Green Supply Chain Management as Competitive Advantage
A Perspective of Intellectual Capital

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Abstract

Since environmental issues have caught attention of academia and practitioners during this decade, enterprises face a great deal of pressure from rivals, customers and suppliers as well in the competitive landscape. Nevertheless, once if green supply chain management (GSCM) practices are to be completely adopted by all enterprises, a demonstrable link between measures and improving competitiveness is inevitable. From the perspective of intellectual capital (IC), an organization theory, this paper aims to explore and identify the adoption of GSCM practice of a case company as a tool of competitive advantage. Based on literature reviews, we adopt a case study strategy, selected representative enterprise, a TFT-LCD leading corporation as well as being one of the largest panel manufacturers in Taiwan, to illustrate how IC (human capital, organizational capital and customer capital) directs the competitiveness of GSCM implementation.

Results from this study, the role of IC in building competitive advantage for enterprises that technological advancement may bring different implications for valuation of IC. Additionally, the main results showed IC has positive impact on the human capital (i.e. opportunity and risk perception, business experience and level of motivation), organization capital (i.e. firm capacity to adapt quickly to change and the advanced technology upgrading), and customer capital (i.e. development of productive business networks and industrial regulations) those of are important intangible assets, and which seem to be related positively to build competitive advantage for organizations. Moreover, we draw three propositions from the results. Finally, implications for the theory and practice of GSCM as well as research limitations are discussed.

Key words: GSCM, Environmental regulations, IC, Competitive advantage, TFT-LCD

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1. INTRODUCTION

Environmental issues cross boundaries from enterprise to customers, suppliers, rivals, the community and the environment itself. Maintaining a working ‘industrial ecosystem’ for industrial technology-based products needs to occur throughout the supply chain, particularly for enterprises with operations in countries that have various levels of environmental regulations (US AEP, 2002). Many enterprises are continuously attempting to develop new and innovative ways to reinforce their competitiveness. Researchers suggest that some of these enterprises enhance their competitiveness through improvements in their environmental performance to meet with environmental regulations (Bacallan, 2000; Rao & Holt, 2005; Zhu, Sarkis, & Geng, 2005).

There are many philosophies of environmentalism that advocate different solutions to these ecological problems. One solution that has received positive support from many environmental camps is the concept of sustainable development (World Commission on Environment and Development, 1987). Sustainability means meeting our current needs without jeopardizing the ability of future generations to meet theirs. It involves pacing the use of resources so that they can be renewed and maintained within a natural equilibrium (Costanza, 1992; Daly & Cobb, 1989).

For the global economy to become ecologically sustainable, it will be necessary to organize business and industry along ecologically sound principles. This will require transformation of corporations, their products, production systems, and management practices. If the world economy shifts towards and ecological orientation, it will change the competitive landscape of industries in terms of consumer preferences and demands, industrial regulations, and competitive opportunities (Buysse & Verbeke, 2003; Cockburn, Henderson, & Stern, 2000; Peteraf & Bergen, 2003; Rouse & Dellenbach, 1999; Rugman & Verbeke, 2002; Shrivastava, 1995).

innovation and upgrading of technologies, making companies more efficient. Regardless of whether environmental regulations hurt or help industry, they influence competitive behavior of firms and competitive dynamics of industries by imposing new costs, investment demands, and opportunities for improving production and energy efficiency (Buysse & Verbeke, 2003; Cockburn, Henderson, & Stern, 2000; Peteraf & Bergen, 2003; Rouse & Dellenbach, 1999; Rugman & Verbeke, 2002; Shrivastava, 1995).

The paper introduces the concept of GSCM practice and argues it can be used to gain competitive advantage for corporations. The first section defines both the definition and conceptualization of GSCM and IC, and the following section discusses and introduces GSCM as a strategic asset for gaining competitive advantage from the perspective of IC. The third section illustrates this concept by describing how AU Optronics Corporation has adopted GSCM orientation to enhance their competitiveness. The forth section will indicate the results and propositions development. Finally, this research concludes with benefits and barriers of implementing GSCM practice at AUO as well as implications of competitive strategy for corporations and research limitations are discussed.

