Cooperation as a Driver of Development and Diffusion of Environmental Innovation

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Abstract. Environmental management and innovation literature has revealed gaps concerning the influence of business cooperation on environmental innovation and diffusion. Cooperation with external partners in the development of environmental innovation is explored using the Australian Business Longitudinal Database. Complementing this is the exploration of the cooperation of supply chain partners in the adoption of environmental products and processes through three case studies from the manufacturing industry.

Keywords: environmental innovation, business cooperation, green supply chain practices, compliance.

1 Introduction

Despite the many advantages of environmental innovations, they are not easily developed and diffused. Unwillingness of firms to promote their development and adoption are in part due to the characteristics of environmental innovations. Other factors are associated with the internal characteristics of a firm (e.g., the lack of financial resources, skills, knowledge and physical capital) and the external environment (e.g., the lack of pressure from influential stakeholders). Forming partnerships, however, may be a feasible strategy to overcome these barriers. Partners may support each other in managing common problems, such as awareness of and compliance with new environmental regulations. Partners may provide access to resources and capabilities that are not available in-house.

In many aspects, development of environmental innovation represents a separate sub-group of general innovation with the aim of avoiding or reducing environmental harm. Likewise, diffusion of environmental innovation across the supply chain requires firms applies a subset of processes known as green supply chain practices. Both buyers and suppliers are involved in implementing these practices, with the aim to eliminate or reduce environmental impacts.

This paper focuses on the role of cooperation between businesses in development of environmental innovation and diffusion of environmental practices across the supply chain. It explores the extent to which buyer organisations implement such practices and the corresponding ways they interact with their suppliers.

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2 Nature of Environmental Innovation

Carillo-Hermosilla et al. [1] distinguish three groups of environmental innovation in processes: component, sub-system and system. Component change consists of incremental improvements to extant systems, in which companies opt for less demanding incremental changes to "end-of-pipe" technologies for reactive solutions for polluting emissions [2]. In sub-system changes, the replacement or modification of underlying systems eliminates sources of some emissions. Whereas, system changes are systemic redesigns of open-loop systems—in which polluting emissions breach system boundaries—into closed loops that divert wastes into inputs for new processes.

Trifilova et al. [3] distinguish four types of environmental innovation, from the sterile to the potent. The "weakest" type is the chicanery they labelled passive/cosmetic in which there is "cosmetic" publicity of "green credentials" without any active innovation. Next is improving existing products or processes, followed by opportunity-driven creation of new products or processes that go beyond compliance with the aim to gain competitive advantage. System-level creation of innovation by engaging external organizations in designing new processes and services is the most efficacious. It belongs to the class of systemic improvements that cause radical instrumental changes in place of incremental changes normally associated with technological change [1], [4].

3 Characteristics Beyond Conventional Innovation

The factors associated with environmental innovation are more expansive than conventional innovation, which focuses on the development of a new or improved product or process that is a "game changer" in terms of functionality and/or productivity. It includes changes to social norms, cultural values and institutional structures [5,6,7].

Drivers of conventional innovation are market expectations and consumer preferences (demand pull) and research and development (push factors). Environmental innovation also often has governmental regulation as a key driver [6], [8]. Where an environmental innovation is not aligned with normal drivers of the market, its success depends on transformation of societal behavior through changes to beliefs, knowledge and values [4]. Hellström [6] contends that as eco-innovation needs evolution in social arrangements and institutional support, a radical innovation strategy is required to break out of entrenched social practices that incremental changes do not provoke.

An innovator of a new product or process has to ensure that the competitive advantage gained has to significantly offset the disadvantages accrued in its development. A competitive advantage is dependent in part on legal protection of intellectual property, but critically on the ownership of valuable and rare resources and capabilities that cannot be easily imitated and in which there are no readily available substitutes. To offset financial exposure, companies may pool resources by collaborating with other businesses for mutual gain.

Unlike conventional innovation, dominant drivers may not be located in the market. While wide adoption of an environmental innovation reduces the impact on the environment, this positive externality may not be realized. If it is not valued by the

market, then it is likely to fail, with consequential impact on the financial sustainability of the innovating firms. Consequently, the likelihood of them becoming a casualty of the gap between the private and social returns provides little incentive in becoming pioneers of environmental innovation [4].

