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ABSTRACT

Green supply chain management has appeared as an essential strategy for enhancing environmental performance of processes, structures, and products accordingly to address regulatory and competitive forces. Korean firms lag in green logistics activities relative to 'green' leading companies in advanced countries. Thus, few papers have identified and investigated green supply chain systems within South Korea. To further understand how some Korean firms may wish to further develop green logistics and supply chain practices, this paper explores a decision making framework of Green Logistics by using ANP (analytic network process). We derived 5 clusters and 21 components forming the strategic green logistics, and then conducted surveys for pairwise comparison of experts on Green Logistics in Korean firms, and computed relative weights of the clusters. Our findings indicate that Green Logistics would be very helpful for managers to adjust their strategic decisions for green supply chain management. The technique proposed in this paper may be generalized to other countries with the framework developed not unique to just Korean industry.

Keywords

Green Supply Chain Management, Green Logistics, ANP (Analytic Network Process), South Korea.

INTRODUCTION

With growing global environmental concerns and issues, preventative environmental practices are at the forefront of advanced countries policies, with these practices diffusing throughout Asian nations including China, Japan, and Korea. One industry that has seen especial concern and development in this area are electronic products. There are consumption fossil fuels for producing electrical and electronic products and through transport the products via global logistics. Thus, major electronic companies have been interested and aware of environmental issues. The global electronics and information technology producers and organizations are at the forefront of green organizational practices and logistics including organizations such as Samsung, Sony, Sony Ericson, Nokia (Wati and Koo, 2010) and Dell, HP, IBM, Motorola, Sony, Panasonic, NEC, Fujitsu and Toshiba (Zhu and Sarkis, 2006).

GSCM (Green Supply Chain Management) has been viewed as critical for environmental issues in a broad variety of countries and industries. For example, Taiwan operates electronic manufacturing factories which are involved in world-wide business and faces significant environmental concerns (Hsu and Hu, 2008). Globalized electrical and electronics companies in other Pacific-Basin regions, such as South Korea, have similar concerns to those industries in Taiwan. The green logistics dimension of GSCM continues to be a serious matter for South Korea as well. Multinational companies will be influenced by the international regulatory policies and environmental agreement. For example, by 2012, 39 industrialized nations must implement mandatory reductions in CO_2 emissions for reducing greenhouse gas emissions. Specifically, these concerns are especially pertinent to South Korea where it has ranked in the top 10 countries in 2005 in CO_2 emissions, increasing 506 million tons, which is 123% over the 1990 baseline. These emissions are projected to grow at more than 3 times the amounts occurring currently (The Korea Transport Institute, 2007). South Korea, which is one of the most industrialized countries in the Asia-Pacific region, is heavily dependent on electrical and electronics manufacturers using road transport, which accounted for 20% of the total green house gas emissions.

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To solve this current environmental problem in South Korea, corporate-oriented GSCM could be applied as strategy and practice capable of complying with the requirements of legislation and strict regulations or to gain competitive advantage. GSCM is a system that can be linked with policy decisions and a significant response to multiple stakeholders such as businesses, government, and consumers. Some have recommended that the strategic use of various tools, e.g. Green IT Balanced Scorecard (Wati and Koo, 2011), should link to stakeholders and greening concerns carefully applied to processes and systems.

To advance the body of knowledge, in this study we explore green logistics systems from the literature to develop a framework for assisting organizational managers to evaluate green supply chain options. Specifically we introduce various strategic and operational elements that form the core of the decision framework. Even though, to the best of our knowledge, a number of studies have investigated the issue of GSCM and different approaches to implement GSCM (e.g. Hsu and Hu, 2008; Zhu et al., 2005; Zhu et al., 2007; Zhu et al., 2008) in electronics companies, little research on identifying the strategic factors and elements of logistics to green logistics systems design and implementation. A systematic analysis, particularly in the logistics and electronics industry, is virtually non-existent.