2. LITERATURE REVIEW

2.1 Green Supply Chain Management (GSCM)

The literature in GSCM has drawn more attention by researchers and practitioners since they began to realize that management and operations of environmental programs do not end at the boundaries of the enterprise. Specifically, research in enterprise environmental management and operations have been growing these decades with a larger numbers of papers (Carter & Dresner, 2001; Gupta, 1995; Sarkis, 2001; Melnyk, Sroufe, & Calatone, 2002; Geyer & Jackson, 2004; Rao, 2004; Rao & Holt, 2005; Zhu & Sarkis, 2004; Zhu, Sarkis, & Geng, 2005).
The definition of supply chain management (SCM) and GSCM originated from the previous literatures we survey during the last decades. Handfield & Nichols (1999) proposed that supply chain encompasses all of the activities associated with the flow and transformation of goods from raw materials (extraction), through the end users, as well as associated information flows. As we have noted, the circular and systemic philosophy of “ecosystem” thinking Shrivastava (1995) is not merely explicitly included but not considered central to its definition in the integration of the full cyclical supply chain.

Admittedly, a number of possible definitions of GSCM have been put forth over the past decade including Green, Morton, & New (1996) posited that Green supply refers to the way in which innovations in supply chain management and industrial purchasing may be considered in the context of the environment. In additions, Narasimhan & Carter (1998) stated that environmental supply chain management consists of the purchasing function’s involvement in activities that include reduction, recycling, reuse and the substitution of materials. The term ‘supply chain’ describes the network of suppliers, distributors and consumers. It also includes transportation between the supplier and the consumer, as well as the final consumer . . . the environmental effects of the researching developing, manufacturing, storing, transporting, and using a product, as well as disposing of the product waste, must be considered (Messelbeck & Whaley, 1999). Zhu & Sarkis (2004) stated GSCM has ranged from green purchasing to integrated supply chains flowing from suppliers, manufacturers, to customer and reverse logistics, which is “closing the loop”.

The research in GSCM addresses a variety of issues ranging from organizational research, practices and prescriptive models for evaluation of GSCM practice and technologies respectively (Faruk et al., 2002; Geffen & Rothenberg, 2000, Hall 2001; Handfield, & Nichols, 2002; Rao, 2004; Rao & Holt, 2005; Sarkis, 2003; Theyel, 2001; Zhu, Sarkis, & Geng, 2005; Zhu & Sarkis, 2004; Zsidisin & Siferd, 2001). This paper focuses on the issues relevant to GSCM adoption drivers and the adoption of GSCM in Taiwanese TFT-LCD Corporation. Since review the definitions of GSCM through the previous literatures, we indeed
have a clear somewhat understanding on the nature of GSCM. The definition of the purpose of green supply chains, which ranges from reactive monitoring of general environmental management programs to more proactive practices such as the 4Re’s (e.g. recycling, reclamation, remanufacturing, reverse logistics) of environmental management and incorporating “innovations,” also seem to differ.

2.2 Aspects of Intellectual Capital: Definitions and Conceptualization

2.2.1 The Definitions of Intellectual Capital

The studies of several authors consider intellectual capital (IC) to be the sum of all knowledge firms utilize for competitive advantage (Nahapiet & Ghoshal, 1998; Youndt, Subramaniam, & Snell, 2004). The definition of IC is often used: “Knowledge is valued for organization.” Klein & Prusak (1994) described the characteristics of intellectual capital as “Intellectual material that has been formalized, captured and leveraged to produce a higher-valued asset.” Bontis (1996) stated intellectual capital has also been defined as the difference between a firm’s market value and cost of replacing its assets. It is like those things that we normally cannot put a price tag on, such as expertise, knowledge and a firm organizational learning ability. Kaplan & Norton (1996) argued IC is the accumulating values that an enterprise invests on its customer, supplier, workflow, technology, and innovation to increase its future value.

