

## Value Transparency in Supply Relationship: An Innovation Systems Approach

Richard Lamming<sup>1</sup>

Wendy Phillips<sup>2</sup>

Nigel Caldwell<sup>3</sup>

Centre for Research in Strategic Purchasing and Supply (CRiSPS)

School of Management

University of Bath BA2 7AY

United Kingdom

### Abstract

Adopting an innovation systems approach, this paper addresses how institutions in supply markets (in the institutional economics sense of informal constraints and formal rules) influence the innovation process between firms. Within an innovation system, institutions may contain the ability not only to support but also to restrain the co-ordination of knowledge and skills in inter-organisational relationships. The paper proposes that *value transparency*, characterised as a relationship resource, is an alternative to existing institutions (such as open-book negotiation) which appear to have failed to adapt to the changing nature of product and process technologies.<sup>4</sup>

**Key Words:** technological systems, value transparency, open-book negotiation, supply.

### Introduction

As Ford *et al.* (1998, p. 270) recognised, viewing one particular characteristic of relationships, such as technological development, provides a unique but not holistic view of a network or industrial system. A different view of the network or system might emerge if, for example, logistical flows were the focus of analysis. Adopting an innovation systems

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<sup>1</sup> Director of CRiSPS, School of Management, University of Bath, Bath, BA2 7AY, UK. Tel: 00 44 (0) 1225 326536. Fax: +44 (0) 1225 323223. E-mail: mnsrcl@management.bath.ac.uk.

<sup>2</sup> Research Officer, CRiSPS, School of Management, University of Bath, Bath, BA2 7AY, UK. Tel: 00 44 (0) 1225 326650. Fax +44 (0) 1225 323223. E-mail:mnswp@management.bath.ac.uk

<sup>3</sup> Research Officer, CRiSPS, School of Management, University of Bath, Bath, BA2 7AY, UK. Tel: 00 44 (0) 1225 323881. Fax +44 (0) 1225 323223. E-mail:mnsndc@management.bath.ac.uk

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approach, this paper examines the way one existing institutional arrangement, 'open-book negotiation', may be hindering rather than supporting inter-firm relationships in supply networks and offers the concept of 'value transparency' as an alternative.

As product and process technologies become more dynamic and complex, firms must access knowledge and skills that lie beyond their core capabilities. This access is critically dependent upon positive exchanges of knowledge and information amongst agents. In practice, however, issues such as trust, intellectual property ownership, the absence of formal agreements, cultural differences and opportunistic behaviour, all serve to hinder this process, inhibiting the flow of knowledge and preventing the exchange and development of capabilities amongst firms. Araujo, Dubois and Gadde, (1999, p. 502) make a salutary point, observing that the accumulation of technological capabilities may also represent a significant cost. Such costs may never be recouped if opportunities to exercise newly acquired capabilities do not materialize.

Intensification of supply chain and network linkages has resulted in increasing dependence between customers and suppliers for the supply of information and expertise (Lamming, 1993, p 213; Coombs and Metcalfe, 1998). Consequently, there is growing recognition of the importance of developing co-operative inter-firm relationships that promote the diffusion of knowledge without the restraining effects of social liability. The paper investigates these restraining effects, examining the role of value transparency in fostering such relationships.

By coupling the concept of transparency with an innovation systems approach, the analysis goes beyond functions such as Sales or Purchasing to consider the nature of the interactions, exchanges and boundaries that may exist between customers and suppliers. A technological systems approach to innovation has been adopted rather than a national systems approach enabling the study to go further than the boundaries associated with a nation state. Removing the restrictions associated with national borders allows the focus to be on the exchange of information within a specific economic/industrial/technological area rather than a specific country as would be the case if a national innovation systems approach were used.

Through combining the technological systems approach to innovation with the concept of transparency the research focus in this paper develops from the customer-supplier dyad to the technology innovation system within which dyads operate. Accordingly, the paper investigates issues affecting knowledge transfer and technological development, proposing value transparency as a means of addressing some of the critical issues.

The paper begins with a review of literature on systems of innovation, particularly technological innovation systems. A definition and exposition of value transparency are presented and finally, conclusions are drawn.

