



A framework for Green Supply Chain Management complying with RoHS directive

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Abstract

The enforcement of the RoHS (Restrictions of the use of Hazardous Substances) Directive on 1st July 2006 requires all new Electrical and Electronic Equipment (EEE) entering the European Union (EU) market to be free of six toxic chemicals, including lead and cadmium. The RoHS Directive prevents the use and presence of these chemicals in all EEE. In recent years in Japan, EEE manufacturers exporting products into the EU have enhanced the Green Supply Chain Management (GSCM) as an effort to comply with the RoHS directive and to subsequently gain a competitive position in the EU market. Considering the future implications of the RoHS Directive, they have implemented new environmental programs and policies into their suppliers.

This paper describes a case study on GSCM in the Shimadzu Corporation, a Japanese EEE manufacturer. GSCM is illustrated as managing collaborative relationships between manufacturers and suppliers to comply with the directive by considering an overview of the literature on GSCM and the RoHS directive. Based on this review of theory, a conceptual framework for GSCM is initially proposed to improve the collaborative relationships between EEE manufacturers and suppliers. Secondly, we explore the gaps between the framework and the present state of GSCM that have been implemented between an EEE manufacturer and a supplier. The paper concludes with discussion regarding the application and possible further development of the proposed framework for GSCM.

Keywords

Green supply chain management, Electrical and Electronic Equipment (EEE), RoHS directive, Collaborative relationship

Introduction

Supply chain management is defined as the management of all the activities associated with the flow and transformation of products from raw material acquisition to final product delivery (Robert B Handfield and Ernest L. Nichols, 1999). The whole supply chain related to manufacturing final products is managed such that a particular product is made as an eco-product. The key to lower the environmental impact of business lies in supply chain management (Ian Wycherley, 1999; Benita M. Beamon, 1999).

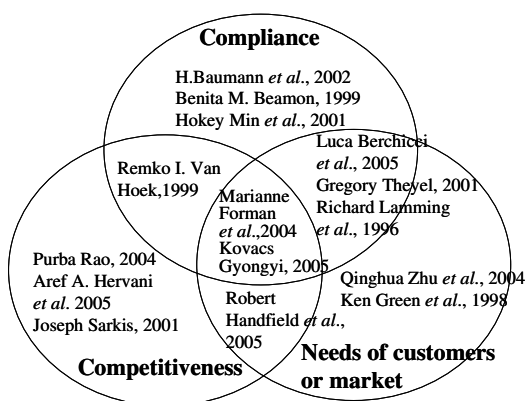


Figure 1. The motivation of implementing GSCM

The new concept of green supply chain management has added an environmentally conscious mindset to supply chain management and has been introduced into many final manufacturing processes (Aref A. Hervani et al., 2005). Over the last decade GSCM has played a key role in the development of eco-products and in advancing cleaner production in manufacturing organization and has been brought about by several motivations (Qinghua Zhu and Joseph Sarkis, 2004; Purba Rao, 2004). The motivations that cause manufacturers to make efforts to implement and develop GSCM are

summarized for the following three reasons, as shown in Figure 1: 1) To meet environmental regulatory compliance. Many manufacturers which utilize environmental regulatory compliance tend to advance GSCM by screening suppliers for their environmental performance and then by doing business with only those that meet the environmental regulations (Purba Rao, 2002; Hokey Min and William P. Galle, 2001). 2) To comply with the needs of markets and customers that prefer to purchase eco-products. 3) To improve the competitiveness of manufacturers so that they may take a more superior position in the market. Through the implementation of GSCM, manufacturers may anticipate benefits such as improvement of a corporation's image, reduction of liability and improvement of business continuity (Joseph Sarkis, 2001).

