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Green Supply Chain Management in Chinese Electronic Manufacturing Organisations: An Analysis of Senior Managements' Perceptions

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ABSTRACT

Green supply chain management and reverse logistics has emerged as a key area of research interest. Recent environmental regulations have also stimulated interest in this field. However, information sharing is a pre-requisite to efficient and effective logistics utilisation. Manufacturing organisations in China were argued to be 10-20 years behind their Western counterparts in relation to information sharing in their supply chains (Li and Yuan, 2009). This barrier needs to be addressed if China is going to maintain and grow its manufacturing position in the world, attempt to address green supply chain issues and their negative externalities. A systematic literature review was undertaken and green supply chain management theoretical framework adopted. The paper explores the perceptions of senior management toward green logistics and information sharing in Chinese electronic manufacturers. Previous research has concentrated on the focal companies (brand owners). This research concentrated on SME organisations further up the supply chain. Semi-structured interviews of eighteen senior managers of electronic manufactures in Jiangsu province China were conducted in 2012. Thematic analysis is applied and the findings contrasted to other research. The paper provides insight to the current status of managers' views on information sharing and green supply chain initiatives. Information platform, skills, investment, and trust emerged as key influences on their willing to engage in information sharing in relation to green supply chains. This research, among others, assists to inform policy for optimal evidence based intervention. Future research directions are also considered.

Keywords: Advanced Environmental Management, Chinese Electronic Manufacturers, Environmental Management, Green Supply Chain Management, Information Sharing

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INTRODUCTION

The green agenda has become increasingly important to society and many organisations in Western developed countries (Brundtland, 1987). Customers of international manufacturers are increasingly demanding higher green credentials from their suppliers (White et al, 2010).

Christmann and Taylor (2001) argue that export and sales to foreign customers are key drivers for improving the environmental performance of enterprises in China. A number of countries, such as Japan, the United States, Norway, and France put forward different environmental requirements for the goods imported from China (Ministry of Foreign Trade and Economic Cooperation of PRC, 2002). Recent changing environmental requirements Restrictions on Use of Hazardous Substances (RoHS) affecting manufacturing operations are placing pressure on organisations in China to develop green supply chain management strategies.

Supply Chain Management (SCM) is defined by Lambert et al. (1998: 39) as,

The integration of key business processes from end user through original supplier that provides products, services, and information that add value for customers and other stakeholders.” while Lee (2008: 186) expands upon this notion to include environmental aspects, defining a green supply chain as “the programs striving to transfer and disseminate environmental management, in particular advanced environmental management practices, through the entire supply chain, by using the relationships between large-sized buying firms and their suppliers.

Seuring and Muller (2008) argued that there was an increased need for co-operation between companies in sustainable supply chain management. Information sharing is essential for successful SCM (Aviv, 2001; Cachon and Fisher, 2000; Gaonkar and Viswanadham, 2001; Huang et al., 2002; Petrick and Echols, 2002) particularly in terms of managing material flow and reducing inventory costs (Zhang and Li,

2006). Furthermore, sharing the information can solve supply chain problems (Moberg et al., 2002; Siau and Tian, 2004; Zheng et al., 2000; Rainer and Turban, 2009). It is also a prerequisite for developing commitment and trust between firms (Morgan and Hunt, 1994). Fisher (1997) observes that information sharing can improve the significant performance in all chain members while Lee and Kim (1999) conclude that quality information sharing can bring quality partnership.

To achieve co-operation, it is important to understand the antecedents that affect it. Cheng et al. (2008) found that trust was pivotal to green supply chains in Taiwan and that communication and co-operation were the antecedents of trust. Evidence suggests that a gap exists between conceptual approaches and practices in green supply chain management. Collaborative partnerships were essential to implementing GSCM and that information sharing is a vital part of that. However, that important information is not necessarily communicated to key players in the supply chains.

This paper reviews the pertinent literature on Green Supply Chain Management (GSCM) and information flow. It empirically evaluates perceptions of senior management of electronic manufacturing organisations (non-focal, non-brand owners) in Jiangsu province China and then considers the barriers and drivers for GSCM.

GREEN SUPPLY CHAIN MANAGEMENT

In 1996, the “Green Supply Chain” was proposed to encapsulate the development of manufacturing supply chains, including the aspects of assessing their environmental impacts and the optimisation of resources (Handfield, 1996). Wang et al. (2005) also note that it’s an effective way to reduce the environmental impacts of products throughout their life cycles.

