THE DEVELOPMENT OF A NEO - INDUSTRIAL ORGANISATION METHODOLOGY FOR DESCRIBING & COMPARING CONSTRUCTION SUPPLY CHAINS

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ABSTRACT

The model draws from theories of industrial economics and supply chain literature, and is an attempt to advance the construction supply chain field through the development of an industrial organisational methodology to describe construction supply chains.

Empirical studies have examined the industrial organisation of other industries, typically forming descriptions based upon vertical integration and horizontal market concentration. A review of the trends in the supply chain literature indicate there is a need to develop a model to describe the industrial organisation of the construction industry through supply chain structure. The merging of the supply chain concept with the industrial organisation model as a methodology for understanding the structural characteristics is an important contribution to construction economic theory. The paper begins to develop a language for describing the structure and behaviour of supply chains specific to the construction industry and is so doing suggests a neo-industrial organisation approach.

KEY WORDS

industrial organisation, supply chain management, subcontracting

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CONTEXT

The merging of the supply chain concept with the industrial organisation (IO) model as a methodology for understanding the structural and behavioural characteristics of the construction industry, is an important contribution to construction economic theory. In recent years the IO model has been increasingly recognised as a methodology through which to examine an industry (Martin 1993).

There has been a growing awareness of the importance of understanding industries through clusters, chains and networks (Marceau 1999, Grabher 1993). Industry analysis has traditionally focussed on sectors, which includes groups of firms with similar characteristics, engaged in similar production processes, producing similar goods or services and occupying similar positions (Marceau et al, 1999). There is a focus on research in emerging concepts such as supply chains, industrial networks and clusters, inter-organisational relationships and strategic alliances. This reflects the growing importance of understanding the underlying nature of industries through the behaviour of firms, their relationships and interdependencies and market environment.

Our understanding of these linkages within the construction industry comes from two directions. Firstly, at a high level, the input-output methodology has in the last five years emerged as a technique to understand interdependencies between various sectors that supply to the production of a construction project (Bon 1990). The other main research focus in construction has tended to concentrate upon the particulars of the relationships between parties at a project level, particularly project management and organisational structures (Walker 1996) and 'best practice' procurement systems. (Rowlinson and McDermott, 1999)

There appears to be a gap in our understanding between the highly aggregated and intersector analysis, which groups many disparate firms together, and inter-organisational project analysis, which examines the project but ignores each firm's market and competitors. This paper is an attempt to bridge this gap, through the merging of the supply chain metaphor and the industrial organisation framework.

This paper is arranged as follows: firstly an introduction to the key underlying concepts of industrial organisation theory, secondly an overview of the major areas of research on supply chains are charted and an industrial organisation construction supply chain model is located. Construction supply chain literature from past lean construction conferences is highlighted along with some other key construction supply chain related literature. Thirdly, a discussion of the most significant models already proposed relating industrial organisation and supply chains is undertaken. Finally a model is proposed that synthesises the literature and is based upon developing a range of supply chain descriptors.

INDUSTRIAL ORGANISATION THEORY

The IO field inquires into the organisation and working of markets and studies market structures, the behaviour of economic agents and their resulting performance. The IO model deals with the performance of business enterprises and the effects of market structures on market conduct (pricing policy, restrictive practices, innovation) and how firms are organised, owned and managed within markets (Bancock et al, 1998).

The emphasis in this research is primarily on the *structure, conduct and performance* of firms that compete with each other within a particular market and then the associated policy considerations (Martin 1993).

Industrial economists are typically concerned with the types of markets in which firms are neither monopolists nor perfect competitors, but something in between. This type of market has been termed the oligopoly. It has been argued strongly that the construction industry operates in perfect competition and therefore is not an oligopoly (Runeson 1998). An ideal competitive market consists of many small buyers and sellers none of whom is able to influence the price, dealing in a standardised product, under conditions of free and easy entry and complete and perfect knowledge (Martin 1993). Runeson (1998) suggests that the products are the same because the product is not a building type but rather the management services offered by the contractor.

