gurbaxani [27] have identified three distinct IT project strategic intents—IS improvement, business impact, and commercial exploitation—on a spectrum of intents, with IS improvement at one end of the spectrum, commercial exploitation at the other, and business impact occupying the middle. These intents can be directly adapted to the e-commerce context, where improvement projects are focused on upgrading or acquiring e-commerce capabilities that serve to enhance a firm’s internal systems [12, 21, 30, 79]. E-commerce investments made with the intent of business impact are focused on developing new IT-intensive business processes and associated application systems that allow a firm to engage in competitive actions [31, 34, 81]. Firms may go a step further and exploit their new e-commerce assets in a commercial manner by creating new businesses that sell information products and services in the marketplace, and this will obviously provide the firms with the most direct and tangible returns on e-commerce investments [27]. Because business impact and commercial exploitation intents are both business oriented and more directly linked to firm performance, we refer to them in the discussion below as business-focused projects/intents. For instance, exchanges in industries such as electrical power created opportunities for regulated utilities to explore revenue opportunities in related businesses outside their core regulated businesses as shown below:

[Along with other U.S. utilities], Ameren Corp. [and Kansas City Power and Light have] signed on as partners in the development [of a business-to-business e-commerce vertical exchange for the electrical industry worldwide. The
exchange] is expected to go live in second quarter 2000. . . . The vertical exchange seeks to streamline companies’ purchasing processes while aggregating companies for increased buying power of equipment and services ranging from office supplies to transformers to heavy machinery.

[Executives at the technology partner, bex.com, said], “This vertical exchange for the electrical utilities industry effectively brings an old economy market into the new economy and [creates] enhanced revenue opportunities for the tightly regulated electric utility market.” [Senior utility company executives said], “This platform is consistent with [our] commitment to lowering the cost of operations through the use of leading technologies . . . the venture [will also help in] maximizing shareholder value by capturing growth opportunities outside our core regulated utility business.” [17, p. 1]

E-commerce project strategic intent is expected to guide the choice of an appropriate sourcing mode as part of a firm’s overall e-commerce investment decision. When a firm makes an investment for developing unique IT-intensive business processes and innovative information products and services using new technologies with the intention of engaging in competitive actions or for commercially exploiting these e-commerce assets, it is more likely to adopt hierarchical governance for sourcing these assets. Organizational and managerial processes and their associated IS embed a high degree of firm-specific tacit knowledge, which has been recognized in the knowledge-based view of the firm as an inimitable and inappropriable organizational asset [38, 74, 89, 90]. The larger the organizational span and higher the richness of these processes and knowledge systems, and the higher the uniqueness of their information products/services, the higher will be the extent of embedded firm-specific tacit knowledge in these processes and products. To gain competitive advantage from this unique knowledge asset, a firm will have to protect tacit knowledge from leakage [15, 58] to external vendors, as sharing it with vendors will erode the competitive advantage and economic rents that may otherwise be appropriated by the firm.

Further, the intellectual property that is created as a result of investments in developing unique e-commerce-enabled business processes has the potential to generate economic rents for the firm only if this property is protected properly and utilized effectively by the firm. The need for protection of e-commerce assets is highest when information products and services are sold in the open marketplace with commercial intent. However, protection of intellectual and knowledge property is quite difficult using property rights instruments such as patents, copyrights, and trade secrets, as they are narrowly defined under the law and are costly to write and enforce [58, 88]. It has been argued that firms with hierarchical controls are better positioned than markets to protect their unique knowledge assets from imitation by competitors using institutionalized capabilities available to them, such as employee conduct rules, job designs, and reducing employee mobility by promises of future incentives [32, 58].

Protection of knowledge by firms is expensive, and firms should protect only unique and valuable knowledge that can repay the costs of protection [58]. The above suggests that a firm will choose hierarchical modes of governance for sourcing e-commerce assets when the tacit knowledge component in this intellectual property is high, as is
the case when investments are being made for creating innovative and unique digital options and information products and services using new IT. On the contrary, the firm is likely to choose markets for sourcing of projects that are geared toward e-commerce capability improvement, which may include physical infrastructure improvement (such as upgrades in hardware and software related to computing, communications, network services, database management, etc.), technical skill set improvement, and implementation of new standards [21]. This is because knowledge pertaining to these types of projects is generally generic e-commerce knowledge and not firm specific, and it need not be protected through hierarchical governance. Further, generic knowledge is not only available in the marketplace; vendors are more likely to possess superior generic e-commerce knowledge due to their core competencies in e-commerce that are developed through a number of projects at a number of client organizations [57], indicating that markets are a better choice for sourcing projects geared toward e-commerce capability improvement.

Furthermore, firms will need to manage, maintain, and upgrade their business application systems using hierarchical governance on a continuing basis to develop firm-specific tacit knowledge embedded in these systems. This would also imply that firms would need to build capabilities in these systems and their underlying technologies at the outset by sourcing these application development projects using hierarchical governance modes, an argument quite consistent with recent research that posits that firm capabilities affect boundary decisions [9]. Initial development of in-house e-commerce capabilities through insourcing of application development projects is important, because capability building is path dependent in general [9, 90] and is more so in the context of software development [13]. Thus, firms are likely to choose hierarchical governance for developing business application systems using new IT based on the logic of in-house capability development as well.

**Growth Versus Maturity Periods.** Whether e-commerce project strategic intent will influence the choice of a particular sourcing mode depends upon the maturity of the underlying technologies and their markets with respect to the e-commerce assets to be sourced. In a two-period scenario—the first being the technology/market growth period and the second the technology/market maturity period, as discussed earlier—strategic intent is expected to be a significant predictor of sourcing mode only during the first period for two reasons. First, protection of tacit knowledge and intellectual property from leakage and expropriation—a primary reason behind the choice of hierarchical modes of governance with respect to business-focused e-commerce investments—matters only in the first period. Over time, all knowledge will leak, including firm-specific tacit knowledge, because knowledge resides in individuals [37], and as individuals move from one organization to the next, so will knowledge. Further, e-commerce professionals who are the holders of the firm-specific tacit knowledge are not only organizational members but are also members of, and participate in, professional communities and networks, and these networks provide another conduit for knowledge leakage [15]. Erstwhile unique business processes and e-commerce applications owned by a firm will also be eventually imitated by vendors and competitors [58]. In fact, over time large vendors and consulting firms integrate the unique
and value-generating aspects of individual firms' e-commerce business processes, practices, and application systems into what has come to be known as "best practices," based on their experiences with a number of client firms on a number of projects, which they then sell or otherwise make available to their clients.

Second, if firms are, for some reason, not able to build capabilities pertaining to business application systems development using new e-commerce technologies in the first period, they have missed the boat, and it will be very difficult for them to develop capabilities in the second period due to the path-dependent nature of organizational capabilities [9, 13, 90]. There are several potential reasons why firms may not be able to develop capabilities in the first period. All firms may not choose in-house application systems development in the first period, when their intent is e-commerce-enabled business improvement, thereby making the capability-building rationale irrelevant in the second period. Even if firms make appropriate investments in the first period in acquiring/developing appropriate skill sets in project management, business processes and applications, and new technologies, and then developing the intended business application systems, there is no guarantee that their investments in capability building will bear fruit. As technologies and markets mature, skilled professionals may be lured away from client firms by vendors who can offer more stimulating environments and challenging assignments, since IT and e-commerce development are their core competencies [57], thereby crippling the capabilities client firms may have developed during the technology growth period. This again makes the capability-building rationale irrelevant in the second period.

