

UNDERSTANDING CONSTRUCTION SUPPLY CHAINS: A MULTIPLE THEORETICAL APPROACH TO INTER-ORGANIZATIONAL RELATIONSHIPS IN CONSTRUCTION

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ABSTRACT

The transaction cost economics (TCE) approach has been applied often as a basis for the analysis and explanation of the functioning and organization of construction processes and supply chains. The objective of this paper is to develop a more complete theoretical framework to better understand inter-organizational relationships (IOR) in construction supply chains from a multi-disciplinary perspective.

The starting point of this paper is the observation that the TCE perspective alone is too narrow to fully explain and understand construction supply chains. In addition to TCE, three additional perspectives are introduced to explain the organization and functioning of supply chains: production and operations management (POM), network theory, and the language/action (L/A) perspective. The POM perspective shows that an organizational form of production must be aimed at the general objective of value creation for customers, not merely on the economic argument of minimizing transaction costs. Both TCE and POM, particularly address bilateral inter-firm business relationships and do not include the complexity of wider industry networks, and additional factors of multiple inter-firm relations. Finally, TCE, POM as well as network theory disregard the dynamics associated with the recurrent process of language and action between firms and individuals.

In the paper, the theoretical principles of the four perspectives are used to explain IOR in construction supply chains. Next, the four perspectives are mapped and classified in a theoretical framework, including additional directions for the further development of the framework. It is concluded, however, that the framework may still be too incomplete to fully explain and understand the organization and functioning of IOR in construction supply chains, and that a more complete theoretical paradigm is needed.

KEY WORDS

Construction supply chain, inter-organizational relationships, transaction cost economics, production/operations management, network theories, language/action perspective

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INTRODUCTION

Transaction cost economics (TCE) has often been applied to explain supply chains in construction and other industries. Winch (2001) for example endeavors to present a comprehensive framework for understanding the governance of the construction project processes, drawing on TCE. Winch refers to several prior attempts to interpret construction from the transaction cost point of view. Thus, TCE can be understood as one specific theoretical angle used for understanding construction supply chains, i.e. the sequence of inter-organizational relationships (IOR) between clients and suppliers along the construction supply chain, e.g. the client-contractor relationship and the contractor-suppliers relationship.

The objective of this paper is to develop a framework in order to understand construction supply chains from a multiple theoretical perspective. Starting point of this approach is that the analysis of supply chains from a mere TCE perspective is too narrow, and that additional perspectives are needed to fully understand IOR.

In this paper, four theoretical perspectives are presented to explain the organization and functioning of IOR in supply chains, i.e.: TCE, production and operations management (POM), network theory, and the language/action (L/A) perspective. Next, the four perspectives are used to explain IOR in construction supply chains. Finally, the different approaches are related to each other in one framework. The aim of this framework is to understand IOR in construction supply chains in a broader socio-economic context. Directions for further development and completion of the framework are indicated.

INTRODUCING THE FOUR PERSPECTIVES ON INTER-ORGANIZATIONAL RELATIONSHIPS IN SUPPLY CHAINS

TRANSACTION COST ECONOMICS

Concepts from TCE are used to analyze circumstances in which co-ordination mechanisms develop. In TCE, the choice of a co-ordination mechanism or governance structure is made by economizing on the total sum of production and transaction costs, while production costs are considered to be constant. Transaction costs are associated with search and information costs, bargaining and decision costs, policing and enforcement costs (Dahlman 1979).

