

Integrating Green Innovations in Logistics Services Towards Logistics Services Sustainability: A Conceptual Paper

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Abstract: Innovation is a primary concern of industry and logistics services are constantly looking for ways to innovate in order to gain competitive advantage revolutionary. Green innovations can have a major impact in reducing the environmental burden of this industry particularly in terms of pollution and greenhouse gas emissions. The collaborations can also engage with industry and play a role by providing the right environment for companies to innovate. From this context, it is evident, there is a need for integrating green innovations in logistics. One of the big challenges facing the industry at present is creating a long term sustainable society with the least possible negative environmental impact. They added that in response to this pressure, a new approach of green innovations to logistics emerged in the early 2000s which went beyond the standard logistical imperatives for efficient, effective and fast handling and movement of goods and took into account measures for protecting the earth's environment or sometimes, it was referred to green logistics approach. The green logistics refers to plan, control, management and implementation the logistics system through the advanced logistics technology and environmental management, aiming to reduce the pollutant emission. This study will only address the issue of green innovations in logistics as a focus of this study. It is believed that a green innovation in logistics is a promising area of study and practice that have the potential to provide significant benefits to the firm and the society.

Key words: Green innovation, logistics service, sustainability, significant, environment, Malaysia

INTRODUCTION

Nowadays, many companies have started to undertake significant efforts towards establishing Green Supply Chain Management (GSCM) initiatives (Srivastava, 2008; Zhu *et al.*, 2007). The concept of GSCM encompasses environmental initiatives in inbound logistics which including green purchasing, eco-design, production, outbound logistics which including reverse logistics. These initiatives involve materials suppliers, service contractors, vendors, distributors and end users that working together to reduce or eliminate adverse environmental impacts of their activities (Vachon and Klassen, 2006). The logistics industry manages the flows of products, services and information across customers and suppliers allowing the integration of supply chains in which success in integrating global supply chains starts with the ability of firms to move goods across borders rapidly, reliably and cheaply.

A competitive and efficient logistics sector is vital for all economies and is an imperative component of trade. Accordingly, logistics management plays a significant role in GSCM. This is supported by Skjoett-Larsen in which he claimed that with the rapid development of the

GSCM, the importance of environmental management for the logistics industry has increased dramatically. Subsequently, the survey done by Capgemini Press Release shows that the greening of the supply chain will have an increasing impact on in logistics activities such as network design, transport modes used, warehousing, selection of equipment, business processes, behaviors and balance sheets.

Yet, few companies rate green capabilities as a deciding factor when choosing 3rd Party Logistics (3PL) partners in which 46% of respondents said that the effect of supply chain operations on the environment was a factor considered when selecting 3PL (Capgemini Press Release).

In order to deliver products and services to customers more environmentally, therefore, logistics service providers need to address more efforts on environmental issues (Murphy and Poist, 2003; Sarkis *et al.*, 2004). For instance, United Parcel Service (UPS), a global logistics service provider uses route planning software and an internet matching system in their logistics service process to reduce the emission of greenhouse gas as well as to save fuel consumption (Lin and Ho, 2008). Integrating green innovation into

Table 1: Examples of green logistics schemes

Category	Implemented policy
Restriction zones	Copenhagen-city goods ordinance for capacity management, Sweden-environmental zones, UK-low emissions zones, Brussels-lorry dedicated routes
Clean vehicles	Rotterdam-electric vehicle city distribution system Osaka-electric vans, Zurich-cargo tram
Coordinated transport	Berlin-goods traffic platform, Stockholm-logistical centre for coordinated transports
Congestion mitigation	Barcelona-multiple use lanes on line parking information; Paris, Barcelona, Rome-Night delivery schemes
Charging	London-congestion charging, Germany-truck toll system
Information system	New York and Vancouver-internet port information system, Tokyo-advanced information systems
Water use	Amsterdam-floating distribution centre, Waterborne traffic management decision support system

logistics services is becoming an important topic for the logistic industry. Furthermore, Lin and Ho (2008) claimed that green innovations in logistics services can help improve efficiency and effectiveness across many sectors of the economy. Following this, several examples of sustainable logistics and green logistics schemes that have been used in various countries is shown in Table 1. It is believed that the schemes have in common a cooperation of all the interest players in logistics industry (shippers, carriers, transporters and suppliers).

Innovation is a primary concern of industry and logistics services are constantly looking for ways to innovate in order to gain competitive advantage revolutionary (Mena *et al.*, 2007). Green innovations can have a major impact in reducing the environmental burden of this industry particularly in terms of pollution and greenhouse gas emissions. The collaborations can also engage with industry and play a role by providing the right environment for companies to innovate.

From this context, it is evident, there is a need for integrating green innovations in logistics. One of the big challenges facing the industry at present is creating a long term sustainable society with the least possible negative environmental impact (Lin and Ho, 2008). They added that in response to this pressure, a new approach of green innovations to logistics emerged in the early 2000s which went beyond the standard logistical imperatives for efficient, effective and fast handling and movement of goods and took into account measures for protecting the earth's environment or sometimes it was referred to green logistics approach. According to Chang and Qin, the green logistics refers to plan, control, management and implementation the logistics system through the advanced logistics technology and environmental management, aiming to reduce the

pollutant emission. They have recommended the evaluation criterions of enterprise green logistics as follows:

Green transportation: The green transportation refers to use a kind of fuel with the least pollution as the power to try to implement the multi-transportation and allocation mode. Correctly, arrange the transportation can in this way reduce the pollution, lower the cost and raise the allocation level.