Hybrid Versus Hierarchical Governance. As discussed above, firms will wish to utilize hierarchical governance when they invest in business-focused e-commerce projects, as the resulting e-commerce assets typically embed a high degree of firm-specific tacit knowledge and trade secrets and represent intellectual property that needs to be protected from imitation and commercial exploitation by competitors. However, client firms may not be able to go it alone, simply because new technologies are highly complex and they cannot expect to match the deep and broad knowledge about ITs that vendors have accumulated over time through multiple projects at multiple clients with related technologies [10, 57]. The depth and breadth of prior accumulated knowledge in related areas contributes to absorptive capacity and enables the faster and successful assimilation of new knowledge [24]. Therefore, although vendors in the marketplace may be on the same level as client firms in terms of knowledge and capabilities about new information technologies during the technology growth period, vendors are better positioned than client firms, owing to their higher absorptive capacity for acquiring and effectively utilizing new knowledge pertaining to new ITs.

As a consequence, client firms will prefer to use hybrid or intermediate governance forms, including strategic alliances, minority equity investments, and vertical contracting with e-commerce service providers and other vendors, instead of pure hierarchical governance forms [9, 62, 76, 100] for sourcing e-commerce assets with business-focused strategic intents during the growth phase.
This governance strategy allows client firms to gain access to and leverage the knowledge assets owned by their strategic partners for developing innovative e-commerce products and services using new e-commerce technologies while ensuring that they have adequate control over their e-commerce projects through the governance mechanisms of partner selection, incentive design, information sharing, monitoring, joint decision-making, and joint action [43, 76, 86, 87]. However, they are expected to utilize equity-based rather than contract-based alliances, as transfer of technological capabilities is much better in the former than the latter type of hybrid governance forms [71]. For example,

Emerson Electric Co. worked with Click Commerce, a leader in Internet-enabled channel management solutions, and created a business-to-business e-commerce platform to enable its divisions to seamlessly integrate their systems—between divisions and with virtually thousands of channel partners located all around the world. [According to senior company executives], “This will ultimately reap top-line benefits from increased sales by reaching new customers and new markets, and [create] other benefits such as improved customer satisfaction and brand loyalty.” [As gathered from personal communication with the lead manager for the project], Emerson took a minority equity position in the service provider, Click Commerce. [16, pp. 1-2]

Based on the above discussions, we hypothesize that:

**H1a:** During the technology/market growth phase, firms are more likely to use hybrid over hierarchical governance forms for sourcing of new e-commerce projects when their strategic intent with respect to these e-commerce investments is more business focused.

**H1b:** During the technology/market growth phase, firms are more likely to use hybrid over market governance forms for sourcing of new e-commerce projects when their strategic intent with respect to these e-commerce investments is more business focused.

**H1c:** During the technology/market growth phase, firms are indifferent in their preference between hierarchical and market governance forms for sourcing of new e-commerce projects with respect to their strategic intent.

**H2:** During the technology/market maturity phase, strategic intent behind new e-commerce investments will not have any influence on the choice of sourcing mode for sourcing of new e-commerce assets.

**E-Commerce Project Task Complexity**

In a widely cited review, Campbell [19] takes an information processing perspective and defines task complexity as emanating from four sources that have the potential to
increase information load, information diversity, or the rate of information change during the course of performance of a task. The four sources of task complexity have been further discussed by Zigurs and Buckland [104] and Rao and An [75] and include (1) outcome multiplicity (i.e., the presence of multiple desired outcomes or end-states to be attained), (2) solution scheme multiplicity (i.e., the presence of multiple potential ways or paths to arrive at a desired end-state), (3) conflicting interdependence (i.e., the presence of conflicting interdependence among paths to multiple outcomes), and (4) solution scheme/outcome uncertainty (i.e., the presence of uncertain or probabilistic links among paths and outcomes).

E-commerce projects are exemplar embodiments of task complexity. Multiple and often conflicting goals of different stakeholder groups, the rapidly changing and complex nature of ITs and the still incipient nature of e-commerce development methodologies contribute to task complexity in e-commerce projects [75].

McKeen and colleagues have studied task complexity in the context of user participation in IS development [66, 67]. McKeen et al. [67] report that the effect of user participation on user satisfaction is higher when task and system complexity are higher, and user participation does not significantly affect user satisfaction when task/system complexity is lower. In a later paper, McKeen and Guimaraes [66] report that user participative behaviors across the four phases of the systems development life cycle are significantly related to user satisfaction in “high need for participation” projects (i.e., those where the combination of task and system complexity is above the median value) and not in “low need for participation” projects. Both of these studies imply that user participation may be a necessary condition for achieving higher levels of user satisfaction when either task complexity or system complexity or both are higher.

Task complexity has also been found to affect coordination needs. As task complexity increases, so does the need for increased coordination using less of impersonal rule-based coordination modes and more of personal and group-based coordination modes [96]. Recent studies in the organizational literature dealing with governance issues and buyer–supplier relationships have also started considering task complexity as an important variable that may affect governance choices [11, 47]. Jones et al. [47] argue that task complexity adversely affects the problem of coordination and, therefore, include it in their theory of network governance.

There is ample evidence in the organizational and strategic management literature that organizational hierarchies possess superior coordination capabilities, which is essentially “managing (inter)dependencies among activities” [64, p. 90]. Malone notes that firms (product and functional hierarchies) are better than markets (centralized and decentralized) in terms of coordination costs, as a task processor in a hierarchy is connected with fewer other agents, and fewer task assignment and scheduling messages flow among agents in a hierarchy [63]. Grant [38] and Kogut and Zander [50], in a knowledge-based view of the firm, suggest that coordination involves integration of individuals’ specialized and tacit knowledge for use in production of goods and services, and firms are better equipped for this task because they use routines, common language, and shared meaning that they develop over time. Further, in a study of strategic alliances, Gulati [41] proposes and finds that the greater the anticipated in-
terdependence in an alliance, the more hierarchical the governance structure that is used to organize it, providing further evidence that hierarchical structures yield superior coordination capabilities. Organizations also possess better information processing mechanisms [33, 94], and using their superior communication and coordination mechanisms, they can effectively meet the varying information processing needs emanating from varying levels of task and environmental complexity [72, 95].

While we are not aware of formal studies that compare internal organizations (hierarchies) with markets in terms of their capabilities to support user participation in systems development activities, it would appear that intensive user participation would be more effectively supported within organizational hierarchies. A high degree of user participation would involve the division of systems development tasks between developers and users, which would create a higher degree of task interdependence and task uncertainty and the consequent need for a higher degree of coordination.

The above discussion about task complexity, systems development, and governance forms provides the rationale for considering task complexity as a determinant of e-commerce sourcing mode. A higher degree of task complexity, which e-commerce projects often exhibit, creates the need for a higher degree of coordination, information processing, and user participation. These needs can be met effectively by hierarchical structures, as they possess superior coordination and information processing capabilities as compared to other governance forms. This would suggest that high-complexity e-commerce projects are more likely to be sourced using hierarchical governance mechanisms (insourcing) than using markets. Further, while the capabilities of markets and hierarchies with respect to managing task complexity, supporting effective user participation, and providing effective coordination may evolve over time, firms are expected to remain superior to markets over time in these respects. These advantages of firms over markets will not erode over time, thereby providing firms with superior coordination capabilities for managing task complexity during both the periods of technology/markets growth and technology/markets maturity. The example below shows a typical instance during the technology growth phase where insourcing was chosen for managing the complexity of building a first-of-a-kind, high-task-complexity e-commerce portal in the airline industry during the growth phase.