TCE provides an explanation for the existence and structure of firms and for the nature of vertical co-ordination within a supply chain (Hobbs 1996). When transaction costs are low, contracting is used (i.e. market structure), while internalization will prevail for high transaction costs (i.e. hierarchy). Intermediate modes are often referred to as hybrid modes (Williamson 1991). TCE recognizes that transactions do not occur without friction. Costs arise from the interaction between and within firms as transaction costs: information costs, negotiating costs and monitoring costs (enforcement costs) (Hobbs 1996). His model uses human factors such as opportunism and bounded rationality. Transaction costs would be zero if humans were honest and possessed unbounded rationality. Transaction costs for a particular transaction depend on the three critical dimensions of transactions: asset specificity, uncertainty and frequency (Williamson 1985). Besides these key concepts underpinning TCE (bounded rationality, opportunism, asset specificity, uncertainty, and frequency), Milgrom and Roberts (1992) add two other items: difficulty of performance

measurement, and connectedness to other transactions. Both are relevant from a supply chain viewpoint.

Asset specificity refers to the situation in which a firm and/or selected suppliers need to engage in specific investments in order to make transactions possible. Asset specificity implies that canceling a contractual arrangement could lead to severe losses for one or both parties when attempting to use this specific asset for other purposes. TCE owes much of its predictive content to the concept of asset specificity (Williamson 1985). Asset specificity is important as a result of human opportunism. Because of opportunistic behavior, resources will be spent on contractual and organizational safeguards.

Loader (1997) concludes that *uncertainty* generally drives a supply chain towards vertical integration, depending on the extent of asset specificity and uncertainty regarding price levels. However, improvement of the levels of information among parties along the supply chain may relieve the uncertainty and by that be a substitute for vertical integration (Loader 1997).

According to TCE, change in the transaction costs arising from the exchange of a product may lead to a change in the management of the supply chain, dependent on the degree of uncertainty of the transaction, degree of asset specificity, and the frequency of the transaction. Transaction costs and their reduction lie in the heart of the interest in supply chain management. High levels of uncertainty, asset specificity, and infrequency lead to more formal types of vertical coordination, towards vertical integration. There is always some kind of vertical organization if any production takes place. Vertical co-ordination is central to the study of supply chain management (Hobbs 1996). Between open market and vertical integration lie a continuum of organization forms representing different degrees of supply chain management: from strategic alliance (contract), quasi-vertical integration (e.g. joint venture), tapered vertical integration (backward integration), towards full vertical integration (Hobbs 1996). Obviously improved collaboration and communication in the supply chain will reduce transaction costs (Hobbs 1996).

PRODUCTION AND OPERATIONS MANAGEMENT

From the point of view of modern POM, TCE can be interpreted as minimizing a few particular cost categories or particular form of waste (i.e. non value-adding activity). Unfortunately, other kinds of waste are not recognized by the transaction cost theory, because it views production as a series of transfers, i.e. changes of ownership of goods and services from one individual/unit to the other.

This is a very narrow view of production that, for instance, disregards the transformation aspect of production. This view is, however, fully compatible with the decomposition principle of the transformation model of production (Koskela 2000), while production is conceived as a the purchase of decomposed tasks or goods. However, purchasing is not generally the essence of production, and the question arises, why production should be organized just on the basis of purchasing costs. Instead of minimizing a specific type of waste associated with one activity type in production, the objective should rather be to organize production in such a way that all kinds of waste are minimized (Figure 1). Another issue is that it is hardly possible to isolate transaction costs from production costs. The transaction behavior of the supplier impacts the production costs in many ways.

The selection of an organizational form of production should be focused on the general objective of value creation for customers⁴, where waste minimization is one sub goal. Seeking a general explanation for the selection of an organizational form of production on the basis of minimizing transaction costs *only* it is not justified. However, this does not exclude the possibility that there might be cases where minimizing transaction costs are indeed the driver of the selection of an organizational form. The transaction cost approach is, however, incomplete to explain behavior between parties, and organizational forms of production. The basic reason is that TCE inherits the basic deficiencies of economic conceptualization, focusing basically on production as a “black box”. TCE does not provide an adequate analysis of production activities (Koskela 2000).