The RoHS (Restrictions of the Use of Certain Hazardous Substances in electrical and electronic equipment) has driven the implementation and development of GSCM for Japanese EEE manufacturers who produce EEE products that are exported to the EU market. The EEE manufacturers have pressed their parts suppliers to participate in various activities for compliance with the directive and for meeting

Table 1. EEE categories and list of the WEEE directive

| I A categories | I B list of products |
|--------------------------------------|---|
| 1 Large household appliances | refrigerators, washing machines, microwaves, air conditioner appliances for cooking |
| 2 Small household appliances | vacume cleaner, iron, toasters, clocks |
| 3 IT and telecommunication equipment | PC, printer, copying equipment, telephone, cellular telephone |
| 4 Consumer equipment | radio set, TV, video recorders, musical instruments |
| 5 Lighting equipment | luminaries for fluorescent lamps with the exception of luminaries in households, compact fluorescent lamps, luminaries for fluorescent lamps in households |
| 6 Electrical and electronic tools | drills, saws |
| 7 Toys, leisure and sports equipment | trains, car racing sets, video games |
| 8 Medical devices | radiotherapy equipment, dialysis, laboratory equipment for in-vitro diagnosis |
| 9 Monitoring and control instruments | smoke detector, thermostats, measuring, weighing or adjusting appliances for household or as laboratory equipment other monitoring and control instruments used installations |
| 10 Automatic dispensers | |



the demands of EU market. The manufacturers have been faced with the fact that they must form collaborative relationships with their parts suppliers. This paper presents a GSCM framework for forming collaborative relationships between the EEE manufacture and the parts supplier through a review of the literature. The elements of the GSCM framework are compared to the case of Shimadzu Corporation who is an EEE manufacturer in Japan and then considered in regard to the application of such elements to the corporation.

The RoHS directive which drives GSCM in Japan

The RoHS (Restrictions of the Use of Certain Hazardous Substances in electrical and electronic equipment) directive is an environmental regulation of the EU made to protect human health and the environment by restricting the use of certain hazardous substances in new EEE. The RoHS Directive is complementary to the Waste Electrical and Electronic Equipment (WEEE) Directive and applies to the same wide range of products covered by eight (category 1, 2, 3, 4, 5, 6, 7, 10 excepting 8, 9) of the ten indicative categories of the WEEE Directive (Table 1). The EEE products targeted by the RoHS directive are large household appliances, small household appliances, IT and telecommunications equipment, consumer equipment, lighting equipment, electrical and electronic tools, toys, leisure and sports equipment, and automatic dispensers. The two categories, medical devices, and monitoring and control instruments are currently not included in the target products of the RoHS directive (the Department of Trade & Industry, 2006). Whether or not the two products are included in the target of the RoHS directive shall be determined by 2010.

Table 2. Activities those EEE manufacturers are requiring to their suppliers

| Manufacturers in Japan | Activities those EEE manufacturers are requiring to their suppliers | | |
|------------------------|---|--|--|
| | Obtaining certification of EMS | Sharing Knowledge of substances present in EEE parts | Warranting RoHS substances not included in EEE parts |
| Matsushita | Requiring | Requiring | Requiring |
| Omuron | Requiring | Requiring | Requiring |
| Shimadzu | Encouraging | Requiring | Requiring |

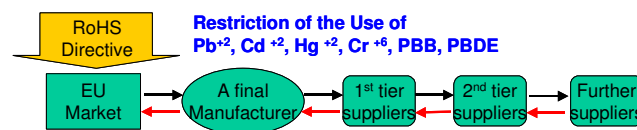


Figure 2. The RoHS directive driving the GSCM

The member States of the EU must ensure that all new EEE placed on the market complies with the RoHS directive starting from 1 July 2006. The RoHS directive has become a strong incentive to stimulate the EU market to enhance green purchasing (Figure 2). Japanese EEE manufacturers exporting products into the EU market are motivated to implement the GSCM by controlling the environmental quality of EEE parts contained in final EEE products in order to comply with needs of the EU markets and the new regulations. Furthermore, they have considered obtaining a competitive position in the domestic market as



well as EU market.