We adopt an analysis method for effective GSCM which incorporates strategic factors and elements networked hierarchically for managerial decision making called the Analytic Network Process (ANP) (Saaty, 1996). The technique was initially applied in the GSCM to evaluate potential options by Sarkis (2003). ANP is a suitable tool for environmental decision making due to its capability to introduce dynamic characteristics, multiple tangible and intangible attributes, and reducing complexity in decision making. Even though other formal models using analytical evaluation to evaluate the relationship between organizational attributes, supplier development program involvement attributes, and performance outcomes do exist (e.g. Bai and Sarkis, 2010), additional research in this area is warranted due to various limitations of these techniques, most of which do not have actual implementation for validation. Focusing specifically on green logistics, which the other papers do not do, this paper introduces a research model that utilizes actual survey data from experts and practitioners in the field. But first we provide an introduction into issues relevant to green logistics and their management. We then introduce green logistics and managerial parameters into a decision framework. The survey data is used to explore the application of the ANP technique to this problem. Discussions and a conclusion complete the paper.

LITERATURE REVIEW

Green Logistics:

Recently eco-friendly logistics has emerged as a new competitive element. A number of factors come into play in the greening of logistics. For example, transport and packaging logistics functions may provide conflicting attributes in this environment, where decisions associated with one attribute may conflict in the environmental performance of the other attribute (Bowersox and Closs, 1996). Eco-friendly logistics systems could contribute to the process of saving resources through recycling of goods and materials or protecting waste of products. Environmental initiatives associate with logistics can occur within four major 'value chain' phases: green inbound logistics; manufacturing and operations; outbound logistics or marketing; and Reverse Logistics (Sarkis, 2003). Furthering the conceptualization of 'environmental logistics', it may encompass issues from the search process of raw materials to the post-consumer waste, reuse or disposal logistics minimize environmental hazards (Sarkis, 2005).

Reviewing the growing and extant GSCM and logistics literature we identified logistics elements that closely related to the strategic factors of green logistics such as external environment factors, external stakeholders, product life cycle, operational life cycle, reverse logistics factors how affect environment logistics performance (Sarkis, 2003). These all represent the decision model factors for the ANP model. The roles of each of these, in turn, are defined as:

(1) External Environmental Regulation: External pressures make an impact on ranging from the environmental logistics implementation, marketing, suppliers, and competitors to the internal and intra organizational process (Zhu and Sarkis, 2006). This pressure is raised by not only the surrounding external macro-environmental regulation but also caused by consumers who are preferably purchase environmental products (Hall, 2000).

(2) External Stakeholders: it is critical to figure out how key stakeholders of companies make a decision for investing in the type of capital, human or financial, on the value chain of a company (Clarkson, 1994, p. 5; Murillo-Luna et al., 2008). Four stakeholder groups influencing firms to protect the natural environment: regulatory stakeholders, organizational stakeholders, community stakeholders, and the media (Henriques and Sadorsky, 1996).

(3) Product Life Cycle: Typically, product life cycle is comprised of four phases: a product initiation phase usually within research and development activities, a growth phase focusing on developing production capacity and logistics channels, a maturity phase for usually implementing process and cost efficiencies, and finally, a decline phase ends on product divestment (Sarkis, 2003).

(4) Operational Factors: Operational factors are depicted by the value chain of interconnected processes in the beginning of procurement, production, distribution, reverse logistics, and including packaging which may affect the overall supply chain (Sarkis, 2003). Procurement or purchasing entails activities of material purchase associated with less profitable but more environmental qualified items. Production processes integrate reusable or remanufactured components in the production systems which can prevent wastes. Distribution and transportation will influence the positions of outlet locations, mode of transportation to be run, control systems, and just-in-time policies including forward and backward reverse logistics network.

(5) Reverse Logistics Factors: Reverse logistics focuses primarily on return of recyclable or reusable products and materials back into supply chain considering environmental aspect. Some processes in the reverse logistics function include reuse, remanufacturing, recycling, claims & commercial returns, and incineration/landfill activities (Carter and Ellram, 1998). Other identified activities include collection, separation, densification, transitional processing, delivery, and integration (Sarkis, 2003).