TRW Aeronautical Systems announced plans to launch a global e-business aerospace marketplace to enable electronic transactions with its customers, suppliers and peer group. TRW Aeronautical Systems believes that the marketplace will be the first announced, all-encompassing, lean-based aerospace e-marketplace incorporating buy side and sell side transactions, engineering collaboration, and supply chain management across the aerospace industry.

[Executives involved in the project said], “We . . . wanted an e-business solution that supported [our] mindset. In the end, we decided to create our own functionally rich solution, and . . . would actively encourage other like-minded companies to join in. TRW recognizes that we will have to work with other formed e-business groupings. . . . E-business fundamentally changes the way you do business and can streamline processes if properly deployed. We . . . see
this launch as a significant investment in our future.” [In direct correspondence with one of the authors], the VP-in-charge of the project confirmed that the project was implemented using internal resources without the involvement of service providers. [18, p. 1]

Similarly, an example of insourcing during the technology maturity phase in the presence of task complexity, driven by the need to develop/modify an online strategy, is provided by Wal-Mart.

Wal-Mart announced [that it would] buy back its independent Web site, Walmart.com . . . and reintegrate it into its core business. The Web site [had] been a financial sinkhole [estimated to lose $100 million in 2000]. The idea that a general merchandise store with its myriad of offerings could survive on the Web was unproven. In the physical world, one-stop shopping is convenient. On the Web, store hopping is much easier. [14, pp. 1–2]

Based on the above discussions, we hypothesize:

**H3a:** During the technology/market growth phase, firms are more likely to use hierarchical over market governance forms for sourcing of new e-commerce projects when the project task complexity is high.

**H4a:** During the technology/market maturity phase, firms are more likely to use hierarchical over market governance forms for sourcing of new e-commerce projects when the project task complexity is high.

There is a growing body of evidence that sociological and relational factors such as trust and macroculture make hybrid governance forms effective in dealing with the problems of uncertainty and coordination. Trust between exchange partners in an interorganizational relationship [36, 77] has been found to positively affect joint action (a relational governance mechanism) [103], which essentially “involves the parties carrying out the focal activities in a cooperative or coordinated way” [43, p. 25]. Further, social systems, such as macroculture, rather than bureaucratic structures prevalent in hierarchical forms, may improve coordination among network partners in the network governance model (a hybrid governance form) [47].

However, trust in interorganizational relationships develops over time [77]. Further, familiarity between exchange partners through prior ties also contributes to trust in interorganizational relationships [40]. But markets are dominated by a large number of new vendor firms during the technology/market growth phase [49], and the likelihood of client firms’ having had long relationships or prior ties with new vendor firms supplying the new focal technologies will be quite low. This implies that hybrid alliances between vendors and clients are not likely to enjoy high levels of coordination capabilities that emanate from interorganizational trust and macroculture and appear to be similar to markets and inferior to hierarchical governance during this early period in terms of coordination capabilities. As a result, client firms are expected to prefer hierarchies over hybrids in the context of task complexity, and are
likely to be indifferent between hybrid and market governance forms during the technology/market growth phase. We, therefore, hypothesize:

\[H3b:~\text{During the technology/market growth phase, firms are more likely to use hierarchical over hybrid governance forms for sourcing of new e-commerce projects when the project task complexity is high.}\]

\[H3c:~\text{During the technology/market growth phase, firms are indifferent in their preference between hybrid and market governance forms for sourcing of new e-commerce projects when the project task complexity is high.}\]

As new technologies and their markets mature, consolidation in the marketplace takes place, most of the erstwhile new and smaller vendor firms exit the industry through mergers, acquisitions, and bankruptcies, and only a few larger and older firms remain in the market [49]. As a result, in this period the likelihood of client firms' having had either longer relationships or a number of prior exchanges with current vendors in the marketplace is quite high. Client firms will either be dealing with large companies (e.g., IBM, EDS, etc.) with whom they will have had prior business relationships in the context of other older technologies or they would be dealing with new vendors who survived the growth phase in the industry and with whom clients may have had prior commercial exchanges in the context of new technologies. In either event, time and prior exchanges will have contributed to the development of high levels of mutual interorganizational trust between exchange partners, thereby creating an environment in which hybrid forms enjoy high coordination capabilities emanating from these relational mechanisms and, thus, becoming similar to hierarchical forms in terms of these capabilities. As a result, client firms are expected to be neutral in terms of their preference between hierarchies and hybrids in the context of task complexity, but are likely to prefer hierarchies over markets during the technology/market maturity phase. For example, with high task complexity driven by the “industry-first” nature of its initiatives, Eastman Chemical chose hybrid governance with its technology partners:

[Adapting ideas from other industries], Eastman [is] using Web technologies to revamp its in-house and business transaction processes [and is one of the first companies in its industry to do so. The company is even helping] its smaller customers to get tech-enabled. The company also invested in auction software partner Moai Technologies and in vertical Internet portal paintandoatings.com. Eastman is also working to create industry XML standards to facilitate electronic buying, selling and delivery of products . . . the company is updating its e-commerce storefront. [These efforts are driven by the belief that] being out ahead gives [the company] a much better chance to win. [70, pp. 1–4]

Based on the above discussions, we hypothesize:

\[H4b:~\text{During the technology/market maturity phase, firms are more likely to use hybrid over market governance forms for sourcing of new e-commerce projects when the project task complexity is high.}\]
H4c: During the technology/market maturity phase, firms are indifferent in their preference between hybrid and hierarchical governance forms for sourcing of new e-commerce projects when the project task complexity is high.

Method

We test the above hypotheses using content analysis, conducted following the procedures used by Ang and Slaughter [5], Gulati and Singh [41], and Slaughter and Ang [83], and logistic regression. We gathered sourcing announcements pertaining to e-commerce projects during the 1999–2002 period from the Dow Jones Interactive database. The sourcing choice for the project included in the announcement was used as the dependent variable. Content analysis was conducted using the NVivo content analysis software.

Sample

Since e-commerce projects were significant initiatives for firms during the period under study, they were typically announced publicly in reasonable detail through the business press. Sourcing announcements were collected using a full text search of announcements made by companies from 1999 through 2002 in the news sources monitored by the Dow Jones Interactive database. These sources provide comprehensive coverage of public announcements by firms and have been used in prior IS research [22]. Relevant announcements were retrieved using a search string to match words in the announcements of interest. While selecting the search string, the goal was to maximize the collection of relevant announcements while screening out irrelevant announcements. After examining a number of candidate search strings and resulting announcements, we found the following search string to be quite effective in identifying announcements of interest and used it to search the database for e-commerce sourcing announcements. The resulting announcements were scanned to select those that provided information on the selected sourcing mode, and these were added to the NVivo database.

