

## **Greening beyond the firm: improving environmental performance through the supply relationship**

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Intended category - philosophy, policy and practice.

### **Abstract**

Supply chains are a significant contributor to the generation of waste. Supply relationships may provide a key way for business to influence the sustainability of their products and services through improvements to the manufacturing system. Addressing the issue of the environmental performance of suppliers may however prove a costly endeavour for the supply chain as management of cross-boundary environmental performance raises major issues of efficacy of the approach and costs of the transaction.

Previous research has found high levels of advanced pollution prevention amongst firms adopting lean manufacturing strategies. This antecedent work has found that reducing waste through product design and better process efficiency can have a positive effect on both manufacturing performance and environmental performance. Developing suppliers in the principle elements of zero-waste manufacturing should support improvements in environmental performance.

The research paper presents a model for improvement of a supplier's environmental performance via the Customer-Supplier relationship which is required to maintain a competitive manufacturing supply chain. The model presents one of the first attempts to understand the transaction environment within which a firm may expect to approach issues of supply 'greening'. The draft research model and early findings from pre-testing work in the Australian automotive industry are reported in this paper.

### **Introduction**

The impact of supply chain activity on the environment is a major contributor to the harder to manage environmental quality issues facing society today. The cumulative impact of product development, manufacture and delivery across a connected supply chain is difficult to address with regulation as each link in the supply chain may not be producing an amount of pollution significant enough to warrant government control. Collectively however, pollution generation on a supply chain scale can be arguably responsible for the more intractable problems of resource scarcity, reducing air quality and diffuse generation of pollution.

The past five years have led researchers in a range of academic fields to investigate the potential for parallels between environmental management and supply chain management. Both research fields have been characterized by an increasing number of academic articles which have looked to develop theory in line with the needs of business for faster, more flexible, more efficient and more socially responsible supply chains. Increasingly organizations have looked outside of the firm and to the

performance of their suppliers in order to achieve the additional sources of competitive advantage, innovation and cost reduction.

In attempting to generate better practice in pollution prevention on a supply chain scale, an important influence is within the manufacturing system. Related research in manufacturing has often found that reducing waste through product design and better process efficiency can have a positive effect on manufacturing performance and a reciprocal effect on environmental performance. Various literature have previously referred to the influence of the supply relationship in the advanced manufacturing – environmental performance relationship (Geffen and Rothenberg, 2000; Bowen *et al*, 2001), yet investigation of the relationship is limited to largely anecdotal evidence and limited case study. The issue of supply ‘greening’ raises critical problems of which type of approach to use, how to minimise the associated transaction costs and minimise the risk of opportunism amongst suppliers.

The relationship between a customer and its suppliers is promoted as an important facilitator for the successful long-term development of production systems and supplier capabilities (Lamming, 1996; Handfield et al, 2000; Scannell et al, 2000). In the environmental management literature, recent articles indicate that the supply relationship is capable of leading to programs of collaborative waste reduction, environmental innovation at the interface, cost-effective environmental solutions, rapid development and uptake of innovation in environmental technologies, and allows customer firms to better understand the environmental impacts of their supply chains (Lamming and Hampson, 1996; Florida 1996; Clift and Wright, 2000; Geffen and Rothenberg, 2000; Hall, 2000). Supply relationships are dominated however by the importance of cost, quality and delivery. Environment is rarely a critical task when matched against requirements driven by each of these three main supply needs. Supplier performance on environment is also likely to be at extreme risk of opportunism without the protection of appropriate safeguards and monitoring.

The Customer–Supplier relationship has been growing in significance as an important factor behind attaining performance improvement and competitive advantage in the supply chain. Supply relationships may provide a key avenue for business to influence the environmental performance of their products and services.

### **Research outline and objectives**

This paper presents the theoretical foundations of a doctoral research project which investigates the relationship between a supplier firm’s environmental management activity and their major Customer–Supplier relationship. An important outcome of this research will be to develop an understanding of the impact that the Customer–Supplier relationship has on the environmental performance of its supply chain. Through a better understanding the role of such relationships the research aims to determine where the customer may be able to facilitate improvements to the environmental performance of its supply chain without incurring high transaction costs.