### **A ‘Systems of Innovation’ Approach**

As product and process technologies become increasingly dynamic, complex and diverse, they present challenges (for example in product design and system implementation) that lie beyond the firm’s internal capabilities (knowledge, skills and expertise). Consequently, it is necessary for firms to access an array of capabilities that lie beyond the boundaries of the firm. Addressing this imperative results in an innovation process that Coombs and Metcalfe refer to as collective and combinatorial in character (1998). In this environment, a firm’s external relationships may be seen as gateways to other knowledge bases or ‘selection environments’ (Nelson and Winter: 1982). One of the drivers, therefore, in the observed behaviour in firms towards adopting collaborative approaches in supply management, may be presumed to be the need to address the technological developments, or as Rosenberg (1982, p. 107) calls it, the ‘technological imperative.’

Observation of collaboration and co-operation such as this reinforces the view that firms do not operate in isolation but within a wider network or system. The importance of such linkages is recognised and explored by the literature relating to ‘systems of innovation.’

Many studies have been carried out since Lundvall first introduced the systems of innovation approach in the 1980s (Lundvall, 1988). This has resulted in an array of perspectives, including: National Systems of Innovation (NSI) (Freeman, 1988; Lundvall, 1988; Nelson, 1993); Technological Systems (Carlsson and Stanckiewicz, 1991; De Liso and Metcalfe, 1996) and Sectoral Innovation Systems (SIS) (Pavitt, 1984; Scherer, 1986).

The standard interpretation of NSI is a: ‘set of organisations, institutions and linkages for the generation, diffusion and application of scientific knowledge operating in a specific country’ (Galli and Teubel, 1997, p. 345). However, the concept of a *national* system of innovation is brought into doubt as business activity, capital and technological change have become more global in nature. Increased internationalisation has led to a call from Nelson and Rosenberg (1993) and Lundvall (1992) for the adoption of a *sectoral* approach, envisaging an innovation system that might take into account the increased globalisation of commercial activities and

also technological development. It still appears, however, that although the processes of technological change may now be largely global, the policies that help shape and direct them are still mainly carried out at a national level (Edquist, 1997b).

Technological systems move beyond the boundaries associated with a nation state, focusing on the exchange of information with respect to a particular economic or industrial area.

According to Carlsson and Stanckiewicz (1991) technological systems may be defined as a:

‘network of agents working and interacting in a specific economic/industrial area under a specific institutional infrastructure to generate, diffuse, and utilise technology. Technological systems are defined in terms of knowledge competence flows rather than flows of ordinary goods and services. They consist of dynamic knowledge and competence networks.’ Carlsson and Stanckiewicz (1991).

### **Interactive learning within systems of innovation**

The increasing complexity and diversity of technology supports the appropriability of the technological systems approach, particularly with respect to its focus on knowledge and information flows. Observers have noted that firms tend to increase their range of technologies while decreasing their range of products (SPRU, 1997). Granstrand *et al* (1997), Granstrand and Sjolander (1990), Oskarsson (1990), Patel and Pavitt (1994) all report of the convergence of distinct technological fields and of products becoming more multi-technological. The effect, as Patel and Pavitt (1994) highlight, is an increased need to develop a broad range of competencies.

Such competence-building underlines the importance of *interactive learning*. Interactive learning is intrinsic to the systems of innovation approaches, not only in terms of the dynamic of the system, but also as a means of holding the whole system together (Archibugi et al, 1999). As Lundvall points out:

‘many different sectors and segments of the economy contribute to the overall process of interactive learning and the specificity of the elements, as well as the linkages and modes of interaction between them, are crucial for the rate and direction of technical change.’ (Lundvall, 1995, p. 40).

The process of interactive learning occurs not only through market exchanges between firms but also through market exchanges between the firm and consumers. In addition, it develops through the gradual diffusion of new technological knowledge throughout the technological

system and through the non-market learning activities that occur between firms and also between firms and other institutions such as universities and research centres (Cantwell and Fai, 1999). Such learning may simply be the exchange of knowledge (including tacit knowledge) or it may be a co-ordinated process between firms. Thus, although each firm may have its own set of firm-specific capabilities, it must not be assumed that these capabilities are acquired through an independent learning process within the firm. Coombs and Metcalfe (1998) use the term 'cross-firm capabilities' and this indeed may be more appropriate when considering the complex nature of today's technological innovations.