(co=<list of companies>) and ((dns=internet) or (key=e-commerce)) and (wc>300) and (lp=e-commerce or e-commerce or e-business or e commerce or (online near1 business) or (online near1 sales))

The search string looks for announcements in the Dow Jones Interactive database that feature companies provided in the list following the term “co.” We used the list of companies in the S&P 500 index. The terms “dns” and “key” denote the news category descriptor and key words, respectively, and were used to restrict the search to those announcements that related to “Internet” or “e-commerce” or “e-business.” This eliminated announcements made by companies that were not directly related to e-commerce activities. The term “wc” denotes word count, and a minimum limit of 300 words was used because we found that a large number of shorter announcements simply informed the press about their new projects without providing details relevant
for our research. The final term "Ip" denotes lead paragraph and was used to narrow the announcements to those where some e-commerce activity was mentioned in the lead paragraph. We did not retain announcements that merely indicated interest in a specific sourcing mode; only confirmations were noted.

We restricted our sampling frame to the firms in the S&P 500 index, as this index consists of 500 firms chosen for market size, liquidity, and industry group representation and is one of the most widely used benchmarks of U.S. business performance. The initial search on the Dow Jones Interactive database yielded 208 announcements in the 1999–2000 period and 64 in the 2001–2002 period. The elimination of announcements for which sufficient information was not available pertaining to the variables of interest resulted in 100 announcements for the 1999–2000 period and 47 for the 2001–2002 period. After we completed the coding for sourcing mode for the entire sample, we found that there were six joint venture announcements for the 1999–2000 period, but none in this sample for the 2001–2002 period. To be able to compare results across the two periods, we removed the six announcements from the 1999–2000 sample. The final sample, therefore, consists of 94 announcements during the 1999–2000 period and 47 during the 2001–2002 period, for a total of 141. A profile of the firms included in the sample is provided in Tables 1 and 2.

After collecting the initial announcements as described above, we collected detailed information about each announcement by searching for articles related to the subject firm around the date of the announcement in the Dow Jones Interactive database. This database includes most publications that cover IT and business issues, and this search helped in gathering additional relevant, publicly available information pertaining to the announcements. This procedure improved the precision of the coding in a significant manner.

Content Analysis

Content analysis is a research technique that allows for the objective, systematic, and quantitative description of the manifest content of communication and is extensively used in management and IS research (e.g., [1, 5, 41, 46, 52, 57, 80, 83]).

Following the steps recommended for content analysis [52, 69], we first used prior conceptual and empirical research to create a coding scheme for categorizing the various constructs in this research. Several steps were taken to ensure coding reliability following prior research [41]. The first step was to develop a precise coding scheme, described later in this section. The announcements were initially coded by one of the authors, who checked for test–retest reliability by recoding announcements about a week after the initial coding. In every case, the recoding was very close to the initial coding, and more than 95 percent of the recoded values were identical to the initial values. To further check the reliability of the coding, two independent coders, who were not involved with the study, coded all the announcements separately. One coder had two years of experience in leading IS development and two years of CMM (capability maturity model) level-4 implementation at a major multinational bank, and the other was a graduate student with prior work experience in engineering design. Cohen's
Table 1. Size Distribution of Firms Included in the Sample (in billions of U.S. dollars)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sales</td>
<td>Assets</td>
</tr>
<tr>
<td>&lt; $1</td>
<td>12</td>
<td>15</td>
</tr>
<tr>
<td>$1–$10</td>
<td>47</td>
<td>41</td>
</tr>
<tr>
<td>&gt; $10</td>
<td>35</td>
<td>38</td>
</tr>
<tr>
<td>Total</td>
<td>94</td>
<td>94</td>
</tr>
</tbody>
</table>

Table 2. Industry Distribution of Firms Included in the Sample

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Aerospace and defense</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Automobile</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>Chemicals and metals</td>
<td>10</td>
<td>5</td>
</tr>
<tr>
<td>Personal accessories</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Finance</td>
<td>15</td>
<td>2</td>
</tr>
<tr>
<td>Food</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Health care</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>Heavy industry</td>
<td>14</td>
<td>7</td>
</tr>
<tr>
<td>Hospitality</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Technology</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Retail</td>
<td>15</td>
<td>11</td>
</tr>
<tr>
<td>Telecommunications</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Transport</td>
<td>9</td>
<td>4</td>
</tr>
<tr>
<td>Utilities</td>
<td>7</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>94</td>
<td>47</td>
</tr>
</tbody>
</table>

kappa was calculated for each construct between each pair of coders. The kappa coefficient reflects the extent to which the observed agreement between coders is superior to what could have been obtained by chance [23]. Following Ang and Slaughter [5], both coders first coded 15 documents from the first-period sample, yielding a kappa coefficient exceeding 0.8 for each construct. The observed disagreements were then reconciled by discussion among the coders, moderated by a faculty member with more than 15 years of experience in IS research. The two coders then coded the remaining announcements, yielding a kappa exceeding 0.95 for each construct. Finally, for 53 companies in the 1999–2000 sample for which contact information was available in the announcements, we contacted the identified representatives in subject firms to validate our coding. We received 24 responses (45 percent), and the match
between the responses and coding was greater than 90 percent. As a result of these extensive precautions, the coding of constructs is expected to be highly reliable.

**Sourcing Mode**

As discussed in the theory section, we follow the typology of governance forms based on the degree of hierarchical control developed by Gulati and Singh [41]. In decreasing order of hierarchical control are internal organizations (insourcing/hierarchical governance), joint ventures, minority equity ownerships, and contractual relations (outsourcing/markets). *Internal organizations* or hierarchies have the highest degree of hierarchical control over their projects. Following Lacity and Willcocks [55], vendor buy-in contracts, where vendors supply skilled IT personnel who work under the supervision of client managers, are included in the hierarchies category. Following the transaction cost economics (TCE) theory [62, 76, 99], hierarchies also include the case of vertical integration, which occurs when a client firm buys a vendor firm to execute its IT project in-house. In *joint ventures*, partners create a separate entity with ownership distributed among the partners, and a separate hierarchy of managers oversees day-to-day operations and addresses problems as they arise. *Minority equity ownerships* are those arrangements where one firm takes a minority stake in a partner firm without creating a separate organization. These provide a lesser degree of hierarchical control, because supervision is typically in the form of board membership for the investing partners in the invested firm. Although these members are not involved in day-to-day operations of the firm, their presence on the board helps share information, ratify decisions, and can help resolve conflicts as they arise. *Classical contractual arrangements* are the arm’s-length market exchanges and do not involve any shared ownership or administrative structures for project control. None of the elements of a hierarchical relationship are necessarily part of a contractual arrangement, and decisions are negotiated between partners as the need arises.

The dependent variable e-commerce *project sourcing mode* therefore measures the extent of substitution of hierarchical controls by market mechanisms and is inferred from the information provided in the announcement. This variable was initially coded in the decreasing order of hierarchical controls, with internal IS organizations coded as 0, joint ventures coded as 1, minority investments as 2, and contractual arrangements as 3. However, since no joint ventures were found in the second period (2001–2), the variable was recoded as internal IS organizations 0, minority investments 1, and contractual arrangements 2.