Data has been collected for this research project within the automotive industry of Australia via case study and industry survey. Automobiles are highly complex products that require varying levels of outsourcing to suppliers for their assembly. Automotive assemblers tend to re-locate their global method of management to a local

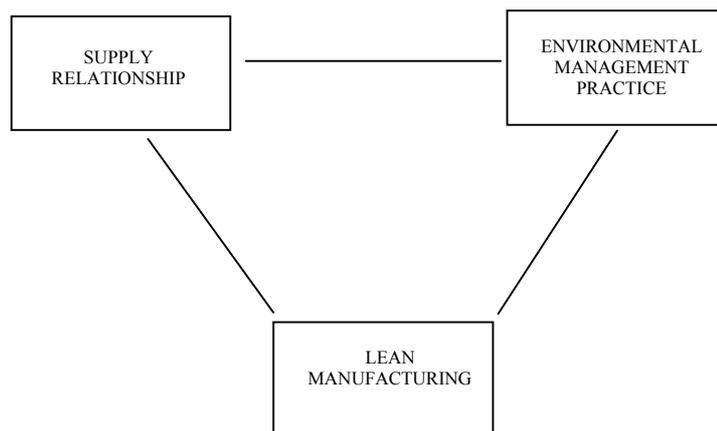
market in which their plants are located. The Australian automotive industry provides for exploration and contrast of both collaborative and arms-length supply relationships in an industry which exhibits both high and low levels of performance in both world-class manufacturing and environmental management.

This research addresses the problem of how to approach improvement of supplier environmental performance through existing methods used to develop suppliers in zero-waste manufacturing. The main objective and focus of discussion for this paper is framed by the following statements:

- Improvements to the manufacturing system are known to support improvements and advances in environmental management activity.
- At the firm level, the manufacturing system is a major contributor to the generation of waste and a source of innovation.
- Supply relationships provide a key way for business to influence the sustainability of their products and services through the manufacturing function.

The draft research model is illustrated in the following Figure 1 and described further in the discussion below.

FIGURE 1: Conceptual model



## **Suppliers and environmental management practice**

Research in the academic and practitioner literature which surrounds the issue of environmental management practice in supply chains (often referred to as green-supply-chain) has largely included examples of customers working with their suppliers to improve the environmental performance of products or manufacturing processes of the supplier, customer or both.

With few exceptions however compliance with regulations has seemed the sole criterion for driving these programs of environmental performance improvement beyond the firm boundary and into the supply chain (Hall, 2000). The range of approaches to greening a supply chain is broad and under-developed in the literature as pointed out by Sarkis (1999: 4):

*‘ ... lack of consensus in practice and definition of green supply chain, is not surprising since its foundational elements of corporate environmental management and supply chain management are both relatively new areas of study and practice. If the practice of green supply chains is novel, the theory is even more so, if true theory even exists.’*

Knowledge of a supplier’s business through the supply relationship allows customer firms to better understand the environmental impacts of their supply activities and may lead to mutual improvements in environmental management practice and cost-effective environmental solutions. Florida (1996) found evidence that customer-supplier relationships facilitated the adoption and diffusion of environmental innovation in manufacturing practices. Geffen and Rothenberg (2000) looked at the role of suppliers in developing and implementing advanced environmental performance technology and found their involvement very important to the process. Greatest success in innovation development and use was found in those firms where suppliers were physically involved in the buyer’s plant and where the buyer spent time in the supplier’s plant. Where the customer did not get involved in the supplier’s activities and kept them at arms length, the level of frustration and failure rate for the new technologies was much higher. Rao (2002) found that high levels of advanced environmental management practice amongst suppliers to leading-edge manufacturing firms in Taiwan were attributed largely to collaborative relationships between the customer and the supplier.

A joint approach between the customer and the supplier to environmental management goals may be an effective way for the customer to introduce environmental performance requirements, environmental innovation activity and environmentally sound process technologies to the supply chain.