(6) Environmental Logistics Performance: Performances of companies would articulate two perspectives: One is an environmental performance, the other is financial performance (Walton et al., 1998; Zhu and Cote, 2004). If a company can reduce environmental pollution, that is increasing environmental performance, and then, it will reflect financially business performance in a long term base. To measure environmental performance, some indexes are adopted for investigating the influence of natural environment: OPI (Operative Performance Indicator), MPI (Management Performance Indicator). OPI is related to the measurement of material consumption, energy management and consumption, and waste emission, another thing is MPI, which has a relationship with managerial competency for environment concerns, contribution, and frequency of measuring (Papadopoulos and Giama, 2007).

EMPIRICAL ANALYSIS

This study adopts ANP for considering the environment of logistics decision-making importance through strategic decision-making process of network analysis methodologies. We followed five steps suggested by Meade and Sarkis (1999). These steps include: 1st step: confirm the goal and define the elements affecting the goal. 2nd step: construct the model and formulate the links. 3rd step: make pairwise comparisons for the elements and clusters. 4th step: form and calculate the supermatrix. 5th step: select the best alternative.

The Analytic Network Process:

Before beginning the steps, we know that completing the ANP technique will require inputs from 'experts'. A larger number of specialists may be used in order to most effectively apply ANP and get general findings. This approach increases accuracy of results, however, it is little difficult to evaluate in-depth analysis for inside and outside of a company's matters. Few specialists in the field exist and extensive expertise and specialty is required for consistency of assessment through consultations between experts. The measurement methodology will be conducted in two phases. The first one is pairwise comparison for every dependency relationship in order to find their relative importance weights. The weight found through the pairwise comparison is used as an input variable to the system-with-feedback supermatrix, which can make a decision for the influence of each networked criteria. The supermatrix evaluation will be conducted by three steps: formation, normalization, and convergence to a possible solution. The final converged supermatrix gives results of the relative priorities for the options within the framework of decision (Sarkis, 2003).

Comparison with Survey and Decision Model

The decision model is shown in Figure 1. At the upper control level, we can see the objective of the ANP model is to select a strategy, with the control hierarchy focusing on corporate performance improvement through green logistics. At the lower network level, three clusters are introduced: External environment (circumstances) which are composed of domestic environmental regulation, external stakeholders, and product life cycle; Green logistics activities which composed of operational and reverse logistics factors, and overall green logistics performance which is composed of environment performance and financial performance index.