Green storage: The green storage refers to adoption the mechanized operation in the process of goods-storing to save the manpower cost, adoption the environmentally friendly products to sterilize the storage goods, adoption the method of centralized-stock to reduce the radicalization to the surroundings and reduce the adverse effect of the warehousing on the environment.

Green packing: The green package refers to a kind of commodity package that will not cause the environmental pollution. The packing materials should save the resources and reduce the packing waste moreover, it is supposed to be recycled and regenerated after using as well as occupies little land while burying in order to be decomposed easily.

Reverse logistics: The reverse logistics is contrary to the traditional supply chain, it devotes to reasonably disposal or recovering the value by planning, managing and controlling the raw materials, middle stock, final products and relative information from consumer place to start point.

Green innovation: The green innovation refers to adoption the innovation such as information and communication technology, biological technology, monitoring technology and a variety of specific technologies in the process of logistics management. The application of the advanced innovation enables the enterprise to improve environmental management, effectively.

However, regarding to Lin *et al.* (2009), green innovation is the accumulating more related technologies with learn new technology by training and educating the workers to become knowledge workers. This study however, will only address the issue of green innovations in logistics as a focus of this study. It is believed that a green innovation in logistics is a promising area of study and practice that have the potential to provide significant benefits to the firm and the society.

LITERATURE REVIEW

Logistics services industry: According to Lin and Ho (2008), logistics has evolved from being a tactical requirement into a strategic activity that links customers and suppliers by managing the flows of goods, services and information from point of origin to point of consumption. The most common activities associated with logistics are transport and warehousing however, other activities such as forwarding, customs clearance, packaging, labeling and various aspects of information management are also considered part of logistics. Although, logistics is commonly associated with manufacturing industries, all industries need logistics services for example, banking, health services, education and retail require very sophisticated logistics systems. Based on various roles of logistics, logistics can be leveled at the centre of economic activity and makes innovation in logistics a key element to improve efficiency and effectiveness across all industries. With the current competitive scenario, companies worldwide continuously were trying to develop new and innovative strategies to enhance their global competitiveness.

Logistics service sector in Malaysia

Growth and activity: According to Mustafa and Potter (2009), the present trend of logistics industry in Malaysia is concentrating on the outsourcing of logistics activities and growth of 3rd Party Logistics (3PL). However, the issue of cost appears to be as the most important factor in the growth of 3PL with greater benefits for cost and reduce delivery lead time (Mustafa and Potter, 2009). It is supported by Sohail *et al.* (2006) in their study in which they found that 67.7% companies in Malaysia use the contract logistics services with a primary focus on domestic operations while Singapore 3PL industry have been focus on international.

Accordingly, Sohail and Sohal (2003) claimed that Malaysia's firms used 3PL because give more effective utilization of human resources, better delivery and handling of cargo and enhancement of information technology system from external parties.

According to Senior Assistant Director (Logistics) Malaysia from MIDA, the government has set up the Malaysia Logistics Council (MLC) in February 2007 to focus on 4 groups, representing; maritime transport services; land transport services; air transport services and ancillary logistics and supply chain management. MLC is acted as the focal point for the overall coordination on strategies, policies, regulations and rules for the logistics sector. It will easier for logistics industry to enhance competitiveness at global and regional levels.

The logistics industry in Malaysia covers four main modes of transportation namely, sea, land, air and rail. The

significance of the industry to the Malaysian economy can be seen from its contribution to the GDP. In 2007, the industry, comprising, transport, storage and communication services contributed 12.8% to the country's GDP. It is estimated that currently, there are about 22,000 companies in the logistics industry in Malaysia undertaking various areas of activities. Targets for the logistics industry set by the IMP3 are overall growth of 8.6% during the plan period and contribution to GDP of 12.1% by 2020.

Industry structure: Presently, the Malaysian logistics industry comprises largely of single specialized service providers such as freight forwarders, transport companies and warehousing companies. Figure 1 portrays the structure of logistics industry in Malaysia.

Accordingly, there is a need for the government bodies to encourage local logistics services providers to assume a bigger role in providing logistics services. In view of this, the Government has introduced the integrated logistics services incentive in 2002 to encourage logistics service providers to consolidate or integrate their activities and become 3rd Party Logistics Service Providers.

The Government is also encouraging local logistics companies to venture abroad in order to participate in the overall global supply chain. Seong has summarized the logistics industry structure in Malaysia into 2 categories, namely:

Transport service providers: Transport service providers including operator of road, rail, air and sea with multimodal operator and terminal operator.

Logistics service providers: The logistics service providers consist of facilitation services (such as freight forwarders, customs brokers, ship brokers, shipping agents, consolidators and non-vessel operating common carriers), distribution services (warehousing and transportation, inventory management and domestic and regional distribution and courier companies), integrated logistics services (3PL and lead logistics providers (4 PL)) and business support services (ICT service providers, banking and insurance, education and training, equipment handling, maintenance and repairs and security).