## **Environmental performance and manufacturing**

In the last ten years the awareness of the potential for synergies between environmental performance and corporate and manufacturing performance has been developing. It was traditionally accepted wisdom that investment in environmental goals was against sound business strategy and a poor allocation of firm investments. The early work of Porter (1991; 1995) and Hart (1995; 1996) challenged this accepted view and offered that firm profitability and pollution prevention are not mutually exclusive goals.

Early studies of the relationship between environmental performance and firm performance provided a negative outcome. These studies were based on an economic argument that government regulations forced firms to invest in costly abatement equipment which made them less economically productive as a result. More recent research provided evidence of a positive relationship between environmental performance and firm productivity by looking less at pollution control and more at pollution prevention as a potential opportunity rather than a cost.

Florida (1996: 101) stated:

*‘... the pursuit of zero defect and zero inventory manufacturing strategies produces spill-over benefits to the environment and creates the context for innovative approaches to emission reduction and pollution prevention ...’*

Improvements in the manufacturing system can lead to direct and indirect improvements to firm environmental management practices, particularly in overall waste reduction. Positive relationships have been established between environmental performance and improvements to the following aspects of the manufacturing system – quality management (Klassen, 2000; Kitazawa and Sarkis, 2000); lean manufacturing practice (Rothenberg et al, 2001; King and Lenox, 2001; Klassen, 2000); worker involvement (Geffen and Rothenberg, 2000; Kitazawa and Sarkis, 2000; Rothenberg, 2003); environmental technologies and advanced manufacturing technologies (Florida, 1996; Sarkis, 2000; Klassen, 2000); and supply strategy (Min and Galle, 2001; Geffen and Rothenberg, 2000).

### **Lean suppliers make green suppliers**

In recent years, a small number of researchers have established links between the occurrence of practices which support advanced pollution prevention and firms adopting lean manufacturing strategies. This work attributes the mutual benefits between lean production and environmental management practice to the zero waste and continuous improvement philosophies of lean.

Rothenberg et al (2001) and King and Lenox (2001) found high levels of advanced pollution prevention amongst firms with lean manufacturing systems. Rothenberg (2003) noted that pollution prevention activities are often value-added for the firm since they reduce costs through material use reduction or through the avoidance of waste management costs.

The objective of lean is to generate a system which is efficient and well organised and devoted to continuous improvement and the elimination of all forms of waste. The potential for a reciprocal benefit to firm environmental management practice is high. Importantly, success of the lean manufacturing system relies heavily on integration of the supply chain and in sharing the gains from mutual investment in performance improvement between the customer and the supplier.

The practices that support lean manufacturing are similar to the practices that support environmental performance. Lean production is broadly described as an integrated approach to the management of a manufacturing organisation, that encompasses a wide variety of practices, including just-in-time, quality systems, work teams, cellular manufacturing and supplier management (Shah and Ward, 2003). The lean production

philosophy focuses on avoiding seven forms of waste and on respecting customers, employees and suppliers (Womack et al, 1990; Womack and Jones, 1996; Monden, 1997). A sizeable body of empirical work supports the capacity of the lean system to continuously remove multiple forms of waste whilst also yielding a significant competitive advantage.

Management of the supply relationship is a critical part of lean production. The supply function in lean production ('lean supply') does not recognize the traditional positions of customer and supplier and expects that its suppliers are active in their independent yet integrated search for the rooting out of all forms of waste (Womack et al, 1990; Womack and Jones, 1996). This requires extensive collaboration between the customer and the supplier.

### **Lean supply**

From the early discussions of the role of lean production in modern manufacturing there has been a focus on the role of the supply system (Lamming, 1993; 1996). In the automotive industry this is an obvious focus because of the large role that component suppliers have traditionally played in the manufactured value of the car. The early Japanese approaches to lean supply arose through a basic necessity to obtain parts for final assembly and manufacture through outsourcing. Relationship management for the Japanese automotive industry became a vital part of ensuring supply and maintaining competitive advantage in growing local and international markets.