Current activities required by Japanese EEE manufacturers to their suppliers are shown in Table 2. Table 2 refers to three common behaviors promoted by the EEE supply chain by large EEE manufacturers such as Matsushita, Omuron and Shimadzu in Japan. Firstly, they have policies which require and encourage their suppliers to obtain certification of environmental management system. EEE manufacturers tend to require accreditation of an environmental management standard or the introduction of an environmental policy by their suppliers because attention to the environmental quality of supplier production processes are necessary to limit amounts of hazardous substances contained in EEE parts and final EEE products (Robert Sroufe et al., 2000; M.H.Nagel, 2003; Lutz Preuss, 2005). Secondly, they have been advancing the new activity of sharing knowledge of substances present in EEE parts with their suppliers. The activity named as SHCS (Survey of Hazardous Chemical Substances present in EEE parts) is a previous requirement for EEE parts suppliers to avoid certain hazardous substances in the final supplied products. The knowledge of hazardous chemical substances present in EEE parts obtained through SHCS is mostly related to decision making for product design, procurement of parts or materials, and business contracts (Hee Kyung An et al., 2005). Finally, Japanese EEE manufacturers demand their suppliers to warrant that the restricted six substances by the RoHS directive are not included in supplied EEE parts or materials. Three manufacturers have tried advancing three activities to comply with the RoHS directive, however, the activities are likely to have been promoted without suppliers' sufficient acknowledgment.

Literature review: Collaborative Relationships between a manufacturer and its suppliers

One of important elements for implementing GSCM is the relationships between a manufacturer and its suppliers (Robert B Handfield and Ernest L. Nichols, 1999). The key for effective GSCM lies in the development and maintenance of collaborative relationships between a manufacturer and its suppliers (Qinghua Zhu and Joseph Sarkis, 2006; Danny Pimentel Clare et al., 2006; Geok Theng Lau and Mark Goh, 2005). Collaborative relationships can be described as situations in which parties in a business relationship work together to achieve mutual goals (Robert M. Morgan and Shelby D. Hunt, 1994). By maintaining collaborative relationships, a manufacturer can anticipate the long-term relationships with its suppliers as well as higher product quality and improvement of environmental performance (Qinghua Zhu and Raymond P. Cote, 2004). Collaborative relationships are to ensure a close match between the parts supplier's sales specification and the final products manufacturer's requirements, and contribute to gain benefits for both parties, thus win-win relationships may be formed between a manufacturer and its supplier (Brian Fynes et al., 2005; Festus Olorunniwo and Tony Hartfield, 2001).

This paper seeks to determine which elements contribute to the formation and development of collaborative relationships between an EEE manufacturer and its suppliers through the implementation of GSCM. We suggest four elements to form and develop collaborative relationships. The elements are; (1) sharing GSCM policy, (2) information sharing, (3) joint action, and (4) programs for supplier support.



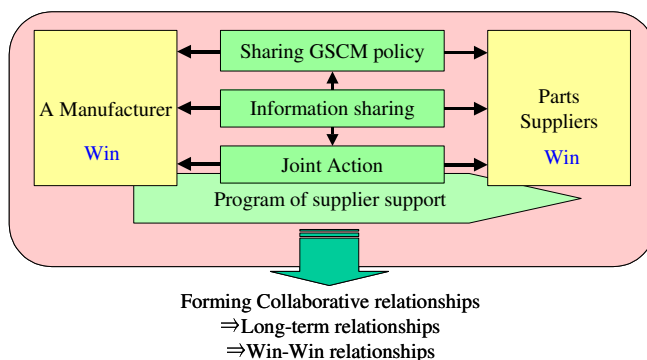
Firstly, a manufacturer sets up GSCM policy and shares those with its suppliers to form collaborative relationships, because suppliers are motivated to work together in order to achieve mutual goals (Kovacs Gyongyi, 2005; Philip Trowbridge, 2001).

Secondly, information sharing is one of most important elements to improve relationships between both parties. The information sharing has two critical functions. One is that a manufacturer allows its suppliers who will usually have less information and knowledge resources, to understand what should be implemented and changed for production and supply to cope with the manufacturer's request and demands of the market through information sharing (Richard Lamming and Jon Hampson, 1996; Louise Canning and Stuart Hanmer-Lloyd, 2001). The other is that a supplier makes a manufacturer who is a customer to understand the present situation and activities of the supplier by sharing information (Dayna F. Simpson and Damien F. Power, 2005). The collaborative relationships between a manufacture and its suppliers can be formed through understanding the nature of the problems and by considering how to solve the problems by sharing information between both parties.