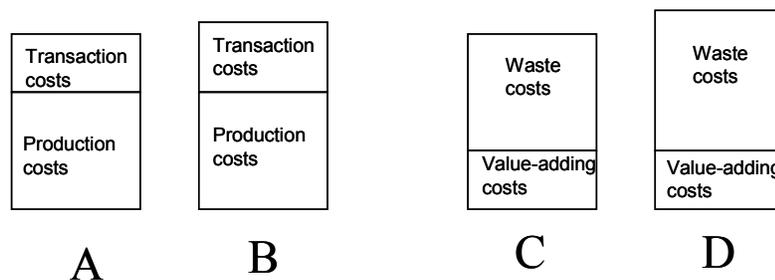


Figure 1: TCE and POM approaches compared

TCE compares different modes of organization based on their transaction costs and assumes the production costs to be constant (alternative modes of organization A and B in Figure 1). Modern operations management may compare different modes of organization primarily based on their waste costs and assumes value-adding costs to be constant (alternative modes of organization C and D in Figure 1). Regarding the design of production systems, inter-organizational transactions are also conceived as flows which lead to long-term co-operation with suppliers with the goal of deriving mutual benefits from optimized total flow (Koskela 2000).

NETWORK THEORY

Karlsson (2003) observes that contemporary industrial organization and production strategies increasingly put emphasis on activities that are external to traditional organizational environments, and managing operations in an external network. Karlsson calls this the shift from an enterprise to an “extraprise”. Sturgeon (2002) introduces a similar new model of industrial organization: the modular production networks.

TCE suffers from not adequately exploring alternative forms of external organization, besides market versus hierarchical mechanisms for solving strategic dependencies. In addition it disregards repeated transactions, the dynamic evolution of organizational forms, and the key roles of trust, risk and equity in the selection of organizational forms and shaping

⁴ This is suggested by Galbraith (1995): “In my view, organizational designs should make it simple for the customer to do business with the organization. Designs should also make it easy for employees with customer and product contact to execute their roles.”

inter-organizational relationships (Ring & Van de Ven 1992). The network approach has been proposed as a conceptualization that allegedly includes such features missing in the TCE approach.

Powell (1990) criticized the argument that hybrid modes of governance can be arrayed in a continuum with market transactions at one end and hierarchy (i.e. vertically integrated firm) at the other end. Powell states that a hybrid mode of organization is a form of governance that is distinctly different from market and hierarchy. He used the term network to classify such ties between firms. Networks are more flexible and complex than hierarchies (Powell 1990). Compared with markets, networks provide potential for flexible integration, learning and exchange of information. Networks are particularly suitable when there is a need for flexible production control (Hakansson 1992). In that sense there, when observing supply networks as complex adaptive systems, there needs to be a balance between control and emergence of the network. Control detracts from innovation and flexibility. Emergence decreases predictability and manageability of operations (Choi et al. 2001).

Teece (1992) and Parkhe (1993) state that synergies can be realized by the combination of complementary resources of different firms. These synergies are particularly possible in design quality, product development or minimizing manufacturing lead times. This is especially the case when firms are involved in highly complex and uncertain building projects. Networks also increase speed. Feedback between parties when technical problems are encountered reduces response times. For suppliers, the fixed formation of parties and the high prefabrication level enables a very fast construction phase.

According to Ebers and Jarillo (1998), industry networks are clusters of organizations that work together more intensely than with other organization within the industry. An industry network is a set of organizations that have developed recurring ties (e.g., buyer-supplier relationships, joint activities, and informational ties) when serving a particular market. A network can arise from a strategy of co-specialization by which member firms carve out new and profitable product-market niches.