Lean customers make large and multiple demands of their suppliers and require them to be highly reliable with respect to cost, quality and delivery (MacDuffie and Helper, 1997). A lean customer wanting to ensure sourcing from lean suppliers has only three options – either vertically integrate, switch from a non-lean supplier to a lean supplier or develop the lean capabilities of existing suppliers.

Switching to a lean supplier attracts high transaction costs, the loss of goodwill from the supplier that was removed and with other suppliers observing this event. New lean suppliers are difficult to attain owing to their likely strong relationship with other customers. Competitive forces in many markets are not strong enough to generate a ready pool of lean suppliers (MacDuffie and Helper, 1997; Lamming, 1993). This leaves the final option – improve the lean manufacturing practices of your own lean suppliers. This requires a hands-on approach within the confines of an established and collaborative relationship for it to be successful (Lamming, 1993; 1996; Handfield et al, 2000).

Good examples exist of Japanese companies that have applied a direct-involvement approach to their suppliers by working extensively to teach them lean production, often by sending their own employees into supplier plants for weeks or months to reorganize process flow, modify equipment, and establish problem-solving groups (MacDuffie and Helper, 1997; Dyer and Nobeoka, 2000). In a lean supply system the supplier is often likely to have a resident engineer of the buyer present in the production plant and available to solve problems. The supplier shares a substantial part of its proprietary information on costs and production. The assembler and the supplier work together over every detail of the supplier's production process, looking for ways to cut costs and improve quality (Womack et al, 1990; Lamming, 1993).

The success of lean manufacturing is dependent on coordination in the supply chain. Coordination in the supply chain is impacted by the very structure of the supply relationship. Lean manufacturing requires a Customer–Supplier relationship that is able to generate high motivation for learning and high trust. Well-developed lean supply arrangements are characterised by high levels of information sharing, rapid performance improvements in suppliers and low transaction costs (Lamming, 1993; Dyer, 1997).

Supply conditions such as this may provide the incentive that customer firms need to legitimately cross the organisational divide and become involved with the environmental practices of their suppliers on a supply chain scale.

### **Supply relationships and supplier development**

Developing and maintaining a supply relationship can be achieved through either collaboration or compliance. Trust provides a basis for achieving collaboration, while power serves as a mechanism for achieving compliance (Handfield and Nichols, 1999; Lamming, 1993). The literature on supply relationships differs in whether trust between the supplier and the buyer (non-contractual forms of transaction) or establishment of a governance structure that minimises opportunism is more critical for customer success in achieving desired business outcomes from a supply base. Both views agree however that any process of information sharing and mutual commitment to performance improvement must be managed in some form with appropriate safeguards. Anything less is prone to opportunism and therefore at risk of incurring high transaction costs<sup>1</sup> (Williamson, 1975; Heide and Stump, 1995).

Supplier development is defined broadly as any activity that a buyer undertakes to improve a supplier's performance and/or capabilities (Handfield et al, 2000; Krause et al, 2000). Supplier development requires of the firms involved to commit financial, capital and personnel resources to the development task and to share timely and sensitive information. Customer firms have increasingly used supplier development strategies to improve the manufacturing performance of their suppliers (Krause et al, 2000). Supplier development can involve a long-term cooperative effort between a customer and a supplier firm to so as to upgrade a supplier's technical, quality, delivery, and cost capabilities (Scannell *et al*, 2000).

The main activities used by buying firms to improve supplier performance as described in the literature, include assessment of a supplier's operations and performance; providing incentives for the supplier to improve; creating competition amongst suppliers; and working directly with suppliers through training, education or other (Krause et al, 2000; Scannell *et al*, 2000; Handfield and Nichols, 1999; Handfield *et al*, 2000).

Supplier assessment and supplier incentives are key enablers of supplier development efforts (Handfield and Nichols, 1999). Supplier incentives motivate suppliers to improve by sending a message that improved performance is rewarded with increased business and preferred status for future business. Supplier assessment allows buying

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<sup>1</sup> A discussion of transaction-cost-theory is provided in the next section of this paper and sourced traditionally from Williamson (1975).

firms to evaluate a supplier's performance, compare it with the performance of other suppliers, and provide suppliers with direction to drive improvement objectives.