The complexity of the industry is worthy of a richer perspective and less atomistic approach than the perfect competition model assumes. This argument oversimplifies interfirm relationships, firm products and/or services and their capabilities and market environments. It is also suggesting that every supply chain is the same.

It is arguable that the service does not differ since different contracting, subcontracting and consultant firms provide different levels and types of service. Firms are known for being specialists in certain areas with certain capabilities. In tendering situations, anecdotal evidence suggests that many contracting firms choose a small group of firms whom they would prefer to work with on projects, canvass a number of prices from beyond the small group and then 'negotiate' the price.

The development of an industrial organisation model of the supply chain assumes that it is worthwhile to understand different supply chains. It is also a contribution to the understanding of the industry if the fundamental details of transactions are analysed, ie what service/product is being provided, by what types of firms, to whom and in what context and the likelihood of this arrangement occurring.

Structural characteristics

The most important elements of market structure are:

- existing distribution of power among rival firms (seller concentration),
- nature of the demand (buyer concentration),
- entry/exit barriers, government intervention,
- product differentiation
- horizontal integration (conglomerateness) and
- vertical integration (Litman 1998).

The role of the IO model is to give substance to the traditional neoclassical abstract concepts of market structures (Litman 1998). Seller and buyer concentration, product differentiation and horizontal/vertical integration are now considered.

Seller concentration is possibly the single most important element of market structure and it refers to the existing distribution of power among rival firms. This relates to the number of sellers within a given market and the size of the sellers. Microeconomic theory refers to this size distribution of power in only the most general terms (large number, few) industrial organisation requires more precision in conceptualising these abstractions. A number of measures have been developed to describe this and these have been termed concentration ratios. It is difficult to calculate concentration ratios for parts of the construction supply chain since statistics have not been available. Furthermore, concentration ratios in general pay little attention to medium or small sized firms. (AEGIS 1999) which predominate the construction industry.

Buyer concentration seems to generate much less interest however this refers to a theory of countervailing power. Concentrations of power in one part of a market will evoke balancing concentrations of power in other parts of the market. For example, when a few large buyers bargain with a few large sellers it will be more difficult for sellers to hold the price above the cost, for example when automobile manufacturers purchase rubber or steel.

Product differentiation refers to the degree to which firms producing similar or identical products can convince buyers that their products/services differ in at least one important dimension from their rivals'. The differences can reflect actual grades of quality, workmanship, durability, warranties/assurances, appearance, business location, service levels, or imagined differences induced by advertising.

Vertical integration refers to the situation in which various firms in an industry simultaneously operate at more than one stage of production. Firms become integrated to achieve greater coordination and efficiencies across the production-distribution process. They also integrate to avoid having to deal with outside firms that are unreliable suppliers or customers, have poor reputations for quality, or are unstable in some other dimension. Alternatively there may be considerable inefficiencies associated with operating at a number of levels (Litman 1998). Vertical integration can take on a number of different forms, the most stable of which is direct ownership and operation by the firm (either fully or as part of a joint venture). Vertical integration is the combination within a firm of functions that can be/usually are carried out by separate firms. Supply chain theorists are mostly concerned with the nature of the vertical relationships. The supply chain concept is concerned with upstream and downstream linkages between firms involved in production.

The model developed in this paper enables describing the supply chain in terms of the firm's relative vertical and horizontal positions, vertical and horizontal integration and relationship types. Although no previous investigations have been carried out linking construction supply chains and IO, there is a small body of literature in the emerging construction supply chain field and a small body of literature in IO of supply chains to draw upon. It is important to understand where the work in this particular study is located in the field of supply chain research, therefore the following discussion charts some of the major movements over the past two decades.

CHARTING THE SUPPLY CHAIN MOVEMENT

The supply chain concept is part of an eclectic and developing hybridised field. It became an explicit area of research in the mid '80's and originated largely from the two separate management streams of distribution and production which seem to merge into the field of logistics (Coyle 1996).