Employment: Logistics has emerged from merely a supporting activity that facilitates trade to a crucial sector by which the nation's competitiveness is measured. Local industry needs to develop skilled and trained manpower

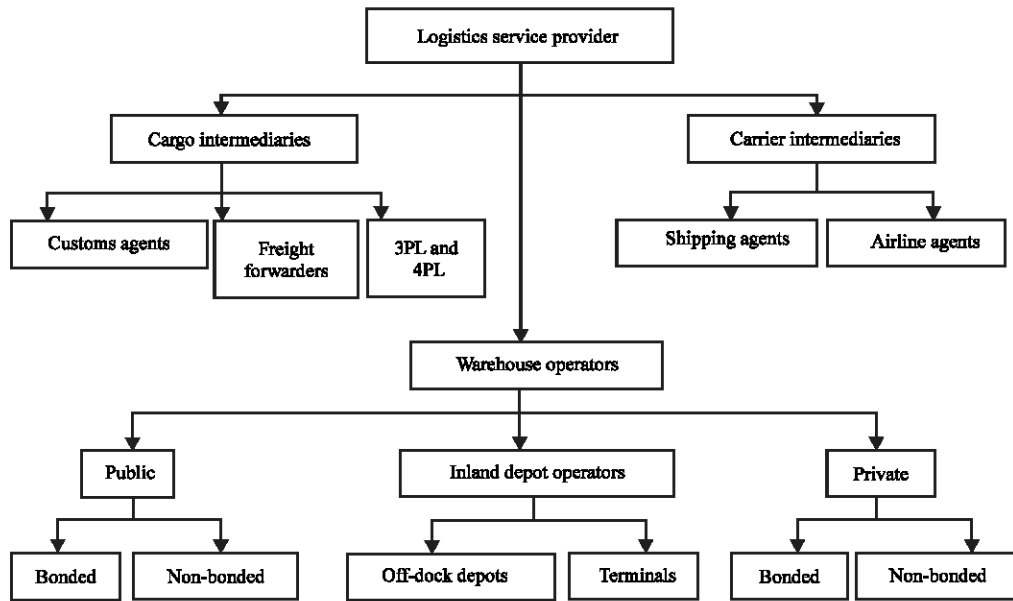


Fig. 1: Structure of logistics service providers in Malaysia

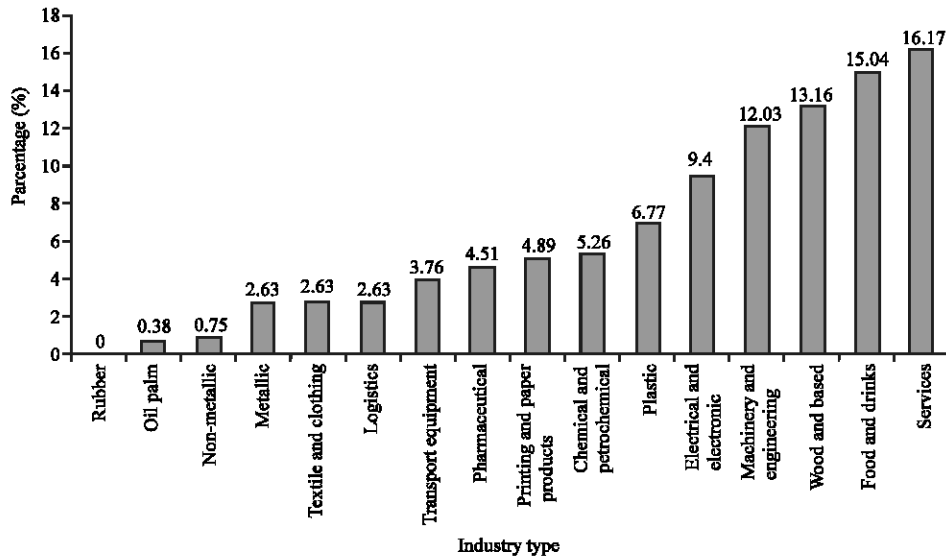


Fig. 2: Percentage distribution of employment growth by industry types, 2006 (industrial surveys for the master plan study)

to enable them serve higher-end clients by introducing new services and bringing innovative solutions (Bernama.com, 2008). Furthermore, employment is become more important part for logistics industry in order to give a better logistics services. Both Fig. 2 and 3 highlights the phenomenon in the industry. As recommended by researcher in USA, skills or expertise and training are required for logistics executives (Razzaque and Sirat, 2001). In other words, the logisticians need to be multi-skilled generalists rather than technically-oriented to

succeed as logistics executives in the complex business environment of today. Following this, Poist recommended the Business Logistics Management (BLM) framework which includes all the desired knowledge, attributes and skills which a senior-level should acquire. The BLM framework is comprises of:

- Business knowledge and skills
- Logistics knowledge and skills
- Management knowledge and skills

