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# ACHIEVING EFFECTIVE PROJECT DELIVERY THROUGH IMPROVED SUPPLIER RELATIONSHIP MANAGEMENT

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## Abstract

Supplier Relationship Management (SRM) has a critical and unique role in the management of construction supply chains. Within the Architecture, Engineering and Construction (AEC) industry contractors generally rely on formal legal arrangements to manage their relationships with subcontractors and suppliers. As a result of the reliance on legal options, it is common to find confrontational and adversarial relationships in many projects. The disputes and claims that arise from such confrontation tarnish the reputation of the AEC industry and more importantly have a significant impact on project processes, with regard to cost, time, and quality. Despite the efforts to have better interactions within and between different supply chain actors, few attempts have been made to understand the variables that help develop, maintain and re-build more co-operative and collaborative relationships.

Within this paper the authors provide a review of progress in construction specific supply chain management as a backdrop to an empirical investigation on improving project delivery by AEC companies. The paper is based on a study aimed at developing a framework that can serve as a roadmap on how supply chain relationships can be better monitored, controlled and managed, which is a research partnership between academia and an industrial sponsor. It reports on the first phase of the study which addresses the attributes of various types of relationships where relationships are categorised into four categories. Without an understanding of the different levels of relationships that a contractor firm has with its supply chain firms, management strategy for various relationships will not be effective as every relationship is composed of different entities that make up its 'DNA'.

The discussion on four types of relationships point out that further empirical study is needed with regards to the processes and technologies currently being applied in construction projects as well as identification of roles and responsibilities of decision makers in AEC supply chains.

**Keywords:** Supply Chain Management, Supplier Relationship Management, Relationships.

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## Introduction

The importance of relationships in supply chains has always been seen as essential for the delivery of construction projects. This is because construction projects involve complex interaction processes, supplies of raw materials, information, products, and services between supply chain actors that create an immense structure of supply networks. Increasingly therefore, relationships are considered to be the veins and arteries of supply networks

that create an intense and unique structure with economic, legal, technical and social dimensions (Håkansson and Ford, 2002). At the same time, the emphasis on management of these relationships is extending beyond immediate tiers of a focal company, thus, giving relationships a greater priority within an organisation's supply chain management practice (Monczka *et al.*, 2011).

Within the scope of construction specific supply chain literature, supplier relationship management is regarded as one of the most important aspects for achieving efficient supply chain management (Maqsood and Akintoye, 2002 and Bemelmans *et al.*, 2012). Despite the significance of

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relationships for the delivery of projects, there is a dearth of research in this area (Bemelmans *et al.*, 2012). What research interest exists is mostly focused on defining specific relationship types, in particular ‘partnering’ relationships, and significant proportion of these studies show very little appreciation of how to manage different relational elements for the various types of relationships. Furthermore, majority of research has been on the contractor-client interface, ignoring the downstream supply chains which account for up to 80% of the total project interaction (Holti *et al.*, 2000). The consequences of unmanaged relationships are strongly related to the problems that currently exist at different layers of the industry (Meng, 2010). The resultant issues of win-lose transactions and adversarial relationships that arise from a lack of relationship management not only tarnish the reputation of the AEC industry, but more importantly have a significant adverse impact on project processes with regard to cost, time, and quality.

Gadde and Snehota (2000) state that relationships are one of the most important and valuable assets of a company. Relationship management do not only play a key role on procurement and transactional relationships (Gadde and Snehota, 2000) but determine the realisation of many other facets of business activities (Chen and Paulraj, 2004b). For example Chen and Paulraj (2004a, b) and Monczka *et al.*, (2011) particularly emphasise the following aspects where relationships play a key role on: outsourcing; supplier selection; supplier certification; supplier involvement; supply base reduction; value-driven interaction; communication; cross functional teams; trust and commitment; and establishing close partnership relationships with strategic or key suppliers. All of these elements have significant importance in the relationship development process but unfortunately relationship management has not received adequate attention to reflect its critical role within construction supply chain management (cSCM).

Despite the efforts to have better interactions within the construction industry, few attempts have been made to understand the inter-organisational and inter-personal dynamics of different types of relationships. Based on a review of relevant literature this paper aims to classify the

different categories of relationships that exist within construction supply chains. In particular, it defines four types of relationships based on variables identified within construction and relationship marketing literature. It argues that there are three essential components of supplier relationship management which are people, processes and tools. The discussion of these elements points to the need for further empirical research in order to have a more detailed definition for the types of relationships; the processes, protocols and procedures employed; and the tools that facilitate and enable effective relationship management process.