Thirdly, the sharing of information should be proactive and should be part of the effort for joint action between a manufacturer and its suppliers. Joint action includes collaborative works from joint goal setting and joint planning to joint problem solving in order to achieve the objectives of GSCM (B.S.Sahay, 2003). The joint action between a manufacturer and its suppliers to GSCM goals may be an effective way for the manufacturer to introduce performance requirements, innovation activity and process technologies to its suppliers (Dayna F. Simpson and Damien F. Power, 2005). On the other hand, the relationship between both parties may take an adversarial tone may lead to a destructive path unless there is collaborative joint action (Danny Pimentel Clare et al., 2006).

Finally, programs for supplier support have to be considered to develop collaborative relationships because many suppliers have less information, resources or expertise readily available to them for dealing with the environmental requirements or high quality standards required by final manufacturers who are mostly large corporations (Richard Lamming and Jon Hampson, 1996; Ypatia Theodorakioglou et al., 2006). Manufacturers need to have plans and implement programs to support their suppliers for improving their environmental practices because suppliers with poor environmental practices can expose

the manufacturers to high levels of environmental risk (Jeremy Hall, 2001).



Conceptual framework of the GSCM complying with RoHS directive

As mentioned previously, it is essential that collaborative relationship be formed to effectively and

Figure 3. A conceptual framework of the GSCM



continuously implement GSCM. Collaborative relationships are win-win relationships that give advantages to both parties of a manufacturer and its suppliers, and have a critical role to maintain the long-term relations of the parties (Lutz preuss, 2005). The present study presents a conceptual framework of the GSCM that is composed of four elements for forming collaborative relationships.

Sharing GSCM policy

In this paper, GSCM policy is defined as a statement by an EEE manufacturer of its intentions and principles in relation to its overall GSCM performance. The GSCM policy provides a framework for the setting up aspects, objectives and targets of GSCM. The GSCM policy complying with RoHS directive includes three incentives for implementing GSCM; reduction of risk caused by violation of environmental regulations, meeting the expectations and needs of a customer or market, and maintaining competitiveness (Marianne Forman, 2004; Kowvc Gyongyi, 2005). The incentives are associated with each other. If an EEE product exported in the EU market is exposed to violate the RoHS directive, the product will be banned to be sold in the market and have a negative effect on competitiveness. The GSCM policy including three incentives may be shared with first-tier suppliers in order to collaboratively implement GSCM. This paper presents two points to be considered for sharing GSCM policy with suppliers for an EEE manufacturer as follows.

- (1) An EEE manufacturer helps its suppliers to understand the importance of the GSCM policy through regular programs.
- (2) An EEE manufacturer motivates top managers of the suppliers to include the GSCM policy in their own environmental or quality policy.

Information sharing

Relationship commitment and trust develop when firms attend to relationships by sharing valuable information (Rober M. Morgan and Shelby D. Hunt, 1994). This paper regards information sharing as a method to implement sharing GSCM policy and joint action. That is, there are two kinds of information; one for sharing GSCM policy and another for joint action. Two points to consider are to advance information sharing as follows.

- (1) Information sharing is implemented for the mutual benefit of a manufacturer and its suppliers through balancing the proffer and the feedback.
- (2) The mutual benefits from the information sharing are clearly understood by the suppliers.

Joint action

If the supply chain is to be a source of compliance with environmental regulation, satisfaction of final market and competitiveness, suppliers' performance must be managed and developed to meet the needs of the manufacturer buying EEE parts (Daniel R. Krause et al., 1998). Joint action is required for EEE parts suppliers to participate in the GSCM activities. Joint action is systemically and continuously processed through four stages of planning, doing, checking and action. The EEE manufacturer sets up previously determined GSCM aspects based on GSCM policy.



The joint action process of four stages is mostly operated and managed by the manufacturer. The manufacturer sets up teams for such joint action programs who review the materials and supplies that serve as inputs to the production process and also work with suppliers to resolve current issues and subjects associated with the green supply chain (Purba Rao, 2004). The parts suppliers participate partially in the process of the joint action by requests of the manufacturer. The summary follows as three considerable points to process joint action.