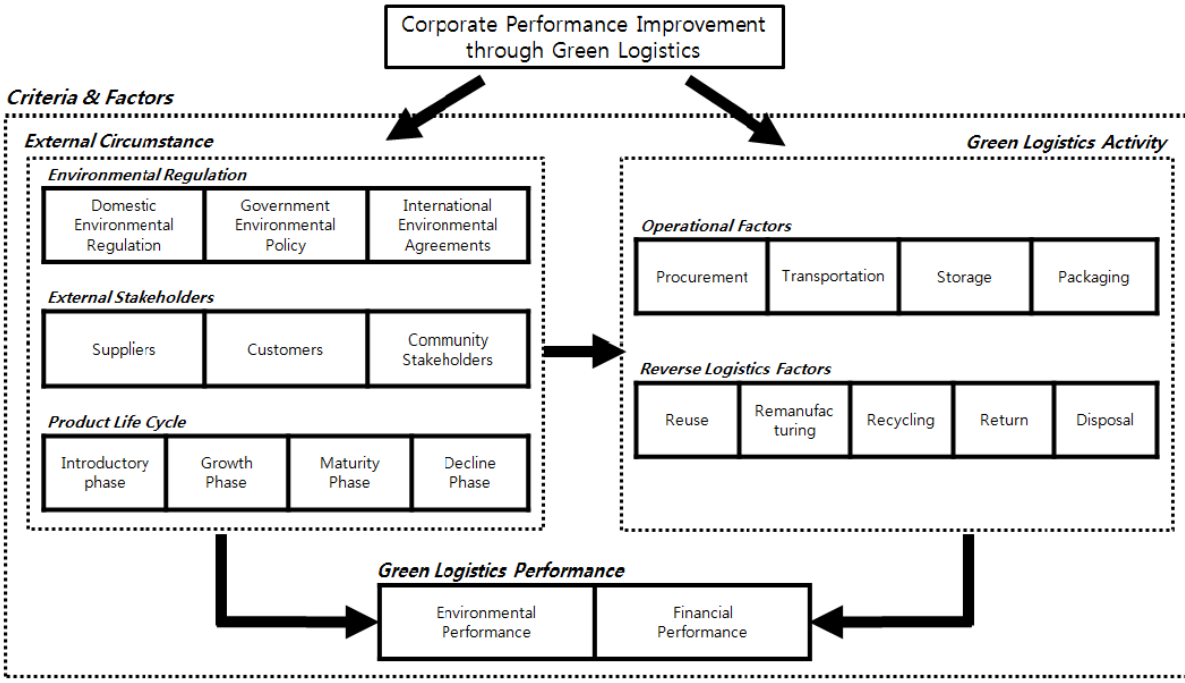

Figure 1. The Structure of the Proposed ANP Model

We did choose 10 eco-friendly environment logistics companies who are conducting an ISO 14000 series of standards for manufacturers of automotive parts of small and medium size were targeted. To improve understanding for experts regarding the ANP questionnaire, we provided each variable to the experts with a detailed definition to make sure that they were perceiving the items consistently (see the Table 1 summary). We used the typical 9-point scale measuring the relative importance as recommended by Saaty. The *AHP Expert Choice 2000* was used to check the consistency amongst the factors by the experts. Geometric means were used to aggregate the data. The analysis of data is carried by the ANP program, *Super Decision 1.6.0.*

Table 1. Cluster, factor, and definition

Cluster	Factors	Adaptive Definition	References
Environmental Regulation	Domestic environmental regulation	Associated with the domestic legal and regulatory environment	EIC (2005) Zhu and Sarkis (2006)
	Government environmental policy	Government policy on the environment (ex. modal shift)	
	International environmental agreements	International environmental conventions on the environment (ex. Kyoto Protocol, WEEE)	
External Stakeholders	Suppliers	Component, parts, and raw materials suppliers	Hall (2000) Sarkis (2003)
	Customers	The finished product' consumer	
	Community stakeholders	Community does not participate in the formation of interest, but org or individual are aware of information	
Product Life Cycle	Introductory phase	Product introduction phase	Sarkis (2003)
	Growth phase	Product growth phase	

	Maturity phase	Product maturity phase	
	Decline phase	Product decline phase	
Operational factors	Procurement	Eco-friendly product procurement	Roberson and Copacino (1994)
	Transportation	Eco-friendly product delivery	
	Storage	Eco-friendly product Storage	
	Packaging	Eco-friendly product packaging	
Reverse Logistics Factors	Reuse	After a brief inspection or cleaning and re-use	Carter and Ellram (1998)
	Remanufacturing	Of new products or repaired parts used in assembling	
	Recycling	Extracting raw materials and recycled, the loss of the original from and function	
	Return	Return the product to the original seller	
	Disposal	Dispose of product which can't be used any more	
Green Logistics Performance	Environmental performance	With community relations and corporate image improvement, waste elimination	Walton, et. al. (1998) Zhu and Sarkis (2004)
	Financial performance	Reduce cost, increase market share, higher profits	

Data Analysis and Results

To solve the ANP problem we first created a supermatrix. The structure of supermatrix has the basic shape as shown in Figure 2, and W_{ij} is called "supermatrix block". Each column of W_{ij} is an eigenvector representing the effect of i^{th} component to j^{th} component of the network.

$$W_{ij} = \begin{bmatrix} w_{i1j1} & w_{i1j2} & \cdots & w_{i1jn} \\ w_{i2j1} & w_{i2j2} & \cdots & w_{i2jn} \\ \vdots & \vdots & \vdots & \vdots \\ w_{inj1} & w_{inj2} & \cdots & w_{injn} \end{bmatrix}$$

Figure 2. The Structure of Supermatrix

Table 3 identifies the submatrices (components) (**A-P**) that form the supermatrix and the various model factors with relationships.