### **Technological Systems**

A technological system can be viewed as a set of interrelated sub-systems that may act independently but, by means of interactive learning, contributes as a whole to the development of a technology. However, the various sub-systems may not act in synchrony and, as Hughes (1992) notes, some components of the same system may progress more efficiently than others. These sub-systems may actually dictate the rate of development for the whole system, possibly creating the development potential for the rest (Andersen and Walsh, 1999). Despite this development potential, however, the rate at which the system progresses may still be limited by sub-systems that are less advanced. Hughes (1983) refers to components (or sub-systems) that trail behind the rest this as 'reverse salients'. If the system is to advance, these components must be improved. When this cannot be achieved a radical solution may be adopted using ideas and principles from another sub-system.

De Liso and Metcalfe (1996) describe the structural tensions that build up within a system in terms of imbalances, linkages and constraints. While there must be some degree of compatibility (linkage) within each system, sub-systems will be following their own design configurations (technological paradigms). Systems may enable interactive learning but they may also create 'interrelatedness constraints' (De Liso and Metcalfe, 1996, p.88) on what may be achieved. In other words, sub-systems may develop at different rates and an improvement within one subsystem may diffuse throughout the rest of the system only if it is economically feasible for all members of the system to remain compatible.

Imbalances may result from various factors, such as changes in the social and economic environment or incentive structures and externalities in technological development. Leoncini (1998) perceives the nature of the relationship that exists between the firms, the interface, as being the salient issue. Where a strongly compatible interface or relationship exists, co-

evolution of the subsystems may be expected to occur. As the degree of compatibility decreases, the influence that the subsystems have on each other becomes less marked until a situation may arise where they are completely disjointed. The degree of compatibility between the subsystems will strongly determine the nature and rate of technological development of the system.

### **The role of institutions**

Institutions play a central role in studies of innovations systems. The term ‘institution’ is commonly applied to a rigid component or establishment with a strict set of rules. We use it here in the sense propounded by institutional economics to include disembodied routines, conventions and customs. Williamson (1998) sees institutions in terms of two complementary parts (Williamson, 1998), a view highlighted earlier by North (1991, p.97):

“Institutions are the humanly devised constraints that structure political, economic, and social interactions. They consist of both informal constraints (sanctions, taboos, customs traditions and codes of conduct), and formal rules (constitutions, laws, property rights).”

This suggests that an institution can act in one of two ways; either as a governing body through, for example, well defined policies and law, or less formally, along a set of behavioural norms such as routines and culture. The notion that societies are shaped by patterns of behaviour may be extended to suggest economic behaviour is instituted through habits, or what Mayhew (1987) calls *enculturation*.

Habits, the most basic level of behavioural patterns, develop into routines. The importance of routines has been well-documented (Nelson and Winter, 1982; Håkansson and Snehota, 1995); Håkansson and Wootz (1979, p. 31) include ceremonies and even myths ‘as exchange between partners simplifies’.

Once habits and routines become widely used they give rise to social regularities such as traditions, customs, rules and law (Lundvall, 1991). Whether they are informal or formal, they both determine how individuals or groups relate to one another. As a result, they act as ‘informational devices’ or guidelines, establishing the nature of relationships.

Edquist and Johnson (1997) perceive institutions as serving three basic functions: to reduce uncertainty; manage conflicts and co-operations, and provide incentives. However, in the

manner of sub-systems discussed above, while providing the stability, co-ordination and incentives to innovate, institutions may also act as a brake, slowing the whole process down. For example, lack of incentives for a new technology may eventually lead to a situation whereby society is 'locked-in' to the 'wrong' technological system (Ackermann, 1998). Consequently, just as firms rely on institutions, those same institutions are dependent upon firms to them up to date with technical advances; in other words they co-evolve. It is naturally possible for some firms to be ahead of their competitors in this institutional evolution. Since, in supply chain relationships, compliance or use of an institution requires two parties (customer and supplier), the notion arises of a dyad, rather than a firm, being ahead in this manner, implying a differential dyadic competence.

The nature of the relationship between organisations and institutions may be characterised as game-playing, the institutions acting as the rules that govern the game and the organisations the players. By pushing against the barriers, or rules, the organisations are the agents of institutional change. Where the game concerns the development of a technology, the firms are initially reliant upon the institutions not only for stability but also for the co-ordination and reproduction of knowledge. This is particularly apparent during the early phases of technological development or with technologies that have an ever-changing knowledge base (Metcalf, 1995). However, as a technology develops there is a shift in balance. Organisations may remain dependent upon an institution for the efficient distribution of knowledge but, as they become familiar with the technology, knowledge accumulates and the institution begin to depend upon the organisations to keep it up to date (with the 'state of play'). *In extremis*, a lack of feedback may result in what Johnson (1981) calls 'rigidity' or 'institutional sclerosis' within the system.