### **Defining Relationship Management**

There are two conceptual fields of study that attempt to develop theoretical and industrial knowledge on inter-firm relationships: Supply Chain Management (SCM) and Industrial Network Approach (INA). From relationship management perspective, the purpose of SCM is to seamlessly integrate all stakeholders in a process through effective and efficient relationships between supply chain actors (Bygballe *et al.*, 2010), whereas INA perspective tries to define and address how various actors, their connections and resources can be managed in intra-firm, inter-firm and network of relationships (Håkansson and Snehota, 1995). Both of these perspectives are thought to have a complementary role within firm-firm relationships where one emphasises a structured, formal approach to management of relationships (SCM) (Bygballe *et al.*, 2010) and the other is more concerned with informal aspects of relationships (INA) (Håkansson and Snehota, 1995). Halldorsson *et al.* (2007) argue that there is no single-unified theory for managing supply chain relationships and suggested a blending of both SCM and INA concepts to develop a framework from a multi-theory perspective that will complement each other’s weaknesses.

Generally, relationships are characterized as having a multi-dimensional relationship structure where many elements (both human and firm) shape a relationship’s type, form, duration and intensity. Håkansson and Ford (2002) and Gummesson (2008) defined the core concepts of relationship management as relationships, interaction and networks. For Pryke and Smyth “*interaction that is*

more than a brief encounter, or that is long lived, is a relationship” (2006: 23). Interaction is the activity which occurs within that relationship (Ford *et al.*, 2003) and a network is where complex pattern of interactions between many parties occur (Gummesson, 2008).

Although, majority of studies conducted on relationship management are from INA perspective, both the SCM and INA studies conclude that relationships; in terms of its content, dynamics and evolution, are unique to every transaction/interaction (Ford *et al.*, 2003). Therefore, as reinforced by Briscoe and Dainty (2005) every relationship requires a different approach to its management which makes the management of relationships complex process. Despite the fact that INA perspective lacks a structured, formal and manageable approach to relationship management; by applying some of the principles developed in the SCM literature inter-firm relationships can become more manageable and controllable.

#### **Relationship Management in the AEC Industry**

For Maqsood and Akintoye (2002) relationship management is one of the driving components of supply chain management which facilitates execution of purchasing and logistics related activities of construction projects. However, this is a rather narrow perspective. Within this study construction specific SRM (cSRM) is defined as a company-wide business strategy to manage its interconnected, dynamic and multi-dimensional interactions through its various resources within the firm and at the interface with other businesses so that it facilitates development of better relationships throughout its upstream and downstream supply chains. The approach should be unique to each relationship, pursue a long-term vision and must extend beyond a simple exchange of product, process and project to cover *all other entities* associated with the relationship (be it value creation process, a new product development, a project package and so forth) (Eriksson *et al.*, 2007). This approach can also be regarded as Total Relationship Management.

Existing literature on construction supply chain relationships explore the subject mainly from two perspectives. On the one hand cSRM is primarily argued from Transaction Cost Economics perspective where the

role of cSRM is mainly concerned with procurement and sourcing of suppliers (Svahn and Westerlund, 2009 and Frödell, 2011). Such a perspective emphasises a cost reduction perspective to management (Vrijhoef and Koskela, 2000) and is not holistic for a wider view of relational entities embedded within the interaction process. On the other hand, cSRM is considered to be management of relationships through human, structural and social capital of firms (Pryke and Smyth, 2006). Moreover, majority of studies that investigate relationship management are usually spread between two dichotomies: (i) management of a single sourcing of a commodity; product or service and, (ii) strategic sourcing; where the aim of SRM is comprehensive management of relationships, to cover management of suppliers and client (or even end-users) from end-to-end perspective. The former is usually blurred within the purchasing function of SCM (Svahn and Westerlund, 2009) whereas the latter is discussed within the context of collaboration and partnering literature (Kumaraswamy *et al.*, 2000; Maqsood and Akintoye, 2002 and Bygballe *et al.*, 2010).

However, the research on SRM is disparate and there appears a very limited empirical study which focuses on relationship types adopted by construction firms within their supply network (Meng, 2010; Meng *et al.*, 2011 and Bemelmans *et al.*, 2012). By understanding how best to manage, coordinate and control different types of relationships, workflow procedures can be improved and better relationships can be formed at all levels in the supply chains and networks.