Designation	ELECTRICAL & ELECTRONIC				LOGISTICS				SALES			
	Malaysian		Foreigners	Total Row%	Malaysian		Foreigners	Total Row%	Malaysian		Foreigners	Total Row%
	Bumi-putera	Non-Bumi-putera			Bumi-putera	Non-Bumi-putera			Bumi-putera	Non-Bumi-putera		
Managers	Row %	11.76	76.00	13.24	100.00	36.80	60.00	1.8	100.00	14.90	72.30	100.00
	Column %	0.73	12.76	0.87		3.03	15.54	100.0		1.77	12.36	2.60
Engineers	Row %	28.86	66.83	4.33	100.00	0.00	100.00	-	100.00	49.70	47.40	3.70
	Column %	1.83	11.59	0.29		-	6.25	-		3.05	4.27	0.40
Other professionals	Row %	31.49	66.38	2.13	100.00	81.80	16.20	-	100.00	64.10	46.00	100.00
	Column %	2.06	13.01	0.16		6.68	4.17	-		1.61	1.56	
Technicians	Row %	76.49	16.88	7.63	100.00	92.90	7.10	-	100.00	61.80	24.50	13.60
	Column %	11.38	6.42	1.20		3.18	0.69	-		7.88	4.27	2.70
Superior and Chief Officers	Row %	70.44	37.31	0.25	100.00	79.40	20.40	-	100.00	45.10	31.60	0.30
	Column %	8.76	9.92	0.03		27.62	20.14	-		15.34	23.67	0.10
Skilled workers	Row %	37.38	6.48	64.15	100.00	81.40	16.60	-	100.00	37.30	20.70	30.60
	Column %	48.76	20.82	66.63		10.04	6.60	-		20.86	16.70	33.60
Semi skilled workers	Row %	71.06	10.60	18.34	100.00	60.00	40.0	-	100.00	36.10	34.50	29.10
	Column %	18.99	6.81	4.37		16.54	29.66	-		17.03	23.58	22.20
Unskilled workers	Row %	37.67	4.08	68.85	100.00	71.80	28.10	-	100.00	79.10	16.7	4.30
	Column %	8.90	2.67	14.97		4.97	6.66	-		16.39	4.97	1.40
General Workers	Row %	20.77	28.81	80.72	100.00	66.30	18.70	-	100.00	36.20	13.70	49.60
	Column %	4.43	16.60	11.47		29.09	13.19	-		16.70	9.24	37.10
Total Column %		100.00	100.00	100.00		100.00	100.00	100.00		100.00	100.00	100.00

Fig. 3: Occupational categories by major selected industry types, 2006 (industrial surveys for the master plan study)

Table 2: Differences means score for management skill/knowledge

Topic	Singapore	Malaysia
	-----Mean score-----	
Personal integrity	3.80	3.61
Ability to plan	3.82	3.04
Ability to adapt to change	3.74	3.25
Problem-solving ability	3.67	3.40
Self-motivation	3.66	3.59
Ability to organize	3.55	3.37
Managerial control	3.14	3.19
Enthusiasm	3.13	3.44
Analytical reasoning ability	3.09	3.28
Ability to manage time	3.05	2.78
Ability to motivate	3.05	3.48
Operational knowledge	3.05	2.58
Identify environmental opportunities/threats	3.04	3.43
Expertise in interpersonal relations	3.03	3.22
Ability to view firm as a system	3.03	3.37
Ability to supervise	2.91	3.26
Written communication effectiveness	2.76	2.65
Ability to listen	2.77	3.51
Self-confidence	2.77	2.94
Ability to negotiate	2.76	2.97
Oral communication effectiveness	2.59	2.76
Ability to delegate responsibility	2.59	3.02
Assertiveness towards others	2.54	2.44
Ability to display statesmanship	2.38	3.13
Outgoing personality	2.38	1.45
Quantitative expertise	2.34	2.09
Ability to persuade	2.29	3.03
Ability to train subordinates	2.28	2.46
Personal grooming habits	2.13	2.69
Computer expertise	2.05	2.12
Personal dress habits	1.94	2.32
Expertise in foreign language	1.66	1.21

Razzaque and Sirat (2001)

Regarding to Razzaque and Sirat's study on the logistics industry in Malaysia and Singapore, they found that senior logistics executives in Malaysia perceive management knowledge and skills as the most important

Table 3: Comparison logistics infrastructure of countries in Asean

Country	Port	Airport	Railway	Road
Cambodia	Poor	Fair	Poor	Poor
Indonesia	Poor	Fair	Good	Fair
Laos	Not applicable	Poor	Not applicable	Fair
Malaysia	Good	Good	Good	Good
Philippines	Fair	Fair	Poor	Fair
Singapore	Good	Good	Good	Good
Thailand	Good	Good	Good	Good
Vietnam	Fair	Fair	Fair	Fair
Burma	Good	Poor	Poor	Fair

factor (Razzaque and Sirat, 2001). Similarly, Singapore's respondents also claimed that management knowledge and skills is the most important factor. Table 2 shown 32 elements in the management knowledge and skills.

The Malaysians logistics infrastructure: Malaysia is known as the strategic location for logistics in the Asia because of the strategic location. Asia is growing fast and infrastructure terms of air and seaports are constantly changing.

The comparison infrastructure of logistics industry in Asean is shown in Table 3. Table 3 shows infrastructure of logistics in Malaysia including ports, airport, railway and road are good condition. It is similar with Singapore and Thailand while others country needs improvement in their infrastructure.

In other hand, Bookbinder and Tan (2003) highlighted that Malaysia as countries of Asean still protections by government because many nations in Asean are still under-development. Malaysia needs to improve in the terms of infrastructure to compete with

Table 4: Differences logistics attribute among three worlds

Description	First world	Emerging	Third world
Infrastructure	Highly developed and well maintained	Developing and partially maintained	Significant development and maintenance are required
Work processes	Highly friendliness	Moderately friendliness	Low friendliness
Availability of skilled labor	Highly availability	Moderately availability	Low availability
Political	Highly stable	Stable	Some risk of instability

Bookbinder and Tan (2003)

other first world countries. Malaysia opened its new, state of the art international airport to match the cargo handling productivity of Singapore Airport. Then, Malaysia and Thailand have been upgrading their ports in order to compete for business with the port of Singapore.