There is much debate in the research community on the confusion regarding interpretations of the supply chain concept (Day 1996, New 1997, Hines 1998). It is not the intention of this paper to favour one definition over another and it is probably more useful to chart some of the more significant streams of research that have influenced models so that this paper and the problem it seeks to solve can be seen within the context of the field. Since it became an identifiable area of research, the concept has been widened through the influence of other research frameworks and for this literature review these have been broadly grouped as: **systems engineering, distribution and production (logistics), strategic organisational and industrial organisation economics.**

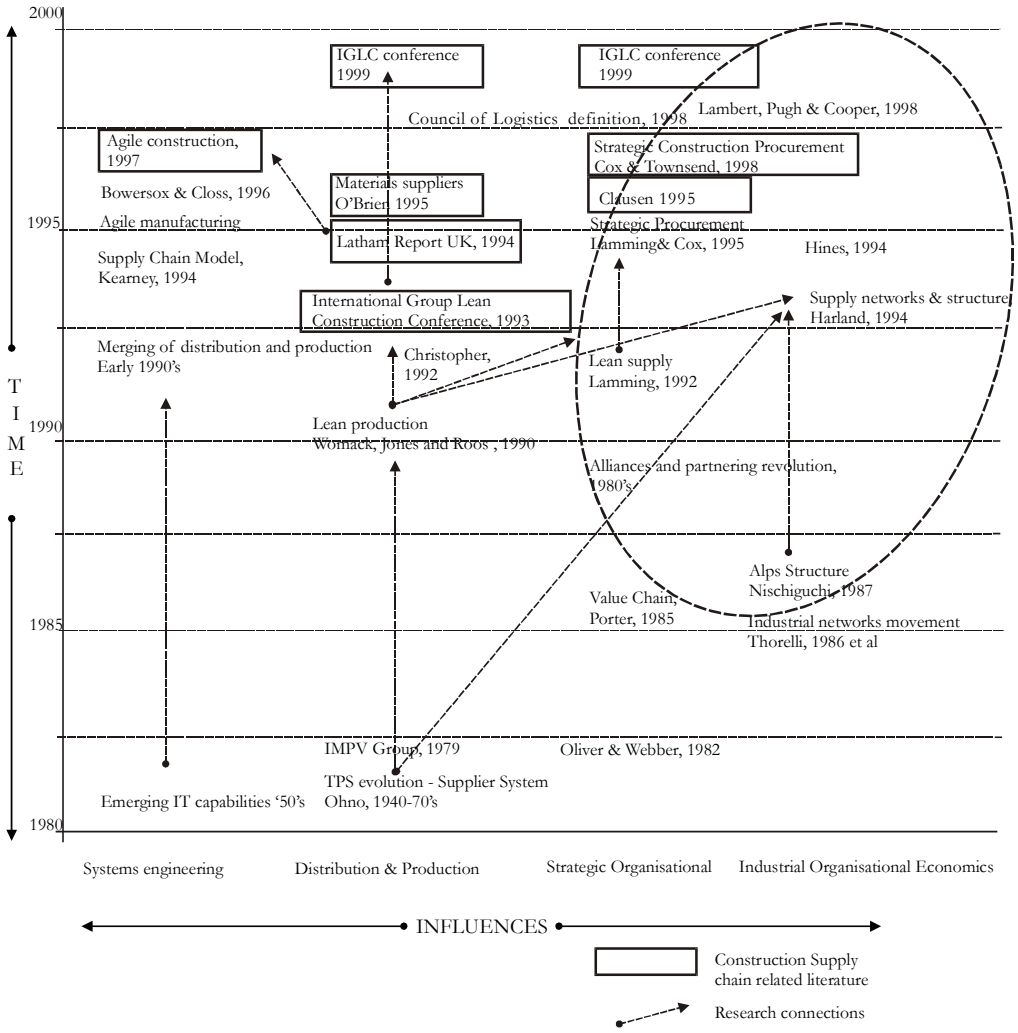

Figure 1 Chart of Supply Chain Influences 1980-1999

These streams of research have tended to introduce a wider variety of research methodologies. Construction research involving the supply chain concept is a relatively new field too, having emerged in the early '90's as an explicit area of research. Similarly, it is evolving with corresponding influences from the logistics, systems engineering, organisational theory fields. Figure 1 charts some of the more significant supply chain events, models and definitions against these four influences for the two decades between 1980-1999. The chart also highlights the trends in the construction supply chain interpretation. Significantly, to date, there have not been any construction industry studies merging the supply chain and industrial organisation fields, similar to those studies of other industries by Hines (1994), Nishiguchi (1987) and Lambert et al (1998). However a number of authors have made some significant contributions.