#### **Classification of Relationships in the AEC Industry**

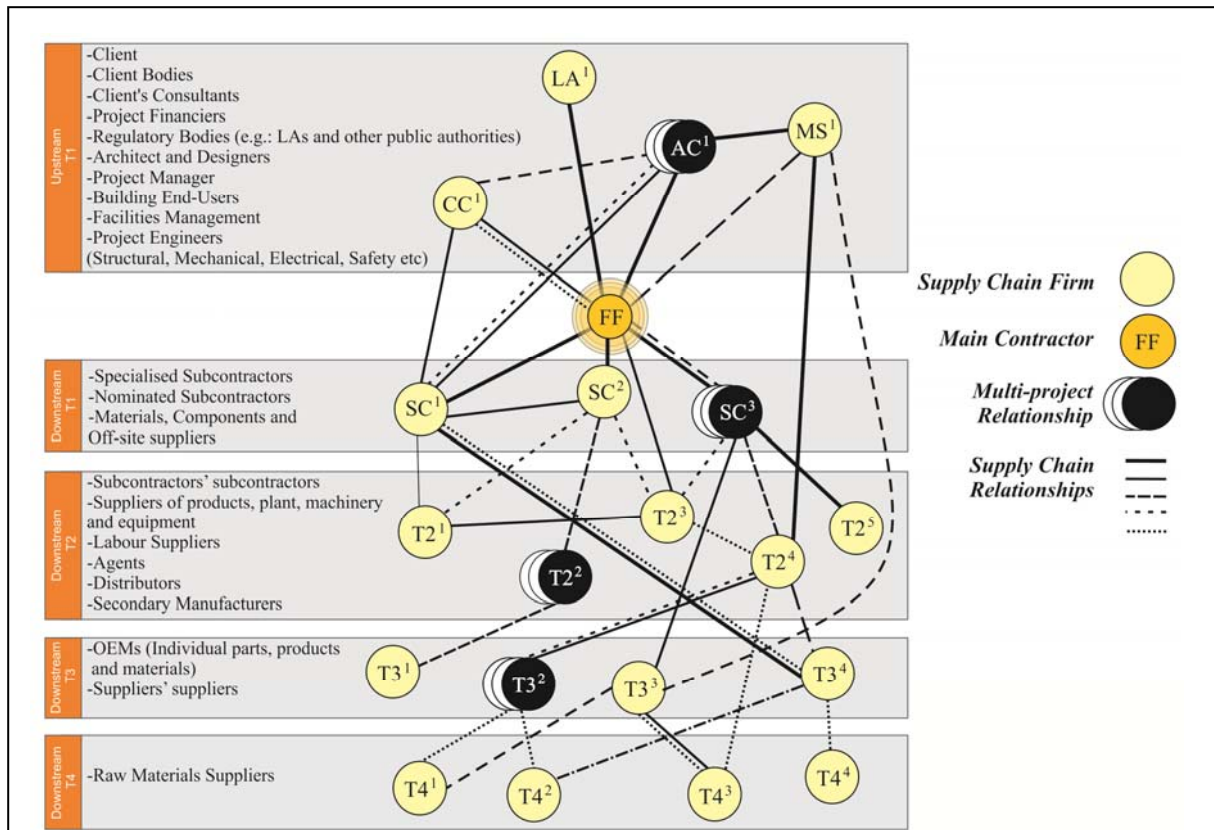
In a typical construction project supply chain a number of actors are connected together through multiple, dynamic, and context specific relationship layers such as product/information/material flows, contractual relationships, monetary relationships, information exchange networks and social networks (Pryke, 2004). Within the project environment the length of the supply chain or complexity of the network is dependent on the characteristics of the project defined by size, duration, complexity, procurement route, and number of stakeholders (London, 2004). Responsibility for managing

this complex, iterative and interactive process usually rests with the main contractors who generally coordinate the design and construction process end-to-end. Considering that the focal firm in a supply chain is the main contractor, other actors at different levels of the supply chain can be associated with the main contractor as in *Figure 1*. This depicts a schematic where the vertical structure of the map is characterised in terms of degree of specialisation and the horizontal structure refers to the number of firms represented within each tier.