Zajac and Olsen (1993) pointed out some additional shortcomings of TCE. They stress the fact that the choice for a governance structure cannot only be explained by a minimization of transaction costs. Besides transfer of specialized know-how and efficient access to information, another condition promoting the rise of networks is mutual trust. In Ouchi's (1980) terms this represents a clan organization. Objectives are achieved through mutual understanding and through mediating differences and disagreements. Dominant parties prefer to co-operate with trustworthy organizations because they have to co-ordinate the building process and are primarily responsible for the final product. These strategic advantages of a governance can be much more important than the potentially higher transaction costs, when this structure is compared with others (Jarillo 1988). The long-term outlook encourages the search for new ways of accomplishing tasks, promotes learning and engenders trust and stability. The shadow of the future (Axelrod 1984) in long-term relations decreases opportunistic behavior. Trust is thereby generated, which is, as Arrow (1974) noted, an efficient lubricant to economic exchange.

LANGUAGE/ACTION PERSPECTIVE

Organizations have been described as ‘the coordination of efforts of people working on a collaborative task broken down in a set of specialized activities. Coordination is then achieved through communication’ (Taylor 1993). The starting point of the Language/Action perspective has been in the analysis of the internal workings of an organization, but in practice it has been applied also for the analysis of market transactions (e.g. Van Reijswoud 1996). Thus, the domain of analysis of the Language/Action perspective is apparently the same as that of TCE.

The interest into the language/action perspective was initiated by the seminal work of Winograd and Flores (1986). They define the basic points of the theory as follows. Firstly, organizations exist as networks of directives and commissives. Directives include orders, requests, consultations and offers. Commissives include promises, acceptances and rejections. Secondly, breakdowns of conversation will occur, and the organization needs to be prepared. Thirdly, people in organizations issue utterances, by speaking or writing, to develop the conversations required in the organizational network. At the core of this communicative process is the performance of linguistic acts that bring forth different kinds of commitments.

Regarding the practical significance of this perspective, two directions were pinpointed by Winograd and Flores (1986). First, the process of requesting, creating and monitoring commitments can be facilitated by computer systems for constructing and coordinating conversation networks. Secondly, people can learn to communicate for action by developing new sensibility towards the ways their language acts participate in networks of human commitments, and improving their skills in understanding requests, promising commitments, etc. This line of exploration is further continued by Solomon and Flores (2001), focusing on the concept of trust, closely related to the concept of commitment. Solomon and Flores suggest that trust must be built one step at a time, by way of interpersonal confrontations and mutual engagements, by way of commitments and promises, offers and requests.

Formulating it sharply, the basic message of the Language/Action perspective is that we can improve an organization by improving the communication that creates that organization. This gives further support to the view that in organizing production, the question is about more than about governance defined narrowly as selection of market and internal organization. On the other hand, the interesting question arises whether it is possible to alleviate the problems analyzed by TCE through better communication, instead of the solutions prescribed by TCE.

Lesser and Storck (1999) stress the importance of building communities of practice in business environments leading to development of social capital and improved business performance. Connections and relationships among community members, and a common language are essential.

APPLYING THE FOUR THEORETICAL PERSPECTIVES ON INTER-ORGANIZATIONAL RELATIONSHIPS IN CONSTRUCTION SUPPLY CHAINS

TRANSACTION COST ECONOMICS

When analyzing the governance of activities in the construction supply chain from a TCE-perspective, the focus is on the basic characteristics of transactions: asset specificity, uncertainty and frequency.

In construction projects, *asset specificity* is low during the pre-contract phase, but high during the post-contract negotiations over variations and claims. The chances for opportunistic behavior are limited before the contract is signed. The client can choose from many suppliers, contractors and architects. Afterwards the situation is reversed. A contract is signed with a small number of parties. Because of the one-off nature of the work, these parties do not have to worry over their reputation.

Several types of *uncertainties* occur during the building process (Winch 1989). Task uncertainties are caused by the fact that each project requires new design and production solutions, but expertise transfer is limited. Weather conditions and geological aspects cause natural uncertainties. Organizational uncertainties are tensions in the temporary project coalitions. Contracting uncertainty is related to the uncertainty of the cost estimation and the relatively high share of a project in the total turnover of the company. In addition, according to Lansley (1994), judging the performance of the service offered by the subcontractor represents an uncertainty, which determines the need for market or hierarchical governance in construction supply chains. In most cases in construction, levels of uncertainty and performance ambiguity are relatively high and objectives are often not compatible, thus a hierarchical approach would seem to be appropriate.