The circled portion of the diagram represents the theoretical origins for the approach to the supply chain concept in this paper.

Distribution and production: lean construction

Significant contributions to the discussion on supply chains has come from the lean construction movement, much of this work has evolved from a production philosophy and been influenced by systems engineering methodologies. Lean construction evolved from lean production, a developing field that is centred primarily upon a production philosophy for construction. In so doing, workflow and conversion (processes) are important concepts (Koskela 1993). Construction researchers have applied the SCM philosophy to the materials flow and site workflow. Some studies related to the construction supply chain have sought to establish the relationship between site productivity and materials flow to the construction site and therefore focussed upon management of materials flow (Akintoye, 1995; O'Brien, 1995; Agapiou et al. 1998).

To date, much of the construction literature has applied the concept of lean without the detailed exploration of economic and organisational structures that underpin the construction environment. Whereas the contextualisation of the lean production phenomenon, through organisational and industrial economic descriptions of the automotive and electrical industry supply chains that support lean thinking, has been provided by Lamming (1993), Hines (1994) and Nischiguchi (1994). This understanding of the organisation of the 'supply chain' is an important part of the philosophy of lean thinking.

The importance of contextualising lean construction has been debated in recent times (Green 1999, Ballard and Howell, 1999). Green challenged the narrowly defined 'instrumental rationalist' approach currently undertaken in the lean construction movement. Lean proponents replied to the debate with the argument that it was based upon a long history of production management thinking, particularly the physics of production and that lean offers a new way to organise production.

Both protagonists were partially correct, 'lean' is dependent upon a long history of production management thinking but it is also dependent upon a history of economic, technological, political, industrial relations and industrial organisational traditions. Neither side of the debate sought to give any indication of the rich and complex economical, and organisational factors that affected the demise of dualism and the subsequent technological rise of the Japanese subcontracting system and its transformation to contemporary practice.

The strategic industrial sourcing and the strategic reorganisation of suppliers and subcontractors into hierarchical clusters undertaken by many of the large Japanese electrical and automotive manufacturers from as early as 1950's largely supported the adoption of lean thinking (Nishiguchi 1994). One of the most significant themes throughout Nishiguchi's analysis was the description of the industrial organisation and subsequent changes to the structure of the industrial organisation.

The reason why such modes of industrial organisation arise is extremely important to the construction supply chain concept, but it is equally important to be able to describe what the modes of organisation are and their nature.

Strategic organisational management: construction

Strategic management is a relatively new field in construction and as noted in 1991 there was little literature available (Langford and Male, 1991). The intervening decade has not seen a growth in this area, but has seen a growth in the research related to the management and procurement of the individual project. Issues related to the strategic management and structuring of interorganisational relationships is still relatively new.

Early research into such concepts as strategic alliances (Garnett et al 1998), organisational design (Murray et al, 1999), component delivery system (Barlow 1999) best practice supply chain procurement (Cox and Townsend 1998; Minh et al, 1999), clustered flow (Smook et al, 1999) and rationalisation of production (Cardoso 1999) are indications of an emerging interest in strategic organisational management of the supply chain.

Cox and Townsend (1999) proposed the *critical asset and relational competence approach to construction supply chain management* model that relied upon clients controlling the supply chain. The authors advocated the need for clients to understand the structural characteristics of their own construction supply chains and to develop contingent approaches to procurement based upon this understanding.

With a similar business model, Cardoso (1999) developed a model for 'new forms of rationalisation of production' (NFRP) based upon two competitive strategies, cost leadership and differentiation. A small study was conducted comparing these variables between six companies in Brazil and France. Cardoso makes interesting comments upon meso and micro economic levels and differences between countries and suggests changes in the organisation of the companies and the sector between the two countries.

