A critical discussion of models for conceptualizing the economic logic of construction

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Abstract

The construction industry has developed a certain economic logic that reflects the way in which tasks, parts, and units are organized and related to each other in order to create economic benefits in the construction process. The present study examines how four different models in the literature that portray this logic complement and constitute alternatives to understandings of the economic logic of construction industry. Along with transaction cost economics, we have identified three more empirically-based models: a project-oriented model, a supply-chain-oriented model, and a network-oriented model. Associated with different streams of research, these models are discussed in terms of the typical problems and key interdependencies in the construction process they address, and the type of solutions they suggest, including organizing principles for how construction parties should relate to each other. The findings show how examining different models provides a comprehensive, albeit non-exhaustive overview and explanation of why the construction process is organized in the way it is. There is a need for increased awareness of the utilization of models (or combinations of models) and the models must also be seen as arguments in a broader discussion of how the construction process could or should function.

Keywords: economic logic, construction industry, models, relationships, interdependencies

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Introduction

The purpose of this study is to identify, examine, and compare the way in which in-depth models that are used and applied in the construction literature conceptualize and capture the specific features of the existing economic logic of construction. This is part of an ongoing stream of research that analyses different theories and models in terms of their usefulness for understanding the construction industry and its firms (e.g., Bon, 1989; Lansley, 1994; Koskela, 2008).

Conceptualizing the economic logic of the construction industry is a complex undertaking, primarily because the industry itself is complex, with a high degree of differentiation and interdependencies between the tasks, parts, and units involved in the construction process (Gidado, 1996). The economic logic reflects the economizing process, in which economic benefits are pursued and distributed among the parties in the construction process. As such, it relates to the organization of the construction process, how the parties relate to each other, and how interdependencies are handled. Several specific features of construction, including its one-off nature, the division of work among several parties, the strong interdependencies that exist, and the adversarial nature of how construction parties relate to each other (Cox and Thompson, 1997), provide arguments for the existence of a specific logic in the construction industry at large. Due to the complexity of the construction process, there is no reason to assume that the overall logic is simple or homogeneous. Instead, it comprises a set of several competing kinds of logic that are associated with the interests of different groups (Kadefors, 1995). This set is the result of many interaction processes in which companies must often balance between different logics (Dubois and Gadde, 2000; Bygballe and Jahre, 2009). This means that it is not a straightforward task to conceptualize the economic logic of construction. Another complicating factor relates to the variation in the theoretical models that are used in the literature to capture the logic. Many of the models applied in construction are taken from general theoretical fields (such as economic theory) and other empirical fields (such as manufacturing), and the various perspectives from which they have developed have led to numerous contradictions (Lansley, 1994). Every model builds on its own logic and tries to conceptualize the existing interaction and economizing processes using certain variables. This selection of aspects is important in terms of where and when the model can be used, which in turn depends on how it captures the specificities of the construction industry. In sum, this means that there exists a complex economic interaction between the involved actors in construction, which are described and analyzed using models that emphasize quite different logics.

The economic logic of the construction industry has been described and analyzed on the macro level, building on micro-economic or Austrian theory (e.g., Bon, 1989). In contrast, the present study focuses on the micro level, especially on the organization of the construction process and how interdependencies are handled and how the involved parties relate to each other. Consequently, the analysis is conducted on a level that corresponds to the empirical level at which the construction process takes place. It is generally acknowledged that interdependencies (Thompson, 1967) and relations between units (Williamson, 1988; Håkansson and Snehota, 1995) are important dimensions of the logic of economic organization. Therefore, the focus is on models that deal with these two dimensions, including one theoretical-based model – the transaction cost economics (TCE) model – and three more empirically-based models: a project-oriented model, a supply-chain-oriented model, and a network-oriented model.

A key assumption that underpins this study is that, on a practical level, construction companies must live with the implications of different logics and try to understand the overall economic logic and develop it further, as researchers do when investigating issues related to the logic. No one has knowledge of the totality, and various models in the literature only reflect partial views. Nevertheless, models are needed in order to both understand and influence what is taking place. An analysis of the models contributes to a better understanding of the economic logic of construction in itself. It also helps establish an awareness of the differences between various models and the extent to which they can be combined for the benefit of both researchers and managers. We believe that the theoretical models should be seen as “arguments” in a larger debate regarding how the construction industry works and develops in order to become more efficient and effective. This is also important for the ongoing debate about the theoretical basis for construction.

Approach

We identified four specific models in the construction literature that have developed from studies of how companies/organizations (should) act in relation to each other. These models form the basis for the analysis that follows and are examined in terms of how they have been used to describe and/or prescribe the economic logic of the construction industry. The first model, the transaction cost economics model (TCE), is predominantly theoretically-based and stems from institutional economic theory. We have referred to the other three models, which are more empirically-based, as the project-oriented model, the supply-chain-oriented model, and the network-oriented model. While TCE is easily identifiable in the construction literature due to its well-developed theoretical concepts, the three other models have, to a larger extent, been derived from the authors' interpretation of the construction literature. We have used a selection of references from the construction literature as a basis for identifying the models and for analyzing, comparing, and discussing all four models. We selected references for which the main unit of analysis is the *transaction* (e.g., Winch, 2002), the *project* (e.g., Walker and Wing, 1999), the *supply chain* (e.g., Vrijhoef and Koskela, 2000), and the *network* (e.g., Dubois and Gadde, 2000; 2002) and examined them in terms of what they said about the division of tasks, the crucial interdependencies, and how parties in the construction process do and should relate to each other in order to provide economic effects. Consequently, the analysis is based on how the models conceptualize the construction industry regarding the main unit of analysis; that is, the economic entity, key assumptions about interdependencies, and normative advice that they provide for handling the interdependencies.