Edvinsson & Malone (1997) defined IC is the possession of the knowledge, applied experience, organizational technology, customer relationships and professional skills that provide Skandia with a competitive edge in the market. Bell (1997) described IC is knowledge resource of an organization. It encompasses the models, strategies, unique approaches, and mental methodologies which an organization uses to create, compete, understand, problem-solve and replicate. Bassi (1997) expressed IC in firm, which is employees’ brainpower, know-how, knowledge, and processes, has always been a source of competitive advantages. Stewart (1997) stated IC refers to the combination of enterprise comparative advantages. Besides, Stewart thought the knowledge of enterprise’s tangible assets including products or services, is less important than their intangible assets
including the employees’ talent, efficiency, and customer relationships. Intellectual capital is the sum of that intangible capital.

2.2.2 The Conceptualization of Intellectual Capital

Since intellectual capital cannot be described tangibly and totally, the scope of IC is very broad, the scholars researching IC who argue different conceptions and components of IC.

Previous research has identified three prominent aspects of IC: human, organizational, and social capital (Subramaniam & Youndt, 2005). Human capital is defined as the knowledge, skills, and abilities residing with and utilized by individuals (Schultz, 1961), whereas organizational capital is the institutionalized knowledge and codified experience residing within and utilized through databases, patents, manuals, structures, systems, and processes (Youndt, Subramaniam, & Snell, 2004). The third aspect, social capital, is defined as the knowledge embedded within, available through and utilized by interactions among individuals and their networks of interrelationships (Nahapiet & Ghoshal, 1998). Brooking (1996) grouped intellectual capital into four categories: markets assets, human-centered capital, intellectual property assets and infrastructure assets. Edvinsson & Malone (1997) occupied a director of intellectual capital at Assurance and Financial Services (AFS) in September 1991. They think intellectual capital can control knowledge, experience, technology, customer relationship, and skills and which can let AFS own the competitive advantage. They classified intellectual capital into three categories: customer capital, innovation capital, and process capital.

Besides, Stewart (1997) classified intellectual capital into three categories: human capital, structural capital, and customer capital. These three capitals separately are ability of employees, operating efficiency, and customer relationships. In addition, Roos et al., (1998) grouped intellectual capital into two categories: human capital, and structural capital, which human capital comes from the knowledge, the attitude and the intellectual agility of employees. The value of human capital originates from competence, attitude and intellectual agility;
structural capital comes from relationship and organizational value, reflecting the external and internal foci of the company, plus renewal and development value, which is the potential for the future. Dzinkowski (2000) argued the components of intellectual capital are human capital, customer capital and organizational capital respectively. McElroy (2002) considered that intellectual capital classified into human capital, as well as social capital and structural capital. Furthermore, Lynn & Peter (2004) set out the basic concept addressing the intellectual capital associated with management know-how (human, corporate, business and functional capital) and marketing know-how (customer, supplier, alliance and investor capital).

2.3 GSCM and Competitive Advantage

Although it has been recognized that competitiveness comes from knowledge assets – intellectual capital – and its useful application (Teece, 1998), the emphasis on it is relatively new. Managing the intellectual capital of the corporation has become one of the critical tasks in the executive agenda. Nevertheless, this work is specifically difficult because of the problems involved in its identification, measurement and strategic assessment. In this situation, when the models of intellectual capital become highly relevant, they allow not only to understand the nature of these assets, but to carry out their measurement.

The term of intellectual capital is used as a synonym for intangible or knowledge assets since the work by Stewart (1991). A joint perspective for intellectual capital (understood as strategic resources and capabilities), led us to raise its assessment in order to state its consistency as such. The different types of intellectual capital represent different types of intangible resources and capabilities.