It was supported by the statement from Datuk Seri Najib Tun Razak which Malaysia had logistics service providers capable of engaging in supply chain management directly with their clients locally and globally (The Star, 6 Nov 2008). Table 4 shows the infrastructure condition in three worlds in which Malaysia is one of the emerging countries.

International comparison: In 2007, the World Bank launched its Logistics Performance Index (LPI), intended as the first in-depth cross-country assessment of the logistics gap among countries. The LPI was calculated on a five-point scale and based on survey responses from over 800 logistics professionals. Countries were given an aggregate LPI score which was in turn made up of seven sub-categories, covering criteria such as the quality of customs, infrastructure and international shipments; logistics competence; tracking and tracing; domestic logistics costs and timeliness.

In the 2007 survey, Malaysia was ranked 27th in the world with an LPI score of 3.5 placing it significantly below the major OECD economies (Table 5). For comparison Malaysia was behind the Netherlands (ranked 2nd in the world with an LPI of 4.2) Germany (3rd with an LPI of 4.1), the UK (9th, LPI of 4.0) and the US, (14th, LPI of 3.8). In comparison to other Asian economies, it was behind Singapore (ranked first in the world with an LPI of 4.2) and Australia, (17th, LPI of 3.8) but ahead of China (30th, LPI of 3.3), Thailand (31st, LPI of 3.3), Indonesia (43rd, LPI of 3.0) and Vietnam (53rd, LPI of 2.9).

Environment and logistics: Environmental issues have become critical issues in the scope of logistics (Murphy and Poist, 2003). For operational effectiveness, companies have a focus in lower cost and shorter lead time without taken care about the environmental issues (Aronsson and Brodin, 2006). The environmental issues will have significant impact on salvage and scrap disposal as well as return goods handling. Firms need to create strategies

in order to overcome these issues especially in logistics industry. For example, Dell company strategies are doing e-commerce to deliver the information to their customer. Thus, they can confirm ordering after receiving product specification and lower inventory cost, outdated product and spoilage cost/waste (Sarkis *et al.*, 2004). This is been supported by Arvis in which they claimed that the logistics industry is central to economic, social and environmental sustainability.

In other words, it is closely linked to issues such as globalization, employment, economic development, international security, pollution, greenhouse gas emissions and congestion and traffic accidents among others. Furthermore, it is essential to the operation of many other industries having an impact on key performance indicators such as cost, service delivery, responsiveness and reliability.

As mentioned earlier, logistic activities include of distribution network design, freight transport, storage, inventory management, material handling, production plan and all the related information in processing. Subsequently, the main objective of logistics is to coordinate these activities to meets customer requirements at minimum cost. According to Piecyk and McKinnon (2007), there are a few types of cost that should be taken which is environmental costs, congestion costs and infrastructure costs.

Environmental costs comprise the climate change, air pollution, noise and accidents (Piecyk and McKinnon, 2007). Wu and Dunn (1995) highlighted that the environmental friendly logistics structures are characterized by fewer movements, less handling, shorter transportation distance, more direct shipping routes and better utilization. In other words, a great logistics structure will provide minimum environmental costs. On the other hand, Rodrigue *et al.* (2001) have stated that there are basic inconsistencies between greenness and logistics. They added that the cost saving strategies in logistics industry are often at variance with the environment in which logistical activities do not usually pay the full costs of using the environmental infrastructures. As a result, logistical operators use the most polluting, least energy efficient and most infrastructure intensive transportation modes to increase the speed of distribution. In other words, the issues of