Table 3. Components of Initial Supermatrix

	Goal	Reverse Logistics Factors	External Stakeholder	Operational Factor	Product Life Cycle	Environmental Regulation	Green Logistics Performance
Goal	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Reverse Logistics Factors	**A**	**0**	**B**	**0**	**C**	**D**	**0**
External Stakeholder	**E**	**0**	**0**	**0**	**0**	**0**	**0**
Operational Factor	**F**	**0**	**G**	**0**	**H**	**I**	**0**
Product Life Cycle	**J**	**0**	**0**	**0**	**0**	**0**	**0**
Environmental regulation	**K**	**0**	**0**	**0**	**0**	**0**	**0**
Green Logistics Performance	**0**	**L**	**M**	**N**	**O**	**P**	**0**

We then derived weights for each of the submatrices. For example, from Table 3 submatrices C, H, O weight effects on the product life-cycle perspective, by reverse logistics, operational factors, environmental factors and green logistics performance are shown in <Table 4>, <Table 5>,<Table 6>.

Table 4. Weight of the Sub-matrix C

		Product Life Cycle			
		Introductory Phase	Growth Phase	Maturity Phase	Decline Phase
Reverse Logistics Factor	Return	0.49411	0.4969	0.07289	0.48511
	Remanufacturing	0.11066	0.12911	0.26798	0.0737
	Recycling	0.07307	0.06936	0.15686	0.04043
	Reuse	0.28255	0.26493	0.45881	0.13884
	Disposal	0.03961	0.0397	0.04346	0.26192

At first, we evaluated in terms of product life cycle considering reverse logistics, when initial and growing stage is importantly considering return and re-use, and showed that maturing stage seems re-use and recycling of important parts, and finally, the declining stage appear a higher return. Overall, its goal is to minimize the loss of product.

Table 5. Weight of the Sub-matrix H

		Product Life Cycle			
		Introductory Phase	Growth Phase	Maturity Phase	Decline Phase
Operational Factors	Retention	0.05105	0.23791	0.05529	0.5555
	Transport	0.28924	0.59544	0.56501	0.24588
	Procurement	0.53337	0.0536	0.1175	0.05726
	Packaging	0.12633	0.11304	0.26221	0.14136

We evaluated operational factors in terms of product life cycle, transport is showed that the most important decision factor, and inferred that declining stage seems more important for the retention in order to in stock turnover and rate of disposal. We evaluated environmental logistics performance at the point of product life cycle and resulted in the priority is financial performance compared with environmental performance in Table 6.

Table 6. Weight of the Sub-matrix O

	Product Life Cycle			
	Introductory Phase	Growth Phase	Maturity Phase	Decline Phase

Green Logistics Performance	Financial Performance	0.83333	0.5	0.75	0.2
	Environment Performance	0.16667	0.5	0.25	0.8

In this study, we created a supermatrix for probabilistic nature using Meade and Sarkis (1999)'s method, by calculating the weighted supermatrix. The Initial supermatrix should be normalized to have the column weights summed to '1'. The converged supermatrix is shown in Table 7.

