

A CASE STUDY ON GREEN INFORMATION SYSTEM

Robert S. Q. Lai

College of Management, Chaoyang University of Technology,
Taiwan, R.O.C.

Li-Ling Hsu

Department of Information Management, National Kaohsiung First
University of Science and Technology, Taiwan, R.O.C.,

Jason C.H. Chen

School of Business, Gonzaga University
502 E. Boone Ave., Spokane, WA 99258

Michael D. Chang

Department of AFC, University of US Virgin Islands
St. Thomas, VI 00802

ABSTRACT

The textile industry plays an important role in creating Taiwan's foreign exchange income. The vast majority of textile enterprises are traditional, labor-intensive small-medium enterprises. Over the recent years, with the increasing consciousness of people's environmental protection around the world and the pressure of competition on the international markets, many textile companies are forced to pay close attention to the environmental protection. In view of this trend, the textile industry hopes the implementation of a green information system help to investigate the extent of business process improvement after implementing the system and key factors for success with an aim to effectively reduce cost, expand business opportunities, and march toward globalization. In this study, a case study approach is adopted to conduct an on-site survey on one enterprise in the upstream, mid-stream and downstream supply chains respectively. The business management cost is increased at the very beginning of the green supply chain introduction. However, the business process is improved after the implementation of Internet interface. The green supply chain brings external effects: the promotion of corporate image, an increase of customer value and loyalty, reduction of customer complaints, and product conformity to global standards. It also generates internal effects: enhanced supply chain integration (for instance, increased information availability, process efficiency and supply chain partnership), the increase of sales revenue, procurement efficiency, and competitiveness.

INTRODUCTION

Taiwan's textile industry recently are facing the threats of low labor and manufacturing costs from China and southeast countries. Furthermore the increased awareness of environmental protection and harsh global competition made the enterprises take environment-related issues seriously. The REACH system (Registration, Evaluation, Authorization and Restrictions of Chemicals) and PFOS (Perfluorooctane Sulfonate) of the European Union impacts the textile

industry most, since it uses chemical substances intensively. Therefore Taiwan's textile industry turned to aim for functional, high-end, design-oriented textiles.

Ho-Yu Textile Corp. is one of the few large companies which owns consolidated upstream and downstream supply chains. Recently, HoYu demonstrated its dedication on green design by recycling PET bottles and turning them into PET fabric and PET cloth. As well, HoYu is also committed to reducing the concentration of hazardous substances, saving the use of natural resources, creating a safe working environment to make their products compliant with applicable laws and regulations. Each year, they not only reduce the carbon-dioxide emissions but also save the material, energy, and disposal costs .

In this paper, we will analyze how the textile industry operates. Then, we proceed to investigate the key factors for successful green information systems with SCM focus, and finally find out a suitable operation mode for the textile industry in Taiwan, which responds to the global trends of environmental protection.

LITERATURE REVIEW

The EU REACH (Registration, Evaluation, Authorization and restriction of CHemical substances) aimed to replace other laws to date regarding the control of chemical substances. When it entered into force, more than 30,000 substances imported or manufactured in quantities of more than 1000 tons were under strict control. PFOS concentration of limits is divided into three levels: (1) Product Constituent < 0.005% (w/w/) (50ppm). (2) Semi-finished Product or Parts Thereof < 0.1% (1,000ppm). (3) Textiles or Coatings < 1µg/m².

BPI is considered as an essential tool for optimizing the corporate business processes. In general, Harrington's BPI involves five stages: organization for Improvement, understanding the process, streamlining, measurement and controls, and continuous improvement.

An ICT platform is a complex and varied set of goods, applications and services used for producing, distributing, processing, transforming information. The fast information delivery through the ICT platform not only effectively shortens the product development cycle, but also enhances customization capabilities.