Some of the references include a combination of models. For example, papers on the subject of lean construction, including the notion of concurrent engineering (e.g., Koskela, 1992), will often combine aspects of project-oriented and supply chain-oriented models. However, our purpose was not to establish a clear-cut relationship between different references (and authors) to specific models, but simply to identify what models exist in the literature. Furthermore, we do not claim that these are the only four models in the extant research. However, we do believe that the references and subsequent models used represent different approaches to the understanding of the economic logic of the working of the construction industry. In their own different ways, the four models all deal with inter-organizational issues and conceptualize the interdependencies and relations between construction parties.

The analytical design is also used to structure the paper in the following sections. We start out in the main theoretically-based model (TCE), which stems from a critique of the classical market model. We then use Thompson's (1967) dependence typology to identify the variation in how different models focus and capture various kinds of interdependencies among the companies. Through this process, we identify three empirically-based models that handle variation in the interdependencies between parties in the construction industry in different ways, both in relation to each other and in relation to the TCE model. We then describe and analyze these models based on how they conceptualize interdependencies and relations between construction parties. We then compare and discuss the four models in relation to the normative advice they offer with regard to economizing. We also outline the implications for practice and research of the analysis in terms of how we can understand the logic of economic organization in construction.

Theoretically-based models of the economic logic of construction

This section discusses TCE, with a focus on how it views interdependencies and relations between parties. Thompson's interdependence typology is then presented with reference to previous applications within the construction literature.

From "perfect competition" to transaction cost economics

The market view has been the dominant model of the logic of economic organization, both in construction and overall (Håkansson et al., 2009). Classic economic theory views the market as an economic system that "works itself," with supply adjusted to demand and production adjusted to consumption (Coase, 1937). The market is characterized by perfect competition in which price is the only coordination mechanism between independent and profit-maximizing firms. This extremely simplified model has attracted at least two main criticisms. Firstly, critics have questioned the model's behavioral assumptions about the economic actor; that is, the firm that underpins the classic model. While classic models within economy and organization theory (such as scientific management) assume rationality and that economic actors are completely informed about all available alternatives when setting goals and deciding which actions to pursue, it is widely accepted in contemporary models that organizations and economic actors are subjects to bounded rationality and that goals are highly ambiguous (e.g., March and Simon, 1959; Cyert and March, 1963; Thompson, 1967; Williamson, 1979). The second criticism, which is closely connected to the first, has questioned the classic model's view of how economic actors relate to each other. This is the aspect that the present study focuses upon. According to Coase (1937), firms exist because the costs associated with organizing a transaction within the firm are lower than those associated with organizing it by exchange on the open market. In other words, there are certain costs associated with operating the market and it is necessary to form an organization to reduce these costs (Coase 1937). Therefore, the transaction is the main unit of analysis for understanding economic organization.

Today, TCE appears to be the most developed theoretical-based model of economic organization, as it acknowledges the usefulness of firms as well as the fact that firms relate to each other and that this affects the logic of economic organization. Apart from economics, the model has been adopted in many other academic disciplines and empirical fields (for an overview, see Rindfleisch and Heide, 1997). Williamson (1988) argued that the transaction cost logic of economic organization implies that economic activity is organized so as “to economize on bounded rationality while simultaneously safeguarding the transactions in question against the hazards of opportunism” (p. 68). TCE represents a contractual approach to economic organization in which economizing on transaction costs is the main objective (Williamson, 2005). A central issue is to minimize transaction costs, both ex ante (before the contract is settled) and ex post (handling potential conflicts after the contract is settled). The critical dimensions for describing transactions are uncertainty, the frequency with which transactions recur, and idiosyncratic investments (that is, asset specificity), the latter of which has been defined as “the degree to which an asset can be redeployed to alternative uses and by alternative users without sacrifice of productive value” (Williamson, 1988, p. 70). These dimensions are aligned with three overall governance structures – the market, the hierarchy, and the hybrid – which differ in their cost and ability to achieve economizing results (Williamson, 1985).

A good deal of construction industry research has adopted TCE to understand how the industry functions and how construction parties relate to each other (e.g., Eccles, 1981; Reve and Levitt, 1984; Winch, 1989; 2001; 2002; 2003; 2006; Walker and Wing, 1999; Lai, 2000; Constantino *et al*., 2001; Rahman and Kumaraswamy, 2002; Turner, 2004; Lai *et al*., 2008; Warsame, 2009; Roehrich and Lewis, 2010). For example, Eccles (1981) used TCE to explain the extensive use of sub-contracting in construction. He argued that the need for specialized labor in construction, combined with the high degree of uncertainty that contractors face in regard to planning future labor requirements, implies that neither the market nor hierarchical governance structure are appropriate. Instead, Eccles' study of US homebuilders found that these contractors rely on subcontractors to obtain the required skills without being overwhelmed by the uncertainty and costs associated with continuous training. Eccles argued that these relationships may be stable and represent a "quasifirm" governance mode (Eccles, 1981).

The traditional TCE literature has considered vertical integration as the main safeguarding device with which to handle asset specificity. However, it is increasingly being acknowledged that firms can also protect their specific assets by pursuing various unilateral and bilateral hybrid governance modes, such as quasi-integration, selection procedures, and the development of relational norms (Rindfleisch and Heide, 1997); this is what Eccles termed the "quasifirm". While TCE has traditionally focused on avoiding dependence and has considered ongoing relationships and relational contracting as ways to deal with opportunism (Williamson, 1985), later contributions have recognized that relationships may create relational rents. For example, Dyer and Singh (1989) argued that such rents not only help reduce transaction costs, but also contribute to value creation initiatives such as investing in relation-specific assets, sharing knowledge, and combining strategic resources. This means that "firms can increase profits by *increasing* their dependence on smaller number of suppliers" (Dyer and Singh, 1998, p. 675). This recognition has led to the theoretical models that deal with the value-creating potential of interdependence.

