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Green Innovation Adoption among Logistics Service Providers in Malaysia: An Exploratory Study on the Managers' Perceptions

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Abstract: Innovation is a primary concern of industry and logistics services are constantly seeking ways to innovate in order to gain competitive advantage revolutionary. Green innovations can have a major impact in reducing the environmental burden of the industry, particularly in terms of pollution and greenhouse gas emissions. From this context, it is evident, there is a need for integrating green innovations in logistics. The purpose of this survey is to find out as to what extent the logistics managers perceived the green innovation and environmental impact on their logistics activities. The preliminary survey was conducted on logistics companies in Malaysia based on proportionate random sampling. The study found that 76.9% among the responding firms considered technology is an important tool in mitigating the environmental in logistics services. In summary, logistics service providers must find innovative ways to improve their technologies to be in green credentials. It is believed that 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 at large.

Key words: Perceptions, green innovation, logistics service sustainability, revolutionary, proportinate, Malaysia

INTRODUCTION

Under the premise of global environmental conscious and awareness, many firms have started to undertake significant efforts towards establishing Green Supply Chain Management (GSCM) initiatives (Srivastava, 2008; Zhu *et al*., 2007; Tarig and Suhaiza, 2010). The underlying concept of GSCM encompasses environmental initiatives in inbound logistics which includes green purchasing, eco-design and production as well as outbound logistics which includes reverse logistics. As being implied by the name, these initiatives involve a pool of relevant stakeholders such as materials suppliers, service contractors, vendors, distributors and end users whom work cohesively to reduce or eliminate adverse environmental impacts which can possibly give rise due to their activities (Beamon, 1999; Vachon and Klassen, 2006; Tarig and Suhaiza, 2010).

Through managing the flows of products, services and information across customers and suppliers and building up the firms' ability to move goods across borders rapidly, reliably and cheaply. Logistics industry strives first to achieve integration of supply chains then integration of global supply chains. As competitive and efficient logistics sector is vital for all economies and is an imperative component of trade, logistics management plays a significant role in GSCM. According to Skjoett-Larsen, environmental management for the logistics industry is now-a-days playing much more important role owing to rapid development of the GSCM. Based on a survey conducted by Langley and Capgemini (2008), it shows that greening of supply chain will have an increasing impact on logistics activities such as network design, transport modes used, warehousing, selection of equipment, business processes, behaviors and balance sheets. Nevertheless, few firms have rated green capabilities as a deciding factor when choosing 3rd Party Logistics (3PL) partners whereby 46% of respondents said that the effect of supply chain operations on the environment was a factor to be considered when selecting 3PL (Langley and Capgemini, 2008).

In order to deliver products and services to customers in a more environmental friendly manner, there is few environmental issues deserved attention from the logistics service providers (Murphy and Poist, 2003; Sarkis *et al*., 2004). In this regard, Lin and Ho (2008) claimed that green innovations in logistics services can help improve efficiency and effectiveness across many sectors of the economy. 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). This implies that integrating green innovation into logistics services has become paramount important topic for the logistic industry. As innovation is

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a primary concern of many industries, logistics services are constantly seeking ways to innovate in order to gain competitive advantage revolutionary (Mena *et al*., 2007). Generally, green innovations can help to reduce the environmental burden of the logistics industry, particularly in terms of pollution and greenhouse gas emissions. Their collaborations with other industries are however, critical in providing the right environment for firms to innovate. As one of the big challenges facing the industry at the present moment is concerning with creating a long-term sustainable society with the least possible negative environmental impact (Lin and Ho, 2008), it is evidently clear that there is a need to integrate green innovations in logistics. In fact, a new approach which was termed as green logistics approach had emerged in the early 2000's in response to the ever rising environmental pressures.

This new approach goes beyond the standard logistical emphasis for efficient and effective by taking into account the protective measures for the environment. According to Chang and Qin (2008), green logistics refers to plan, control, management and implementation the logistics system through the advanced logistics technology and environmental management with the aim to reduce the pollutant emission.

There is a consensus that innovation (vehicle technologies and environmental fuels) which can contribute to reducing the environmental impacts, especially in terms of reduction of air emissions already in existence but does not act as a bottleneck to environmental progress in most cases (APFFP, 2007).