Table 5: International logistics performance index

Logistics performance index			Logistics performance index			Logistics performance index		
Country	Rank	Score	Country	Rank	Score	Country	Rank	Score
Singapore	1	4.19	Romania	51	2.91	Senegal	101	2.37
Netherlands	2	4.18	Jordan	52	2.89	Cote d'Ivoire	102	2.36
Germany	3	4.10	Vietnam	53	2.89	Kyrgyz Republic	103	2.35
Sweden	4	4.08	Panaa	54	2.89	Ethiopia	104	2.33
Austria	5	4.06	Bulgeria	55	2.87	Liberia	105	2.31
Japan	6	4.02	Mexico	56	2.87	Moldova	106	2.31
Switzerland	7	4.02	Sao toam and principle	57	2.86	Bolivia	107	2.31
Hong Kong, China	8	4.00	Lithuania	58	2.78	Lesotho	108	2.30
United kingdom	9	3.99	Peru	59	2.77	Mali	109	2.29
Canada	10	3.92	Tunisia	60	2.76	Mozambique	110	2.29
Ireland	11	3.91	Brazil	61	2.75	Azerbaijan	111	2.29
Belgium	12	3.89	Guinea	62	2.71	Yemen, Rep.	112	2.29
Denmark	13	3.86	Crotia	63	2.71	Burundi	113	2.29
United states	14	3.84	Sudan	64	2.71	Zimbabwe	114	2.29
Finland	15	3.82	Philippines	65	2.69	Serbia and Montenegro	115	2.28
Norway	16	3.81	El Salavador	66	2.65	Guinea-Bissau	116	2.28
Australia	17	3.79	Mauritania	67	2.63	Lao PDR	117	2.25
France	18	3.76	Pakistan	68	2.62	Jamaica	118	2.25
New Zealand	19	3.75	Venezuela, RB	69	2.62	Togo	119	2.25
United Arab Emirates	20	3.73	Ecuador	70	2.60	Madagascar	120	2.24
Taiwan, China	21	3.64	Paraguay	71	2.57	Burkina Faso	121	2.24
Italy	22	3.58	Gosta Rica	72	2.55	Nicaragua	122	2.21
Luxembourg	23	3.54	Ukraine	73	2.55	Haiti	123	2.21
South Africa	24	3.53	Belarus	74	2.53	Eritrea	124	2.19
Korea, Rep.	25	3.52	Guatemala	75	2.53	Ghana	125	2.16
Spain	26	3.52	Kenya	76	2.52	Namibia	126	2.16
Malaysia	27	3.48	Gambia	77	2.52	Somalia	127	2.16
Portugal	28	3.38	Iran, Islamic Rep.	78	2.51	Bhutan	128	2.16
Greece	29	3.36	Uruguay	79	2.51	Uzbekistan	129	2.16
China	30	3.32	Hondurus	80	2.50	Nepal	130	2.14
Thailand	31	3.31	Cambodia	81	2.50	America	131	2.14
Chile	32	3.25	Colombia	82	2.50	Maurituis	132	2.13
Israel	33	3.21	Uganda	83	2.49	Kazakhstan	133	2.12
Turkey	34	3.15	Cameroon	84	2.49	Gabon	134	2.10
Hungary	35	3.15	Comoros	85	2.48	Syrian Arab Republic	135	2.09
Bahrain	36	3.15	Angola	86	2.48	Mongolia	136	2.08
Slavenia	37	3.14	Bangladesh	87	2.47	Tazania	137	2.08
Ozech Republic	38	3.13	Bosnia and Herzegovina	88	2.46	Solomon Iselands	138	2.08
India	39	3.07	Benin	89	2.45	Atania	139	2.08
Poland	40	3.04	Macedonia, FYR	90	2.43	Algeria	141	2.06
Suadi Arabia	41	3.02	Malawi	91	2.42	Gyuna	141	2.05
Latvia	42	3.02	Sri Lanka	92	2.40	Chad	142	1.98
Indonesia	43	2.01	Nigeria	93	2.40	Niger	143	1.97
Kuwait	44	2.99	Morocco	94	2.38	Sierra Leone	144	1.95
Argentina	45	2.98	Papua New Guinea	95	2.38	Djibouti	145	1.94
Qatar	46	2.98	Dominican Republic	96	2.38	Tajikistan	146	1.93
Estonia	47	2.95	Egypt, Arab Rep.	97	2.37	Myanmar	147	1.86
Oman	48	2.92	Lebanon	98	2.37	Rwanda	148	1.77
Cyprus	49	2.92	Russian Federation	99	2.37	Timer Leste	149	1.71
Slovak republic	50	2.92	Zambia	100	2.37	Afghanistan	150	1.21

environmentalism on logistics industry are highly imposed on transportation and distribution (Rodrigue *et al.*, 2001).

Muller (1992) suggested that the growing importance of environmental concept has two major impacts on logistics management which are the scope of logistics and an influence on the way logistics managers do their jobs. Meanwhile, Rodrigue *et al.* (2001) describe that globalization and global logistics are destructing the

environment unevenly because firms are required to maintain high environmental standards in developed countries but can lower these in less developed. Nevertheless, the growing importance of environmental in logistics has become a universal issue and generated a great deal of discussions among the international academic and business communities all around the world to solve the conflicts. Table 6 shows the major characteristics of these conflicts. The outcomes column

Table 6: Dimension outcomes paradox

Dimensions	Outcomes	Paradox
Costs	Reduction of costs through improvement in packaging and reduction of wastes Benefits are derived by the distributors	Environmental costs are often externalized
Time/Flexibility	Integrated supply chain. Provide flexible and efficient physical distribution system	Extended production, distribution and retailing structures consuming more space, more energy and producing more emissions
Network	Increasing system-wide efficiency of the distribution system through network changes (Hub and Spoke Structure)	Concentration of environmental impacts next of major hubs and along corridors
Reliability	Reliable and on-time distribution of freight and passengers	Pressure on local communities Modes used, trucking and air transportation are the least environmentally efficient
Warehousing	Reducing the needs for private warehousing facilities	Inventory shifted in part to public roads, contributing to congestion and space consumption
E-commerce	Increased business opportunities and diversification of the supply Chains	Changes in physical distribution systems towards higher levels of energy consumption

Rodrigue *et al.* (2001)