GSCM covers many salient concerns of traditional strategic management. Strategic management is concerned with aligning organizations with their environments (Schendel & Hofer, 1979). Corporations that can parlay new and unique resources can establish competitive advantage (Barney, 1992; Buysse & Verbeke, 2003; Cockburn, Henderson, & Stern, 2000; Peteraf & Bergen, 2003; Mahoney & Pandian, 1992, Prahalad & Hamel, 1990; Rouse & Dellenbach, 1999; Rugman & Verbeke, 2002; Shrivastava, 1995). Moreover, GSCM is a potential
strategic resource because it affects the value chain at multiple points (Shrivastava, 1995). It is capable of providing firms with unique and inimitable advantages at each stage of the value chain. Firstly, in the input system, competitive advantage accrues from resources commitment, labor force and ability to manage the energy conservation (in terms of human capital). It allows firms to create new goals, and reshuffle priorities in favor of preserving ecological value with legitimacy. Secondly, in the throughput system, manufacturing for the environment improves production efficiencies and minimizes waste and pollution. It makes production lean and green. As we note, industries ecological performance is important both for company image and to minimize environmental liabilities. Lower environmental liabilities make companies a better credit risk and less vulnerable to litigation, both of which can be important sources of competitive advantage (in terms of organizational capital).

Eventually, in the output system or the outbound logistics, GSCM creates competitive advantage through better product designs and business portfolios, and through savings from better management of wastes (Shrivastava, 1995).

Industrial ecosystems provide ecological method for building interorganizational relations among firms. They involve cooperative strategies for reducing costs by minimizing waste and maximizing resource utilization in a network of firms (in terms of customer capital). As we note, GSCM also has competitive significance at the industry level. If used strategically throughout the industry, it may reduce the need for environmental regulations in the industry.

3. METHODS

Traditionally, there are several prejudices against the case study strategy such as the lack of rigor, as the findings will largely depend on the strengths and attitude of the researcher (Yin, 2003), however, case study methodologies offer idiographic richness due to their ability to study more complex phenomena than nomothetic
research methodologies (Larsson, 1993). Methodologically, this paper used case study strategy as well as corporation annual report, documentation supported by the Dept. of Supply Chain Management of AUO and the published descriptions of its environmental programs, whereas, in this paper, the GSCM orientation is being implemented in corporations in selective ways. It describes AU Optronics (AUO) Corporation’s approach to GSCM as an illustration of how these concepts are implemented. Based on perspective of IC, this study endeavors to identify and explain the adoption of GSCM of a case company as a tool of competitive advantage.

3.1 Case Background

AUO was founded in 2001 in Hsinchu, Taiwan by the merger of Acer Display Technology Inc. and Unipac Optoelectronics. In October 2006, AUO merged with Quanta Display Inc. to a stronger, larger and more efficient global company. In addition, its Technology Center (ATC) was established in Hsinchu in 2002 which remains Taiwanese largest TFT-LCD R&D facility, but dedicated to the advancement and development of new products and technologies, manufacturing processes and continuous product improvement. Furthermore, in 2005, AUO set up its second Technology Central Taiwan Science Part in Taichung, the central city in Taiwan.

AUO currently has a core force of approximately 1,300 dedicated R&D engineers and knows to have filed the highest number of patents in Taiwan’s flat panel display industry. By mid 2006, the company owned over 1,750 patents worldwide. Additionally, IFI Claims Patents Services placed AUO as the fifth fastest growing patent applicant in the United Sates in 2004 with a 98% annual increase.

The company is a world-leading manufacturer of large-size thin film transistor liquid crystal display (TFT-LCD) panels, which are currently the most widely used flat panel display technology. AUO is the third largest manufacturer and the number one manufacturer of large-size TFT-LCD panels in the world and in Taiwan with a market share of approximately 20.7%, based on unit shipment in
2006. Meanwhile, AUO employs approximately 42,000 people and with facilities from Taiwan, USA, Japan, South Korea, Holland and China respectively. A truly global company, AUO has been publicly held and successful launch of ADR in New York Stock Exchange (NYSE) under code AUO since 2002. Table 1 shows a 5-year summary of financial data.