Cox and Ireland (2002) have suggested that classification of various types of supplier relationships is not clear. Classification of a supply chain relationship is important because multitude of relationship types exist in an organisation's supply network and not every relationship type is appropriate for different contexts (Spekman *et al.*, 1998; Cox and Townsend, 1998; and, Cox and Ireland, 2002). Another reason why classification is important is because added value in every relationship differs from one another as some relationships are considered to be more

valuable than others (Ford and McDowell, 1999). This is supported by Spekman *et al.*, (1998: 114) who suggested that “*not all suppliers are treated equally, nor should they be*”. Therefore, some relationships may require greater resources for its maintenance and development whereas some relationships may need a specific strategy which is tailored for its continuity. In addition to this relationships have an interdependent role within a supply network such that certain types of relationships will influence and be influenced by other relationships (Cox and Ireland, 2002 and Bygballe *et al.*, 2010). Similarly, certain strategic decisions can have different level of impact on some relationships (Ford and McDowell, 1999), therefore, by categorising relationships firms will be able to manage, develop and re-build their relationships with correct sets of tools, processes, procedures and motives so that relationships become an asset for the company, not just a mere mechanism to interact with other businesses.

As identified previously, within the cSRM literature relationships are generally studied from two perspectives:



**Figure 1:** A conceptual supply chain map and description of the actors involved at each stage (Marceau *et al.*, 1999; Edum-Fotwe *et al.*, 1999; Cox and Ireland, 2002; London, 2004 and Beach *et al.*, 2005)

procurement relationships and firm-firm relationships. For example, Vrijhoef and Koskela (2000) identified four levels of interactions at project supply chains; however they did not make a clear distinction between various relationship types within these supply chains. From the literature reviewed it seems that there is a gap of knowledge in AEC supply chain relationships in terms of what are the characteristics of different types of relationships; in what circumstances these relationships are created, developed and ended; and, what are the core components and elements of each relationship type.

Table 1 summarises different types of relationships that have been mentioned in the past studies. Majority of research concerning supply chain relationships have only analysed the partnering relationship and typified different levels of partnering within their studies, hence they are biased towards one particular form of relationship. Secondly, one of the main weaknesses in almost all of these studies is the inadequate coverage of key relationship characteristics for each relationship category. In other words there is a lack of detailed description on what each relationship type encompasses in terms of actors in the relationship and links between them.

Meng *et al.*, (2011) and Meng (2010) have developed a relationship maturity model which describes some of the

key relationship elements within each relationship category. The study by these authors provide a good model for evaluating different types of relationships in a buyer-supplier interface however key aspects of relationships and its management are not fully covered within their model. For example, some key relationship elements such as duration of the relationships, extent of adaptation and attraction, power symmetry, and length of the supply chain is not included in their model.

From the review of literature on construction supply chain management four categories of relationships can be identified. These categories are labelled as transactional relationships, series of transactions, project collaboration and long-term strategic partnerships. The literature distinguishes these relationship categories by the following generic characteristics: counter-productive, compliant, cooperative and collaborative, respectively; however it does not clearly differentiate these relationships in terms of their multi-level, multi-faceted and dynamic relational elements. Following sections will discuss these relationship types in more detail.

**Transactional Relationships**

In the construction industry the most common type of relationship that a firm has with its suppliers and buyers is

**Table 1:** Studies on relationships in construction supply chains

		<i>Classification of Firm-Firm Relationships</i>			
Authors	Topic	Single Sourcing		Strategic Sourcing	
		Commodity, Product or Service	Project	Project Partnering	Total Relationship Management
Jones and Saad, 2003	Partnering	Traditional	Two-stage with negotiation	Project Partnering	Strategic Partnering
Thompson <i>et al.</i> , 1998	cSCM	Preferred Supplier	Single Sourcing	Network Sourcing	Strategic Alliance
Li <i>et al.</i> , 2000	Partnering	-	Pseudo-partnering	Project Partnering	Strategic Partnering
Saad <i>et al.</i> , 2002	cSCM	Contractual	Project Based	Full Partnership Alliance	Strategic Partnering
Maqsood and Akintoye, 2002	cSCM	-	Cooperative	Coordination	Collaboration
SfFC, 2003	SCI	-	Historic	Transitional	Aspirational
Humphreys <i>et al.</i> , 2003	Partnering	Traditional	Semi-Project Partnering	Project Partnering	Strategic Partnering
Gadde and Dubois, 2010	Partnering	-	Local Level Partnering	Central Level Partnering	Intermediate Level Partnering
Meng, 2010	cSCM	Traditional	Limited Cooperation	Project Based Collaboration	Long-term Collaboration
Meng <i>et al.</i> , 2011	cSCM	Price Competition	Quality competition	Project Partnering	Strategic Partnering/Alliancing
Bemelmans <i>et al.</i> , 2012	cSCM	Project Level	Regional Level	Division Level	Corporate Level