Some studies have widened the perspective and have introduced elements of industrial organisational concepts, for example vertical integration (Clausen, 1995; Tommelein and En Yi Li, 1999) and buyer concentration or pooled procurement (Taylor and Bjornsson, 1999)

The interplay between supply and demand, the balance of power or control and incentive has been considered by others in the form of serial contracting (Green and Lenard, 1999) and multiple project delivery (Miller 1999). Although many authors suggest the importance of understanding the entire scope of the supply chain (Taylor and Bjornsson, 1999; Vrihjhoef and Koskela, 1999) the supply chain is often still perceived as the contractor's supply chain. London et al (1998, 1999) suggested that rather than focussing upon the contractor the client is the most likely proponent for the management of the supply chain.

Many of these authors have moved the debate regarding supply chains considerably, with respect to the need for the development of appropriate relationships, the problems of unreliable supply, the different degrees of control between firms and the difficulties due to the temporary nature of a project based industry. However these are all characteristics of the 'real world' industry that exists.

Industrial organisation economics

One of the significant contributions of the industrial economics approach to supply chains is the ability to describe and analyse the system of supply chains. New (1997) noted that the development of the idea of the supply chain owes much to the emergence from the 1950's onwards of systems theory and the associated notion of holistic systems. There are many variations to systems theory but at the core is the observation that a complex system cannot be understood completely by the segregated analysis of its constituent parts (Boulding, 1956). New (1997) provides an interesting discussion regarding the scope for research of the supply chain and explains particularly the twin dichotomy between research on 'supply chains' versus 'supply chain management'

Selected supply chain research in mainstream management literature, have studied the structure of the production supply chain. These are important models that merge the field of IO and supply chain theory (Hines, 1994; Nischiguchi,1987; Lambert et al,1998; Lamming,1993; Hobbs,1996). In many ways the work by Nishiguchi, Lamming and Hines have provided an even richer picture of lean production and supply chains than other writings of the 'apocalyptic posturing' of the field's success.

Lamming and Hines describe the organisational and economical structure of the Japanese subcontracting supply system across automotive and electronics industries. Typically suppliers are categorised and organised into either specialised subcontractors or standardised suppliers, based upon the degree of complexity of the supply item. It is within the specialised subcontractors that the pyramidal Japanese subcontracting system lies. This system has traditionally been described as a pyramid with an individual assembler corporation at the top and successive tiers of highly specialised subcontractors, along the chain, increasing in number and decreasing in organisational size at each progressive stage. This suggests a rather closed system, however in reality according to Nischiguchi (1987) across the industry, first tier suppliers supply to many assemblers. This led him to the Alps Structure of supply chains, a series of overlapping pyramids resembling mountain alps across an industry.

Hines (1994) from his studies enlarged the industry specific view to look at the wider economy and has suggested that rather than this closed rigid system, the Japanese subcontracting system is moving more towards a structure of interlocking supplier networks. In this system, many firms supply more than one industry sector and potentially operate in different tiers, for example electronics suppliers.

Unique structural and behavioural features have been observed within this system Each tier sources down the chain from a small group and through a highly structured method. Typically associated with each tier are the horizontally integrated Supplier Associations (Hines, 1994). Since 1939, this system has evolved into a highly developed, cascading network of integrated tiers of associations. For the major materials supply, large corporations are typically sourced directly by the large assembler corporation, through strategic procurement sourcing alliances. This is dealt with separately from the pyramid system. The supply of the material is then provided to appropriate subcontractor tiers for the manufacture of components.

Further to this research, Hines and Rich (1997) developed a generic technique for understanding what a particular supply chain looks like at an overview or industry level and termed it *physical structure mapping*. Within this technique, the number of firms involved at various stages in the production process in the supply chain are related to tiers of suppliers. Subsequent to this, a secondary industry map is developed where "instead of linking the area of the diagram to the number of firms involved, it is directly linked to the value-adding process (or more strictly to the cost-adding process)".