Table 1 AUO 5-year financial performance***

<table>
<thead>
<tr>
<th>Year</th>
<th>Sales*</th>
<th>Sales Revenue*</th>
<th>EPS**</th>
</tr>
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<tr>
<td>2006</td>
<td>293</td>
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<td>1.41</td>
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<tr>
<td>2005</td>
<td>217</td>
<td>6.6</td>
<td>2.77</td>
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<tr>
<td>2004</td>
<td>168</td>
<td>5.3</td>
<td>5.82</td>
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<tr>
<td>2003</td>
<td>105</td>
<td>3.1</td>
<td>3.65</td>
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<tr>
<td>2002</td>
<td>76</td>
<td>2.2</td>
<td>1.65</td>
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*Sales and net income expressed in billion New Taiwan Dollars  
**EPS= earnings per share expressed in New Taiwan Dollars  
***2002-2006 Summary Annual Report of AUO

AUO has always been at the forefront of new technology. It is the first TFT-LCD manufacturer in Taiwan to produce large-sized TFT-LCD panels by means of G3.5, G4, G5, G6 and G7.5 Fabrications. In addition, it is one of the few manufacturers globally with the core competence to serve from panels in sizes ranging from 1.5 inches to greater than 46.

3.2 Green Supply-Chain Management Practice at AUO

As respect of the waste solvents and the waste liquids, the recycling/reusing rate has reached to 100%. AUO have installed waste solvent recycle systems in facilities (for example: waste stripper recycle systems, waste developer recycle system etc.) to purify the waste solvents and reuse them in producing process. It is not only decreasing the requirement of raw materials, decreasing the amount of the waste solvents but continually finding out the recycling/reusing sources to treating the waste solvents and the waste liquids that can’t be reused in process.
The material of second-class products is the top prior selection of certain recycling/reusing ways. The second selection is to be materials of other kind of products such as fertilizers or lacquers. Finally, if the waste solvents can’t be used as materials for any production, they can also be reused as substitute fuel because of their properties of high calorific value. Consequently, the proportion of being materials of second-class products, being materials of other products, and being substitute fuel is 16%, 62%, and 22%.

3.2.1 Human Capital

Human capital can be defined as the accumulation of personal attributes (i.e. knowledge, abilities, personality, vision, etc.) More investment in human capital is expected to yield a higher productivity of individuals. The talent, experience and motivation that top management team (TMT) bring to an organization can be expected to determine the success level achieved by firms. Specifically, executives who feel strongly motivated to overcome the adversities of business operations and to achieve challenging growth goals for their ventures are expected to show a better business performance.

A. Upper management team strongly supports at AUO

There are many drivers and champions for GSCM at AUO, and AUO wants to be recognized as a sustainable organization with strong extended producer responsibility. This ambition, rising from the concepts of corporate and extended producer responsibility initiatives, has increased emphasis on EH&S issues associated with upstream and downstream stakeholders.

B. Energy Savings Team

Besides, AUO has established an "Energy Saving Team" to implement the company's environmental protection and energy conservation policies. It is the role of the team to structure budgets and put together educational training programs for staff trainings.
Internally, GSCM practice is driven by:

(a) A desire to better manage the risk of a potential supply chain or business interruption arising from an EH&S issue

(b) A desire to work together with suppliers to identify alternative materials and equipment that minimize environmental impacts

(c) The recognized advantage of a strong corporate EH&S programs

GSCM practices that avoid even a single supply interruption incident arising from an EH&S issue can offer a substantial return on investment by decreasing lost production time. As the practices mature and additional information is collected, AUO will work towards developing quantitative metrics to evaluate GSCM practices.

Evolution of green supply-chain management at AUO, it has grown and evolved over the past few years in a manner similar to the environmentally sound supply-chain management methodology (Lamming & Hampson, 1996).

3.2.2 Organizational Capital (Structure Capital)

Business strategies are the result of managerial decision, and decisions that are constrained to the resources of a firm. A larger amount of financial capital provides and entrepreneur with more flexibility to undertake a wider array of strategies, and therefore it would influence positively business performance (Duchesneau & Gartner, 1990). Additionally, both firm’s resources and business strategies are considered into the contents of organizational capital. Roos et al. (1998) argued the variable of level of adaptation to the market (i.e. changes in items such as the number of new products, quality and prices of products, customers, suppliers, firm location, partners, and so on) is related to the renewal and development component of organizational capital.