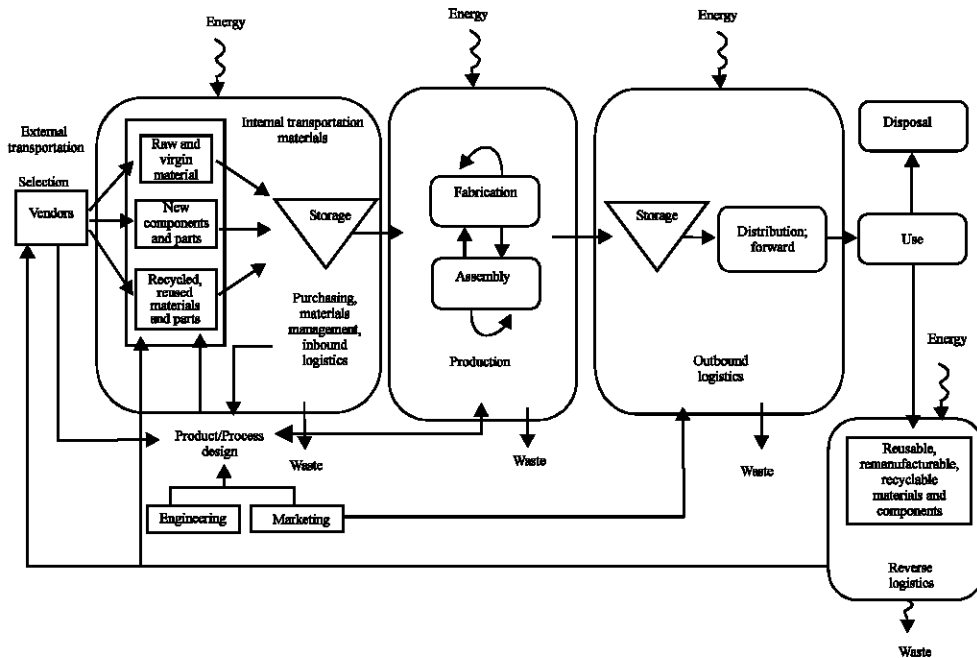


Fig. 4: Logistic discipline (Sarkis *et al.*, 2004)

lists the positive effects on the logistics companies and the paradox column the negative effects on society.

The logistics discipline has generally focused on producer-to-consumer movement of products, considering transportation, warehousing and inventory management (forward distribution) but the desire for greenness, led in the early 1990s to the concept of reverse distribution where consumer-to-producer movements become equally important.

Reverse logistics is the process of continuously taking back products or packaging materials to avoid waste or high energy consumption through the incineration process (Hervani *et al.*, 2005). Figure 4 shows the concept of logistics discipline. The operation of logistics services often leads to several negative

impacts on the natural environment, including air pollutants, hazardous waste disposal, solid waste disposal, fuel consumption and others. This suggests that it is necessary to study environmental issues in the logistics industry. Although, a body of research on the is implementation of green innovations in the manufacturing sector can provide some guidelines for the development of environmental management in the logistics industry, it still required to conduct more research on environmental issues in the logistics industry as firms in different industrial sectors may exhibit dissimilar attitudes toward environmental issues (Zhu *et al.*, 2007). Green logistics has become one of the major issues of the decade and impossible for anyone in the industry to avoid. All logistics companies boast of

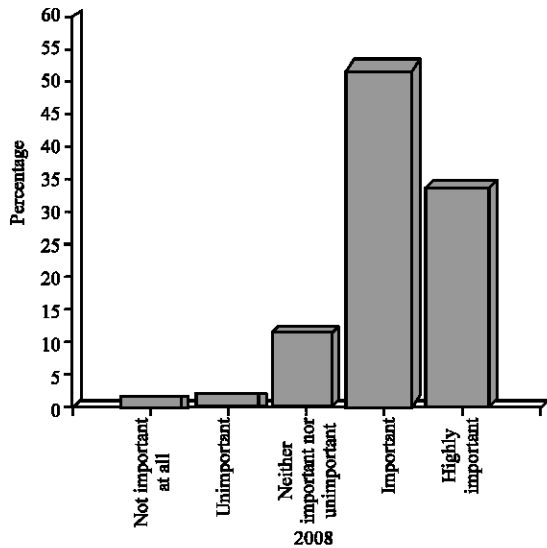


Fig. 5: Transport survey on how important is the environment to your companies strategy

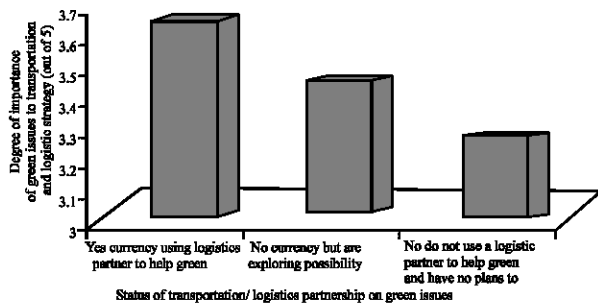


Fig. 6: Transport survey on use of transportation/logistics partner depending on importance of green issues to transportation and logistics strategy (Green Transportation and Logistics Report)

their environmental credentials and manufacturers and retailers spend large amounts of money convincing suppliers and customers of their ethical sourcing strategies. In June 2008, Transport Intelligence undertook a major survey examining how companies were reacting to environmental concerns. The survey was designed to probe beyond the public relations spin in order to identify what logisticians really felt about the new set of pressures, they face. The survey attracted high levels of interest with 450 respondents from around the world, representing the full spectrum of the logistics sector as well as manufacturers/retailers. Unsurprisingly the vast majority of respondents stated that the environment was either important (52%) or highly important (35%) to their companies strategy (Fig. 5).

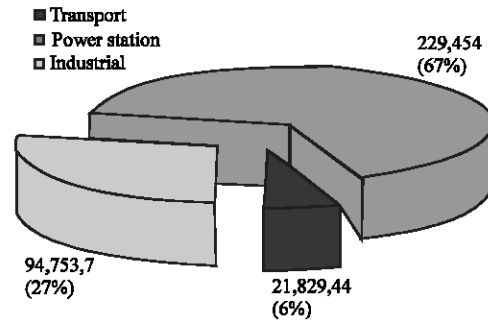


Fig. 7: Nitrogen Oxides (NO_x) emission by sources (Metric tons) (social development strategies master plan study)

Another study conducted by Green Transportation and Logistics revealed that there is a correlation between the degree of importance of green issues to a companies transportation and logistics strategy and that companies use of a transportation/logistics partner to help them green their supply chains (Fig. 6). The survey revealed that more importance green issues were given to companies transportation and logistics strategy; the more likely they were to either have partnered with a 3PL or other service provider to help them with green initiatives, or be exploring the possibility of doing so.