It has long been recognised that the interaction between users and suppliers promotes innovation and technological development (Teece, 1986; Lamming 1993, p. 230; Gadde and Håkansson, 1994, p. 34). With respect to technology and innovation, an understanding of the concept of institutions must be developed in studies of supply relationships. This is particularly important if we wish to go beyond the discussion of price to include the processes of interaction and communication. This is highlighted by Edquist and Johnson:

'Pure markets, i.e., markets in which sellers and buyers only communicate with the help of prices and quantities, will not produce any innovations. Innovations require qualitative

communication through which technical possibilities and user needs can be confronted and matched. Such communication and interaction can be organised in many ways but usually it is supported by different institutions. Markets are usually not 'pure' but are institutionally supported in different ways and the character of these institutional arrangements affects interactive learning and innovation.' (Edquist and Johnson, 1997, p. 49).

### **Open-book negotiation as an institution**

Open-book negotiation is the practice observed in customers requiring their suppliers to reveal operating details that would normally be kept secret for commercial purposes (see Lamming, Caldwell and Harrison, 2000). The justification usually offered for such intrusion is the customer's assumed ability to judge the supplier at the micro-level and, possibly, to suggest ways of improving cost performance. The practice is flawed in its assumption of generating sound operating data, since the supplier, faced with a *carte blanche* ultimatum (in some sectors, open-book has become a pre-requisite for tendering) runs the risk of sensitive data being exposed to competitors (i.e. via the customer). Thus the supplier must hedge the risk by corrupting the information. Far from the simple opportunism of transaction cost economics, such corruption, or 'cheating' is in fact a necessary practice for the supplier to avoid loss of competitive advantage. Customers realise this and tolerate the corruption, presumably resorting to idiosyncratic interpretation (frequently mathematically based) in order to use the data for purposes of assessment.

Open-book negotiation has become stylised and formalised in many sectors and is assumed to be a reasonable approach to gaining management information at the interface, for the customer's use (and benefit). Over half a century, it has gathered its own set of customs, routines, and rules.

Consequently, it appears appropriate to suggest that open-book negotiation within supply relationships may be classified as an institution, employed as a means of reducing the risk that the customer faces when developing a relationship with a supplier. As noted above, institutions may develop more slowly than the organisations to which they relate, creating discontinuities in the business model. It may be the case that the institution of open-book negotiation currently lags behind the needs of its practitioners. Institutions are meant, *inter alia*, to help the firms they impact upon to manage and/or adopt new approaches that promote knowledge flows and communication; open-book negotiation appears to be failing in this. It



may actually be the case that open-book negotiation is leading or contributing to institutional sclerosis in some sectors.

Previously, we considered technological systems as a set of interrelated sub-systems that may act independently contributing to the development of a technology by means of interactive learning. Such learning goes beyond the exchange of codified knowledge to include tacit knowledge and also the unintentional exchange of knowledge that inevitably arises within an inter-organisation relationship (so-called 'spill-over'). By accepting that sub-systems may develop at varying and different rates, we acknowledge that if the system (the supply network) is to advance, sub-systems must develop in some co-ordinated fashion. What is required is the efficient diffusion of knowledge throughout the system if it is to avoid becoming static or stalled. Preventing such stagnation will require the development of organisational capabilities that will promote interactive learning and either the removal or evolution of institutions that constrain technological progression.

A customer-supplier dyad or supply network may be characterised as a component or sub-system of a technological system. The linkage helps bind the system together, the flow of knowledge and information between the firms influencing the way in which the system functions and operates. Simply altering the nature of these linkages may have important implications for the development and dynamics of the system.

As it stands, open-book negotiation appears to restrict knowledge flows because of its inherent corruption (cheating). Its inability to meet the need for improved communication and knowledge flows acts, therefore, as an imbalance within the system, constraining the co-evolution of sub-systems. Co-evolution is strongly influenced by the nature of the relationships existing between firms; where this relationship is strongly compatible co-evolution may be expected to occur. As noted above, as the degree of compatibility decreases, the degree of influence that the sub-systems have on each other becomes less marked until a situation may arise where they are completely disjointed. With respect to relationships within supply networks, preventing this uncoupling may require the removal or radical evolution of failing institutions such as open-book negotiation. This may then promote the development of practice that is more in keeping with the factors faced by firms, such as the rate of technological change (and the commercial pressures for early adoption) and emergence of new concepts. We suggest that one such alternative that might be seen as a

resource to organisations is the concept of *value transparency* and this is introduced in the next section.