However, arguably trends indicated that compared to other industries, logistics is not amongst the most innovative one because it is considerably a mature industry where changes are typically evolutionary rather than revolutionary (Mena *et al*., 2007). In terms of innovation in the Malaysian context, Hasnida and Suhaiza (2009) have conducted a study on the logistics technology intensity among logistics firms in Penang. Their findings show that warehouse management system applied the most technology by the logistics firms followed by freight consolidation, electronic data interchange, vehicle routing and radio frequency communication technology.

Nevertheless, Malaysian logistics service providers must find innovative ways to improve their technologies to be in green credentials. With this argument in mind, questions aroused about to what extent managers of the logistics services providers in Malaysia perceived about green innovation adoption. This study therefore will address the importance of green innovations in logistics as the focal point of this study. It is believed that green innovation in logistics is a promising area of study and a practice that has the potential to provide significant benefits to firms and the society at large.

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 being considered as part of logistics. Although, logistics is commonly associated with manufacturing industries, all industries need logistics services; for example, banking, health services, education and retail, just to name a few, require very sophisticated logistics systems.

Based on various roles of logistics, logistics can be leveled at the centre of economic activity and this makes innovation in logistics a key element to improve efficiency and effectiveness across all industries. With the current competitive scenario, firms worldwide continuously attempt to develop new and innovative strategies to enhance their global competitiveness (Lin *et al*., 2009). Further, clarification is therefore being made in the following subsections to include a brief description of the logistics services industry in Malaysia as well as the very importance role played by the environmental concerns in the industry.

Malaysian logistics industry: According to Mustaffa 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 the utmost important factor in the growth of 3PL where greater emphasis is placed on reducing cost and delivery lead time (Mustaffa and Potter, 2009).

It was supported by Sohail *et al*. (2006) in their study in which they found that 67.7% of firms in Malaysia use contract logistics services with a primary focus on domestic operations in contrary to Singapore 3PL industry which focus internationally. Sohail and Sohal (2003) claimed that Malaysia's firms used 3PL because the latter gives 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 (2007), 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. The main function of MLC is to act as coordinator which aims to achieve synergistic of strategies, policies, regulations and rules for the logistics sector. Hence, assists the logistics industry to enhance competitiveness at both the regional and global 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 which comprised of transport, storage and communication services, contributed 12.8% to the country's GDP (MIDA, 2008). It is estimated that currently, there are about 22,000 firms in the logistics industry in Malaysia, undertake various kinds of activities. Targets for the logistics industry as being set by the IMP3 are to achieve an overall growth of 8.6% during the plan period and contribution to 12.1% of GDP by 2020 (MIDA, 2008).

Nevertheless, the substantial contribution of large trucks to air pollution and other gaseous or airborne pollutants has become an important issue because it can reduce CO_2 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 researchers state that if goods delivery policies do not change such that logistic operators can use the advantages of each mode of transport more rationally, CO_2 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 on the environment, particularly regarding air pollution and noise. In the context of Malaysia, CO_2 (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%).

With regards to the industry performance in 2007 the World Bank launched its Logistics Performance Index (LPI), intended as the 1st in-depth cross-country assessment of the logistics gap among countries. Computation of LPI is based on a five-point scale and survey responses from >800 logistics professionals. Countries are given an aggregate LPI score which is 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. Based on the 2007 survey, Malaysia was ranked 27th worldwide with an LPI score of 3.5, placing it significantly below the major OECD economies (Fig. 1). Globally, Malaysia was ranked behind Netherlands (ranked 2nd in the world with an LPI of 4.2) Germany (3rd with an LPI of 4.1), UK (9th, LPI of 4.0) and US, (14th, LPI of 3.8). Whereas in comparison to other Asian economies, it was ranked behind Singapore (ranked first in the world with an LPI 0f 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) (Table 1).

Environmental and Logistics: Environmental issues have become critical issues in the scope of logistics (Murphy and Poist, 2003; Lin *et al*., 2009). 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 *et al*. (2007) 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