Variation in interdependencies among organizations

Despite the recent attention given to relational rents, TCE has primarily focused on the cost side of relating to others and, therefore, the minimization of transaction costs. Research in other fields, such as organization theory, provides more elaborate ways of describing and analyzing the relationships between organizations in order to capture the value creation potential of interdependencies among firms (Scott and Meyer, 1994). The typology presented by Thompson (1967) has been used in economic analysis and seems particularly interesting for the purposes of the present study. Thompson developed a technology typology associated with specific types of interdependencies in order to explain how complex organizations act to produce desired outcomes. The long-linked technology is associated with serial interdependencies, where the order of interdependence can be specified and output from one activity is the input to the next. This technology is typically reflected in mass production, where planning is a key coordination mechanism. The mediating technology is found in organizations whose primary function is the linking of clients or customers that want to be independent, such as banking and insurance companies. These organizations rely heavily on standardization to coordinate pooled interdependencies, which implies that each part renders a discrete contribution to the whole and each is supported by the whole. In other words, the overall result is jeopardized unless each individual part performs adequately (Thompson 1967, p. 54). The final technology is intensive technology, which characterizes organizations that offer a set of techniques to achieve a change in an object, and where the chosen and applied technique is determined by feedback from this object itself. This technology is applied in situations where the object is human (such as in hospitals) and in situations where the object is non-human (for example, in the construction industry): "In the construction industry, the nature of the crafts required and the order in which they can be applied depend on the nature of the object to be constructed and its setting" (Thompson, 1967, p.17). The intensive technology is associated with reciprocal interdependencies, for which the outputs of each activity become the inputs for the other activities and vice versa, and requires mutual adjustments for coordination. Thompson (1967) noted that these different types of interdependencies reflect the degree of complexity in an organization. All organizations have pooled interdependencies. Complex organizations have both pooled and sequential interdependencies, while the most complex organizations have pooled, sequential, and reciprocal interdependencies.

A basic premise of Thompson's (1967) model is that organizations are open systems, which means that they are interdependent of the larger environment and must exchange with several others actors, "each of which is itself involved in a network of interdependence" (Thompson, 1967, p. 29). Therefore, interdependence is not merely an internal issue for organizations, and the task environment, together with the technology, is a major source of uncertainty for the organization. Thompson (1967) argued that the main responsibility of the boundary-spanning units of the organization

– the management level – is to mediate between the technical core and the institutional level. This is of interest for the present study because the technical core in construction is, by definition, inter-organizational.

The various interdependencies that exist are likely to lead to different ways of economizing. For example, Stabell and Fjeldstad (1998) argued that there are three types of value creation: one for each type of technology/interdependency. They suggested that the scale and capacity utilization to reduce cost are the main drivers in companies that are based on long-linked or mediating technology, whereas companies based on intensive technology are assumed to be more concerned with value creation, which makes them value-oriented rather than cost-oriented. Similarly, Håkansson and Persson (2004) used the characteristics of the interdependencies to identify different economic drivers in various logistics companies. Economies of scale and scope will be pursued and exploited by solutions that support standardization, similarity, and specialization, where management perceives pooled interdependencies between involved companies as a major driver for economies. Economies of integration will be pursued and exploited by solutions that support coordination and adaptation, where management perceives serial interdependencies in the supply chain as major drivers for economies. Economies of innovation and agility will be pursued and exploited by solutions that support collaboration, learning, and implementation, where management perceives reciprocal interdependencies between activated resources to be major drivers for economies (Håkansson and Persson, 2004, p. 24).

Thompson’s (1967) typology, along with the importance of different types of interdependencies, have also been acknowledged in the construction literature (e.g., Eccles, 1981; Winch 1989; Shirazi *et al*., 1996; Walker, 2007; Bygballe and Jahre, 2009). Even if all three types of interdependencies are identified in the construction process, the acknowledgement of reciprocal interdependencies seems to dominate (Walker, 2007). Bygballe and Jahre’s (2009) empirical study of how construction companies balance between different value creation logics identified reciprocal interdependencies, particularly in the design and planning phase of construction projects, in which clients and consultants, and increasingly contractors, combine their knowledge to reach a solution.

Based on Thompson (1967), the following section aims to identify how different models conceptualize the ways in which construction companies create value and economic benefits through their interaction with each other.

Empirically-based models of the economic logic of construction

We have used Thompson’s typology to characterize, analyze, and compare three empirically-based models. One model is based on studies of the construction industry, while the two other have developed from other settings that have more recent applications in construction.

The project-oriented model

The project process is a fundamental business process in construction (Winch, 2001). It is easy to identify the first model – the project-oriented model – in the literature. This model is particularly prominent in the traditional project management literature, in which the dominant unit of analysis has been the individual project and the construction industry is seen as a set of autonomous projects (Engwall, 2003). Although research on project management has not been explicit about its theoretical lenses, much of the work in this area has adopted a systems approach that focuses on how the parts of the system are related in order to fulfill clients' objectives (Walker and Wing, 1999). The system perspective is also reflected in the expanding literature on complex product systems, in which construction is used as an empirical field (e.g., Caldwell *et al*., 2009). Project management originated in construction and can be traced back to the development of large complex system industries, including the construction of railways and electrical supply (Winch, 2003). The solutions that were developed focused particularly on project planning systems that could map and plan the complicated net of processes needed to design and erect a building or other type of infrastructure (Gidado, 1996; Winch and Carr, 2001). Since then, this perspective has had a major impact on the way the construction industry is viewed (Bennett, 1983; Winch, 1989), and project-level issues have dominated the construction literature (Betts and Lansley, 1993).