### **Value transparency**

Initially developed as ‘cost transparency’, value transparency aims to eliminate waste<sup>5</sup> and reduce costs between customer and supplier through the exchange or sharing of sensitive information. As we have observed elsewhere, cost transparency involves:

‘the sharing of costing information between customer and supplier which would have traditionally been kept secret by each party, for use in negotiations. The purpose of this is to make it possible for customer and supplier to work together to reduce costs (and improve other factors)’, (Lamming, 1993, p. 214).

Unlike open-book negotiation, cost transparency involves the two-way flow of information between customer and supplier, rather than simply the one way flow of information from supplier and customer. Furthermore, such exchange is selective, rather than *carte blanche*, justified, rather than demanded, and respectful rather than cavalier). By doing so, cost transparency is proposed as a contribution towards optimising the supply chain through the removal of the high degree of risk undertaken by the supplier through opening its books to scrutiny by the customer (see Lamming et al, 2000).

Elsewhere, and more recently, we have proposed the concept of ‘value transparency’ as: ‘the potential mode of operation within an inter-organisational relationship in a supply network, specifically in terms of the need for uncorrupted exchange or sharing of sensitive information and knowledge between a customer organisation and its supplier’ (Lamming, Caldwell and Phillips, 2001). This goes beyond the bilateral sharing of information suggested in cost transparency and involves managed risk for both parties, with identifiable additional returns. It also addresses two important issues that arose from the development of cost transparency. Firstly, agreeing upon the type and degree of sensitive information that is to be shared and, secondly, the assumption that each party has both the technical and organisational capabilities

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<sup>5</sup> The term ‘waste’ is used in the normal, lean production, sense of resources that do not add value. This excludes medium-term assets such as experimental capacity (e.g. redundancy necessary for learning) and tactical inventory necessary for assuring responsiveness or agility in meeting demands. The validity of maintaining medium-term resources is, of course, based upon short-term market competitiveness.

necessary to exploit this information in a manner that will bring about improvements in, for example, profits and/or quality.

To develop an understanding of the concept of value transparency, we have drawn on the behaviour of light as theorised by students of Geology, employing this as an analogy for the transfer of information or knowledge in relationships (see Table 1).

**Table 1. The metaphor of transparency as applied to inter-firm relationships**

	Opaque	Translucent	Transparent
Geological case (light shining through mineral)	Light cannot even penetrate the surface	Light can enter and exit the surface of the substance, but in a disturbed and distorted fashion	Light enters and exits the surface relatively undisturbed
Business Case (information shared between two organisations)	No information is shared between the parties; even operational day-to-day information is obscured or distorted (lack of clarity or reality in delivery requirement schedules)	Information is gleaned by each party and must be treated with caution. This could extend to disinformation (lying) as a tactic in negotiations. Poor systems debase the validity of information.	Information is shared well and extensively, on a selective and justified basis. Development and processing of shared information leads to shared knowledge and collaborative abilities.

From: Lamming, R.C., Caldwell, N.D. and Harrison, D.A. (2000)

As Table 1 demonstrates transparency recognises the importance of the bilateral sharing of information that is so lacking in open-book negotiation. Furthermore, transparency, rather than acting statically, has developed into a dynamic property of the relationship. As such, it is not constantly in place and is able to adapt and alter to meet the conditions demanded at a particular point in time by the supply relationship. Furthermore, it is accepted that each or all *states* (opaque, translucent and transparent) are likely to exist at some period in accordance to the type of interface required and the stage and condition of the relationship.

In addition to the states outlined in Table 1, we have identified two further, unmanageable states; *dazzle* and *black hole* (Lamming et al, 2001). *Dazzle* describes a state beyond transparency where the receiver is supplied, either accidentally or deliberately, with an insurmountable amount of data. *Black hole* is a situation in which information is either too complex or is buried too deeply to be explained or shared.