- (1) The joint action is processed systemically and continuously through planning, doing, checking and action stages.
- (2) In the planning stage, aspects, objective and targets of GSCM are designed.
- (3) The manufacturer organizes a particular team who takes full charge of operating the joint action.

Program of supplier support

To effectively advance sharing GSCM policy and the joint action, the manufacturer is faced with problems to aid its parts suppliers because many suppliers lack knowledge, resources and technology for complying with demands of the final market or regulations associated with the final products. The manufacturer's aid for parts suppliers includes activities providing information and educating through seminars, visiting the suppliers, invitations to the suppliers and on-line or phone communication, as well as technological aids. The program of supplier support is operated within the process of sharing the GSCM policy and joint action. Two points to consider are to implement the programs of the supplier support.

- (1) The program is operated systemically in the joint action process.
- (2) The manufacturer announces the content and nature of the program to its suppliers and makes them recognize the details supported by the manufacturer.

Methodology

An exploratory case study research was conducted within the Japanese EEE industry. The research is implemented with in depth interviews and research related to environmental management and GSCM. Interviews and research were conducted with key purchasing and environment staff within Shimadzu Corporation from 1st October 2004 to 31st December 2004 and a first-tier parts supplier to Shimadzu Corporation from 4th April 2005 to 30th September 2005.

Shimadzu Corporation employing 3,109 people, manufactures various analytical and measuring instruments, and medical systems and equipment, and aircraft equipment. The interviews were implemented sixteen times with three managers and three staff from three departments of environment, purchasing and compliance of EU regulation in Shimadzu Corporation.

Company A who is a first-tier parts supplier of Shimadzu Corporation is a small and medium sized enterprise employing 212 people and manufactures 3D flat panels, name plates, various assemblies and printed circuit boards by order of over 200 manufacturers. Company A has shared over 11% of total profit



with Shimadzu Corporation. The profit amount is the most among the profits shared with manufacturers in the parts supply sector. The interviews were conducted nine times within five months with two managers from the quality and environment department.

This paper describes the results from searching Shimadzu Corporation and Company A. The results are to show the current situation of GSCM complying with the RoHS directive by Shimadzu Corporation and to explore the gaps between the current situation in the case of Shimadzu Corporation and the elements of the GSCM framework.

Results and Discussion

Shimadzu Corporation's GSCM driven by RoHS directive

The EEE products by Shimadzu Corporation were included in the categories of 8 and 9 from EEE list of the WEEE directive. The categories of 8 and 9 have been determined as exception items of the RoHS directive until 2010. However, Shimadzu Corporation has performed GSCM complying with the RoHS directive with two motivations of reducing risk and improving competitiveness. The Shimadzu Corporation has paid attention to the possibility that the EEE products of Shimadzu Corporation would be targeted by the RoHS directive after 2010. If categories 8 and 9 are included in the item restricted by the directive in the future, the Corporation has to rapidly meet the compliance. Thus, the Corporation needed to advance the GSCM to avoid the risk that would be raised in the future. Furthermore, Shimadzu Corporation was aware that the GSCM for complying with the directive has positive effects on brand images and competitiveness.

According to the two motivations promoting GSCM, Shimadzu Corporation newly organized DCER (Department of Compliance with EU Regulation) to operate GSCM from the 1st April 2004. The main activities of DCER are setting up the SGS (Standard of the Green Supply), advancing the GSCM activities based on the SGS and holding a seminar for explaining the GSCM to parts suppliers. The SGS set up on May 2004 consisted of SCS objectives, scope and requirements. The SCS objectives presents the purchasing standards that restrict the goods or services from the supplier to be in compliance with various environmental regulations from each country. The SGS is applied to all parts and materials included in the EEE products manufactured by Shimadzu Corporation. The requirements consisted of two parts of requiring items; one is for first-tier suppliers and the other is for supplied goods. The requirements for first-tier suppliers were only mentioned in this paper. The requirements are three items; encouraging implementation of EMS for suppliers; sharing knowledge of substances present in EEE parts or materials; and warranting RoHS substances not included in EEE parts. This paper illustrated about 'Encouraging implementation of EMS for suppliers' and 'Sharing knowledge of substances present in EEE parts or materials' among the GSCM aspects.