The basic characteristic of the project-oriented model is its emphasis on the construction project as a temporary organization that is made up of a project coalition of different firms engaged in the successful completion of the project (Winch, 1989), which is related to discreet time, and financial and technical goals (Bennett, 1983). In this respect, the key tasks for management are, firstly, to achieve a balance between the objectives, project description, and organizational arrangements (Bennett, 1983), and, secondly, to mobilize and adjust the contributions of participants in the project coalition (Winch, 2002; 2006; Engwall, 2003). Since neither the client nor the general contractor have the skills or capacity to undertake all the construction work themselves, it is common to subcontract and mobilize external resources in construction (Eccles, 1981; Reve and Levitt, 1984). The project model focuses primarily on the dyadic relations between participants in the project coalition, such as client–engineering-consultant relationships, client–contractor relationships (e.g., Reve and Levitt, 1984), and general contractor–sub-contractor relationships (Eccles, 1981). More recently, the whole range of relations among the client, consultants and contractors, and sub-contractors has been taken into account (e.g., Winch, 2001), with the project coalition being considered as a network of relationships (Pryke, 2005).

The project-oriented model focuses on handling reciprocal interdependencies among parties in the project coalition and suggests that these interdependencies be handled in a systematic way using a specific temporary system – a project organization – that is responsible for mobilizing, coordinating, and adjusting the various actors' contributions in order to achieve the project's goals and fulfill the client's objectives (Bennett, 1983; Winch, 2006). The reasoning is that the contributions of participants in the project coalition depend on each other in such a way that "the outputs of each become inputs for the others" (Thompson 1967, p. 54) and mutual adjustment is required. Eccles (1981) noted that construction projects involve the simultaneous presence of a large number of labor specialties on-site, and that a unique combination of labor and material inputs must be performed and coordinated on-site. By establishing a clear division between what is inside the project and what is outside, a new temporary organization is created with clear boundaries. The project-oriented model makes an organization out of the interfaces between the involved firms in the project coalition, within the temporary organization – that is, that project – and the contribution that the firms make to the output of the project – that is, the building or other construction. The decision regarding which other actors will be included in the unit of interest (that is, the project) depends on the direct relations and the interdependencies in the project coalition. The key issue is the roles of the actors and the relationships between them within the individual project (Pryke, 2005).

The focus on relations in the individual project coalition has been accompanied by an interest in governance modes that is highly influenced by transaction cost economics. While the project-oriented model associated with the traditional project management literature was primarily concerned with processes and the organization of the various parts in the system, more recent contributions have incorporated the economics of different structures and the ways in which different functions are provided in the construction process (Walker and Wing, 1999). According to Walker and Wing (1999), a decision on the project organization structure must consider not only construction costs (that is, production costs), but also transaction costs. Winch (1989) argued that applying TCE makes it possible to consider the relations and the divergent interest within and between construction firms. As Winch noted, the core economic entity in construction is the firm, and “while the short-term interest of the firms in the coalition may be the ‘successful’ completion of the project, their longer term interests of survival and growth as firms are divergent, if not at times contradictory” (pp. 335). Therefore, another key management task is to motivate the project participants and ensure that they will contribute to a satisfactory execution of the contract, rather than pursuing their own objectives at the expense of the project's objectives (Winch, 2002).

In the traditional project management literature, normative advice for coordination includes the application of professional standards and training, target setting, defined management roles, and information and planning systems to ensure that everyone involved in the project carries out their appointed task according to the project's objectives (Bennett, 1983). Project structuring, planning, performance measurement, and quality management are considered to be basic and necessary conditions for successful project management (Engwall, 2003). While these project management advices have been complemented by a focus on formal contracts and conflict handling to cope with uncertainties and risk (e.g., Turner, 2004), there is increasing recognition of the importance of relational contracting (e.g., Rahman and Kumaraswamy, 2002; 2008; Roehrich and Lewis, 2011) and partnering agreements (Lahdenperä, 2012; see Bygballe *et al.*, 2010 for an overview of the partnering literature). As Winch (2001) noted, these new forms of governance illustrate the need to consider power and trust issues when discussing alternative governance modes for construction in order to mobilize and motivate the project coalition, and to achieve the needed mutual adjustments of the parties' contributions.

The supply-chain-oriented model

The second model, which we have termed the supply-chain-oriented model, is highly associated with what is known as supply chain management (SCM), which originated in studies of logistics in manufacturing companies. SCM is based on the notion that competition is between supply chains, not companies. Like most popular concepts, SCM has been defined in numerous ways and from different perspectives (Harland, 1996; Bechtel and Jayaram, 1997; Lambert *et al.*, 1998; Ballou *et al.*, 2000; Svensson, 2002; Heikillä, 2002). Mentzer et al. (2001) conducted a review that identified more than 100 definitions for SCM. Based on these, they defined the supply chain as "a set of three or more entities (organizations or individuals) directly involved in the upstream or downstream flows of products, services, finances, and/or information from a source to a customer" (p. 4). Regardless of the perspective taken or the definition used, "there is an inherent (but not explicit) assumption that the focal organization [i.e. one specific organization, often the manufacturer or a retailer chain] has the power to manage/co-ordinate the other actors" (Gripsrud *et al.*, 2006, p. 646).