Environmental collaboration requires the buying organization to devote specific resources to develop cooperative activities to

address environmental issues in the supply chain (Vachon & Klassen, 2006). It involves the investment of resources, joint planning sessions and knowledge sharing (Lee, 2007). Some literature has showed that forging supply chain relations improves environmental performance (Florida, 1996; Florida and Davison, 2001; Geffen and Rothenberg, 2000; Green et al., 1996; Handfield et al., 2002; Sarkis, 1995). Geffen and Rothenberg (2000) state that good relations with suppliers will no doubt help the adoption and development of innovative environmental technologies. The interaction between customers and supplier staff, partnership agreements, and joint research and development, can lead to significant improvements in environmental performance (Zhu et al., 2005).

Kou et al. (2007) advise in the reverse logistics (RL) sector, companies can collect four kinds of information: customer inventory information; statistical data of production's useful life; feedback information of productions' quality; and customer satisfaction information. Yan (2006) observes that in RL, companies should improve their information sharing performance since it can reduce the bullwhip effect (Hui, 2006; Kou et al., 2007; Mason-Jones and Towill, 2000). Yang (2008) suggests that, small and medium-sized companies can use public information sharing platforms to share information in RL.

Seuring and Muller (2008) carried out a comprehensive review of the literature on sustainable supply chains. It indicated that focal companies, brand owners, were likely to come under pressure from stakeholders. Seuring and Muller (2008) developed a conceptual model. Their model refers to central trigger, pressures on the focal company then being passed to their suppliers. Corbett and Kirsch (2001, cited by Seuring and Muller 2008) evidence suggested that this is an important method for the spread of management systems such as ISO 14001.

Li (2007) concludes five challenges for China: that there is a lack of widespread green supply chain initiatives and efforts; it has a less well developed green supply chain policy; there is a lack of green supply chain skills and

technologies (including information sharing technology); a low recycle rate, and a lack of green supply chain professional people. In many supply chains, China has been used as a point of disposal of end-of-life products for multinational organizations and developed countries. But most companies in China do not currently have an effective infrastructure or the tools available to care for the end-of-life product, this leads to serious environmental issues (Zhu et al, 2005). Li (2007) suggests that most manufacturing companies in China still insist the notion of "pollution before and treatment after" which brings tremendous losses for the Chinese government and restricts China's economic development.

Angel del Brio and Junquera (2003) identify several factors which effect Chinese enterprises ability to develop green supply chains: limited financial resources, organizational structure, little influence of the strategic adaptation competence against changes in the enterprises, poor training of managers, short-term orientation, lack of environmental awareness and training among all staff, low levels of innovation, and poor relationships with external stakeholders. Hassini et al. (2012) argue that it is easier for larger firms to adopt sustainable supply strategies and that there was a poor rate of return. Also, as metrics tend to be focused on an individual firm as opposed to the chain, many current metrics are not appropriate.

INFORMATION SHARING AND TECHNOLOGY

Zi et al. (2008) found that the facilities for information sharing in China are poorly developed: information sharing technology in China is outdated; the content of shared information is not rich; and companies don't have a clear aim to share their information. Chen (2009) finds that because of information-sharing disadvantages, Chinese companies are slow to improve their supply chains and therefore are not able to claim the operational efficiencies that successful SCM is capable of delivering.

Hui (2006) agrees a good information sharing platform is necessary when supply chain members want to achieve long-term green supply chain collaboration. However, this alone is not sufficient to ensure success. Good information sharing also needs appropriate technology and collaboration between supply chain partners (Hui, 2006).

Wang et al. (2005) and Chang (2007) highlight further problems with information sharing in China that are caused by information asymmetry. Wang et al. (2005) explain this as the inability of customers to see the environmental performance data of the manufacturing processes. While Chang (2007) states if the government, supplier, manufacturer and customer mutually developed policies for sharing such performance data, the difficulties of asymmetric data availability would be eliminated.

Li and Yuan (2009) observe that Chinese companies' information-sharing network is 10-20 years behind those found in western developed countries. Wu and Wang (2007) propose that Chinese companies must therefore strengthen their information infrastructure. Chen (2009) recommends that Chinese companies should explore the application of more information sharing technologies such as EDI and GPS.

Focussing upon improving information-sharing performance in small and medium-scale companies, Yang (2008) states that China should even build a public information sharing platform to facilitate SCM and collaboration.

METHODOLOGY

The literature search utilised broad search terms developed through a pilot search. Peer reviewed journals of the database Business Source Premier were included in the search, augmented by a number of government publications.