However, in the construction industry the *frequency* of transactions between parties is relatively low because of ever-changing project coalitions and the use of market-based bidding procedures during the selection. The temporary character of relations may also stimulate opportunistic behavior of firms because they may try to obtain as much as possible benefit from contracts before the end of projects.

According to TCE, these characteristics of asset specificity, uncertainty and frequency would require integration of construction activities within a hybrid or hierarchical governance structure. However subcontracting and outsourcing are common practice in construction. Application of hybrid or hierarchical modes of governance would be the rational response to uncertainty, complexity and post-contract bilateral monopoly situations. It would economize on bounded rationality and opportunism, ease the transfer of expertise and facilitates systematic feedback, and solve co-ordination problems with design attributes through centralized co-ordination mechanisms (Milgrom & Roberts 1992).

Winch (2001) points to the fact that the deployment of third parties, i.e. trilateral governance, which was previously coined by Williamson (1975) for occasional transactions, is a distinctive feature of transaction governance in many project-oriented industries. Third parties, also known as “control parties” (Winch and Champagnac 1995) may well perform a central role in managing the supply chain. In addition, Nooteboom (1999) argues that third parties act as a go-between in monitoring and controlling compliance to agreements,

safeguarding the performance and flexibility of networks of firms, and forming an important part of the social capital that supports the organization and functioning of supply chains.

PRODUCTION AND OPERATIONS MANAGEMENT

Koskela 2000 argues that production and operations management needs to address the value, transformation (conversion) and flow aspects of construction in an integrated manner resulting in an transformation-flow-value generation model for production management in construction (Koskela 2000).

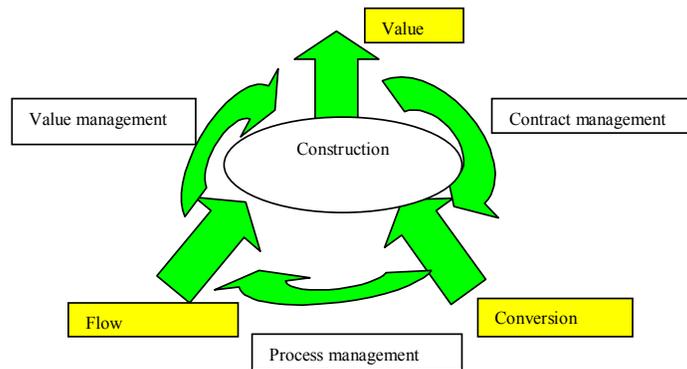


Figure 2: Three view management in construction (Koskela & Huovila 1997)

Based on Bertelsen and Koskela (2002), three fields of management can be defined: contract management, process management and value management. The traditional project management – here renamed contract management – creates and maintains the relations between the value as defined in the drawings and specifications and the operations (as well as associated production capacities and materials) needed for the delivery of the project and to be performed by the contract parties. Being one-of-a-kind production with a temporary production organization, this management is of a greater importance than probably found in most manufacturing industries.

The process management undertakes the role of coordinating the production flow (as well as the flow of information, materials and equipment) as expressed by the processes through which the product flows towards its final form. It is a management that to great extent is executed on the spot – management by walking around, and most of its actions take place at the work site – not down in the shed. And thus it is the process that deliver the actual value to the client, managed by the value management.

The value management ensures that the construction process generates the value wanted by the client. As most of the product value is defined through the design, the value management during construction mainly looks after the process related value such as timeliness, dialogue with the owner, users and other stakeholders. Customer satisfaction is the most important criteria for success.

In order to be successful, on an aggregate level, production and operations management must address all three management aspects: contract, process and value management.