More recently, SCM and logistics have received increasing attention in the construction industry, starting with two seminal reports in the 1990s (Latham, 1994; Egan, 1998), followed by a number of articles in the last decade or so (e.g., Vrijhoef and Koskela, 2000; Cox and Ireland, 2002; Love *et al*., 2004; Briscoe and Dainty, 2005; Hatmoko and Scott, 2010). Despite the vast number of references made to SCM, Bankvall et al. (2010) noted, "the most common approach to SCM and integration of supply chains in the construction industry, however, is to examine each separate project and to consider what is needed for that particular project as one supply chain" (p. 387). For example, Love et al. (2004) used the term "project SCM" with reference to "…the network of facilities and activities that provides customer and economic value to the functions of design development, contract management, service and material procurement, materials manufacture and delivery, and facilities management" (p. 44). However, the supply-chain-oriented model constitutes a specific way of doing business and implies an understanding and appreciation of the permanent vertical relationships along the individual chain supplying several projects. In this respect, it relates to Eccles' (1981) "quasifirm", which is comprised of long-term relationships between a general contractor and its sub-contractors. However, the SCM orientation goes further than Eccles, assuming that the supply chain – specifically, its flows, processes, activities, technologies, systems and actors (Fabbe-Costes and Jahre, 2008, p. 134) – should be integrated, and that one actor takes the role as the "integrator"; that is, the focal firm. As Vrijhoef and Koskela (2000) noted, integrating the supply chain with the site production means replacing the usual temporary chains in construction with more permanent (traditional) supply chains. Many researchers have noted that improving the efficiency and effectiveness of construction supply chains requires a fundamental change in the management of relationships between clients, contractors, and sub-contractors towards longer-term relationships (e.g., Fearne and Fowler, 2006). However, it remains be seen whether those involved in the construction process prefer to be integrated within a permanent supply chain (Dainty *et al.*, 2001).

A review of the construction literature reveals three slightly different perspectives on SCM (for an in-depth overview, see Bankvall *et al.*, 2010). One approach perceives the construction industry as a single chain, which suggests full integration of all activities (for example, see Akintoye *et al.*, 2000; Proverbs and Holt 2000; Love *et al.*, 2004). Another perspective focuses on parts of the construction industry and suggests solutions for these specific parts, such as builders–merchants (Agapiou *et al.*, 1998a; 1998b) and sub-contractors (Dainty *et al.*, 2001). A third approach suggests that the construction industry consists of different chains that must be managed and organized differently (for example, see Vordijk *et al.*, 2000, Cox and Ireland, 2002). In all of these approaches, the main point is to have a more industrialized approach to the construction industry, similar to that found in the manufacture of cars (Love *et al*., 2004; Höök and Stehn, 2008). This is despite the fact that the car industry is quite different from construction in a number of areas (Winch, 2003), such as the need to converge many components and many flows into one object, the temporary and one-off nature of construction projects, and the make-to-order production (Vrijhoef and Koskela, 2000). A variant of the supply chain model that has attracted considerable attention during the past decade is lean construction, which developed from lean manufacturing and Toyota production philosophy (Womack *et al*., 1991), as well as other production theories (Koskela, 1992; Ballard and Howell, 2003; Koskela and Ballard, 2006; Höök and Stehn, 2008). Lean construction emphasizes integration of the temporary aspects of the project with the permanent features of the supply chains: “We understand projects to be temporary production systems linked to multiple, enduring production systems, from which the project is supplied materials, information and resources” (Ballard and Koskela, 2003, 120). Despite recognition of the role of the permanent supply chains, there seems to be an emphasis on the production process *within* the project; that is, the temporary production system. This could suggest that lean construction only *appears* to be associated with the supply chain model, and that the project logic is just as important. This notion is reflected in the role that concurrent engineering plays within lean construction (Koskela, 1992).

With regard to interdependencies, the supply-chain-oriented model focuses on the relation between partners in direct exchange, where one partner produces outputs that serve as inputs for the actor in the next step of the process (Thompson, 1967, p. 54). Typical examples are suppliers of raw material that provide inputs to manufacturers of modules and manufacturers that sell their products to retail chains. The focus is on the vertical connections between subcontractor/contract/client rather than on architects/consultants and connections across different chains (Bygballe *et al*., 2010, p. 245). In this way, this model gives a special role to the sequential interdependencies between pairs of actors in the supply chain and handles them systematically. Other actors are included based on this focal relation and are usually defined as going upstream (that is, integrating backwards (suppliers' suppliers)) and/or downstream (that is, forward integration (customers' customers)) in the supply chain (e.g., Nordin *et al*., 2010). When looking at the chains from the production of raw materials to the construction at production sites and the use of the facilities, certain important interdependences can be utilized to a greater or lesser degree from an economic point of view. As noted earlier, a supply-chain-oriented model is reflected when the construction project is seen in relation to a longer-term production structure. Emphasis is placed on the flow of information, materials, labor, and equipment, and the transformation of physical flows in the supply chain and the organization in a way that ensures efficiency and increases value through cost reductions. The main focus is to improve the productivity of the industry by increasing supply chain efficiencies from design to construction and maintenance. The goal is to exploit the economic potential that lies in the creation of more integrated and permanent chains of companies and their activities that supply multiple projects.

In this respect, economizing is achieved by finding the right level and means of integration. In the construction literature that deals with SCM, normative advice to improve integration often includes the early involvement of not only contractors, but also subcontractors in the design phase (e.g., Proverbs and Holt, 2000; Love *et al*., 2004; Hatmoko and Scott, 2010; Nordin *et al*., 2010), coordinated working and development of close relationships (Nicolini *et al*., 2001; Saad *et al*., 2002; Love *et al*., 2004), and the use of ICT systems for information exchange (Vordijk, 1999; Titus and Bröchner, 2005; Xue *et al*., 2007). Furthermore, the use of standards for aligning systems, quality assurance, and innovation, as well as risk reduction, has also been said to be essential (e.g., Höök and Stehn, 2008; Hofman *et al*., 2009). It has also been argued that developing solutions based on modularity in design and building (e.g., Hofman *et al*., 2009) and pre-assembly would increase both short-term and long-term efficiency (Gann, 1996; Gibb and Isack, 2003; Vordijk *et al*., 2006). Again, however, the question remains whether these "success factors" for construction supply chain integration really capture the essentials of the supply chain model, which relates to the more permanent supply chain.