**E-Commerce Project Strategic Intent**

The e-commerce project announcements were content analyzed for e-commerce project strategic intent using the three-tier strategic intent framework developed by DiRomualdo and Gurbaxani [27], discussed earlier, and the hierarchical framework of e-commerce developed by Zwass [106]. Zwass’s framework provides for three hierarchical metalevels of e-commerce, with e-commerce products and structures at
the highest level followed by e-commerce services and ending with e-commerce infrastructure at the lowest level. E-commerce products and structures are business-focused e-commerce assets that are developed either with business impact strategic intent or commercial exploitation strategic intent. Therefore, these announcements were coded as either 2 (business impact) or 3 (commercial exploitation), depending upon whether the announcement explicitly alluded to a commercial intent. The commercial intent was evident when the announcement included statements referring to the sale of information products/structures in the marketplace or to the starting of new lines of business. E-commerce services and e-commerce infrastructure are foundational e-commerce assets that provide the platform for developing business applications and information products and services normally not sold by client firms who possess domain expertise and would sell e-commerce products and structures. Therefore, services and infrastructure type of e-commerce projects are developed with the intent of e-commerce system improvement and were coded with a value of 1 (for improvement intent). The integrated coding framework used for coding strategic intent of e-commerce announcements is shown in Table 3.

E-Commerce Project Task Complexity

Task complexity can be viewed as (1) a primarily psychological perception of the task performer with respect to the task being performed, (2) a person–task interaction that acknowledges both the objective complexity of a task and the perception of complexity of that task by a task performer, or (3) emanating purely from objective task characteristics [19]. We consider task complexity in this research as emanating from objective task characteristics—that is, objective task complexity—because a task can be “objectively” labeled by a researcher as less or more complex as compared to another task, whereas the other two views of task complexity depend upon perceptions of the organization that are not always included in press announcements.

Following McKeen and colleagues [66; 67], we divide task complexity into two categories: (1) business task uncertainty, which pertains to the business tasks (processes) for which the e-commerce solution is being developed, and (2) technology task uncertainty, which pertains to the technologies used in developing and implementing an e-commerce–based solution. By definition, task complexity is low when the likelihood of a task’s achieving its desired outcome is high. This will occur when sufficient overall industry familiarity and experience with the particular task has been gained, and empirical evidence gained over time has been used to refine the task for achieving its intended outcomes with near certainty. For business task complexity, this implies that the business processes to be supported by a proposed e-commerce solution have been in vogue for a long time, are well understood, and to some extent have become industry standard. For technology complexity, this implies that the task of developing and implementing the e-commerce infrastructure or business solution follows a proven or an industry standard methodology. Some example phrases that were found in the announcement sample indicating high or low business or e-commerce task uncertainty are shown in Table 4.
<table>
<thead>
<tr>
<th>Metalevel</th>
<th>Level</th>
<th>Function</th>
<th>Examples</th>
<th>Coded as</th>
</tr>
</thead>
<tbody>
<tr>
<td>Products and structures</td>
<td>7</td>
<td>Electronic marketplaces and electronic hierarchies.</td>
<td>Electronic auctions, brokerages, dealerships, and direct search markets; interorganizational supply chain management.</td>
<td>2 (for business impact strategic intent), or 3 (for commercial exploitation strategic intent).</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>Products and systems.</td>
<td>Remote consumer services (retailing, banking, stock brokerage); infotainment-on-demand (fee-based content sites, educational offerings); supplier–customer linkages; online marketing; electronic benefit systems; intranet- and extranet-based collaboration.</td>
<td>Products and structures were coded as 3 only if the announcement clearly identified a direct commercial exploitation intent by making statements about selling of information products/services or starting of new lines of business, and so on.</td>
</tr>
<tr>
<td>Services</td>
<td>5</td>
<td>Enabling services.</td>
<td>Electronic catalogs/directories, smart agents; e-money, smart card systems; digital authentication services; digital libraries, copyright protection services; traffic auditing.</td>
<td>1 (for e-commerce improvement strategic intent).</td>
</tr>
<tr>
<td>Infrastructure</td>
<td>4</td>
<td>Secure messaging.</td>
<td>EDI, e-mail, electronic funds transfer (EFT).</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>Hypermedia/multimedia object management.</td>
<td>World Wide Web with Java.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Public and private communication utilities.</td>
<td>Internet and value-added networks (VANs).</td>
<td></td>
</tr>
</tbody>
</table>
We coded overall task complexity of an e-commerce project as low (value of 0) when both the project’s business and technology complexity are judged to be low. A project’s task complexity has been coded as high (value of 1) when either its business task complexity, or its technology complexity, or both its business and technology complexity are judged to be high. This is to ensure that e-commerce projects that are primarily infrastructural in nature and have no direct business component can be coded with high overall task complexity when their technology complexity is indeed high.

A summary of the frequency of announcements pertaining to the various coded values for the research variables is shown in Table 5. Announcement examples pertaining to the coding of the research variables are shown in the Appendix.

Results

THE E-COMMERCE PROJECT BEING SOURCED is the unit of analysis in this study. Spearman rank correlations indicate that there is no significant problem of multicollinearity and all correlations are less than 0.5. Next, we tested the hypotheses using the multinomial logit model provided by the Limdep 7.0 software. The general specification of the logit model is

$$\ln\left(\frac{P_{ij}}{P_{0j}}\right) = a + b_j \cdot X_j,$$

where $P_{ij}$ is the probability of the $i$th event occurring and $P_{0j}$ is the probability of the $0$th event occurring for the $j$th case. The $0$th event is generally the base event with respect to which we wish to calculate the odds ratio and is a choice made by the researchers. In our case, we wish to estimate the likelihood ratios of the three governance modes with the two independent variables as the predictors over two different periods. We also used firm size as a control variable, following prior IS research on outsourcing [6]. Further, to check for robustness of results, we used two different measures of firm size—natural logarithm of firm sales and firm assets at the end of the year prior to the announcement, based on data from Research Insight (i.e., Compustat). Therefore, we created eight distinct logit models for the two base events
Table 5. Frequency of Codes in the Sample for the Research Constructs

<table>
<thead>
<tr>
<th></th>
<th>First period</th>
<th>Second period</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>E-commerce asset sourcing mode</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hierarchical governance</td>
<td>35 (37.23%)</td>
<td>9 (19.15%)</td>
</tr>
<tr>
<td>Hybrid governance</td>
<td>22 (23.41%)</td>
<td>8 (17.02%)</td>
</tr>
<tr>
<td>Market governance</td>
<td>37 (39.36%)</td>
<td>30 (63.83%)</td>
</tr>
<tr>
<td><strong>Total cases</strong></td>
<td>94</td>
<td>47</td>
</tr>
<tr>
<td><strong>E-commerce project strategic intent</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Improvement</td>
<td>16 (17.02%)</td>
<td>12 (25.53%)</td>
</tr>
<tr>
<td>Business impact</td>
<td>45 (47.87%)</td>
<td>16 (34.04%)</td>
</tr>
<tr>
<td>Commercial exploitation</td>
<td>33 (35.11%)</td>
<td>19 (40.43%)</td>
</tr>
<tr>
<td><strong>Total cases</strong></td>
<td>94</td>
<td>47</td>
</tr>
<tr>
<td><strong>E-commerce project task complexity</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low task complexity</td>
<td>54 (57.45%)</td>
<td>30 (63.83%)</td>
</tr>
<tr>
<td>High task complexity</td>
<td>40 (42.55%)</td>
<td>17 (36.17%)</td>
</tr>
<tr>
<td><strong>Total cases</strong></td>
<td>94</td>
<td>47</td>
</tr>
</tbody>
</table>

(markets and hierarchies), two firm-size measures (sales and assets), and two periods (growth and maturity). We first ran these models with only the control variable (firm size) included. Then we included the two predictors in the model. Results of the eight models with predictors included as estimated by Limdep are presented in Tables 6 and 7. Table 6 includes results for the first period (technology growth phase; 1999–2000) and Table 7 includes results for the second period (technology maturity phase; 2001–2002).