AUO does not only strongly abide to the principles of environmental protection, industrial safety, and employee health but recognize with numerous awards, including, the National Industrial Waste Minimization Excellent Performance Awards, and Pollution Control Equipment Maintenance Outstanding
Performance Plan, and Energy Conservation Awards. Besides, all of fabs at AUO have passed both the certification of ISO 14001 and OHSAS 18001 (Occupational Health & Safety Assessment Series) certified, and additionally, new factories are also continually acquires certifications. The management operation model following the circle of Plan, Do, Check and Action has been applied as it continuous improvement principle. (See Figure 1)

3.2.3 Customer Capital (Relational Capital; Social Capital)

Customer capital is a core concept in business, economics, organizational behaviour, political science and sociology, defined as the advantage created by a person's (or organization) location in a structure of relationships. It explains how some people (or organizations) gain more success in a particular setting through their superior connections or link to other people (or organizations).

A. Development of green product-supply side

Dedicated to environmental conservation issues, AUO not only applies "Design for Environment" principles and environment regulatory measures on its products and operations to minimize impacts on the environment but continually and actively engaged in the R&D of green products, as well as waste minimization to the environmental impact.
For reducing the environmental impact, AUO keeps researching and developing environmental friendly products. Hazardous substance management system has been applied in product R&D, material purchase, and production as control measure.

B. Supply Chain Management-demand side

On the other hand, external drivers for GSCM at AUO include:

(a) Comply with Regulatory Requirements. Customers’ requests for more specific chemical content data and the increased interest of investors and foreign buyers in environmental issues are more critical ever.

(b) Conserve Energy and Nature Resources. AUO conserves natural resources by reusing and recycling materials, purchasing recycled materials, and using recyclable packaging and other materials.

(c) Communicate Information to Stakeholders. AUO discloses ESH-related information on its business activities, products and services to stakeholders, utilizes and the resulting feedback to critique itself to further improve its ESH programs.

For ensuring the certain harmful substances not containing in their products, AUO has established the management system to control all the procedures including R&D, purchase, and producing etc. Meanwhile, AUO also requests suppliers must follow its rules for green design as well as extends these demands on its suppliers and contractors within the mass industry. Suppliers have been requested to follow "AUO Green Design" rules by complying "AUO green design checklist", which clearly states AUO's requirements for designated hazard substances. All raw materials and parts supplied as AUO's components, including manufacturing process as well, need to be complied with AUO hazardous substance control and restriction rules. In other words, supplier environmental audit has been applied as one of supply chain management programs. Meanwhile, well management in environmental protection is also the requirement for AUO's designated suppliers and contractors who obtaining certification of ISO 14001.
3.3 Performance of GSCM at AUO

AUO continuously makes concerted efforts to waste reduction and recycling/reuse of waste. Recyclable/reusable materials will be firstly sorted out and collected through well waste classification in AUO’s facilities. Presently the recycling/reuse rate of waste has reached 57.5%. (Data Period: Jan. 2005 ~ Dec. 2005). Moreover, AUO has installed waste solvent recycling facilities (for example: recycling system for waste stripper and waste developer.) for waste solvent purification which would be reused in AUO process and it was benefited from not only decreasing demand of raw materials, but decreasing the amount of the waste solvents.

For waste solvent / liquid unsuitable for recycled or reused within process, AUO still continually surveys possible recycling/reusing treatment sources. 8% of those waste solvent / liquid have been reused in AUO process through external purification process cooperating with vendors, which is AUO's top priority of treatment solution. The secondary treatment approaches for those wastes are applied as raw material of second-class products (32%) or fertilizers or lacquers (22%). Since waste solvents can't be used as materials for any production, they have been still reused as substitute fuel because of high calorific value (37%). The recycling / reuse rate of waste solvents and liquids has reached to 99.5%. (Data Period: Jan. 2005 ~ Dec. 2005)

Source: The Dept. of Global Supply Chain Management, AUO

Figure 2  the recycle flow chart of AUO waste solvents/liquids.
4. RESULTS AND PROPOSITIONS DEVELOPMENT

This paper found some relationships of GSCM implementation with competitive advantage in this case company. Based on the literature reviews and integrate the case corporation, we identify the specific issue for discussion and analysis respectively. According to the following three elements of IC framework, “human capital”, “organizational capital” and “customer capital”, we herewith draw three propositions to argue when implementing GSCM practice, it will lead enterprise to competitiveness.