Table 7. Limited Supermatrix

		Goal	Reverse Logistics Factors					External Stakeholder			Operational Factors				Product Life Cycle				Environmental Regulation			Green Logistics Performance	
	Goal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Reverse Logistics Factors	Return	0.05774	0	0	0	0	0	0.05774	0.05774	0.05774	0.05774	0.05774	0.05774	0.05774	0.05774	0.05774	0.05774	0.05774	0.05774	0.05774	0.05774	0	0
	Remanufacturing	0.02341	0	0	0	0	0	0.02341	0.02341	0.02341	0.02341	0.02341	0.02341	0.02341	0.02341	0.02341	0.02341	0.02341	0.02341	0.02341	0.02341	0	0
	Recycling	0.01264	0	0	0	0	0	0.01264	0.01264	0.01264	0.01264	0.01264	0.01264	0.01264	0.01264	0.01264	0.01264	0.01264	0.01264	0.01264	0.01264	0	0
	Reuse	0.06293	0	0	0	0	0	0.06293	0.06293	0.06293	0.06293	0.06293	0.06293	0.06293	0.06293	0.06293	0.06293	0.06293	0.06293	0.06293	0.06293	0	0
	Disposal	0.00994	0	0	0	0	0	0.00994	0.00994	0.00994	0.00994	0.00994	0.00994	0.00994	0.00994	0.00994	0.00994	0.00994	0.00994	0.00994	0.00994	0	0
External Stakeholder	Customers	0.04746	0	0	0	0	0	0.04746	0.04746	0.04746	0.04746	0.04746	0.04746	0.04746	0.04746	0.04746	0.04746	0.04746	0.04746	0.04746	0.04746	0	0
	Suppliers	0.00812	0	0	0	0	0	0.00812	0.00812	0.00812	0.00812	0.00812	0.00812	0.00812	0.00812	0.00812	0.00812	0.00812	0.00812	0.00812	0.00812	0	0
	Community Stakeholders	0.02776	0	0	0	0	0	0.02776	0.02776	0.02776	0.02776	0.02776	0.02776	0.02776	0.02776	0.02776	0.02776	0.02776	0.02776	0.02776	0.02776	0	0
Operational Factors	Storage	0.02024	0	0	0	0	0	0.02024	0.02024	0.02024	0.02024	0.02024	0.02024	0.02024	0.02024	0.02024	0.02024	0.02024	0.02024	0.02024	0.02024	0	0
	Transportation	0.09192	0	0	0	0	0	0.09192	0.09192	0.09192	0.09192	0.09192	0.09192	0.09192	0.09192	0.09192	0.09192	0.09192	0.09192	0.09192	0.09192	0	0
	Procurement	0.01497	0	0	0	0	0	0.01497	0.01497	0.01497	0.01497	0.01497	0.01497	0.01497	0.01497	0.01497	0.01497	0.01497	0.01497	0.01497	0.01497	0	0
	Packaging	0.03954	0	0	0	0	0	0.03954	0.03954	0.03954	0.03954	0.03954	0.03954	0.03954	0.03954	0.03954	0.03954	0.03954	0.03954	0.03954	0.03954	0	0
Product Life Cycle	Introductory Phase	0.00452	0	0	0	0	0	0.00452	0.00452	0.00452	0.00452	0.00452	0.00452	0.00452	0.00452	0.00452	0.00452	0.00452	0.00452	0.00452	0.00452	0	0
	Growing Phase	0.00904	0	0	0	0	0	0.00904	0.00904	0.00904	0.00904	0.00904	0.00904	0.00904	0.00904	0.00904	0.00904	0.00904	0.00904	0.00904	0.00904	0	0
	Maturing Phase	0.04637	0	0	0	0	0	0.04637	0.04637	0.04637	0.04637	0.04637	0.04637	0.04637	0.04637	0.04637	0.04637	0.04637	0.04637	0.04637	0.04637	0	0
	Declining Phase	0.0234	0	0	0	0	0	0.0234	0.0234	0.0234	0.0234	0.0234	0.0234	0.0234	0.0234	0.0234	0.0234	0.0234	0.0234	0.0234	0.0234	0	0
Environment Regulation	Domestic Environment Regulation	0.05308	0	0	0	0	0	0.05308	0.05308	0.05308	0.05308	0.05308	0.05308	0.05308	0.05308	0.05308	0.05308	0.05308	0.05308	0.05308	0.05308	0	0
	International Environmental Agreement	0.00873	0	0	0	0	0	0.00873	0.00873	0.00873	0.00873	0.00873	0.00873	0.00873	0.00873	0.00873	0.00873	0.00873	0.00873	0.00873	0.00873	0	0
	Governmental Environmental Policy	0.02152	0	0	0	0	0	0.02152	0.02152	0.02152	0.02152	0.02152	0.02152	0.02152	0.02152	0.02152	0.02152	0.02152	0.02152	0.02152	0.02152	0	0
Green Logistics Performance	Financial Performance	0.23101	0.23101	0.23101	0.23101	0.23101	0.23101	0.23101	0.23101	0.23101	0.23101	0.23101	0.23101	0.23101	0.23101	0.23101	0.23101	0.23101	0.23101	0.23101	0.23101	0	0
	Environment Performance	0.18566	0.18566	0.18566	0.18566	0.18566	0.18566	0.18566	0.18566	0.18566	0.18566	0.18566	0.18566	0.18566	0.18566	0.18566	0.18566	0.18566	0.18566	0.18566	0.18566	0	0