The coefficients shown in the cells in Tables 6 and 7 provide estimates for the increase (decrease) in the log likelihood ratio for the chosen sourcing mode over the base sourcing mode. For example, a $\beta$ coefficient of 1.33 for e-commerce project strategic intent (Table 6, model 1) means that a unit increase in e-commerce project strategic intent will increase the log likelihood of hybrid governance over hierarchical governance by 1.33, implying that as strategic intent increases (i.e., becomes more business-focused), hybrid governance becomes a more likely governance choice.

As can be seen from Tables 6 and 7, the $\chi^2$ values for all the eight logit models are significant at 0.01 or better levels, indicating that the models are significant overall. Further, the firm size is not a significant predictor of the log likelihood ratios in seven of eight logit models. It is weakly significant at the 0.10 level only in one model.
Table 6. Logit Regression Results for the First Period (Technology Growth Phase, 1999–2000)

<table>
<thead>
<tr>
<th>Independent variables</th>
<th>Firm size measured in firm sales</th>
<th>Firm size measured in firm assets</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Model 1 (with reference to hierarchical governance)</td>
<td>Model 2 (with reference to market governance)</td>
</tr>
<tr>
<td></td>
<td>Hybrid governance</td>
<td>Market governance</td>
</tr>
<tr>
<td>Intercept</td>
<td>-3.5** (0.045)</td>
<td>-0.049 (0.97)</td>
</tr>
<tr>
<td>Log (firm size)</td>
<td>0.40 (0.31)</td>
<td>0.15 (0.65)</td>
</tr>
<tr>
<td>Project strategic intent</td>
<td>1.33*** (0.008)</td>
<td>-0.07 (0.86)</td>
</tr>
<tr>
<td>Project task complexity</td>
<td>-0.53 (0.38)</td>
<td>-0.99* (0.07)</td>
</tr>
<tr>
<td>N</td>
<td>94</td>
<td>94</td>
</tr>
<tr>
<td>Log likelihood</td>
<td>-92.74</td>
<td>-92.74</td>
</tr>
</tbody>
</table>

Notes: p-values are shown in parentheses; * is significant at 0.10; ** is significant at 0.05; *** is significant at 0.01; boldface entries indicate statistically significant values.
Table 7. Logit Regression Results for the Second Period (Technology Maturity Phase, 2001–2002)

<table>
<thead>
<tr>
<th>Independent variables</th>
<th>Firm size measured in firm sales</th>
<th>Firm size measured in firm assets</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Model 5 (with reference to hierarchical governance)</td>
<td>Model 6 (with reference to market governance)</td>
</tr>
<tr>
<td></td>
<td>Hybrid governance</td>
<td>Market governance</td>
</tr>
<tr>
<td>Intercept</td>
<td>-4.94 (0.24)</td>
<td>-3.02 (0.30)</td>
</tr>
<tr>
<td>Log (firm size)</td>
<td>0.68 (0.50)</td>
<td>1.07 (0.15)</td>
</tr>
<tr>
<td>Project strategic intent</td>
<td>1.10 (0.12)</td>
<td>0.77 (0.19)</td>
</tr>
<tr>
<td>Project task complexity</td>
<td>1.17 (0.38)</td>
<td>-2.26** (0.02)</td>
</tr>
<tr>
<td>N</td>
<td>47</td>
<td>47</td>
</tr>
<tr>
<td>Log likelihood</td>
<td>-31.41</td>
<td>-31.41</td>
</tr>
<tr>
<td>$\chi^2$</td>
<td>22.2*** (0.001)</td>
<td>22.2*** (0.001)</td>
</tr>
</tbody>
</table>

Notes: p-values are shown in parentheses; * is significant at 0.10; ** is significant at 0.05; *** is significant at 0.01; boldface entries indicate statistically significant values.
Further examination of the $\beta$ coefficients and their $p$-values in Tables 6 and 7 indicates that all hypotheses except H3b are supported. We hypothesized that a high degree of strategic intent would lead to a preference for hybrid governance over hierarchical (H1a) and market (H1b) forms during the growth period. In this period, we also hypothesized that firms would be indifferent between hierarchical and market governance as far as strategic intent is concerned (H1c). The $\beta$ coefficients in model 1 (growth period; sales as a measure of firm size; 0th event is hierarchical governance) and model 3 (growth period; assets as a measure of firm size; 0th event is hierarchical governance) for hybrid governance are positive and significant at the 0.01 level, indicating that the likelihood of hybrid governance over hierarchical governance increases as strategic intent increases (i.e., becomes more business focused), providing strong support for H1a. Similarly, the $\beta$ coefficients in models 2 and 4 for hybrid governance are positive and significant at the 0.01 level, indicating that the likelihood of hybrid governance over market governance increases as strategic intent increases in value (i.e., becomes more business focused), providing strong support for H1b. Further, market governance over hierarchical governance is not more likely with respect to strategic intent during the first period (Table 6), as the $\beta$ coefficients for market governance in both models 1 and 3 are not significant, supporting H1c. Coefficients for e-commerce project strategic intent for the second period (Table 7) provide support for H2. We hypothesized that e-commerce project strategic intent would not have any influence in the choice of sourcing mode in the maturity phase. None of the coefficients for strategic intent in models 5 through 8 are significant, indicating that no particular governance mode is more likely than any other with respect to strategic intent. Thus H2 is fully supported.

H3a through H3c deal with the effect of task complexity on the choice of sourcing modes during the first period. During the growth period, we predicted a preference for hierarchies over markets (H3a) and hybrids (H3b). We also hypothesized indifference between hybrids and markets (H3c) as far as task complexity is concerned. The $\beta$ coefficients for hierarchies over markets in models 2 and 4 for task complexity are positive and significant at the 0.10 level, providing weak support for H3a. H3b is not supported, as the $\beta$ coefficients for hybrids over hierarchies in models 1 and 3 for task complexity are statistically insignificant. The $\beta$ coefficients for hybrids over markets in models 2 and 4 for task complexity are statistically not significant, indicating that H3c cannot be rejected. With respect to task complexity for the second period, we predicted a preference for hierarchies over markets (H4a), a preference for hybrids over markets (H4b), and an indifference between hierarchies and hybrids (H4c). Results support all these three hypotheses fully. The $\beta$ coefficients for hierarchies over markets in models 6 and 8 for task complexity are positive and significant (0.05 level), providing support for H4a. Similarly, the $\beta$ coefficients for hybrids over markets in models 6 and 8 for task complexity are positive and significant (0.01 level), providing strong support for H4b. Finally, coefficients for hybrids over hierarchies in models 5 and 7 with respect to task complexity are not significant, providing support for H4c.
The eight models shown in Tables 6 and 7 also show an improvement in the log likelihood function and $\chi^2$ value over their respective control models (models with only the appropriate firm-size measure included), indicating a better model fit resulting from the inclusion of hypothesized predictors. The log likelihood value reflects the odds that the observed values of the dependent variable may be predicted from the observed values of independent variables. The $\chi^2$ value is used to test the significance of the logistic model, and a significant $\chi^2$ rejects the null hypothesis that none of the independent variables are linearly related to the log odds of the dependent variable. Improvement in the $\chi^2$ values in models 1 through 8 over their respective control models resulting from the inclusion of predictor variables also increases our confidence in the results. The final results are summarized in Table 8.