GREEN SUPPLY CHAIN MANAGEMENT

In a greening process, enterprises have to work closely with upstream suppliers and downstream customers to effectively manage the supply chain environment. On the whole, a green supply chain consists of the following aspects:

- **Green Design :**
It refers to the use of natural, organic, and recyclable material, which aims for zero waste designs; that is, making old outputs new inputs .
- **Green Purchasing :**
A green purchasing program can integrate environmental criteria to restrict the use of hazardous substance on the procured material, components or products to reduce the generation of hazardous chemicals.
- **Green Production :**
Green production is a business strategy to preserve resources, reduces consumption of new raw material, and restricts the use of toxic chemical substance in purchasing and production decisions to minimize negative impacts over the environment .
- **Reuse and Recycling :**
At the end of a product life cycle, firms shall recycle old products and reduce components to

minimize resource waste and pollution .

RESEARCH METHODOLOGY

We collected relevant literature concerning the issue of interaction between buyers and sellers, and combined the research results with the green supply chain management system, then designed the structural questionnaires and open-ended questionnaire. We use the case study approach, because of the following reasons:

- (1) The problems arising from the interaction between buyers and sellers in a green supply chain management are complex. As a result, a case study method is an essential tool to analyze the potential problems that exist in Taiwan's textile industry in the process of implementing green supply chain management system. Meanwhile, the investigation on the textile companies' using green supply chain management system for previous literature is insufficient, and most of them were just exploratory, instead of empirical.

general, Harrington's BPI involves five stages: organization for Improvement, understanding the process, streamlining, measurement and controls, and continuous improvement.

An ICT platform is a complex and varied set of goods, applications and services used for producing, distributing, processing, transforming information. The fast information delivery through the ICT platform not only effectively shortens the product development cycle, but also enhances customization capabilities.

GREEN SUPPLY CHAIN MANAGEMENT

In a greening process, enterprises have to work closely with upstream suppliers and downstream customers to effectively manage the supply chain environment. On the whole, a green supply chain consists of the following aspects:

- Green Design :
It refers to the use of natural, organic, and recyclable material, which aims for zero waste designs; that is, making old outputs new inputs .
- Green Purchasing :
A green purchasing program can integrate environmental criteria to restrict the use of hazardous substance on the procured material, components or products to reduce the generation of hazardous chemicals.
- Green Production :
Green production is a business strategy to preserve resources, reduces consumption of new raw material, and restricts the use of toxic chemical substance in purchasing and production decisions to minimize negative impacts over the environment .
- Reuse and Recycling :
At the end of a product life cycle, firms shall recycle old products and reduce components to minimize resource waste and pollution .

RESEARCH METHODOLOGY

We collected relevant literature concerning the issue of interaction between buyers and sellers, and combined the research results with the green supply chain management system, then designed the structural questionnaires and open-ended questionnaire. We use the case study approach, because of the following reasons:

- 1) The problems arising from the interaction between buyers and sellers in a green supply chain management are complex. As a result, a case study method is an essential tool to analyze the potential problems that exist in Taiwan's textile industry in the process of implementing green supply chain management system. Meanwhile, the investigation on the textile companies' using green supply chain management system for previous literature is insufficient, and most

- of them were just exploratory, instead of empirical.
- 2) The conceptual model is generated through the deduction of relevant literature, and none of them has been verified with empirical evidence.

Table 1 A Summary of Variables of Conceptual Model

Variables	Definition
Necessary Factors (NF) for Green SCM introduction	In the selection of suppliers or business partners (including purchasing activities), the first thing to do is to investigate if they have environmental policies or certificates at hand .
Management on Change Effect (MCE) of Green SCM introduction	Choosing firms that took the initiatives in implementing green supply chain management system to analyze how they strive to implement green supply chain management system, the problems they encountered, and operational strategies they built.
Anticipated BPI	The firms’ fulfillment of green supply chain management reduces negative impact on the environment, increases its operational efficiency, and reduces operational costs.
Anticipated Performance (KPI)	Successful green supply chain management reduces operational costs, facilitates response time and customer service. Benign environment is built upon mutual interest and benefits.