The network-oriented model

The final empirically-based model, which we have termed the network-oriented model, is highly associated with the network approach that has been developed within the Industrial Marketing and Purchasing (IMP) group (for an overview, see Håkansson *et al.*, 2009). This approach is the result of a number of large-scale empirical studies into how producing companies deal with each other in an economic sense. Theoretically, the approach has been related both to inter-organizational and economic-based theories and, in the last decade, has also been used to explain relationships in construction. However, it is important to note that networks are considered in various ways in construction (e.g., Pryke's (2005) social networks). Here, we have used the IMP network approach as a basis because it includes the notion of inter-organizational relationships that extend beyond the individual project and capture the importance of both direct and indirect relationships in the broader network of relationships. In this approach, relationships are formulated as tied resources, linked activities, and bonded actors (Håkansson and Snehota, 1995). This means that relationships are built up over time through mutual investments from the involved parties. Investments in terms of adaptations of resources, development of joint routines, establishment of a joint communication pattern, and social exchange are all key ingredients. These investments are necessary in order for the parties to utilize each other's resources and activities and they affect both efficiency (Dubois, 1998) and innovations (Håkansson and Waluszewski, 2007). Relationships become assets, but the investments also create connections between the relationships (resources are shared); in other words, they create a network, which makes the indirect relationships crucial. Relations to or via third parties are an important influencing factor for business development.

The network-oriented model has been increasingly applied to construction (e.g., Håkansson *et al*., 1999; Dubois and Gadde 2000; 2002; Doreè and Holmen, 2004; Andersen *et al*., 2004; Holmen *et al*., 2005; Holmen *et al*., 2007, Johnston *et al*., 2006; Bengtsson and Håkansson 2008; Bygballe and Jahre, 2009; Håkansson and Ingemansson, 2011). The model sets the project within an activated network and focuses on the coordination and adaptation of activities and resources, both in the temporary project network and in the permanent network, in order to facilitate innovation and create long-term network effects. Identifying combinations of resources and actors that foster innovative solutions helps attempts to exploit the complexity of the construction industry rather than minimizes them. Hence, the network-oriented model seeks to build proactively on the interdependencies when searching for good solutions, with the goal of exploiting the economic potential of the indirect relationships.

Dubois and Gadde (2000; 2002) reported that the construction industry faces challenges due to it interdependence and uncertainty. They found that the supply of materials is primarily characterized by the exchange of standardized products, even if the site-specific solution is customized; this is what Dubois and Gadde referred to as "collective adaptations" (2000). Another important feature is the temporary network (project) within the permanent network (the actors in the industry). As Dubois and Gadde (2000) put it, "The project network activates resources in the permanent network to perform the activities required for completion of the building" (p. 213). A firm's resources are activated in a number of projects simultaneously, which means that their use must be coordinated at the project level, the firm level, and the relationship level. Dubois and Gadde (2002) concluded that the strong reliance on standardized components and interfaces characterized by "loose couplings" does not foster technical development and that the current coordination mechanisms hamper product development. A detailed case study of a construction project by Håkansson et al. (1999) found a similar pattern, with most of the suppliers handled in a rather isolated manner and indirect relationships only considered in relation to some of the larger sub-contractors. As Holmen et al. (2005) argued: "Although firms are able to create some relationship substance, they behave as if they do not expect to benefit from this substance in later construction projects (i.e., substance created is categorized as loose)" (p. 1249).

The relevant unit in this logic is considered to be the relationships between companies, as well as the company itself. The emphasis is on the interaction between companies rather than just the transactions as such, and the focus is on how interdependencies can be exploited as opposed to avoided. For example, Anderson et al. (2004) attributed the successful diffusion of new technology in solar energy projects to the ability to select and manage partner networks throughout all phases of the project. This enabled access to resources, the combination of actors across industries, and the active participation of the lead firm to help disseminate information and knowledge in the network.

Furthermore, in a study of the re-introduction of wood frames in houses, Bengtsson and Håkansson (2008) found that even if the previous interaction was characterized by loose couplings, it had produced a heavy structure, both in technical and organizational terms, that made all changes, even those that did not require new knowledge or new competence, difficult and costly. This finding indicates the importance of indirect relationships and the fact that the pooled interdependencies play an important structural role in the construction industry. One result of this finding is that many construction companies mediate between others, which means that all actors must combine with other actors. Common examples of indirect relationships in construction are sub-contractors sharing equipment on-site, competing manufacturers depending on the same suppliers of components, and projects that share the same administrative resources within a firm. Hence, even if the parties are not directly related, changes to one party can have consequences for another through a third party, which means that this model gives pooled interdependencies a special role and handles them in a systematic way. Actors connected through the third party are included in the "network," which is the basic structure. However, the network constitutes sets of direct relationships, which are based mainly on the two other types of interdependencies (sequential and reciprocal), each of which requires more advanced coordination. Consequently, the total structure demands a certain type of coordination, such as balancing between standardization and adaptation, while specific relationships require other types of coordination in which the different interdependencies must be combined. Similarly, Bankvall et al. (2010) called for caution when it comes to supply chain integration, since the strong emphasis on coordination of sequential interdependence within individual supply chains does not fit with the complex interdependencies that are present in and among supply chains and projects in construction (that is, the construction network).