Discussion and Conclusions

The aim of this paper was to distinguish between the influence of drivers of sourcing mode choice during the technology growth and maturity phases. Focusing on e-commerce projects, we identified two sourcing determinants—e-commerce project strategic intent and e-commerce project task complexity—that have received scant attention in prior IT outsourcing research, and we performed a two-period analysis of sourcing modes. E-commerce projects were used because the growth and maturity phases could be easily identified. January 1, 2001, was used as the cutoff point between the technology growth and maturity phases.

In addition to the conventional distinction between insourcing and outsourcing, we used a classification of sourcing modes that also included minority equity alliances, a hybrid governance form. This governance form combines characteristics found in hierarchical governance, such as managerial oversight, with characteristics commonly associated with market mechanisms, such as contractual obligations. The advantage of examining sourcing modes on a continuum of governance forms is that it helps provide a better understanding of the determinants of sourcing choices, as technologies being sourced evolve on their product life cycles.

The hypotheses were tested by content-analyzing public announcements made by large firms during 1999–2002. These announcements were collected from the Dow Jones Interactive database and coded according to a scheme created for this research. We found 94 announcements during 1999–2000 and 47 during 2001–2002 that met our requirements and for which all information necessary for coding was available. Support for hypotheses was based on the significance of coefficients of the multinomial logit regression models relating sourcing mode choice to the sourcing drivers. Magnitudes of the coefficients showed the extent to which changes in independent variables increased the likelihood of a particular sourcing mode compared to the reference.

We found, as hypothesized, that during the technology growth phase, firms are more likely to use hybrid governance mechanisms for e-commerce projects when their strategic intent with regard to these projects is business focused. They do this not
Table 8. Summary of Research Hypotheses and Findings

<table>
<thead>
<tr>
<th>Independent variable</th>
<th>Time period</th>
<th>Hypothesis</th>
<th>Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>E-commerce project</td>
<td>First period—</td>
<td>H1a: Hybrid governance preferred over hierarchical governance.</td>
<td>Supported</td>
</tr>
<tr>
<td>strategic intent</td>
<td>growth phase</td>
<td>H1b: Hybrid governance preferred over market governance.</td>
<td>Supported</td>
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<tr>
<td></td>
<td>Second period—</td>
<td>H1c: Indifference between hierarchical and market governance.</td>
<td>Supported</td>
</tr>
<tr>
<td></td>
<td>maturity phase</td>
<td>H2: No effect on the choice of sourcing mode.</td>
<td>Supported</td>
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<tr>
<td>E-commerce project</td>
<td>First period—</td>
<td>H3a: Hierarchical governance preferred over market governance.</td>
<td>Weakly</td>
</tr>
<tr>
<td>task complexity</td>
<td>growth phase</td>
<td>H3b: Hierarchical governance preferred over hybrid governance.</td>
<td>supported</td>
</tr>
<tr>
<td></td>
<td></td>
<td>H3c: Indifference between hybrid and market governance.</td>
<td>Not supported</td>
</tr>
<tr>
<td></td>
<td>Second period—</td>
<td>H4a: Hierarchical governance preferred over market governance.</td>
<td>Supported</td>
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<tr>
<td></td>
<td>maturity phase</td>
<td>H4b: Hybrid governance preferred over market governance.</td>
<td>Supported</td>
</tr>
<tr>
<td></td>
<td></td>
<td>H4c: Indifference between hierarchical and hybrid governance.</td>
<td>Supported</td>
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only to protect effectively their firm-specific tacit knowledge for gaining competitive advantage but also to gain access to the deep and broad knowledge about ITs that vendors possess. We also found that strategic intent is not a determinant of sourcing decisions during the technology/market maturity phase, because protecting firm-specific knowledge is unnecessary during this late phase in the technology life cycle (all knowledge eventually leaks), and vendors would have developed superior capabilities with regard to the new technologies by this time as compared to client organizations. All but one result is in line with our hypotheses.

E-commerce projects are one of the best examples of task complexity in modern businesses. Hierarchies are considered superior to markets in managing task complexity because of their superior information processing, communication, and coordination capabilities arising from shared identity, common language, and common routines. However, over time, hybrid governance forms may also develop communication and coordination capabilities similar to those of hierarchies, due to repeated ties among alliance partners. We found that hierarchical sourcing modes are preferred over market-oriented mechanisms in both the technology growth and maturity phases. Hybrid sourcing modes are preferred over market-oriented mechanisms only in the technology maturity phase.

The research has some obvious limitations that point to directions for future research. Due to the general slowdown in the e-commerce industry during the technology maturity phase of our sample, our sample for the second period is only about half the size of that for the first period. Further, our coding scheme for task complexity was based only on the task uncertainty dimension. Future research should look at the other dimensions of task complexity as well. Finally, although we started with a classification scheme that included two hybrid governance modes—joint ventures and minority equity alliances—our sample for the second period had no joint ventures, so the paper presents results using only minority equity as a hybrid governance form. Future research should attempt to create a finer classification of sourcing mode choices including joint ventures, minority equity alliances, and other forms that enable relational governance through information sharing, shared decision-making, or joint action.

Overall, these results provide evidence that the maturity of IT assets and of their markets has an influence on firms’ decisions pertaining to sourcing of those assets. Further, they suggest that research on e-commerce sourcing mode choice should include variables other than those derived from TCE. As our results for strategic intent indicate, firms may choose to invest in developing e-commerce capabilities during technology growth periods, even if these investments may be expensive in the short term, in order to derive business advantage in future periods.

We venture some reasons for the lack of support for H3b where no significant preference for hierarchies over hybrid arrangements was found for the technology growth phase to manage project task complexity. The most likely reason is the low resolution of a content-analytic classification scheme. A finer-grained scale, possibly from a survey, is likely to bring out the preference for hierarchies over hybrid arrangements to manage task complexity during the technology growth phase.
There are two key managerial implications of this research. First, managers should seriously consider their strategic intent for an e-commerce project while making sourcing decisions during periods when technologies and their markets are relatively immature. While vendors may offer a cheaper price due to their larger scale and scope, this study suggests that a better option will be to make an equity investment and form a minority equity alliance with a vendor for sourcing e-commerce projects with a business-focused strategic intent during the technology growth period. This investment will allow managers to develop in-house e-commerce capabilities by drawing upon the expertise possessed by the vendors while protecting their firm-specific knowledge assets. However, when technologies and their markets mature, the rationale for investing in developing internal capabilities is diminished, because vendors, consultants, and professionals are able to provide their clients with industry "best practices" synthesized from their varied experiences with a number of clients on a number of projects. Second, managers should also consider the task complexity of their e-commerce projects and choose a governance mode that is appropriate for managing the task complexity involved in the project. During the earlier phases of technology growth, high levels of task complexity are best supported by hierarchical governance, but as technologies mature and firms consolidate, clients become increasingly likely to have had prior relationships with service providers, leading to the formation of trust that enables hybrid arrangements to be as effective as hierarchies in managing task complexity.

Acknowledgments: The authors are grateful to Vladimir Zwas.s and three anonymous reviewers, whose comments on earlier drafts of this paper have significantly improved it. They thank Larry Sanders for his encouragement. They gratefully acknowledge the support of the National Science Foundation for funding this research through grant number 9907325. Any opinions, findings, and conclusions or recommendations expressed in this research are those of the authors and do not necessarily reflect the views of the National Science Foundation. This paper is based in part on the second author's dissertation research. The first two authors have contributed equally to this paper and their names are listed in a random order.