CASE STUDY AND ANALYSIS

Evertex obtained ISO9001, ISO14001, and Oeko-Tex 100 certifications. At present, Evertex sell the products to the most prestigious brands in the world, such as FILA, Reebok, Champion, Umbro, Asica, Errea, Arc’Teryx, and many others (see Table 2).

Table 2 Company Profile

Company Name [↵]	Central Factory: [↵] <u>Evertex Fabrinology Limited</u> [↵]	Supplier: Jin-Ta Chemical Corp. [↵]	Customer: <u>Jiu-Hon Industries, Ltd.</u> [↵]
Years of Business [↵]	24 years [↵]	38 years [↵]	10 years [↵]
Number of Employees [↵]	250 [↵]	20 [↵]	44 [↵]
Capital [↵]	850 million [↵]	less than 80 million [↵]	less than 80 million [↵]
Sales Revenue [↵]	716 million [↵]	80~200 million [↵]	200 million~ 1 billion [↵]
Major Products [↵]	(1) OEM for dyeing and finishing products [↵] (2) Warp knitting (grey cloth) [↵] (3) Warp knitting and circular knitting [↵]	printing and dyeing additive, dyeing material, printing ink [↵]	Trading Agent for Textiles [↵]
When was Green SCM introduced [↵]	April, 2010 [↵]	May, 2010 [↵]	May, 2010 [↵]
When was Green SCM was implemented On-line [↵]	October, 2010 [↵]	September, 2010 [↵]	May, 2010 [↵]
Name of Green SCM [↵]	Green Textile, Green Value Chain [↵]		
Green SCM initiator [↵]	<u>Evertex</u> [↵]	<u>Evertex</u> [↵]	<u>Evertex</u> [↵]
Green SCM Investment Amount [↵]	Less than 5 million [↵]	Less than 3 million [↵]	none [↵]
Green SCM Training Cost [↵]	1~5 million [↵]	100 thousand [↵]	none [↵]

The non-structural analysis results are summarized in Table 3

Table 3 A Summary of Non-Structural Questionnaire Results

Case Companies Constructs	Supplier: Jin-Ta Chemical Corp.	Central Factory: Evertex Fabrinology Limited	Customer: Jiu- Hon Industries, Ltd.
Problems	<ol style="list-style-type: none"> 1. Difficulty of information availability. 2. Unable to obtain product eco-profile in time. Waiting too much time to get feedback. 3. Threat of low price 		
Before Green SCM Introduction	All the orders were placed via phone calls, fax or email.		
After Green SCM Introduction	Both parties (suppliers and customers) access timely information via the ICT platform and grasp Evertex’s operational processes clearly. It shortens the operational process and reduces human error.		
BPI	<ol style="list-style-type: none"> 1. Accommodate Evertex’s system to establish product traceability data system. 2. Procure textiles via the ICT platform. 	<ol style="list-style-type: none"> 1. Create collaborate development strategies to facilitate R&D efficiency. 2. became proactive in verifying green material information. 	Use the ICT platform to search for product eco-profile and place order to comply with Evertex’s green SCM system.
Processes Having Greater Effect	Procurement, Research & Development, and Marketing	Procurement, Production, and Marketing	Marketing
Processes Having Little Effect	Inventory, Finance, and Quality Control	Inventory and Distribution	Finance
Supply Chain Relationship	An ICT platform enables information transparency among three parties, and shortens the lead-time in procurement. It also helps customers to understand related certificates and regulations for environmental protection, and enhance the mutual understanding and consensus.		
Implementation of New Green SCM System	Audit System, Procurement Strategy	Audit System	None
Anticipated Performance (KPI)	<ol style="list-style-type: none"> 1. Increase the sales of green materials 2. Reduce the complaints arising from disputes over environmental concerns. 3. Shorten query time for product eco-profile 4. Shorten procurement lead-time 5. Get Rid of low cost competition 	<ol style="list-style-type: none"> 1. Enhance the development of green textiles 2. Increase the sales of green cloth 3. Reduce the complaints arising from disputes over environmental protection 4. Shorten the time for tracing product eco-profile 	<ol style="list-style-type: none"> 1. Increase the sales of green cloth 2. Reduce the complaints arising from disputes over environmental concerns. 3. Shorten query time for product eco-profile