In practice, the research to-date has suggested that value transparency should be implemented on a project-by-project basis. That is only where a sound business case, and identifiable benefits have been proposed and mutually agreed upon. Having identified and assessed a mutually beneficially opportunity in the supply market, the degree and level of transparency can then be agreed upon for each stage of the project. This is illustrated in Table 2.

**Table 2 Value Transparency: its role in the elements of the supply relationship**

Relationship	Opaque	Translucent	Transparent
Geological case (light shining through mineral)	Light cannot even penetrate the surface	Light can enter and exit the surface of the substance, but in a disturbed and distorted fashion	Light enters and exits the surface relatively undisturbed
Market	Bazaar – arms-length trading; possibly, internet trading	Imperfect Market; competitive advantage gained by secrecy and guile	Theoretically perfect market; commoditisation
Flexibility for customer and supplier	None	Maximum	Limited
Disclosure	None	Limited by both customer and supplier	The disclosure of value creation, nurture and delivery is bilateral and mutually understood
Strategy	Very difficult to be strategic – little knowledge beyond own boundaries	Strategies become tactically delivered to allow for poor information	Permits strategy through mutual understanding; second order strategy needed for contingency
Account/cost focus	The transaction	Cost reduction, sometimes open-book on some items	The value created and delivered through the relationship
Dealing with change	Little provision for planning; surprises	Expectation of prior notice for changes; relies on formal partial information	Flexibility should support ‘lumpy’ development (quick response to changes).

By working together on a project-by-project basis, firms can ‘freeze’ the dynamics of an innovation process for as long a period as the relevant variable can be held constant. This is the basis for a ‘project’ (hence our suggestion that value transparency may be best, or only, managed within the context of a project of change, supported by a mutually advantageous and economically justifiable business case). One issue for the research is to establish whether the length of this freeze may need to be linked to the technology or to the product life. There would be no point in engaging in confidentiality on matters which will either become exposed (e.g. by competitors launching new products) or redundant (by such products

moving the technological competition to new dimensions) in the meantime. We hypothesise that in practice, transparency would be applicable to a bounded part of the technology system (the relationships applying to a specific product, or part of a product or its manufacture/configuration). Such a part would be capable of being ‘frozen’ for long enough for something to be done (transparency used for commercial benefits) but short enough not to impede progress on the innovation trajectory (see Araujo and Harrison, 2000).

Through adopting value transparency, both parties are able to operate on a level playing field, which positively encourages communication between the parties, and the mutual sharing of risk. Unlike open-book negotiation, value transparency is able to adapt and change as the relationship between the firms evolves and is sufficiently flexible to respond to any sudden changes in the firms’ external environment. Furthermore, it goes beyond the simple exchange of data to encompass value and strategic information, so recognising the importance of the interactions occurring not only between the customer and supplier, but also the supply networks. By doing so value transparency accepts the ability of these interactions to benefit not only the co-operating parties, but also organisations and institutions operating in the same technological system.

## **Conclusions**

In their roles as institutions supporting the commercial and technical survival of firms in supply network, sales and purchasing must adapt to reflect the changing nature of product and process technologies. The supply relationship is increasingly acknowledged as a critical means of supporting this adaptation and firms may be expected to develop more co-operative relationships in attempts to expand their existing knowledge and skills base. Open-book negotiation is apparently viewed as a valid approach to the more immediate pressures on firms (e.g. costs) and appears to be widely practised in some sectors (including the manufacturing sector). In its current state, however, we suggest that the institution of open-book negotiation has failed to adapt to the character of these more co-operative relationships. The rate at which it might evolve or be replaced by some more appropriate institution is uncertain. As Edquist and Johnson (1997) point out (echoing Polyani, 1957), institutions may continue to survive even after they have no function or fail to serve anybody’s interests although in time they will fade away or adopt a new role.

If the processes of industrial buying and selling have become routinised, it may be that open-book negotiation is no longer necessary (e.g. suppliers can be left to their own devices in achieving stipulated cost-downs, driven by consumer markets). Consequently, to operate effectively, parties to supply dyads must develop new organisational skills and resources that help to manage the processes more effectively. It is suggested that *value transparency* may be one such resource; possibly a *shared competence* in a *rich relationship* representing an inimitable competence for the dyad.

Thus, the ability to develop value transparency in interorganisational relationships within supply networks may be perceived as an organisational capability but not one that may be developed independently so emphasising the need for shared or distributed capabilities.

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