Encouraging implementation of EMS for suppliers



As corporations adopting ISO 14001 as a tool of EMS have increased, ISO 14001 certification became the most significant variable relating to the environmental index. Many large manufacturers have not also adopted the certification of ISO 14001 for them, but encouraged their suppliers to apply for the certification of ISO 14001. More and more manufacturers regulate the certification as a requirement in selecting suppliers (Morgan P. Miles et al., 1997; Déirdre Crowe and Louis Brennan, in press; Tage Skjoett-Larsen, 2000; Joseph Sarkis, 2003). Shimadzu Corporation has adopted the certification of ISO 14001 as a tool for continuous improvements to meet the goals of sustainability since 1997. Shimadzu Corporation has specially organized five environmental technical committee sections under the organization for EMS based on ISO 14001. Green procurement section among the five sections has managed the subjects encouraging parts suppliers to apply for EMS based on ISO 14001 and KES. KES (Kyoto Environmental management System) is set up as an EMS certification for small and medium sized enterprises in Kyoto where the headquarters of Shimadzu Corporation is located.

Table 3. The Objective and target for encouraging suppliers to acquire the certification of EMS

| Objective | years | Target |
|--|-------|---|
| Encouraging 30 main parts suppliers to acquire the certification of ISO 14001 or KES until 2005. | 2003 | 15 main parts suppliers acquiring the certification |
| | 2004 | 25 main parts suppliers acquiring the certification |
| | 2005 | 30 main parts suppliers acquiring the certification |

The Green procurement section undertaken by the Department of Procurement has set up the environmental objectives and targets related to parts suppliers' EMS certification as shown in Table 3. The objective is to encourage 30 main parts suppliers to obtain the certification of EMS until 2005. The staff of the Department of Procurement have provided and educated the representatives of parts suppliers for establishment and implementation of EMS through irregular seminar and visiting suppliers, with other staffs engaged in the Department of Global environmental management.

Sharing knowledge of hazardous chemical substances present in EEE parts

As an effort to study how to comply with the RoHS directive, Shimadzu Corporation has implemented SHCS (Survey of Hazardous Chemical Substances present in EEE parts), with the purpose to obtain knowledge of chemical substances present in EEE parts supplied by its suppliers after setting up the SCS. The SHCS has been managed and operated by DCER (the Department of Compliance with EU Regulation). DCER has held several seminars about the current trends of the RoHS directive and summary of SHCS with the GSCM policy and plan to encourage over 500 parts suppliers limited in Japan to cooperate SHCS. Most activities of DCER are systemically managed with PDCA cycle.

The survey items of SHCS are about whether the restricted substances are present; their content; in which parts they are used; and the purposes of using them. The knowledge obtained through SHCS was coded into computer system as a datum in order to construct DBMS (Database Management System) that would be used for decision making of product design, procurement of parts or materials, and business contract. Company A has provided information associated with SHCS to Shimadzu Corporation from the beginning of 2005, but there was not any feedback from Shimadzu Corporation. According to interviews



with Company A, the burden from the requirements of Shimadzu Corporation was comparatively less than other manufacturers although parts or materials ordered by Shimadzu Corporation took the most amount of shared profits among the products in the company, because Shimadzu Corporation directly searched data of hazardous substances present in parts and materials with the point of supporting parts suppliers. The standard of support was limited in parts and materials made by Shimadzu Corporation's design and order. However, Company A did not understand the standard of the support.

The gaps between an exploratory case study and the conceptual framework of GSCM

Table 4 shows the gaps between the current status of GSCM in Shimadzu Corporation and the conceptual framework of GSCM. The conceptual framework presented the four elements forming collaborative relationships; sharing GSCM policy, information sharing, joint action and program of supplier support.

At the phase of sharing GSCM policy, the framework indicated that an EEE manufacturer helps its suppliers to understand the significances of the GSCM policy through regular programs and encourages top managers of the suppliers to include the GSCM policy into their own environmental or quality policy. Shimadzu Corporation has set up the GSCM policy and announced it to suppliers through irregular seminars and guide books of SGS (Standard of the Green Supply), which has not affected the environmental or quality policy of the supplier. If the seminars or visiting supplier for education and explanation are opened regularly with systemic management, the suppliers would become more considerable regarding the GSCM policy and objective.