Lambert, Cooper and Pugh (1998) also provide insights for mapping supply chain structure. They claim quite simply, that there are three primary structural aspects of an organisation's supply chain structure: **members of the supply chain, structural dimensions and different types of process links (relationships).**

With regards to structural dimensions they argue there are three critical dimensions:

- Horizontal structure refers to the number of tiers across the supply chain, which is in effect, the number of different functions that occur along the supply chain and indicates the degree of specialisation
- Vertical structure refers to the number of suppliers and customers represented within each tier. This reflects the degree of competition amongst suppliers
- Horizontal position is the relative position of the focal company within the end points of the supply chain

A Building and Construction Industry Cluster model was proposed to assist developing construction industry policy (AEGIS,1999). This model considers the industry through two lenses, firstly as a manufacturing system and secondly as a complex of activities. The classification divides the industries into five main *product-system* segments: on-site services, client services, B&C project firms, building products and supplies, and building fasteners, tools, machinery and equipment manufacturing. Each of these is divided into four product/service classes. It is argued that this provides a stepping-stone between traditional industry statistics based on hierarchical systems of classification and broader conceptual views of industry activity as depicted in clusters, chains and complexes. It also gives a perspective on the interrelations between segments of the industry, a view of the ‘chain’ of production and a framework on which to base a variant of cluster analysis**.**

de Valence (2000) assessed both the industrial organisation and the cluster approach and concluded that the most appropriate model of the industry will depend on the use for which it is intended. Given the complexity of the industry, the cluster approach is more representative of the industry than the tradition industry structure approach. However, it is also difficult to use to generate statements about the industry and research questions to be investigated because of its generalised nature. For many of the issues associated with construction industry performance the traditional structure-conduct-performance model may not be applicable. This is due to structural characteristics of the industry, processes used to deliver projects and the project based nature of the industry (de Valence, 2000)

NEO -INDUSTRIAL ORGANISATION METHOD FOR ANALYSING AND DESCRIBING CONSTRUCTION INDUSTRY SUPPLY CHAINS (CISC)

This section outlines the proposed method for describing CISC, considering the supply chain in terms of firms involved and structural and behavioural characteristics and relationships. The first criteria when mapping the relationships and the structure is the identification of a project and that the relationships are those associated with a project. Within this context the specific characteristics of the relationships are considered. The three key entities within the system are **projects, firms and relationships**.

Project inception involves a demand for a facility or infrastructure by client organisations. In figure 2, these are grouped as the demand organisation or the focal organisation according to Lambert et al (1998) terminology.

For the model developed in this paper, the construction demand organisation is equivalent to the large assembler in Hines' and Nischiguchi models. This challenges the general assumption that the contractor is the equivalent to the assembler. In terms of longevity, financial risk, initiation of the supply chain and potential control, the conglomerate demand organisation is the key stakeholder.

It is proposed that, generally throughout the project procurement process, little control or management is taken up by the focal organisation. Each tier acts as a *procurement gatekeeper*. The first tier organisations typically act as gatekeepers to the remainder of the subcontracting industrys' tiers of suppliers. Each trade subcontractor subsequently acts as a gatekeeper to the suppliers of the third tier. Architectural and project management consultants often act as procurement gatekeepers as well. The role of procurement gatekeeper may be quite critical if the firm is at the centre of a firm cluster. Problems of integration between specialist firms may escalate if the number of firms is beyond a manageable level. Investigating the categorising and grouping of similar supply chains may lead to alternative configurations, coordination and management.

Horizontal structure

In figure 2 the horizontal structure tiers are grouped into those that supply to produce the facility/infrastructure (production suppliers), the focal demand organisation and those that supply after project completion (in-use suppliers).