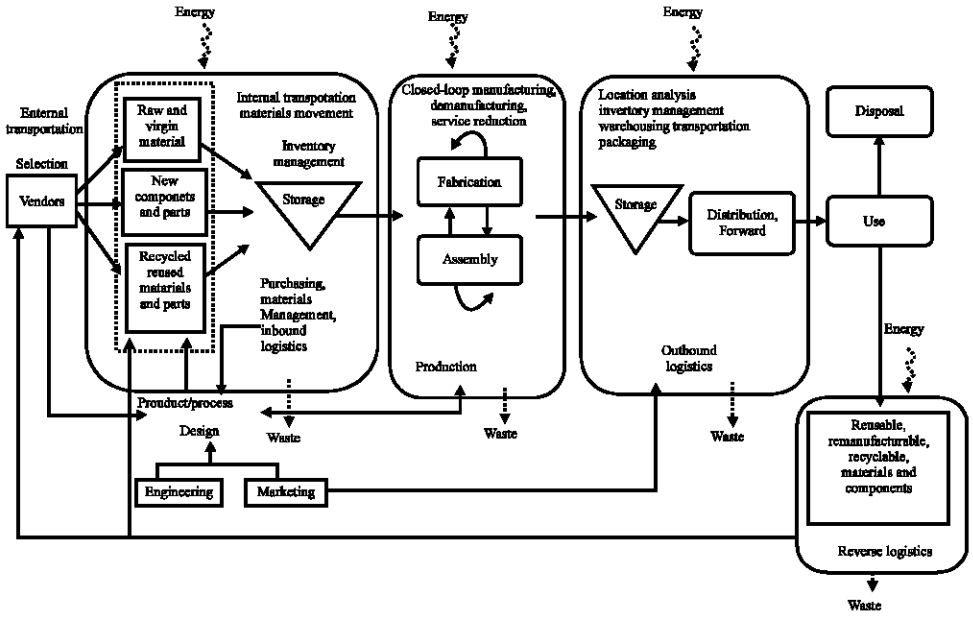

Fig. 1: Logistics discipline

Table 1: International logistics performance index

	Logistics performance index			Logistics performance index			Logistics performance index	
Countries	Rank	Score	Countries	Rank	Score	Countries	Rank	Score
Singpore	1	4.19	Romaina	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	Vientam	53	2.89	Kyrgyz Republic	103	2.35
Sweden	4	4.08	Panama	54	2.89	Ethiopia	104	2.33
Austria	5	4.06	Bulgaria	55	2.87	Liberia	105	2.31
Japan	6	4.02	Mexico	56	2.87	Moldova	106	2.31
Switzerland	7	4.02	Sao Tome and Principe	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	Croatia	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 Salvador	66	2.66	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	Venzuela, 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	Costa 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	Uraguay	79	2.51	Uzbekistan	129	2.16
China	30	3.32	Honduras	80	2.50	Nepal	130	2.14
Thailand	31	3.31	Cambodia	81	2.50	Armenia	131	2.14
Chile	32	3.25	Colombia	82	2.50	Mauritius	132	2.13
Israel	33	3.21	Uganda	83	2.49	Kazkhstan	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

Table 1: Continued

	Logistics performance index			Logistics performance index			Logistics performance index	
Countries	Rank	Score	Countries	Rank	Score	Countries	Rank	Score
Solvenia	37	3.14	Bangladesh	87	2.47	Tanzania	137	2.08
Czech Republic	38	3.13	Bosnia and Herzegovina	88	2.46	Solomon Islanda	138	2.08
India	39	3.07	Benin	89	2.45	Albania	139	2.08
Poland	40	3.04	Macedonia, FYR	90	2.43	Algeria	140	2.06
Soudi Arabia	41	3.02	Malawi	91	2.42	Guyana	141	2.05
Latvia	42	3.02	Sri Lanka	92	2.40	Chad	142	1.98
Indonesia	43	3.01	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	97	2.37	Myanmar	147	1.86
Omar	48	2.92	Lebanon	98	2.37	Rwanda	148	1.77
Cyprus	49	2.92	Russian Federation	99	2.37	Timor-Leste	149	1.71
Solvak Republic	50	2.92	Zambia	100	2.37	Afghanistan	150	1.21

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 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. 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 1 shows the concept of logistics discipline. From the pervious study, 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.