NETWORK THEORY

In centrally coordinated supply chains of construction projects, relations between firms are maintained for the duration of the project. Centrally coordinated supply chains are not merely directed towards minimizing transaction costs, but also towards enhancing the transfer of expertise and systematic feedback on planning, design, construction and maintenance between parties, and ultimately towards striving for joint value maximization. A more centralized governance in the building industry may therefore decrease costs as well as increase value (Voordijk et al. 2000). The emergence of centralized forms of organizing supply chains cannot completely be described in terms of market and hierarchy. Co-operation and integration between supplying, constructing, and designing parties in networks make it possible to present a total product with quality guarantees to the market. Instead of bounded rationality, know-how is transferred between firms for product development. Opportunistic behavior is replaced by mutual trust.

Mutual trust is necessarily for an open dialogue (language) and an optimal knowledge sharing. Extending best practices downstream along the supply chain thereby enables further reductions in transaction costs. Cooperative learning and the sharing of tacit knowledge in strategic alliances can reduce transaction costs and relieve the shortcomings of TCE regarding the lack of recognition and understanding of the realms of bounded rationality and opportunism. Need to control these facets through a mechanism between organizations involved in an alliance (Love et al 2002b). In addition, long-term alliances support inter-organizational learning and improve total quality management beyond the project horizon (Love et al. 2002a).

On an industry scale, Dubois and Gadde (2002) distinguish tight couplings in individual couplings in projects and loose couplings in the permanent network within the industry as a “loosely coupled system”. The pattern of couplings influence productivity and innovation, and the behavior of firms. In terms of organizational behavior, cultural and human issues such as trust and learning have been indicated as major implications on construction supply chains (e.g. Love et al. 2002a).

The network approach may therefore improve not only the performance of supply chains, but also the socio-organizational basis of the inter-firm relationships within the supply chain.

LANGUAGE/ACTION PERSPECTIVE

It has been argued (e.g. Vrijhoef et al. 2001) that construction supply chains can advantageously be conceptualized on the basis of the language/action perspective. Such supply chains form temporary organizations, where people from different organizations must collaborate and coordinate their tasks. Thus, independent of the question whether a particular work package has been procured from the market or internally, the language/action perspective applies to the coherence of the communication through the construction supply chain, the interpretation and execution of orders, and thus the business performance of the supply chain. Improvement of communication, e.g. sending and receiving orders, through the supply chain obviously improve the performance of the supply chain. Therefore, understanding and systematization of the communication between individuals and organizations in the supply chain are crucial.

DISCUSSION

In this paper, the inter-organizational relationships (IOR) in the construction supply chain have been observed from four perspectives: transaction cost economics (TCE), production and operations management (POM), network theory, and the language/action (L/A) perspective. The perspectives are partly competing and incomplete as well as complementary with respect to the understanding of IOR in construction supply chains.

TCE as a governance system for IOR in the construction supply chain alone is too narrow. From the POM perspective, not only transaction costs but production costs and added value of production are relevant too. A major problem of TCE is that the theory stays on an economical level without penetrating to the basic production level (Koskela 2000). From the perspective of network theory alternative formats of industrial organization are suggested increasing the opportunities for lowers transaction costs and higher added value. In that sense, the network theory challenges both the TCE (minimizing transaction costs is not always the optimum) and the POM perspective (added value changes with different organizational forms of production). Finally, from the L/A perspective, the network approach as a static alternative governance structure (besides hierarchy and market) must be extended with the dynamics of inter-human and inter-organizational communication.