a transactional relationship (Thompson *et al.*, 1998). This is not surprising as the construction projects are generally characterised as collection of temporary multiple organisations (Dubois and Gadde, 2000). Transactional relationships are short, simple and price-based transactional interactions between dyadic actors in the chain. At the project level, Dubois and Gadde (2002) described this kind of relationship as low involvement relationships and cited that transactional project relationships have better localised adaptations (i.e. firms can benefit from knowledge transfer); can serve as a buffering mechanisms against unfavourable conditions (such as logistical issues); provide a sensitive sensing mechanism; appropriate for situations where a greater number of mutations and novel solutions required (i.e. as there are more options for variety and innovation); and, sign of an interest in further transactions/relationships. However, at a much smaller scale, one of the driving forces for adapting transactional relationships is that it requires very little investment and involves less risk in the transaction process which is favoured in situations where there is an element of uncertainty and complexity in the project (Dubois and Gadde, 2002; and Gadde and Dubois, 2010).

However, the main disadvantage of having a transactional relationship is the discontinuity in the relationship (Cox *et al.*, 2006). Dubois and Gadde (2000) noted that transactional exchange hampers the development of both, temporary and permanent network relationships. Transactional relationships generally comprise of short-term, operational and limited relational interaction between the firms. For example, every transaction is considered to be a new relationship making this type of relationship inefficient (i.e.: a new learning curve is climbed at every interaction and higher transaction costs associated with searching and finding information, negotiation costs such as bargaining costs and, enforcement costs which are related to costs associated with monitoring and enforcing contracts).

Furthermore, on transactional relationships suppliers are usually selected on a minimum cost basis and greater emphasis is placed on fully documented conditions of the contract (Thompson *et al.*, 1998). Findings from empirical

studies show that the main problems with transactional relationships are related to the lack of commitment; misaligned values, visions, goals and objectives between the actors; transfer of knowledge and experience to subsequent projects; and “*deep-rooted cost driven agendas in transactions*” (Wood and Ellis, 2005: 324); which consequently results in opportunism and mistrust.

From the INA perspective transactional relationships may not be created merely by an exchange of a commodity or service but also thorough other variables between firms and individuals (Holmlund, 2004). A transactional relationship could have different entities that constitute to its formation (London, 2004). For example, a transactional relationship can occur as a result of structural and behavioural characteristics of procurement events (London, 2004) such as a social, legal, economical, technical, interpersonal interaction between the firms and individuals (Holmlund, 2004). Furthermore, a transactional relationship could trigger or result in another transaction as well as lead to more intense form of relationships (i.e. series of transactions) (London, 2004). Here, it must be highlighted that an empirical study is needed to find out which relationship elements and dimensions of interaction result in further transactional engagement within and between the supply chain firms.

### ***Series of Transactions***

The next level in relationship category is called series of transactions. This kind of relationship usually occurs between a client who is a regular buyer or a contractor who interacts with a supplier more intensely and frequently (Cox *et al.*, 2006). It is also termed as ‘parallel sourcing’ where a buyer sources a product and/or service from a list of preferred suppliers for multiple projects (Homlund, 2004). For example, most clients and contractors nowadays have a framework agreement with their pre-selected suppliers, so the transaction may happen in a stream of projects, but sometimes the type and nature of the product/service may be different compared with the previous transaction (London, 2004).

The main advantage of having this type of relationship is to benefit from the ties/links that exist in an extended relationship. Dimensions of interaction are much more

dynamic compared to the transactional relationships therefore there could be opportunities for cooperation, however these also depend on the strength of the entities associated with the interaction (eg. volume of transaction, frequency of interaction, degree of strategic importance, level of actors involved in the relationship and so forth) (London, 2004).

Series of transaction relationships are usually blamed for the same adversarial conditions that arise during a transactional relationship. This is mainly due to the fact that firms have little interaction outside the transactions and relationships generally embrace standard forms of contracts. Dubois and Gadde (2000) reasoned the first point to the lack of interdependence, standardisation and adaptations between parties which inhibits forming of sustainable long-term relationships. Furthermore, Thompson *et al.*, (1998: 37) noted that majority of the contracts used at this level of interaction are “reactive mechanisms designed to apportion blame between the parties”, therefore relational elements are marginally reflected in the interaction/transaction process.