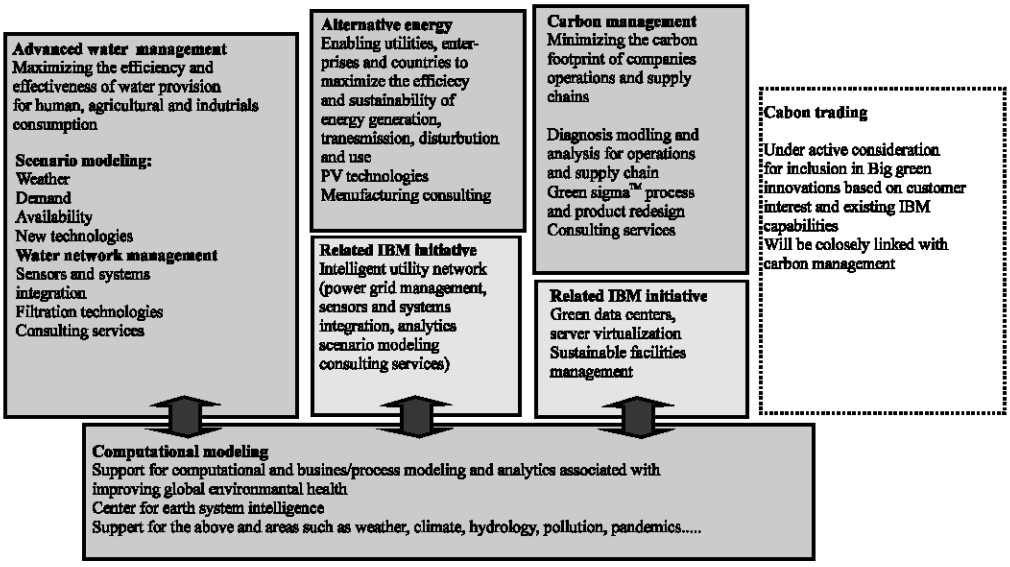

Fig. 2: Development of green innovation

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 and White (2007) 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.

Green innovation: Much of the theory that explains about innovation and the factors associated with successful innovation can clarify the action of innovating business in response to green issues (Foster and Green, 1999). As stated by Noci and Verganti (1999), the fact that the costs associated with environmental management and the consumption of natural resources and the disposal of wastes are in escalating trends. This forces many firms opted to attain certified environmental management system and to develop technological innovations that are aimed at constantly improving the environmental performance of their processes and products.

Nonetheless, implementation of green innovation requires high abilities in accumulating more related technologies. As being put forth by Lin *et al.* (2009), the successfulness of green innovation depends on the ability to acquire new technology via training and educating thus to make rereacher become more knowledgeable. There are three factors that influence implementation of green innovation, namely management skills, organizational encouragement for innovation and support of innovation resources. While, Lin and Ho (2008) found that environmental practices, organizational encouragement, quality of human resources, environmental uncertainty and governmental support exhibit significant influences on the willingness to adopt green innovations for logistics services providers. Chen *et al.* (2006) defines green innovation as hardware or software innovation that is related to green products or processes and this includes innovations in technology such as energy-saving, pollution-prevention, waste recycling, green product designs or corporate environmental management.

Similarly, support from top management is important because the resource required for the implementation of new technology will be more easily available if the major person responsible for these resources supports the plans. When knowledge can be distributed more easily within the organization, high development of the organization's green innovation approaches will be more likely to be achieved. For example, IBM company formed a group that is specially take charge of green innovation strategy. The group which was known as Big green innovations, holds the portfolio of environmentally focused initiatives that IBM launched (Williams, 2007) and is dealing mainly with the advanced materials science, physics, modeling tools, materials science and integration expertise to address emerging environmental management opportunities. On top of this, they have also established close collaboration with clients through bringing of innovative perspectives to resolve the problems faced by the latters. Figure 2 shows the core development of green innovation in IBM by Big green innovations group. The development includes advanced water management, alternative energy, carbon management and computational modeling.

MATERIALS AND METHODS

The purpose of this survey was to understand how well the logistics firms understand about green innovation and the need to be environmental friendly, especially in respect to their impact on logistics activities. The study was conducted on logistics firms in Malaysia through research questionnaires which is consisted of three sections. Section A is intended to gather personal information, section B is designed for collection of organization information and section C is specifically tailored for information pertaining to green innovation and environment information related to logistics service providers. The selection for 120 firms was based on proportionate random sampling. Out of 120 of the logistic firms surveyed, 70 completed the questionnaire.

RESULTS AND DISCUSSION

Firms profiling shows that majority of the firms have full time employees ranging from 5-50 people with percentage of 69.2%. Most of the firms have established in the logistics industry for >21 years with percentage of 15.4% while just a few of them are have establishment history >10 years in the industry. It can thus be summarized that most of the logistics firms have a vast experience in their field. This implies that it will give them advantage to improve their service and performance. Apart from this, it is noticeable that most of them are fully owned-Malaysian Firms. Accordingly, the basic information about the application of technology and environment for the firms are also been analyzed. Table 1 shows that more than half of responding firms do not have formal environmental policy in their Corporate Social Responsibility (CSR) strategy.