Direct involvement activities, where the buying firm directly involves itself in the supplier development effort, involves investments by the buying firm in the supplier through activities such as training and education of a supplier's personnel. A direct involvement strategy deserves special attention because such efforts represent transaction-specific investments in the supplier by the buying firm (Williamson, 1975). As the buying firm must internalise the costs of direct involvement the activity represents a risk to the buying firm of unrecoverable transaction costs in the event the supply relationship dissolves prematurely.

### **Transaction cost theory**

Transaction cost theory (TCT) has received recent attention for its use in framing choices for investment within inter-organisational relationships (Rindfleisch and Heide, 1997; Grover and Malhotra, 2003; Dyer and Chu, 2003). TCT provides an efficient mechanism for describing the coordination costs and transaction risks of inter-organisational activities. A direct involvement strategy by a buyer aimed at improving a supplier's manufacturing performance, may include investments in tooling, equipment and organizational procedures that are uniquely tailored to the relationship with an individual supplier. Eventually, costs associated with these performance investments may represent a strong disincentive to change suppliers.

According to transaction cost theory (TCT) modes of exchange should be selected that economise on these costs (Williamson, 1975). In TCT the most efficient investment in supplier performance improvement would occur within a supply relationship that is governed (either contractually or relationally) and where transaction costs are reducing (Williamson, 1975; Heide and Stump, 1995).

Improvements to the environmental management practices of supplier firms or the inclusion of environment as a part of purchasing criteria may attract significant transaction costs if not managed appropriately. A poorly developed set of environmental specifications from the customer to the supplier leads to issues of bounded rationality; problems of adaptation to changing circumstances if the specifications are brought in ex-post; and high behavioural uncertainty – difficulty in verifying whether compliance with agreements has taken place. Few examples exist of well developed safeguards to protect investments in environmental knowledge or in the monitoring of a supplier's improving or continuing performance.

Research in TCT has not yet resolved to provide a singular view on the most effective method for extracting performance improvements from the Customer–Supplier relationship. The arms-length method for structuring supply relationships is characterised by an increasing number of suppliers with a) non-specific asset investments; b) minimal information exchange; c) separate technological and functional systems and low levels of interdependence; and d) minimal investment in safeguards (Porter, 1980; Williamson, 1975; Dyer and Singh, 1998). Its greatest criticism however is in the adversarial climate that it creates which limits the opportunity to share information and attain a beyond-compliance approach to performance improvement in suppliers.

The relational approach to structuring supply relationships is characterised by fewer and better relationships with a decreasing number of suppliers and a) investments in relation-specific assets; b) substantial knowledge exchange; and c) the combining of complementary, but scarce, resources or capabilities (Dyer and Singh, 1998). Both supply relationship structures lay claim to facilitating a low transaction cost environment – this may be one-sided in favour of the customer in the arms-length relationship. As an example comparison from the literature on this topic, several authors have compared Japanese and US automotive supply relationships against measures of transaction costs and success in supplier performance improvement. Dyer (1997) found that the Japanese automotive supply relationships were characterised by higher asset specificity than their US counterparts and also had lower transaction costs. In other studies U.S. automotive assemblers were reported to be more likely than their Japanese counterparts to utilise competitive pressure as opposed to direct involvement of the buyer in the supplier's firm, to attain improvements in supplier manufacturing performance (Lamming, 1996; Liker and Wu, 2000; Cousins and Stanwix, 2001).

Several authors propose that an established and reliable routine of inter-firm collaboration can lead to reducing transaction costs and improvements to supplier manufacturing performance (Dyer, 1997; Handfield and Bechtel, 2002; Dyer and Chu, 2003). Heide and Stump (1995) propose that structuring inter-firm relationships in accordance with transaction cost theory should have positive performance implications.