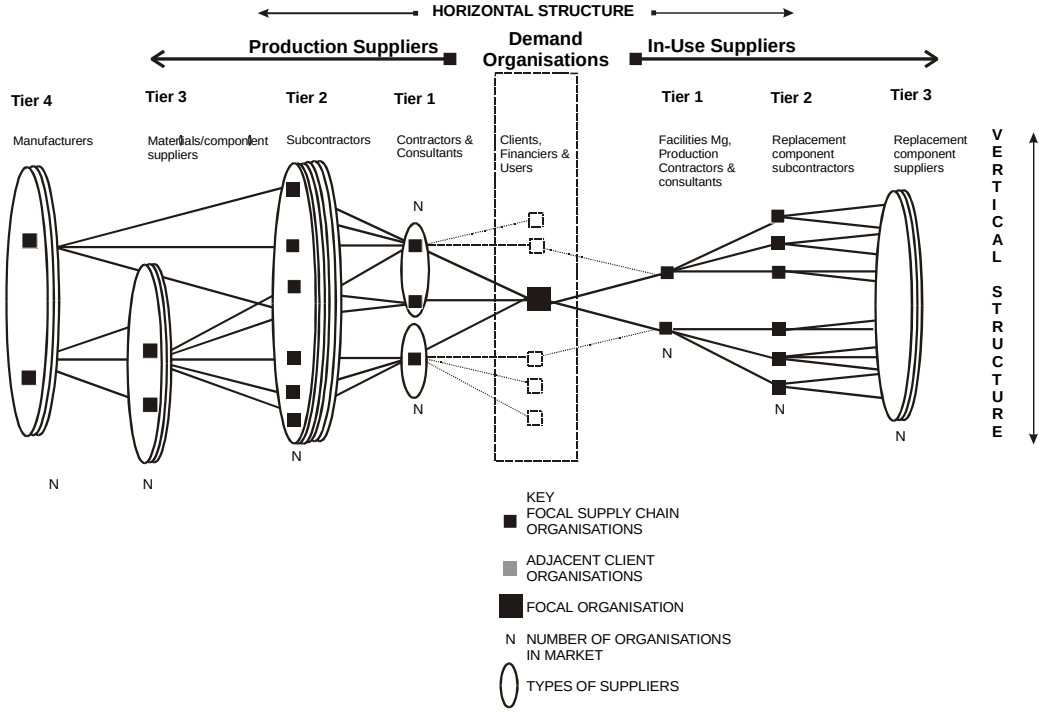

Figure 2 Construction Supply Chain Structure (after Lambert, Cooper and Pugh 1998).

The first tier of project production suppliers to the demand organisation are t*ypically* of two types, primary consultants and prime contractors. Second tier suppliers are typically contracted to the prime contracting organisations and are grouped as subcontractors or sub consultants. This second tier is where there are potentially a large number of different specialist types of subcontractors and subconsultants as a result of the different trade packages and specialist design services. Finally 3rd tier suppliers involve products suppliers who typically contract to subcontractors who install on-site. The number of different types of products is at least of a similar number to the number of subcontractors. In many cases the third tier product suppliers are supplying a component and they in turn source products or materials from suppliers. Tier 4 suppliers may include materials suppliers who are agents/distributors for tier 5 manufacturers.

It is difficult to determine the number of organisations supplying products and literature does suggest that the supply of building materials largely traces back to a small number of large, publicly listed, multinational organisations (DIST 1999, Warren 1993). The model can become quite complex as there are multiple layers of product types with many organisations supplying at each layer, yet there are cases when organisations are located in more than one layer.

Vertical structure

The vertical structure of a tier reflects the degree of competition amongst suppliers. Numerous reports in the past have suggested that the industry is dominated by a large number of small firms, but that it is usual to find that a small number of very large firms are important in terms of overall construction industry output (Warren 1993). Therefore although there are many trade packages, many consultants, contractors etc, it is important when analysing the vertical structure of a supply chain, that only those firms that compete for the same product and/or service are considered.

Within each tier there are different types of suppliers offering similar products/services and this is the specific supplier market. For example Tier 1 for production suppliers may include architectural design consultants, construction managers, project managers. These groups within the tier reflect specialist functional groupings and unique markets. Within each market there are typically many firms who are able to supply this service and/or product and this is indicated on the diagram by N, the number of organisations. It is within the specialist functional group that the market structure and individual firm characteristics and capabilities will be reflected. At this level supply chain relationships become a critical part of the model.

Relationship types

The types of competitive and collaborative relationships that are available to link organisations range from acquisition through to transactional. Ellram (1990) suggested the following continuum of relationships between firms: acquisition, equity interest, joint venture, long term contract, short term contract and transaction.