#### ***Project Collaboration***

The third level of relationship in the relationship categories is the project collaboration. The literature describing this kind of relationship is generally concerned with the firm-firm relationships which comprise of closer relational arrangements between firms. An example of this is the alternative forms of procurement to source suppliers as well as alternative forms of contracts between project firms (Thompson *et al.*, 1998 and Kumaraswamy *et al.*, 2000). Project collaboration may have been evolved from the previous relationship levels (series of transactions or transactional relationships over a period of time) or a firm may decide to work collaboratively with a supplier in a specific project for strategic purposes (Gadde and Dubois, 2010).

Relationships at this level are described as ‘cooperative’ and partnering arrangements between main contractor and the client is one of the most adopted relationship approaches. At this level of interaction, relationships are primarily characterised on length and duration of the interaction which is generally as long as the project’s

duration (Humphreys *et al.*, 2003). Other common characteristics include integration of facilities/infrastructure (such as sharing project offices for teambuilding); predetermined risk/benefit sharing mechanisms (framework agreements); early involvement in the projects; focus on the project and client requirements; and, focus on logistics and economic efficiency and performance.

#### ***Long-Term Strategic Partnerships***

The highest ranking relationship type is considered to be the long-term strategic partnerships (LTSP). These are high level, strategic and long-term orientated relationships between two actors in the supply chains (Gadde and Dubois, 2010). Most firms engage in LTSP relationships with limited number of firms as it requires a lot of investment and commitment from the parties involved. The reviewed literature on construction specific supply chain management reveals that much of the research and practice in the industry has only considered the relationships between contractors and client, ignoring the downstream supply chain firms, so the extent of relationship management is restricted to immediate tier of the partnering firm.

The most common terminology that appears to describe this type of relationship is ‘collaboration’ within the context of Integrated Supply Chain Management (ISCM) literature. The term ‘collaboration’ is used interchangeably in the literature however at this level of interaction collaboration is described as a hybrid business operation where the aim is to create synergy by achieving vertical and virtual integration between the two supply chain actors (Gadde and Dubois, 2010). Gadde and Dubois (2010) described the main characteristics of this kind of relationship as longevity, interdependence, relationship atmosphere, previous interaction, mutual orientation and adaptations in the relationship. The intensity of the interaction can be easily figured out by looking at the relationship characteristics in *Table 2*. The relationship variables in *Table 2* are drawn from relevant literature which describes what the best-practice for each relationship type should be. It can be easily identified that LTSP relationships embrace all of the relationship variables as an essential entity. However literature



**Table 2:** Suggested best-practice relationship variables relative to four relationship levels in the literature reviewed

<i>Dim</i>	<b>Relationship Elements</b>	<b>Transactional</b>	<b>Series of transactions</b>	<b>Project Collaboration</b>	<b>LTSP</b>
<b>Social</b>	Honesty		○	●	●
	Trust (Universal)		+	●	●
<b>Economic</b>	Open book accounting		+	○	●
	Joint conflict resolution		○	●	●
	Best value approach (i.e. whole-life-value and value for money)	+	○	●	●
	Profitability and repeat business	+	○	○	●
	Logistics and operations management		+	○	●
	Alternative forms of procurement and sourcing		○	●	●
	Sharing of risks and rewards	+	○	○	●
	Transparency	+	○	○	●
<b>Organisational</b>	Power Symmetry			○	●
	Partnering			○	●
	Reliability and interdependence	+	+	○	●
	Previous experience	+	○	●	●
	Common purpose-mutual Interest (coalescence and win-win)	+	+	○	●
	Project teambuilding		○	●	●
	Structural alignments for strategic interactions			+	●
	Organisational trust	+	○	●	●
	Customer/Sub-Contractor/Supplier Relationship Management		+	●	●
	High level commitment		○	●	●
	Organisational culture			●	●
	Cooperation	+	○	●	●
	Project Culture			●	●
	Early involvement		+	●	●
	Continuous Improvement		+	+	●
	Long-term focus		+	+	●
<b>Individual</b>	Alignments for operational interactions		+	●	●
	Individuals' trust in and between organisations	+	+	○	●
	Individual commitment		+	○	●
	Training and skills		+	●	●
	Individuals' attitude, behaviour and culture		+	●	●
<b>Technological</b>	Collaboration	+	+	●	●
	Lean Construction Principles		○	●	●
	Integrated ICT infrastructure/Virtual Organisations			○	●
	Communication/Information Exchange	●	●	●	●

<b>Key:</b>	
●	<i>Essential</i>
○	<i>Necessary</i>
+	<i>Desirable</i>
Dim.	<i>Dimension</i>

reviewed warns that LTSP is very difficult to realise in practice (Khalfan *et al.*, 2008). Yet, if all relationship elements are in place, it is the best relationship type that a business can have for a long-term sustainable inter-firm relationship strategy.