		5. Shorten procurement lead time 6. Get Rid of low cost competition	4. Shorten procurement lead-time 5. Get Rid of low cost competition
--	--	--	--

The research results reveal that the introduction of GSCM systems with ICT increased the sales for Evertex and its suppliers and customers altogether. For instance, the development quantity of new green products and the sales revenue of green cloth were increased. Other effects include the reduction of operational cost and operational time, the procurement lead-time, and query time. A summary of research results is shown in Tables 4, 5 and 6.

Table 4 Diagram Analysis of Evertex’s As-is and To-be

Company Name	Central Factory: Evertex Fabrinology Limited	
Items	As-is	To-be
Price Verification	Distributors or wholesale plants get quotes from numerous suppliers at the same time. The one offering the lowest price will get the order.	Because of Eco-in effect, Evertex will be able to negotiate the price with brand merchants directly. It avoids the low cost competition.
Order Types	Low price governs everything. Evertex has weak bargaining power.	Have higher bargaining power, with its green material advantage.
Product Traceability System	Not required	Big brand merchants will ask for product traceability services and information integration.

Table 5 Diagram Analysis of Jin-Ta Chemical Corp. As-is and To-Be

Company Name	Supplier: Jin-Ta Chemical Corp.	
Items	As-is	To-be
Qualification Validation and Confirmation	It relied on the purchasing engineers’ memory and experience to locate certified suppliers. The supplier lists were not shared by the purchasing.	Pre-validation and assessment systems will generate certified supplier lists. Supplier information and qualification data are managed and maintained in the system.
Inquiry	It relied on human operation to sourcing the suppliers.	RFQ is delivered to certified suppliers from the system.
Price Negotiation and Order Placement	Human Judgment	Screening price range via the procurement strategy management on the system to find bids that matches the conditions through the ICT platform, and locate suppliers that possess certifications and meet customer’s spec.
Product Eco-profile Auditing	Paper documents were supplemented.	Timely report in downloadable from the system

Table 6 Diagram Analysis of Jiu-Hon Industries, Ltd. As-is and To-Be

Customer Name	Customer: Jiu-Hon Industries, Ltd.
---------------	------------------------------------

Items	As-is	To-be
New Product Promotion	No chances available to propagandizes their products	New product eco-profile is released to customers' member area on the system.
Shipment Verification and Maintenance	Brand merchants and distributors found it difficult to grasp timely product eco-profile and specification test data.	Product traceability data and test profiles are available in Member's area. It enhances information reusability, shortens the time for problem tracking, clarifies responsibility, and ensures administrative efficiency. An Order Service Area is created to provide nation-wide customers, distributors and agents to place and follow up orders, track ordering progress, and query information. It increases the effect of preventive administration.

CONCEPTUAL MODEL OF REASONING

We modified the feasibility GSCM system with ICT. If the evaluation results satisfy the variables for the green supply chain introduction, then we proceed with the investigation on the impact of green supply chain on BPI. Finally, we assess the firm' KPI after the implementation of green supply chain, and testify if it influences the firm's BPI, business innovation and value added performance. The conceptual model was constructed and illustrated in Figure 1.