NOTES

1. Klepper [49] develops an analytical model and a number of propositions concerning the entry, exit, market structures, and product and process innovations from birth through maturity in technologically progressive industries. He posits that the number of firms in a technological industry rises initially to attain a peak (or it attains a peak at the very beginning of the industry) and then declines over time despite continued growth in the industry. E-commerce technologies and their markets show remarkably similar characteristics and patterns during the course of their evolution.

2. For example, agile and extreme programming methods have only been recently introduced, and process models for these methods have yet to evolve based on empirical experience.

3. Limdep 7.0 is an econometric software program that provides capabilities for data analysis with qualitative dependent or independent variables.

4. $\beta$ coefficients in the first column in model 2—hierarchical governance over market governance—are a mirror image (i.e., same values with opposite signs) of the second column in model 1—market governance over hierarchical governance. This is obviously expected, and the redundant values are reported only for the sake of completeness of the tables. The same is
true in models 3 through 8. We will use only one of these two columns in our discussion from this point onward.

REFERENCES

14. Briody, D. Kmart and Wal-Mart pull sites back in the fold: The retailers are buying back their Web sites, which were developed independently back in the day when e-commerce IPOs were all the rage. *Red Herring* (September 28, 2001).


### Appendix: Coding Examples

<table>
<thead>
<tr>
<th>E-commerce asset sourcing mode</th>
<th>Example announcement</th>
</tr>
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<tr>
<td><strong>Hierarchical governance</strong> (in-house development)</td>
<td><strong>UTX July 19, 2000</strong> Claiming to be the world's first Internet elevator company, Otis.com currently allows architects and builders to specify and price new elevator systems online. Building owners and managers can also obtain detailed data about their elevators' performance. According to [company executives], Otis.com's site is developed in-house using a combination of different solutions, namely its content management application by Vignette and e-mail management system by eGain. . . . [Executives] also advise that Otis.com is encouraging online ordering with its in-house developed tools. These include Plan Your Project, Price Your Project, and Track Your Project, as well as a drawing tool called ExpressDraw that allows architects to create scalable drawings.</td>
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<td><strong>Hybrid governance</strong> (minority equity partnership)</td>
<td><strong>EMN May 8, 2001</strong> SAQQARA(R) Systems Inc., a leading provider of product content software and services for business-to-business (B2B) e-commerce, today announced that Eastman Chemical Company (NYSE: EMN) has joined as an investor. SAQQARA's investors currently include Cross Atlantic Capital Partners, Dresdner Kleinwort Capital, Edgewater Funds, GE Capital, Limm Ventures and Vision Capital. Eastman recently selected SAQQARA Commerce Suite to transform its product information into differentiating e-commerce enabled catalogs that will increase its international trading partner base and sales, while time lowering costs. Following its selection of SAQQARA for its business needs, Eastman elected to further the relationship by becoming an investor.</td>
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<tr>
<td><strong>Market governance</strong> (contractual arrangement)</td>
<td><strong>BCR May 22, 2000</strong> C.R. Bard Inc. announced today that it has signed a letter of intent with eMedExpress, an operating division of Owens &amp; Minor (NYSE: OMI), to establish e-commerce and enhanced supply chain capabilities for C. R. Bard, a developer, manufacturer, and marketer of health-care products and services. Under the letter of intent, the goals of the initiative are to establish a state-of-the-art, customer responsive, e-commerce presence for Bard, and to consolidate and refine the company's supply chain capabilities. C.R. Bard Inc. and eMedExpress plan to use Time0, a business unit of Perot Systems Corporation (NYSE: PER) and a digital marketplace partner of Owens &amp; Minor, to provide the e-commerce framework and systems architecture for this initiative.</td>
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E-commerce project strategic intent

Commercial exploitation

KLT March 23, 2000
bex.com, a leading global business-to-business Internet transaction infrastructure vendor and developer of e-marketplaces, announced it will join with U.S. utilities to pursue a business-to-business e-commerce vertical exchange for the electrical industry worldwide. KLT Inc., a wholly owned subsidiary of Kansas City Power & Light Co. (NYSE: KLT), and Ameren Corp. (NYSE: AEE) have signed on as partners in the development project, which is expected to go live in the second quarter of 2000. "Consolidated buying power and complete end-to-end automated procurement processing will result in cost savings and enhanced revenue opportunities for the tightly regulated electric utility market. The business of utilities will shift from a regional to a global focus." "This venture is consistent with Kansas City Power & Light's strategy of maximizing shareholder value by capturing growth opportunities outside our core regulated utility business," said Greg Orman, president of KLT Inc. "This vertical exchange for the electrical utilities industry effectively brings an old economy market into the new economy."

Business impact

TRW June 18, 2001
TRW Aeronautical Systems has launched its e-Business Portal, AeroVantix™. The portal launch is the result of a multimillion dollar investment by TRW Aeronautical Systems, designed to make them more customer responsive. "We listened and talked to many companies in the industry, and then decided to move forward and implement a fully integrated, benefits-derived solution that should significantly improve our service and performance to all our customers," said Ken McIver, President and CEO, TRW Aeronautical Systems. "e-Business fundamentally changes the way you do business and can streamline processes if properly deployed." AeroVantix is the world's first fully functional, all-encompassing aerospace e-Business portal that ensures TRW Aeronautical Systems' customers have 24x7 access to the company and its supply base. TRW Aeronautical Systems selected Izodia as the founding technology partner in August 2000 after a rigorous selection process involving most of the leading industry players.

IT improvement

BBY May 22, 2002
Value-added network services from GE Global eXchange Services (GXS) will help Best Buy continue to streamline e-business processes and reduce supply chain costs. GXS will be providing the following services to Best Buy:

- transaction processing—for the exchange of business documents in standardized electronic data interchange (EDI) format;
- client implementation services—to help Best Buy successfully implement electronic document exchange with individual trading community members;
<table>
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<th>Variable coded as</th>
<th>Example announcement</th>
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<tr>
<td><strong>E-commerce project task complexity</strong></td>
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| **Low** | Xerox January 17, 2001  
To communicate more consistently and effectively with customers around the world, Xerox Corporation (NYSE: XRX) has redesigned its corporate Web site and infrastructure to serve more countries and to offer more online features, customizable services, and speed. The global site... increases the site's speed, flexibility, and reliability. It also makes it easier for the xerox.com team to manage and update pages for each country now served. The site will recognize when an Argentine customer, for instance, comes to www.xerox.com. It will then display all Web pages in Spanish, with up-to-date pricing in local currency. |
| **High** | AXP August 3, 2000  
American Express Co. (NYSE: AXP) and Ventro Corp. (NYSE: VNTR) plan to form a new company, MarketMile LLC, to build and operate an Internet-based marketplace aimed at streamlining the way corporations buy everyday business products and services. As for MarketMile, [analysts] say that AmEx must prove to businesses that it has the technical savvy, while Ventro will have to show it is financially stable. American Express is anchoring MarketMile to the approximately 30,000 midsize companies that now use its corporate purchasing card. During a pilot earlier this year, Amex found it lacked the skills needed to run an e-marketplace, so it began looking for a new partner. "[MarketMile] is a continuation of our Commerce Network strategy, only it is kind of supercharged by working with Ventro and creating our own company," said [AmEx executives]. |