Comparing the four models

The four models discussed above differ in terms of how they conceptualize the construction industry and its economic logic. In the theoretically-based model (TCE), the main unit of analysis with regard to economizing is the transaction itself and its key features. Interdependencies are captured in the concept of asset specificity, which is seen as a key reason for the use of alternative governance forms other than the market. The normative advices state that when asset specificity is high, various safeguarding mechanisms are needed to reduce transaction costs. These include formal mechanisms such as contracts and monitoring, and more informal mechanisms such as trust and long-term relationships. Of the more empirically-based models, the project-oriented model has primarily focused on the project as the main unit of analysis, even if it has been argued that the project consists of companies and that the firm should be considered the main economizing actor (Winch, 1989). Specifically, the model focuses on the reciprocal interdependencies that exist as parties in the construction project contribute simultaneously with their various resources. The role of project management relates particularly to the mobilization and coordination of the participants in the project coalition. Planning and adjustments are seen as important means with which to achieve the project’s objectives. The supply chain model focuses on the chain of companies, particularly the upstream chain of suppliers that are involved in supplying many construction projects under a “lead” firm; that is, an “integrator” or supply chain manager. Handling sequential interdependencies by coordinating and integrating the various activities is seen as the key to reducing costs in the supply chain. Planning and standardization are both important in this respect. Finally, the network model focuses on the connections between relationships involved in the construction process; by acknowledging the importance of indirect relationships, pooled interdependencies become particularly vital in this model. It is important to coordinate and combine various actors and their activities and resources through both direct and indirect interfaces in order to handle the interdependencies and create value, especially for innovation, which is how companies are assumed to economize. A key issue is to combine standardization and adaptation in new ways. Table 1 summarizes the main features of each of the three models and compares them with the more theoretically-based TCE model. These aspects are discussed further in the following section.

Insert Table 1 here

Discussion

The above analysis has shown that the four models complement each other in terms of how they approach the challenges that face the construction industry in practice, and how they approach the existing economic logic of the industry. Each model captures important aspects of the economizing (and active coordination) process by focusing on different types of interdependencies and relations between the parties involved. There are several important ways to handle the economizing dilemmas that actors face on a daily basis as a result of the complexity and interdependencies in the construction process. These techniques include reducing transaction costs through formal and informal means; mobilizing, coordinating, and adjusting the contributions of the participants of the project coalition to achieve the project's objectives; integrating the various supply chains to create cost efficiencies; and combining activities and resources in the broader network of direct and indirect relationships to enable productivity and innovation. Consequently, all of the models are useful for understanding and solving certain problems.

However, the four models are based on various basic assumptions that cannot coexist or are at least contradictory. The models vary, both in terms of their key economic entity and what they view as the crucial problems in organizing the construction process. The transaction cost model focuses on the optimal transaction mode and how efficiency is created through minimizing transaction costs (Williamson, 1985). The goal of the model is to find the best governance form for each situation. This fits with the focus on projects and on sub-contracting in the construction industry, which makes it easy to combine the transaction cost model with both the project-oriented and the supply-oriented models; it may also explain the transaction cost model's attractiveness in the construction literature and practice. The project-oriented model focuses primarily on the project as the key target for economizing efforts and how the contribution of each member of the project coalition can be assured to fulfill the project's goals and client's objectives. Because the project coalition can be seen as an organization in itself (that is, a temporary organization), the model can easily be combined with the three other models in terms of how to treat the other parties involved in the construction process that are not part of the project coalition. The model has developed from the construction area and captures the specific project-based nature of construction. The supply-chain-oriented model takes its starting point from the existence of a larger vertically-oriented system, in terms of chains, that each supply many projects with similar components. The model assumes the advantage of cost reduction through closer integration within these separate chains. While it can be combined with the TCE model, combining it with the project-oriented model might present certain problems as it has a much longer-term focus. This could explain why it has not been adopted to a greater extent in practice in the construction industry (Briscoe and Dainty, 2005), particularly by contractors, while it is likely to work better for the producers of components/services and their supplier relationships. Finally, the network-oriented model points to the need for an entire set of coordination mechanisms at different levels in the industry – specifically, various types of relationships on the one hand, and the network on the other – in order to create value and reduce costs. The network-oriented model focuses on the opportunities to combine and recombine internal and external resources. One tool that has been suggested to increase revenues is to invest in turning relationships into resources in order to get more out of them; that is, investing to increase value creation. It is difficult to combine the underlying heterogeneity assumption with TCE. However, it can be combined with both the project-oriented and the supply-chain-oriented models, although it gives both models some special new attributes. The results of using the network model for the construction industry are mixed. All network based studies have suggested that construction companies in general seem to be rather uninterested in utilizing the economic potential in the network structure that is so highly appreciated in many other industries, at least in relation to suppliers. This is probably due to the traditional focus on single projects as well as the active use of competitive biddings, even if partnering approaches are increasingly adopted, at least downstream towards customers (Håkansson and Ingemansson, 2011; Lahdenperä, 2012).

An important explanation for the differences between the four models is how they focus and deal with interdependencies. The project-oriented model focuses primarily on the reciprocal interdependencies between the most important parties in the project coalition. By creating a special organization – a project organization – these interdependencies are internalized within this organization and can be dealt with efficiently. The organization can handle problems related to these reciprocal interdependencies in the short run, which means that other problems and opportunities are externalized and less prioritized. The supply-chain-oriented model focuses on sequential interdependencies, both within the project and outside it, including suppliers and sub-suppliers. This model focuses particularly on exploiting the economic potential in the sequential interdependencies by creating more integrated solutions to reduce time and inventories. One important dimension of sequential interdependence is that it can often be extended from the dyad to the next level, thereby creating chains. All such chains include the potential to reduce costs by identifying better integration forms across several companies. Finally, while the network-oriented model focuses on both sequential and reciprocal interdependencies among pairs of companies, particular attention is paid at the network level to the general pooled interdependencies among the firms. In the network-oriented model, units are assumed to be economizing on all three types of interdependencies, thereby combining the acting (networking) in relation to the existing mix and using it to develop the interdependencies in an active way. Instead of trying to become independent (in order to use the market mechanism), the companies are assumed to be trying to become even more dependent on certain other companies to enhance productivity and innovation.