Overall, companies consider the most important factors to be financial performance (0.23101) which composes of cost reduction, improved market share, and creation of profitability, and environmental performance (0.18566) which composes of community relations, enhancement of corporate image, and removal of waste.

Next, we generalized each interclusters for the relative importance of the calculated factors in Table 8. The results showed reverse logistics' reuse (0.377595), external stakeholder's customer (0.569474), operational factor's transport (0.551509), product life cycle's maturing stage (0.556462), and environmental regulations' domestic environmental regulations (0.636985) were of importance.

Table 8. Cluster Generalization

Cluster	Factors	Normalization	Cluster Generalization
Reverse Logistics Factors	Return	0.05774	0.346454
	Remanufacturing	0.02341	0.140466
	Recycling	0.01264	0.075843
	Reuse	0.06293	0.377595
	Disposal	0.00994	0.059642
External Stakeholder	Customers	0.04746	0.569474
	Suppliers	0.00812	0.14469
	Community stakeholders	0.02776	0.198399
Operational Factors	Storage	0.02024	0.121438
	Transportation	0.09192	0.551509
	Procurement	0.01497	0.089818
	Packaging	0.03954	0.237235
Product Life Cycle	Introductory phase	0.00452	0.054242
	Growth phase	0.00904	0.108484
	Maturity phase	0.04637	0.556462
	Decline phase	0.0234	0.280811
Environmental Regulations	Domestic environmental regulation	0.05308	0.636985
	International environmental agreement	0.00873	0.104764
	Government environmental policy	0.02152	0.25825
Green Logistics Performance	Financial performance	0.23101	0.55442
	Environment performance	0.18566	0.44558

CONCLUSION

We reviewed literature and developed decision making framework, then, selected case companies and collected data through survey from those companies, and finally compared with pairwise comparison method. The used ANP methodology has provided a robust multiattribute decision making technique, which can be able to include important factors and practical approach to reach the final goal through selected input factors with a relative intuition (Sarkis, 2003).

The decision framework has modeled and integrated by not only external influences such as external environment regulations and stakeholders but also internal factors such as product life cycle, reverse logistics, and operational factors. The model therefore was formed control hierarchies and network hierarchies for decision modeling propose. Through the ANP analysis, the logistics activities of the Small & Medium (SME) sized automotive parts industry seemed that they have made their strategic decisions, but only basically and necessarily under control of direct legal regulations rather than any of the government's environmental policies or any international environmental agreements, which are not seemed to be affected directly by those loosened recommendations.

The findings indicated that companies have a preference toward financial performance (0.554422) rather than environment performance (0.445588) at the introductory phase, however; conversely indicated the ratio between environment performance (0.8) and financial performance (0.2) at the decline phase. We may infer that S&M sized companies may have more interest in financial profitability at a short term base. Surprisingly, the companies have paid attention on both of financial and environment at the phase of growth, which we induced that companies should concern all facets that are related to directly financial aspect as well as indirectly non-financial aspects such as customer satisfaction and eco-friendly transport delivery. In addition, our findings show that the companies have tendency to reuse for the returned product from their consumers to minimize their loss.

This study can help upper level managers understand Green Logistics Practices and enable the decision makers to assess the perception of necessity of Green Logistics in their companies. Although we only selected and used data from S&M sized automobile parts companies, which we wouldn't say our findings can be generalized, however it may give results for one of the most important supplier and manufacturer relation areas for further research on exploring the implications of Green Logistics under forthcoming electronic car manufacturing period shortly. Also, the application of analytical tool in determining weights for various approaches of Green Logistics is provided to utilize analytic network process (ANP) in terms of feedback systematic and interrelated activities.

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