Table 1: Comparison between different approaches to inter-organizational relationships in construction supply chains

Theory	Conceptualization	First principles	Major principles / relationships	Primary prescription for organizing
TCE	Transactions between buyer and seller, characterized by asset specificity, uncertainty and frequency	Minimize transaction costs	Optimal governance structure determined by lowest transaction costs	Depending on level of transaction costs: market or hierarchy as governance
POM	Three different concepts: transformation, flow, value generation	Get the product produced; minimize waste; maximize value	Principles associated to each concept: for example, "reduce variability" to the flow concept	Organize in a way for achieving the primary concern: getting the product produced, minimizing waste or maximizing value
Network	Networks of actors	Maximize value by information exchange and decreasing opportunistic behavior	Complex products and their development and manufacturing processes demand for third type of governance	Organize by creating or modifying networks
L/A	Conversation; sending and receiving orders between individuals and organizations	Avoid breakdowns in conversation	Create commitment and trust through conversation	Organize in a way allowing for conversations to take place in their complete form

In addition to the fact that the four perspectives still do not give a complete theoretical framework for the full understanding of IOR in construction supply chains, the question is also of predicting, and thus prescribing action based on the perspectives. However, from the perspectives presented in this paper, indications to various related and additional theories, concepts and influences can be derived and identified. These theories, concepts and influences can be arranged in larger theoretical “streams”, building upon previous attempts to chart the field of construction supply chain research (e.g. London & Kenley 2001). These attempts show that it is, and will probably keep being, an ongoing activity to try and establish a “virtually complete” interdisciplinary research agenda for construction supply chain research (e.g. O’Brien et al. 2002). Nevertheless, this calls for further development of the theoretical framework, and further introduction of new complementary theoretical concepts to a multiple theoretical approach to IOR in the construction supply chain.

To conclude, the four perspectives presented in this paper are mapped and classified in the below framework (Figure 3), including related concepts and additional directions for further development of the framework based on the theories and concepts mentioned or referred to in the literature of this paper.

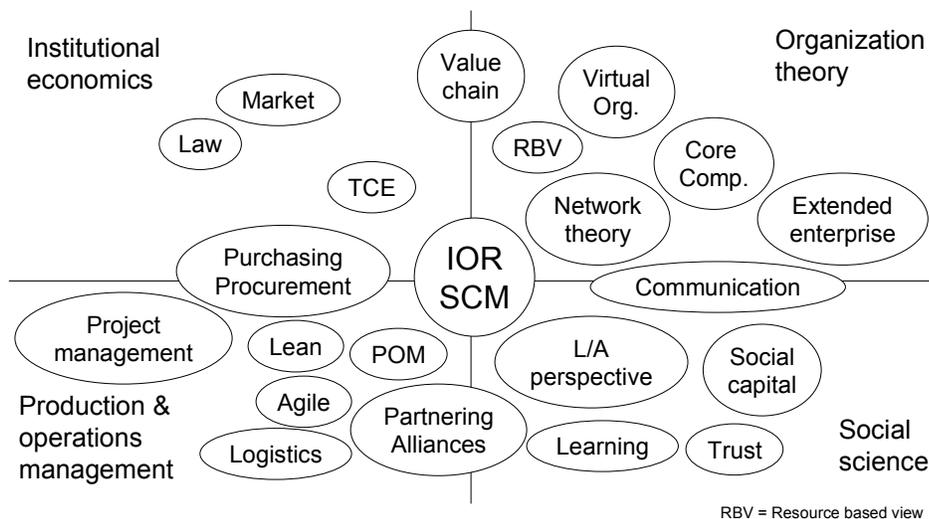


Figure 3: Extended theoretical framework for inter-organizational relationships in construction supply chains

From this first analysis, four basic fields of research or even paradigms to analyze the organization and functioning of IOR in construction supply chains are identified:

- Institutional economics
- Organization theory
- Production and operations management
- Social science

These fields, however, have many cross links from a one field to the other. Certain concepts and theories in one field could be positioned near to concepts and theories in other fields. The extended framework is not meant to present a complete and absolute framework, which is virtually impossible, but showing that the research field is large and complex. All these theories and concepts can be used when appropriate, and they help, as such, to improve construction supply chains. There is no need to wait for a “final integration”, and not all theories and concepts must always be used in practice. On the other hand, it could be discussed to what extent the potential of all these approaches has been exhausted in practice.

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