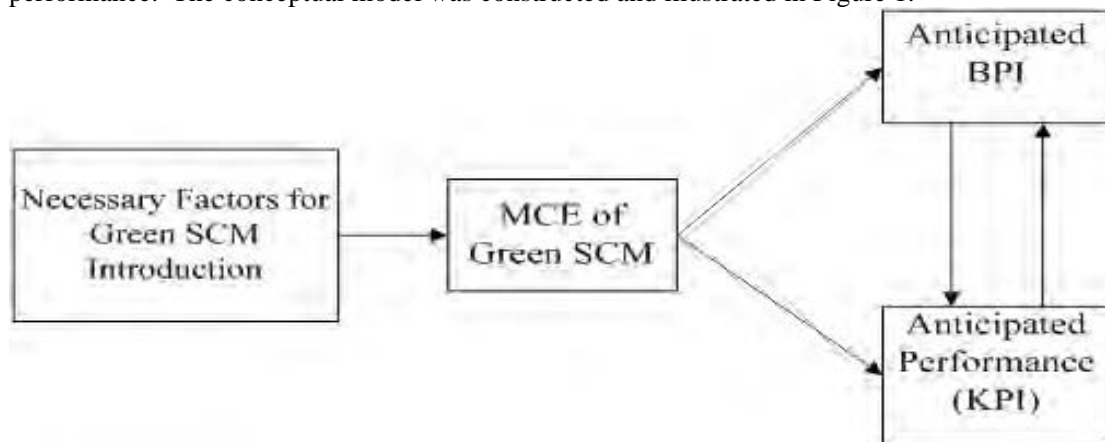


Fig. 1 Conceptual Model

CONCLUSION

The globally recognized validation certifications are able to add value to enhanced corporate competitive advantages and new business opportunities. The administrative cost may increase at the implementation stage of GSCM system. Nevertheless, the GSCM system with ICT does help the integration of processes with the rest of the supply chain members, the reduction of customer complaints, and the promotion of customer value and loyalty. The findings also reveal that Evertex is able to meet customer's expectation and requirements in a timely manner, and reduce the time in negotiation with sellers and buyers, after the introduction of the green supply chain management system. Further, the recent awareness of environmental protection triggers customers to look for green products, and that implementing a GSCM has becomes indispensable for enterprises to catch up with the trend.

The GSCM system with ICT implementation ensures the products compliance with green policies and process integration in a supply chain (such as information transparency, production efficiency,

and supply chain partnership). It also makes the information available and visible to customers, and production efficient within the supply chain system. Meanwhile, it facilitates the development speed of new products, customer trust, and reduces the complaints over environmental problems. It saves the time in material procurement, information processing and query. In addition, the quantity and sales revenue of green products is significantly increased. These advantages relieve enterprises from low price pressure. Finally, In the case of Evertex, GSCM helps its supplier and customer create new opportunities in a competitive context, and become a way to improve core competitiveness.

REFERENCES

- Benita M. Beamon (1999), "Designing the Green Supply Chain," *Logistics Information Management*, Vol.12, No.4, pp. 332-342.
- Cousins, P.D., Lamming, R.C. & Bowen, F. (2004), "The Role of Risk in Environment-Related Supplier Initiatives", *International Journal of Operations & Production Management*, Vol.24(6), pp.554-565.
- Hansmann, K.W. & Kroger, C. (2001), "Environmental Management Policies", *Green Manufacturing and Operations: From Design to Delivery and Back*, Greenleaf Publishing, Sheffield, UK.
- Helo, P. & Szekely, B. (2005), "Logistics information systems: an analysis of software solution for supply chain co-ordination", *Industrial Management & Data Systems*, Vol. 105(1&2), pp.5-25.
- Hsiang-Cheng Hsu, Ying-Chin Ho (2006), *A Study on the Establishment of Green Supply Chain Management*, EMBA in National Central University.
- Hsin-Hung Lee (2010), *The Development in Taiwan's Textile Industry, Retrospect and Prospect*, Chinese National Federation of Industries.
- Joseph Sarkis (2003), "A Strategic Decision Framework for Green Supply Chain Management," *Journal of Cleaner Production*, 11, pp.397-409.
- Judge, W.Q. & Douglas, T.J. (1998), "Performance Implications of Incorporating Natural Environmental Issues into the Strategic Planning Process: An Empirical Assessment", *Journal of Management Studies*, Vol.35(2), pp.241-262.
- Jyh-Shing Yang (2004), "Operation Mechanism and Case Studies for Industrial Green Supply Chain: Management", Taipei, Industry Development Bureau.
- Damij N., Damij T., Grad J. and Jelenc F. (2008), "A Methodology for Business Process Improvement and IS Development". *Information and Software Technology*, Vol. 50, pp. 1127-1141.