**Discussion**

The literature describing relationship levels in the AEC industry is fragmented and there are only a few studies which look at characteristics of different relationship types that exist in supply networks (for example: Meng, 2010, Meng *et al.*, 2011 and Bemelmans *et al.*, 2012). This study has categorised the supply chain relationships into four categories which are transactional relationships, series of transactions, project collaboration and long-term strategic partnerships. Although *Table 2* provides the essential relationship variables for each relationship type, the core characteristics of these relationships are not fully covered within this study due to space permissions. The contexts within which these relationships occur are presented in *Table 3*. By analysing the relationship characteristics further studies can establish the contextual factors that give shape and form to a relationship.

Each relationship level described above requires a specific and tailored management approach as every relationship is

considered to be distinct and context specific (Spekman *et al.*, 1998; and, Cox and Ireland, 2002). Therefore, it would be acceptable to describe *what* the management should pursue for rather to define *how* to manage each relationship level.

Literature reviewed indicates that the role of SRM within construction projects is strongly related to characteristics of a relationship. By focusing on the key aspects of a relationship, relationship management strategy can become more effective and efficient. For transactional relationships the aim of relationship management would be to monitor the relationship rather than manage the links and actors in that relationship. This is because there are many different entities that constitute to the formation of a transactional relationship where exchange/interaction is very short and transient. Management at this level would refer to the supplier selection process where the monitoring the transactions/interactions and determining the core characteristics of the relationship would enable a targeted management strategy to be applied to that relationship (Cox and Ireland, 2002). At the project level, monitoring of transactional relationships would generally concern the interface between the supply chain actors and the construction site (Vrijhoef and Koskela, 2000).

SRM for series of transactions would involve an active

**Table 3:** Relationship characteristics

Relationship Variables	Description
<b>Continuity</b>	Frequency, regularity and intensity of the interaction
<b>Complexity</b>	Number of people involved, volume of transaction and asset specificity
<b>Symmetry</b>	Power differences in terms of human, knowledge, financial and technological resources
<b>Process Nature</b>	Nature of exchange interaction, dynamism in relationships and future perspective
<b>Relationship Embeddedness</b>	Existing connections, links, and legal ties
<b>Attitude, Trust and Commitment</b>	Level of attitude and commitment to collaborative practices, and inter-firm trust
<b>Firm Position</b>	Firm position in the supply chain/network
<b>Dependence, Competence and Congruence</b>	Extent of dependence, competence and congruence that is required in the relationship
<b>Collaboration</b>	The degree of collaboration in the relationship
<b>Risk and Uncertainty</b>	Risk and uncertainty involved in the relationship
<b>Adaptation</b>	Level of investment in the relationship and synergy
<b>Attraction</b>	Commitment, dependency and importance, i.e.: financial motives, psychological factors, firm reputation and brand image
<b>Closeness and Remoteness</b>	Physical proximity of the parties, e.g.: geographical distance, cultural differences, language differences)
<b>Formality, Informality and Transparency</b>	Level of formality and informality in the relationships. Existence of risk and reward sharing mechanisms
<b>Routinization/ Standardisation</b>	Degree of routinization and standardisation of procedures, processes, protocols
<b>Social Network</b>	Extent of inter-personal and social network on the inter-firm relationships
<b>Market Structure</b>	Availability of the product/service in the market

administration procedure to control that relationship. At series of transaction relationships, the elements that shape the relationship would be more settled and identifiable. This would make relationship management relatively easy as the connections and actors in that relationship are more rigid and traceable due to relationships being more systematic and structured. Management of relationship can be extended by the focal firm depending on the relationship determinants such as power symmetry, trust, continuity, interdependence and degree of strategic importance. However, in a study on Dutch construction firms, Bemelmans (2012) found that this was not the case. The authors' study indicated that relationship management for frequent transaction relationships was mostly implemented at project level confined to immediate tier of the focal firm and lacked majority of the relationship management constructs. As pointed out by Vrijhoef and Koskela (2000) relationship management at this level would be highly concerned with monitoring and control of actors and processes so that costs related to logistics, lead-time and inventory on project supply chains are reduced.