As the research is phenomenologist in nature the empirical data collection was a qualitative approach. The semi-structured interview approach was undertaken, therefore giving rich data depending on the flow of the

conversation (Klandermans and Staggenborg, 2002). The semi-structured interviews were undertaken by electronic interviews and telephone interviews. However, Saunders et al. (2007) proposed electronic interviews are unable to achieve the "same high levels of interactivity and rich and spontaneous communication" than face-to-face interview. However, Sweet (2001) argues it is possible to have "considerable rapport" in an electronic interview. Considering the geographical distance the interviewer's choice was restricted.

Non-probability snowball sampling was used. The researcher contacted a semi-conductor manufacturer, the organisation IIC identified other interviewees and they were subsequently contacted. This research obtained participation from 18 electronic manufacturing managers in Jiangsu province China. The organisations selected were not focal companies (non-brand owners) in the chain but suppliers to them.

The eighteen organisations are medium or small scale Chinese electronic manufacturing companies. The questions concentrated on four key areas: definitions, drivers, barriers and challenges, and practices. However, it is important to highlight that an SME in Industry in China is defined by a combination of number of employees and income; less than 1,000 employees or income less than 400 million Yuan (approximately £40M, €50M) (Ministry of Associated Enterprise, 2011).

FINDINGS

All participants were senior managers in Chinese electronic manufacturers. There were twelve General Managers, two Marketing Managers and four Presidents. All respondents had at least three years' work experience, the majority (11 managers and 2 presidents) had between eight and twelve years' experience, and two (2 presidents) had more than twenty five years' experience. All the interviewees were managing the information sharing in green supply chain collaboration within their companies or had prior experience of this.

Table 1. Reasons for sharing information in GSCM

Respondent	Reason
5, 6, 7, 8, 9, 10, 17	People's awareness, their customers wanted more green production than before.
All respondents	Foreign countries environmental requirements, such as RoHS and WEEE.
3, 14	Responsibility to society
2, 4, 5, 6, 9, 10, 13, 14, 18	Chinese government formulated the policy of sustainable development
9	Reduce the fuel bill

All participants were asked about their understanding of the term green supply chain management, 14 managers didn't know exactly what it was, but did refer to the environment. One respondent replied "some kinds of environmental stuff". However, eight respondents discussed green supply chain; these companies did in fact use some green logistics, such as green vehicle, green package and green stock. Six respondents also identified ISO 14001, WEEE, RoHS and reverse logistics as the first environmental ideas they understand. Five respondents provided clear and similar definitions of green supply chain management. Their definitions were fragmented but can be abridged as "green supply chain is an integrating environment thinking supply chain, it includes product design, material sourcing and selection, manufacturing processes, delivery of the final product, and recycle and reuse the product after its useful life."

Although not all the respondents truly understood green supply chain management, all of them believed that it will be a necessary future component in electronic manufacturing industry. Three of the respondents stated that they were RoHS compliant and referred to green supply chain management giving them access to international business and improving their competitive position. Respondents who have global standard requirement, such as WEEE or RoHS, their green supply chain management is simply to match those requirements. A respondent argued customers were requesting more specific chemical content data and investors and non-governmental organisation groups

are becoming more interested in environmental issues. Seven respondents reported they were following their customer and that customers were increasingly demanding green credentials. Table 1 highlights the key responses of interviewees to the question as to why they share information in GSCM.

A number of respondents considered themselves as "benefit-driven". Other respondents only considered sections of GSCM, such as green design and green procurement (4 respondents) green inventory (1 respondent). While 4 other respondents considered "green" through the whole supply chain.

Almost all the respondents believed trust is very important in supply chain collaboration except Respondent 1. Respondent 1 thought "it is not necessary to build a trust relationship with my supply chain partners". Respondent 1 ran their business for benefit, if their partners don't bring them substantial benefit, they will change that partner.

These strong relationships can create potential value for companies. Due to this, all the respondents except Respondent 1 conclude green supply chain collaboration in China is based on a high level of trust. However, Respondent 1's idea was presented to the other interviewees they agreed. Respondent 13 advised, "this is indeed that "nowadays many people in China believe money is everything", "they can sacrifice everything for money" (Respondent 9), "we need trust in our relationship" (Respondent 4) but "it is hard" (Respondents 8, 13, 17 and 18).