4.1 The characteristics of Human Capital

Edvinsson & Malone (1997) think intellectual capital can control knowledge, experience, technology, customer relationship, and skills which can let AFS own the competitive advantage. They classified IC into three categories: customer capital, innovation capital, and process capital. Besides, human capital comes from the knowledge, the attitude and the intellectual agility of employees (Roos et al., 1998) and it originates from competence, attitude and intellectual agility (Dzindowski, 2000). Consequently, the results suggest the perception of top management teams (TMT) in environmental regulation and risk management as well as strongly support by the upper management team in GSCM implementation will enhance the coherence and adopt GSCM policy within AUO successfully. Based on the analysis and results, herewith, we draw the following proposition:

Proposition 1: The vision, motivation, training and support of TMT will impact on the competitive advantage of GSCM implementation within the enterprises.

4.2 The Characteristics of Organizational Capital (Structural Capital)

Bassi (1997) expressed IC in firm, which is employees’ brainpower, know-how, knowledge, and processes, has always been a source of competitive advantages. In addition, Stewart (1997) classified organizational capital is ability of operating efficiency and Roos et al., (1998) argued the value of structural capital comes from relationship organizational value, reflecting the external internal foci
of the company, plus renewal and development value, which is the potential for the future. AUO does not only strongly abide to the principles of environmental protection, industrial safety, but has been recognized with numerous awards, such as the National Industrial Waste Minimization Excellent Performance Awards, and Pollution Control Equipment Maintenance Outstanding Performance Plan, and Energy Conservation Awards. Consequently, based on the above analysis, we draw the following proposition:

**Proposition 2:** The more efforts and earlier investment in innovate production technology will impact on the competitive advantage of GSCM implementation for enterprises.

### 4.3 The Characteristics of Customer Capital (Relational Capital; Social Capital)

Customer capital explains how people (or organizations) gain more success in a particular setting through their superior connections or link to other people (or organizations). Stewart (1997) thought the knowledge of enterprise’s tangible assets including products or services, is less important than their intangible assets including the employees’ talent, efficiency, and customer relationships. IC is the sum of that intangible capital. Kaplan & Norton (1996) also argued IC is the accumulating values that an enterprise invests on its customer, supplier, workflow, technology, and innovation to increase its future value. In compliance with regulatory requirements, conserve energy and nature resources and communicating information to stakeholders, All raw materials and parts supplied as AUO’s components, including manufacturing process as well, need to be complied with AUO hazardous substance control and restriction rules. Well management in environmental protection is also the requirement for AUO’s designated suppliers and contractors who obtaining certification of ISO 14001. In sum, we hence draw the following proposition:

**Proposition 3:** The better interactions among individuals and their networks in suppliers, customers, as well as stakeholders will impact on the competitive advantage of GSCM implementation to enterprises.
5. DISCUSSION

5.1 Implication

Environment regulations and GSCM practices are becoming more pervasive and integrated into AUO operations and practices, however, few barriers have developed thus far. Most of the difficulties encountered in implementation and execution have been associated with integrating GSCM into existing operational practices. Operationally, integrating suppliers and environmental projects into the decision-making and managerial processes was initially challenging for TMT. GSCM is a combination of growing environmental consciousness among business, and the continual need to be cost efficient and a desire for long-term sustainable business development. Many of internal and external groups of AUO admittedly realize the value of environmental considerations and understand the necessity of environmental involvement and have been accepting of the change. From the aspects of IC- human capital, organizational capital (structural capital) and customer capital (relational capital), the internal environmental management, such as the commitment from the top management team and the coordination from business level managers will be critical for development of any kinds of GSCM tasks At AUO (human capital); the adoption and the process of GSCM (organizational capital) lead the AUO to enhance his competitiveness; the establishment of external GSCM system for controlling all the relationship between supply-chain partners, such as customers, suppliers and stakeholders whom were requested to follow AUO’s rules for green design (Customer capital).