In recent years such concepts as partnering and alliancing have begun to emerge in the construction industry that are based upon risk/reward contracts aligned to a particular project. There is also evidence of many international joint ventures between firms for projects (Strassman and Wells 1988).

These types of relationships are typically individual project contracts between contractors and clients, sometimes including selected specialist subcontractors or suppliers. They impact upon the *project* supply chain and for that particular project impact the unique markets that these firms operate within. However construction contracts are made up of no less than 20 or 30 trade packages and these sectors may remain largely unaffected by such alliance contracts. Also there are different types of contractual relationships along the CISC that are not project based and that affect more globally the nature of relationships and industrial organisation.

For eg. it is probably less known that long term contracts such as national price agreements have supported relationships between manufacturers and their customers for many years. There is evidence to suggest that residential sector firms have developed such agreements, which have relied upon volume purchasing to negotiate reliability of supply in terms of timing and price (Barlow 1999).

SUPPLY CHAIN DESCRIPTION: STRUCTURAL AND BEHAVIOURAL PROPERTIES

To summarise the key points, a construction supply chain has a number of structural and behavioural properties.

Each firm within a supply chain is positioned within the chain according to a ***tier structure***. Firms can be located by horizontal tier and by vertical market. A supply chain can be described by attributes associated with tiers, vertical markets and links between firms. A horizontal structural attribute (HSA) will include the number of ***tiers*** of firms from the focal firm. Vertical structural attribute (VSA) describes the characteristics of the particular tier. Within each tier there will be one or more ***functions or markets for services and/or products***. Within each function there will be one or more firms supplying a product and/or service. Contractual relationship attributes (CRA) between firms in the supply chain can also be developed to describe the behavioural properties of the supply chain. The following table summarises structural and behavioural properties of the CISC:

Property	Descriptors: Attributes
Structural	Horizontal Structural Attributes: (HSA) • Number of firms and tiers in chains • Relative position of firms to focal firm • Relative size of firms in a chain • Location and number of firm clusters
	Vertical Structural Attributes: (VSA) • Location and categorisation of markets and product/service differentiation • Number of firms in markets • Distribution of size of firms • Degree of vertical integration • Degree of horizontal integration
Behavioural	Contractual Relationship Attributes (CRA) • Purpose: service, product, service and product • Duration • Location and number of relationship types • Number and location of different sourcing strategies • Number of relationships between firms

Table 1 CISC Descriptors: Behavioural and structural properties

DISCUSSION

Comparisons between supply chain differences or similarities with respect to such attributes as distributions of firm size, degree of horizontal and vertical integration and number of relationships will be indicators for such characteristics as competitiveness, power distribution, innovation, effectiveness and efficiency.

There are a range of comparative analyses that would be available to us. As discussed previously, IO of an industry is more than simply the mapping of these explicit structural dimensions. The structure of the industry refers to all the institutional forces that shape an industry. However, mapping various attributes for the horizontal and vertical structures, horizontal position and relationships enables descriptions to be developed corresponding to single supply chains and then between different chains.

Within the context of this model it would be possible to *locate such relationships and the likelihood of such relationships occurring within a particular tier and between particular types of firms*. The value of this model is to understand change in the structuring of relationships and in time model the residual impact that occurs within markets. The model also creates a mechanism to understand and locate any product/service differentiation that occurs between firms and create new relationships.

This paper has developed the argument for reporting on simple descriptions of horizontal and vertical structure, 'who' supplies to 'whom' along the supply chain and potential numbers within the tiers. There is scope to examine further the competitive environment within each tier and the nature of the links between organisations along the tiers. There is also scope to further develop the methodology for different types of markets. There is potential for future research to refine this model and develop detailed maps of the industry through the industrial organisation characteristics of the supply chain. This paper has served to highlight that the development of a neo-industrial organisation construction supply chain methodology provides an extra dimension to our understanding of a complex and layered industry. The results of a study designed to refine this model are reported elsewhere (London and Kenley, 2000).

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