At the phase of information sharing, while the framework pointed out the significance of balancing the proffer and the feedback of the information, Shimadzu Corporation has not provided feedback of the information received from the parts supplier through activities of SHCS (Survey of Hazardous Chemical Substances present in EEE parts) with the reason that the activities associated with SHCS have not finished. If the information of hazardous chemical substances present in EEE parts from the supplier is recreated by DBMS of Shimadzu Corporation, the recreated information would be available knowledge to develop the new designed products or technology for parts suppliers. To make supplier understanding the value of the information sharing by SHCS, Shimadzu Corporation should deliberate the method and contents of information feedback to be provided for its parts suppliers in the middle of the building the DBMS as well as after finishing the works for DBMS.

Although the Shimadzu Corporation has supported its parts suppliers on activities of SHCS and encouraging them to acquire EMS certification, the supplier recognized unclearly the efforts of Shimadzu Corporation, at the phase of program of supplier support. While the GSCM framework describes the program of supplier support operated systemically in the joint action process and perceived by the parts suppliers, the program was not operated in the system of joint action because there was not the joint action built and implemented systemically at the moment. This paper, therefore, considered that the gaps



between the current status and the GSCM framework were fundamentally due to joint action not systemically implemented with PDCA cycle. In conclusion, it is essential that a joint action system is established and operated to improve GSCM continuously and effectively with PDCA cycle. The joint action system is a basic system to manage other three elements of sharing GSCM policy, information sharing and program of supplier support.

Table 4. The gaps between the current status and the conceptual framework of GSCM

| The elements forming conceptual framework of | The key points to implement the conceptual elements for GSCM | The current status of GSCM in Shimadzu Corporation |
|--|---|---|
| Sharing GSCM policy | An EEE manufacturer helps its suppliers to understand the importance of the GSCM policy through regular program. | An EEE manufacturer has helped its suppliers to understand the importance of the GSCM policy through <u>irregular program</u> . |
| | An EEE manufacturer motivates top managers of the supplier to include the GSCM policy into their own environmental or quality policy. | GSCM policy <u>was not included</u> in the environmental or quality policy in a first-tier supplier |
| Information sharing | Information sharing is implemented for mutual benefits of a manufacturer and its suppliers through balancing the proffer and the feedback. | There was <u>no feedback</u> on SHCS. |
| | The mutual benefits from the information sharing are clearly understood by suppliers. | The parts supplier <u>did not understand benefits</u> from information sharing by SHCS |
| Joint action | The joint action is processed systemically and continuously through planning, doing, checking and action stages. | The joint action <u>was not processed</u> systemically and continuously through planning, doing, checking and action stages. |
| | In the planning stage, aspects, objective and target of GSCM are designed. | No dorrespondence |
| | The manufacturer organizes a particular team who takes full charge of operating the joint action. | No dorrespondence |
| Program of supplier support | The program is operated systemically in the joint action process. | No dorrespondence |
| | The manufacturer announces the content and nature of the program to its suppliers and makes them recognizing the details supported by the manufacturer. | The supplier has obscurely felt the helps from Shimadzu Corporation without clear understanding the details of the support. |

Conclusions and further study

As the RoHS directive motivates a Japanese EEE manufacture to implement GSCM, the manufacturer has recognized collaborative relationships with its parts suppliers to essential condition for effectively implementing the GSCM. The collaborative relationships are advanced by sharing GSCM policy, information sharing, joint action and programs of supplier support. Among the four elements, joint action is a system managing sharing GSCM policy, information sharing and program of supplier support. That is, three elements can be operated effectively and continuously in the system of the joint action with PDCA.



The manufacture has been making efforts to implement sharing GSCM policy, information sharing and program of supplier support without building and implementing the system of joint action. In order to effectively manage and continuously improve the GSCM including the three activities, the system of joint action has to be built and implemented by Japanese EEE manufacturers as well as Shimadzu Corporation. We have been conducting research on the development of a methodology to build and operate a system of joint action in Shimadzu Corporation.

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