DISCUSSION

The substantial contribution of large trucks to air pollution and other gaseous or airborne pollutants has become an important issue because it can reduce CO₂ emissions and decelerate global warming (Thompson and Taniguchi, 2001). According to a European Commission (2001), economic growth will almost automatically generate greater needs for mobility with estimated increases in demand of 38% for goods services and 24% for passengers by 2010. The same report claims that 44% of the goods are transported through the road network and 78% of the passengers.

Furthermore, non harmonious growth in all modes of transport is one of the main reasons for the existing situation (congestion, environmental impacts, accidents etc). Consequently, the authors state that if goods delivery policies do not change such that logistic operators can use the advantages of each mode of transport more rationally, CO₂ and NO_x emissions will increase 50% in comparison with 1990 levels.

This is supported by Aronsson and Brodin (2006) that the transport sector is one of the main sources of pressure

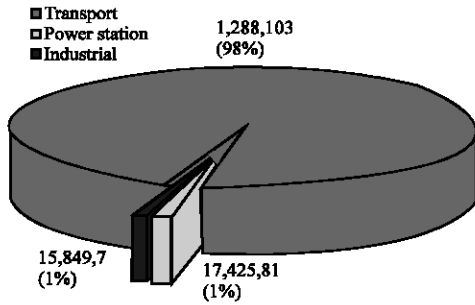


Fig. 8: Carbon Monoxide (CO₂) emission by sources (Metric tons) (social development strategies master plan study)

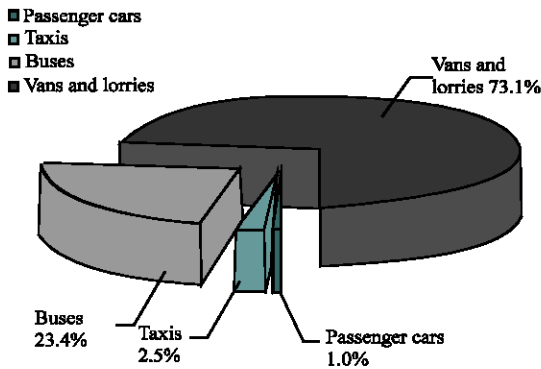


Fig. 9: Number of registered vehicles, 2004-2005 (social development strategies master plan study)

on the environment, particularly regarding air pollution and noise. In the context of Malaysia, CO₂ (98%) and NO_x (67%) emissions are mostly been contributed by the transport industry compared to power station and industrial as evidenced towards the increased number of lorries and van (73.1%) (Fig. 7-9).

CONCLUSION

It is evident there is a need for integrating logistics into a sustainable development process. Two general approaches for reducing the environmental impact has been suggested by Aronsson and Brodin (2006), the first is to rely on new, more energy efficient technology which for goods transport and logistics has proven to be insufficient. The second is to rely on companies to restructure their processes. In the logistics literature, two methods to reduce the environmental impact of industry are to either introduce more energy efficient technology, or to organise logistics in a different way. According to Byrne and Deeb (1993), one of the big challenges is to create a long-term sustainable society with the least possible negative environmental impact. In

response to this pressure in protecting the earth's environment: the green innovation in logistics services approach is introduced. Logistics innovation has been defined as any logistics related service from the basic to the complex that is seen as new and helpful to a particular focal audience. The audience could be internal where innovations improve operational efficiency or external where innovations better serve customer (Flint *et al.*, 2005). Innovations are usually classified into two broad groups: technical/technological and administrative/non-technological. The former refers to technologies for data acquisition, information management, warehousing and transportation; the latter to changes in structures, business processes, customer and supplier relationships management and knowledge management issues that lead to innovation. Nagarajan further elaborated that logistics innovation as innovation is gaining importance in the logistics industry. The advent of new technologies and globalization has inspired firms to look for new solutions for the challenge of business in today's competitive landscape.

There was a consensus that innovations (vehicle technologies and environmental fuels) which can contribute to reducing environmental impacts, most importantly the reduction of air emissions, already exist and do not present a bottleneck to environmental progress in most cases. However, trends indicated that compared to other industries, logistics is not amongst the most innovative, arguably because it is a mature industry, where change is evolutionary rather than revolutionary (Mena *et al.*, 2007). Hans Hickler, CEO, DHL Global Customer Solutions stressed that 3PLs and their customers must be open about expectations and capabilities, if they are to find innovative ways to improve green credentials. He further said that When companies cooperate with 3PLs, there is often limited readiness for both parties to adequately learn current practices, develop joint solutions and share the benefits. But those willing to advance the 3PLcustomer relationship beyond today's sticking points stand to be rewarded with supply chain efficiencies that deliver competitive advantage and customer satisfaction (Capgemini Press Release).

With these arguments in mind, questions arise about to what extent green innovation exist in practice among logistics services providers in Malaysia? What are the actual outcomes realized by the logistics services providers in implementing green innovation?

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