As relationships get more intense, the dimensions of interactions increase and consequently relationships get harder to control. Project collaboration relationships comprise of simultaneous relational entities which have more physical content and span over a longer period of time. The influence of the relationship management strategy can extend beyond the first tier supply chain firms as well as beyond several project phases (i.e.: design development, construction, hand-over) as relational entities are attached to the various project and organisational processes. The main roles of different actors, the links between the actors, the resources and all other primary characteristics of collaborative relationships are usually determined, structured and embedded into the project-wide processes. Past interactions provide a historical record of relationships and a reference for future transactions. Thus, the project collaboration relationships need to be controlled and coordinated in a proactive manner e.g.: to transfer activities from the site to earlier stages of the supply chain.

The management strategy for the LTSP relationships would require a total relationship management approach where all the dynamics of the relationship is managed.

With regards to the role of contractors in managing their supply chain relationships it would mean that management approach would embrace an integrated management of the supply chains with the emphasis on improvement of supply chain and the site production (Vrijhoef and Koskela, 2000). Therefore total relationship management would involve monitoring, controlling, coordinating and managing all relational aspects of the interactions at many dimensions as possible such as project, organisational as well as organisation-individual.

Within the literature reviewed there is a general consensus that the impact or influence of relationship management strategies in dyadic relationships is determined by five important factors which are power symmetry, trust, continuity, and degree of strategic importance and interdependence of the other actors. However there appears lack of knowledge on what strategy would be most appropriate for managing different relationship levels in supply networks that extend beyond a simple dyadic relationship. Identifying the best route for a management strategy across a supply network would involve mapping different dimensions of relationships within supply chains so that different routes can be used to apply incentives or penalties to penetrate deep into the required tiers in supply networks.

The process for mapping the supply network relationships must consider the three essential components of relationships identified earlier. In terms of the actors involved in supply networks further research is needed to identify the individuals who are decision makers during procurement, design and construction process at a project level. In an organisational level there is also a need to study the influence of these decision makers in supply network relationships. Future studies can look at the correlation between power, trust, interdependence, and strategic importance which helps to develop better relationships with those actors.

There are various processes, procedures and protocols mentioned in the reviewed literature for supplier relationship management process, however there is scarcity of research with regards to their use by contractor firms. Such processes can be studied in two contexts: formal and informal, where formal processes are referred to as written

hard facts about how to implement a relationship management approach and informal processes are those that belong to activities within social context. Some of the formal processes used to manage relationships include Supply Chain Council's Supply Chain Operations Reference framework; Integrated Project Delivery method; Constructing Excellence's Strategic Forum for Construction Integration; OGC Guidance Documents; and British Standards 8534 and 11000.

Lastly, the tools and technologies which facilitate the interaction/transaction processes also need to be further studied. There are plethora of ICT tools and technologies available to support and enable the above-mentioned processes however the extent of their use by supply chain actors in construction supply networks is not thoroughly researched. The objective of these studies could be steered towards identifying and exploring the role of ICT tools and technologies in maintaining and sustaining relationships within project networks and in inter-firm relationships.

### Conclusions

Studies in the past and the practice in the industry have seriously neglected the strategic and operational importance of managing their relationships within project and organisational networks. The attention of focus in the past studies was solely directed on dyadic relationships between upstream firms (client-contractor) and certain types of relationships, such as partnering, were given more consideration despite the fact that no single type of relationship is appropriate for a firm's relationship strategy. This study has explored some of the relationship types that exist in the AEC industry and defined four relationship levels where characteristics of each relationship type were outlined from INA and SCM perspectives. In summary each of the above relationship type needs appropriate management strategy as every relationship is composed of different entities that make up its 'DNA'. The most appropriate strategy for each of these relationship levels would involve: monitoring transactional relationships; monitoring and/or controlling more frequent relationships; control and coordinating collaborative relationships; and, managing long-term strategic partnering relationships. Improving relationships at operational and strategic level

would involve looking at three core components of relationships; people, process and technologies. Further empirical studies are needed to fill the gaps within these three areas so that performance of construction projects could be improved through better relationships between the supply chain firms.

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