### **Synthesis**

Although there has been substantial growth recently in the number of research articles which explore supply chain environmental management many questions still remain for academics and practitioners as to why and how customers might facilitate programs to green their suppliers. Research work into the mutual benefits possible from combining the firm's manufacturing and environmental management goals provides a suitable framework for clarifying unresolved supply issues relevant to supplier environmental performance such as:

- the appropriate supply relationship structures which facilitate supplier responsiveness to environmental performance requirements;
- the reliability of such investments in supplier development efforts; and
- the likely inter-organisational transaction costs of environmental performance improvement and their impact on opportunism and behavioural uncertainty.

The foundational research work of authors such as Porter (1995), Florida (1996) and Welford and Starkey (1996) supports the potential for reciprocal benefits between essential improvements to the manufacturing system and beyond compliance environmental management practice. The more recent contributions of Rothenberg et al (2001) and King and Lenox (2001) provide strong empirical support for the debate by highlighting the relationship between an advanced form of manufacturing (lean production) and advanced pollution prevention. Looking to the future of this field of research there is significant potential to extend the benefits to one firm of sustainable business practice into the benefits possible from extension to a supply chain scale.

- H 1. The lean performance of a supplier firm is positively related to the environmental management practices of the supplier firm.

- H 2. The customer's level of involvement in improvements to the lean performance of a supplier firm is positively related to the environmental management practices of the supplier firm.
- H 3. An arms-length customer-supplier relationship is negatively related to both the lean performance of a supplier firm and the environmental management practices of the supplier firm.
- H 4. A relational customer-supplier relationship is positively related to both the lean performance of a supplier firm and the environmental management practices of the supplier firm.

### **Early research findings**

Structured and semi-structured interviews were conducted with senior personnel from Purchasing, Production and Environment at Toyota Motor Corporation Australia (Toyota). A main finding of the interviews was the difficulty faced by Purchasing in bridging the gap between having a requirement for suppliers to meet environmental performance criteria set by Toyota and monitoring to ensure that the performance criteria were being met by suppliers. There were also significant differences between Purchasing and Production in the approach being used to facilitate green activities with suppliers. The corporate commitment of Toyota toward a program of supply greening was high however there existed a significant gap between the intent and the practice. Difficulties were faced in aligning the standard goals of automotive supply with the non-standard goals of environmental performance.

The management structure exists at Toyota to incorporate environmental performance measurement and improvement into its routine purchasing and production activities. The transaction costs of such an activity however are currently high for Toyota and unknown from the supplier firms' perspective. Reducing the gap between intent and practice is required to reduce the associated transaction costs.

In relation to managing supplier environmental performance the greatest transaction costs arise for Toyota through being unable to incorporate appropriate safeguards and subsequently being unable to monitor and control opportunism amongst suppliers. Opportunism is defined here for environmental performance as inadequate or false data provision or non-compliance with environmental performance requirements.

Research work continues in April and May 2004 with in-depth case studies in 15 supplier firms and a separate automotive industry survey.

### **Conclusions**

Supply relationships may present a key way for business to influence the sustainability of their products and services. Where the Buyer chooses to incorporate management of supplier environmental performance into the Purchasing function they face a complex set of issues.

A major literature review has revealed that efforts to improve or influence a supplier's environmental management practice raises critical issues of transaction costs and efficacy of approach for the Buyer. The review allowed development of a model for approaching issues of supplier environmental performance through lean supply. This model is then planned for testing – as part of a doctoral research project – within the Australian automotive sector.

Supplier development for performance improvement requires of the firms involved to commit financial, capital and personnel resources to the development task and to share timely and sensitive information. The supplier development task is challenging. The buyer must be convinced that investing company resources in a supplier is a risk worth taking. The supplier must be convinced that their best interest lies in accepting direction and assistance from their customer.

### **Acknowledgements**

The research project described in this paper benefits greatly from the intellectual and financial support provided by the Victorian Environment Protection Authority; the Department of Innovation, Industry and Regional Development, and the Toyota Motor Corporation Australia.

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