Respondents were asked their understanding of information sharing in green supply chain

Table 2. Benefits for sharing information in GSCM

Respondent	Reason
6 and 10	Save inventory cost
5, 8	Improved demand forecasting
9	Production quality can be increased
8, 10, 13, 15 and 17	Improve the service
3	Increased delivery speed
5 and 6	Higher inventory turnover
3, 5, 7, 19, 11	Better collaboration/relationship
5, 6, 17	Better customer satisfaction

management. Their views can be summarised as “information sharing is to share the information includes sale data, updated forecasts, production and the delivery schedules, inventory levels, delivery lead-times, and inventory carrying costs.” One respondent argued in green supply chain, information sharing was a bit different, because they have environmental concern. They would use more in-depth information exchange to provide customers with the information on how green their production process was and receive feedback to improve their green production. Respondent (3) maintained that in green supply chain collaboration, supply chain partners should share information and sources. Table 2 highlights the key responses from respondents in regards to the benefits of information sharing.

A number of barrier to information exchange were identified. The first barrier and the most discussed was lack of platform for information sharing. Three respondents advised leading large-scale companies can share both internal and external information. Small medium-scale companies like them have ability to share internal information but they have difficulty to share external information because they didn't have information sharing platform. Thus they advised as a result they have fewer opportunities to work with better supply chain partners and/or communicate better information.

Seven respondents in this research were only using MS Excel to collect and store the data. The way they shared information was to have regular meetings: daily meeting (3 respondents); weekly meeting (3 respondents); and monthly meeting (1 respondent). Respondent 3 said, “meeting is one part of Chinese culture”.

Furthermore, when these small and medium-scale companies were asked why they used such technology to share information, they answered: “we only record and share the inventory data” (Respondent 11); “we only record and share the demand and inventory data” (Respondent 5); “we don't want to spend extra money on this” (Respondent 11); “even we input these new stuffs, we have no professional people to use it” (Respondent 7); “we are fine now, we don't need new technology” (Respondents 5 and 15).

DISCUSSION

The majority of respondents' organisations appear to be at an initial stage of Green Supply Chain Management. Those participants that were more active in the area had links to the Resource-based View of the firm gaining advantage through being market orientated and meeting customers' needs.

Green supply chain had been research since the mid-nineties. Through this exploratory

investigation, the barriers and challenges for green supply chain were explored:

Participants are clearly focused on the practical aspects of the SCM and GSCM. However it appears to be patchy rather than a comprehensive approach to GSCM throughout the supply chain. The evidence suggests that organisations are involved with certain elements of GSCM such as green design, green production, green logistics and reverse logistics.

The principal driver for GSCM (or subsections of it) was government policy and customer demands. Surprisingly only one respondent advised that they were motivated to pursue GSCM initiatives to reduce costs. Participants also advised that they were driven by social responsibility and this motivated them to pursue green SCM initiatives. This has similarities to Seuring and Muller's (2008) research view of triple bottom line, economic, environment, and social.

There appears to be a low level of supply chain management and the underlying fundamentals in order to successfully implement SCM. A large number of participants in this study were not effectively communicating basic fundamental information. If SCM is underdeveloped in organisations it seems difficult to achieve a more sophisticated level that is involved in the greening of the supply chain. While evidence also suggested that investment in information technology was required, the training of staff to use this technology and further develop their skills around Supply Chain Management. There are still fundamental aspects, in particular trust, that would need to be addressed in order to tackle information sharing issues.

However, the evidence did provide some support to Seuring and Muller's conceptual framework and the model of spreading environmental system (Corbett and Kirsch, 2001 cited by Seuring and Muller, 2008) with a number of the respondents indicating that the focal organisation was pressurising them to adopt environmental systems such as ISO 14001. Support was also found for Christmann and Taylor (2001) work with foreign customers playing a key role in driving environmental performance.

CONCLUSION AND RECOMMENDATIONS

While the participating Chinese organisations did recognise issues such as sustainable development, they were only principally internally driven if a benefit (positive expected outcome) could be foreseen. External drivers did also emerge in the form of government policy and international customers. A low level of awareness could be improved with further development of supply chain professionals. Also, government support may aid the development of the profession.

The evidence suggested that information sharing technology was still a principal barrier. Without recognition of the need for the supporting technology it is unlikely that these organisations are going to invest as the benefits of such actions are not universally recognised. Also, the content of shared information was not rich.

FUTURE RESEARCH

As this was an exploratory study further and deeper research would add value. An expectancy-value theoretical framework would allow greater theoretical foundations and insights into managers' motivations, perceptions and potential behaviour. Other branches of research that would aid in arguing the point of GSCM would be to quantify its impact on the efficiency and effectiveness of the organisation.

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