4 Cooperation and Environmental Innovation

In the literature on environmental innovation a commonly stated proposition is that the inclusion of environmental aspects requires more extensive cooperation with external sources than does conventional innovation of products or process [9,10,11,12,13,14,15]. In testing the proposition that research and development tends to move from an internal activity to collaboration with other organizations, Yarahmadi and Higgins [16] explored the relationship between environmental innovation and cooperation between businesses by reprocessing data from the Business Longitudinal Database, which is the product of a survey of 2,732 Australian businesses by the Australian Bureau of Statistics for the period 2006 to 2007. They deduced that for 28.8% of firms that environmental innovation was a major reason for businesses to cooperate, which they compared to 15.3% claiming cooperation for other types of innovation (see Table 1). However, this increased to 73.3% and 60% for customers and suppliers, respectively. Putting this in context of conventional innovation, 37.7% stated that they had introduced improvements in goods or services, operational processes, organizational/managerial processes or marketing methods. While cooperation may be significant for innovation, by far a major reason for innovation was profit-related (79.4% of respondents), with factors concerning responsiveness to customer needs, maintenance of market share, establishment of new markets and increasing efficiency of delivering goods and services (54.1%, 47.3% and 39.2% of respondents, respectively) were also dominant reasons for innovation. The least important drivers for innovation were responding to government regulations (10.9%) and standards and reducing environmental impacts (12.1%).

The industrial sector that had the largest group of innovators was manufacturing[1]. While 35% of firms within this sector were innovators, only 8.23% of these were environmental innovators. The largest group of environmental innovators was in the construction industry; 21% were innovators of which 20% were environmental innovators.

Performing a logistic regression analysis of the data, Yarahmadi and Higgins [16] found three significant variables associated with innovation: cooperation, research and development, and size of the firm. Thus, partnering and investment on R&D distinguish between firms who do and do not introduce environmental innovation and the distinction is very strong. Size of the firm is significant and its coefficient is positive, indicating that larger organizations are more engaged in introducing environmental innovations than small to medium enterprises. Nevertheless, exports, grants, subsidies and industry were not significantly different from zero at 5% level.

[1] Some reservation most be noted on the representativeness of these results. Most firms in the database were small: 46% had less than 19 employees. Furthermore, manufacturing and construction firms only comprised 16.4% and 5.2% of the dataset, respectively.

Table 1. Major factors for environmental innovation derived from Business Longitudinal Database

Factor	Main reason: environmental-innovation	Main reason: Other
Size 0-4	13.5%	26.4%
5-19	44.2%	36.1%
≥20	42.3%	37.5%
Exports	25%	25.7%
Subsidies	5.8%	3%
Grants	15.4%	9.8%
R&D	30%	15.9%
Cooperation (Yes/No)	28.8%	15.3%
Cooperation with clients, customers	73.3%	39.7%
Cooperation with suppliers	60%	48.3%
Cooperation - other	60%	46.6%

Firms that introduced innovations—20% in the construction, 12.82% in the wholesale trade, 11.90% in the transport and storage, and 11.76% in the personal and other services industry—reported reduced environmental impacts (environmental innovation) as the prime motivator. Surprisingly, given the size and propensity of the Australian mining industry, it showed no evidence of innovation that aimed to reduce impact on the environment. For firms that identified the environment as a main concern, manufacturing firms scored as the largest environmental innovators with 25%. For the wholesale trade, construction, personal and other services, and transport and storage, environmental innovation were 19%, 12%, 12%, and 10%, respectively.

There are numerous reasons why firms do not develop or adopt environmental innovations [17,18,19]. Nevertheless, it is not easy to come up with a solution, as this is a multi-faceted issue. However, there is ongoing research on the positive role of cooperation with external partners in helping firms to develop environmental innovations. The analysis of the data set of Australian businesses also confirms this hypothesis. The sign and the magnitude of the regression coefficient of cooperation show this strong relationship. According to the resource-based view and institutional theory, the advantages and competitive benefits that result from cooperative arrangements include: access to new markets, acquisition of sources of technical support and expertise, increased market power, risk and investment sharing, economies of scale and scope, reductions in government or trade barriers, and the acquisition of institutional legitimacy [20,21]. Nevertheless, as Carrillo-Hermosilla et al. [1] state, this may be a chicken and egg situation, where the more competency that firms possess, the more they engage in cooperation.

5 Case Studies

Yarahmadi, Clements and Higgins [23] further explored the role of cooperation through in-depth interviews of three manufacturing firms in Victoria, Australia. The manufacturing was chosen as it is a major contributor of greenhouse gas emissions (27.7% total emissions of Australian industry), ranking second to the agriculture industry. Contrastingly, they are among the largest green innovators (25% of all Australian industry [16]). The firms were selected to contrast situations (see Table 2). For the objective of exploring practices of green supply chains, the firms selected had already proven to be environmentally aware and had provided evidence of commitment to adopt or develop environmental practices. Also, they were medium or large size manufacturers with the ability to influence their suppliers.