The present study offers two implications for practitioners trying to manage and measure IC when implementing GSCM practice. Two important implications both at the industry level and firm level are discussed. At the industry level, GSCM provides a way of fundamentally altering the profitability dynamics of industries, which affects basic cost parameters of resource use, energy use, manufacturing efficiency, waste disposal, and pollution prevention; whereas, at the individual firm level, GSCM affects corporate domain choice and competitive posture, which provides new bases for creating competitive advantage.
5.2 Limitation and Future Research

Because of our data constraints, this study is not without limitations. First, this is a study of a particular industry, hence, it should not be hastily generalized to other settings, whereas, focuses on particular setting as opposed to providing information on the generalizability of the findings to other settings. Second, the case study provides little basis for scientific generalization which is limited due to a single, non-probability sample of a case corporation being used to verify the theoretical framework in this research, indeed, it needs to be extended across further industries as well as instead of single sample and single industry research in the future. Third, in this paper, since we conducted by cross-sectional data instead of longitudinal data to measure its efficiency when implementing GSCM at AUO, consequently, in order to have a deeper understanding and more concisely assessment its efficiency and competitiveness, the research should employ longitudinal data for future research.

5.3 Conclusion

The case is discussed with regard to the potential contribution to long-term environmental efforts, including how these practices and approaches contribute to the spread of environmental competency to other TFT-LCD manufacturers, as well as how certain GSCM aspects fit into the arrangements of AUO supply chain management, including the interaction between social, economic, legal, and environmental facets among others. The experiences of AUO suggest that integrating GSCM into strategic management does not only offer many competitive advantages, but face many barriers as we mentioned above. Despite these barriers in individual company, GSCM is being adopted widely and are collectively affecting competitive landscape nowadays. As we noted, it permits companies to remain competitive in global markets, reduce costs and production time, and enhance strategic flexibility as well. The paper makes a contribution by reinforcing and extending the argument about the importance of GSCM for strategic success and it focuses on GSCM which can produce ecological efficiencies.
REFERENCES


以智慧資本的觀點探討綠色供應鏈管理為企業競爭優勢的利器

方世杰
成功大學企業管理系

林素莉
樹德科技大學國際企業與貿易系

摘要

近十年來，環境的議題引起學術界與實務界的關注，企業在這競爭的世代，面臨了分別來自於競爭者、消費者與供應商等前所未有的壓力。顯而易見的，一旦綠色供應鏈管理(GSCM)實務的措施與競爭力之間存在有某種的關聯時，則企業全面實施GSCM將是不可避免的。現今，為了迎合產業網路內消費者的要求，多數的企業必須遵循國內與國際的環保法規。無可否認的，環境的議題不再侷限於國內的環保規定，尤其企業在建構產業與國際市場競爭力之際，也應檢視組織內部所具備的能力(特別是無形資產)是否能為企業帶來競爭優勢。因此，本研究的目的在於以智慧資本(IC)的觀點來探討企業如何透過GSCM的實施進而提昇其競爭力。本文除了針對智慧資本與綠色供應鏈管理進行文獻探討外，將以國內實施綠色供應鏈管理的某薄膜電晶體液晶顯示器(TFT-LCD)的個案企業為研究對象，輔以組織理論中的IC觀點來確認與解釋GSCM的實施如何成為企業競爭優勢的利器。本研究結果顯示，以IC的三項要素(人力資本、組織資本、顧客資本)來探討GSCM實務對企業競爭力的提升有其正面的影響。此外，作者針對個案整理的內容，整合相關文獻，找出企業施行GSCM以提昇其競爭優勢的特定議題進行分析與探討，並據此結果提出了三項研究命題。最後，也將對個案企業的實務做法進行分析與討論，並提出其研究限制與管理實務意涵。

關鍵字：綠色供應鏈管理、環保法規、智慧資本、競爭優勢、薄膜電晶體液晶顯示器

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