The logic in TCE does not differentiate between various types of interdependencies, but it does make a basic assumption about the importance of dependence due to factors such as small numbers and asset specificity. This means it can be combined with both the project-oriented and SCM-oriented models.

The differences between the models become even more obvious when they are used for prescription. The network model suggests a more systematic use of relationships in order to identify better combinations/solutions, emphasizing that it is combinations of relationships that create positive (or negative) network effects. Furthermore, the balance between standardization and adaptation is important for handling pooled interdependencies. The TCE, on the other hand, suggests a situation-specific adaptation to the type of transaction mechanism; in other words, every counterpart should be handled in isolation. The project-oriented model concentrates primarily on the efficient mobilization and adjustment of the involved parties in the project coalition for each single project and recommends treating each project as unique. The supply-chain-oriented model, on the other hand, suggests that the interest should be focused on the long-term relationships within the upstream supply chains.

Conclusions and future research

The aim of this study was to examine, analyze, and compare how different models applied in the construction literature conceptualize and capture the specific features of the economic logic of construction – that is, the division of tasks – and how to pursue and accomplish economization. The analysis contributes to the ongoing debate in the literature regarding the potential to harmonize different theories and models (e.g., Lansley, 1994), which theory should be applied (e.g., Bon, 1989; Koskela and Ballard, 2006; Winch, 2003; 2006), and whether it is feasible or even possible to pursue one theory in order to understand construction (for example, the special issue on theory in *Building Research & Information*, 2008; Koskela, 2008).

We identified four models based on how they conceptualize relations and interdependencies among the parties involved in the construction process. Among these are one theoretically-based model (transaction cost economics, or TCE) and three empirically-based models (the project-oriented model, the supply-chain-oriented model, and the network-oriented model). Each model was examined based on how it has been applied in the literature to understand the construction industry and how this understanding affects the way in which the economic logic is perceived and the subsequent normative advices for economizing. The exercise was conducted in order to identify the degree to which the models are competing (which would make them substitutes) and/or are complementary and can be used together to understand the logic of economic organization of construction. Being explicit about the differences between the models helps clarify the complementarities of the models. While this makes it easier to use combinations in practice, it also helps researchers recognize the lenses they use when studying and attempting to understand the economic logic of construction, and when they make recommendations, which is also relevant for teaching and consultancy purposes.

The analysis suggests that there is no easy answer to the question of what is the “right” way to conceptualize and model the economic logic that exists in the industry. One conclusion is that the four models have important complementary features and deal with different issues and different logics that can be at least partly combined, which means they can all be useful for construction companies in certain situations. A second conclusion, however, is that there are also important differences between the models and there could be contradictions as to the picture drawn through the research in terms of problems identified and the normative advice suggested. The main reason for the differences can be traced back to the type of interdependence upon which each of the different models focuses. This reflects how the companies are assumed to relate to each other and how they should economize; that is, what kind of issues they should concentrate on and the key economic factors that are likely to affect the economic result. Should companies pursue efficiency in terms of highly integrated production chains, or should they have greater freedom to make changes? Similarly, should they pursue increased utilization of resources by relating more systematically to other parties, or should they seek to use resources in a more standardized and independent manner? As the models indicate, it is impossible to achieve all of these aspects at the same time.

A third conclusion is that while all four models can be relevant alternatives for understanding how the construction process is organized and how the industry works, none of them seems able to capture the totality. This brings us to the debate about whether one single theory or model is needed or even feasible to conceptualize the construction process and to offer sound advice to managers. Winch (2003) argued that the suitability of different models depends upon the construction sub-sector being analyzed. In practice, however, many construction companies and suppliers work across different sub-sectors, including housing, building, and major projects, and must handle and balance between various logics at different times and on different levels (e.g., Kadefors, 1995; Shirazi *et al*., 1996; Dubois and Gadde, 2000; Bygballe and Jahre, 2009). Therefore, there seems to be an argument for developing one model of the economic logic of construction that considers all three interdependencies and technologies that exist for the benefit of the manager. On the other hand, Lansley (1994) noted that while managers have viewed some theories as being too simple for the purpose of handling the complexities of construction, many other theories have been considered too complicated and inconsistent, even confusing, because they involve too many factors and dimensions.

Given the differences between the four models considered in this paper, simply merging them into an overall model of the economic logic of construction might create confusion among managers and cause them to retain existing practices and models. Therefore, a final conclusion is that the models must be seen as "arguments" in a larger debate, the main issue of which is what kind of overall system do we want when it comes to design of activities and utilization of resources? While it seems reasonable to argue that TCE and the project-oriented model reflect and reinforce existing construction practice in terms of the short-term focus and an emphasis on various forms of contracting as safeguards towards opportunism, the supply-oriented and network-oriented models do, to a larger extent, represent alternative approaches. It is important to realize that industrial policy and regulations, the way in which companies are managed, and the recommendations offered in research, teaching, and consultancy, combine to create a result that we all have to live with. Therefore, several parties should engage in what this totality should look like. Researchers can contribute by further examining the economic logic of construction, which makes it possible to develop model(s) that reflect practice and provide a basis for recommendations that could change the existing practice.

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Table 1: Summary of the analysis of the four models.

Models/ Features	**Transaction cost economics**	**Project-oriented model**	**Supply-chain-oriented model**	**Network-oriented model**
Unit in focus	Transaction	Project/firm	Chain	Connected relationships
Interdependence in focus	Asset specificity	Reciprocal	Sequential	Pooled
Economizing action in focus	Transacting	Mobilizing	Integrating	Combining