Table 2. Characteristics of interviewed firms

	Firm B1	**Firm B2**	**Firm B3**
Sector	Automotive	Clothing	Machinery and Equipment
Size (number of employees)	139	~3000	180
Presence of an environmental department	Yes: embedded in the quality function	No: but has risk an compliance department that handles environmental issues	Yes: six employees
Environmental management system	Yes: ISO 14001	No	Yes: ISO 14001

Firm B1 is a supplier of automotive parts, for which the supply network quality assurance is mandated to comply with ISO/TS16949:2009. Reducing costs and meeting delivery times are major concerns. However, although an environmental system is not mandatory for the suppliers of B1, it prefers that its suppliers are certified to ISO14001 or have either an environmental policy or engaged in some environmental activities such as recycling. To control for the conformity of suppliers with desired criteria, B1 monitors suppliers regularly and checks the expiry date of their certificates. If a supplier fails to meet the requirements, B1 first considers the extent that the failure is affecting its business and operations. In one occasion, B1 had to stop dealing with a supplier because the supplier did not have adequate OH&S, environmental and quality systems and was not willing to take any action.

Firm B2, a clothes manufacturer, has hundreds of stores worldwide. It has a few thousand employees in Australia, including employees in the retail sector. The company does not have an environmental department. However, it has a "risk and compliance department" that handles environmental issues. Its major suppliers are Asian, with the China being the largest. Suppliers must agree not to avoid environmental harm. Compliance is checked through twice yearly audits that examines suppliers against ethical, environmental and quality requirements. B2's expectation is in line with ISO standards ISO9001, ISO14001 and ISO18001 for quality, environmental, and health and safety issues, respectively. Nevertheless, since certification is difficult

to obtain, B2 evaluates the suppliers only on the critical elements of those standards. The audits are conducted without notice: either by an internal team from B2 or a third party.

Firm B3, a manufacturer of water-related equipment that has 180 employees, is certified to ISO 9001 and ISO14001 and sources its materials and products both locally and abroad. It has worldwide export to many countries. Its environmental policy emphasises continuous improvement of its environmental performance. The company has adopted a proactive approach towards the environment since 2006 and has, as a consequence, won environmental awards. As its policy emphasises waste reduction, it demands that all packaging must consist of recycled materials (paper, wood paper, and cardboard). Other than these demands, it does not incorporate environmental requirements in tenders or contracts. Their audit of suppliers is purely quality driven. Furthermore, it does not dictate suppliers to use environmental management system such as ISO14001.

A comparison of three case studies suggests that there are similarities and differences in the way purchasers implement Green Supply Chain Practices. In all cases, buyers implemented compliance and monitoring practices. For B1 and B2, there were formalised practices for assessing and evaluating suppliers. Although environmental criteria are part of the suppliers' rating, they were not mandatory. All buyers indicated that decisions regarding selecting or maintaining a supplier are more flexible concerning environmental qualifications than price, quality and delivery.

In implementing green compliance and monitoring-oriented practices, the three cases treat all suppliers similarly. Contrastingly, for cooperative-oriented practices, buyers prefer to work with those suppliers who are keen and a major part of their business. One possible justification for such an approach is that compliance practices are less expensive to implement, while safeguarding buyers from the risk of breaching regulatory requirements due to the poor environmental performance of their suppliers. On the other hand, cooperative arrangements would not generate successful outcomes, unless participants dedicated resources and were willing to share their knowledge and capabilities, which in fact is not easy to handle.

When asking buyers about the impact of their practices on suppliers, compliance practices were directed towards avoiding risks of not meeting legal requirements. These practices, at their maximum potential, have enforced suppliers to generate incremental innovations. For instance, B3 enforced suppliers to change their packaging. Whereas, cooperative-oriented practices exhibit more breakthrough and systematic changes as in the case of B1's supplier, the partnership lead to certification to ISO14001. Likewise, the cooperation between B2 and a supplier provided the opportunity to produce a more efficient product.

6 Conclusion

The findings from the study of the Business Longitudinal Database imply that cooperating with external partners increases the likelihood of introducing environmental innovations. Having this knowledge helps corporate managers with intention to

develop environmental innovation strategies to reinforce their relationships with existing partners (e.g., supply chain partners) or/and form new partnerships. The implication for policy makers is to set regulations and strategies [8],[22] that facilitate the cooperative activities of businesses.

The conclusion of the case studies is that buyers use both compliance and monitoring-oriented and cooperative-oriented practices to some degree. However, the results suggest that there is more emphasis on compliance practices and firms are in the early stages of incorporating environmental expectations into their supplier selection procedures. Cooperative practices are not yet well established and there were only limited occasional cooperation with suppliers on small environmental improvement projects. Further research could study how buyers and suppliers can move beyond compliance to cooperative practices and become more innovative in their supply chains with benefits to all supply chain members.

Regardless of the industry sector, while all claimed cooperation with suppliers on environmental innovations, examples of such practices were not demonstrable. The main reason for this could be that environmental issues are perceived as new areas for collaboration but are not historical suppliers' measures. Another reason could be that environmental innovations are costly and the payback period of such investments is often longer than other business investments. Therefore, those firms who have access to limited fund prefer to invest it on joint initiatives that result in more immediate returns.

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