Similarly, most of the logisticians do not consider environmental issues as part of their firm's strategy. As the analysis revealed, most of the firms do not measure their carbon footprint corresponding to the impact of their logistics activities. This situation might be possibly due to firms only think of maximizing their profit and quantity of service at short term without taking a serious stance on the need to address sustainable development issues related society, community and the environment impact for long term achievement. In fact, sustainablity development requires organizations to balance the three element in triple bottom line model which is environment, society and economic.

Fortunately, most of them are willing to invest and spend money for environmental initiatives, although in time of suffering from economic slowdown. Table 2 shows that firms recogned that technology is an important tool in mitigating environmental impact with percentage of 76.9%. As being stressed by Chang and Qin (2008), application of the advanced innovation will enable enterprises to improve environmental management effectively. Wu and Dunn (1995) argued that environmental friendly logistics structures are typically characterized by fewer movements, less handling, shorter transportation distance more direct shipping routes and better utilization. In other words, a sound logistics structure incurs minimum environmental costs. Figure 3 shows that most of the logistics firms prefer and willing to pay more to become environmental friendly. Nevertheless, there is still some logistics firms that are neither willing to neither invest more into environmental friendly program

Table 2: Basic information of technology and environmental issues

	Percentage	
Items	Yes	No
The firm have a formal environmental policy as part of CSR strategy	46.2	53.8
Technology is consider as an important tool in mitigating environmental impact	76.9	23.1
In light economic slowdown, we will invest in environmentally friendly services	53.8	46.2
The firm measure the carbon footprint	38.5	61.5
The firm spent money on an environmental initiative	53.8	46.2

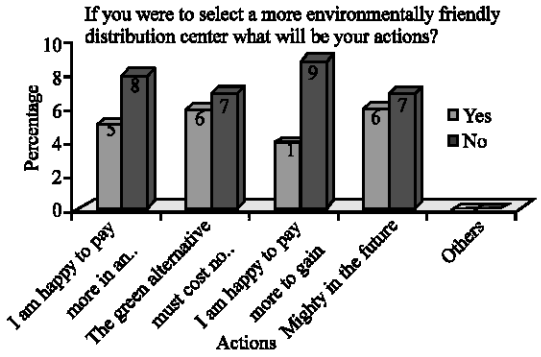

Fig. 3: The actions to select a more environmentally friendly

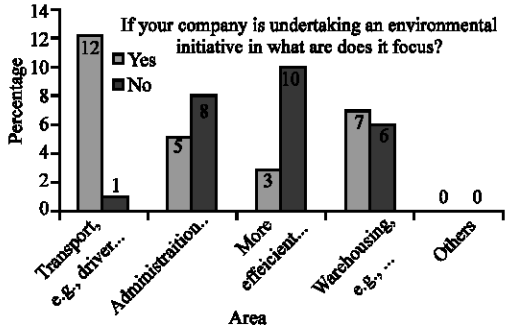

Fig. 4: The focus area in undertaking an environmental initiative

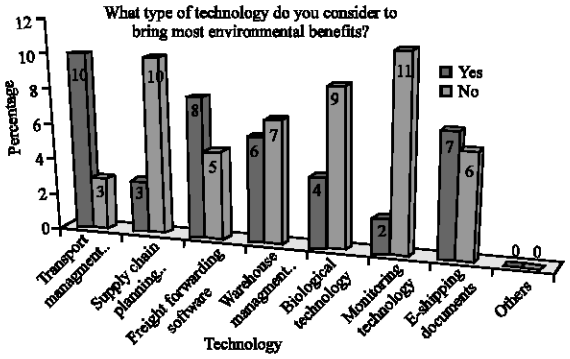

Fig. 5: Type of technology to bring most environmental benefits

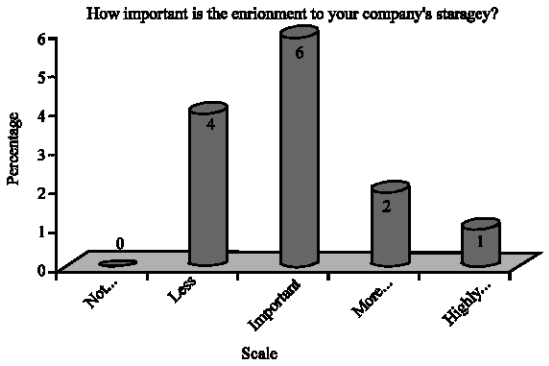

Fig. 6: Important of environment to firm's strategy

nor embark on any environmental friendly actions. While some of the logistics firms expressed that they will consider becoming more environmentally friendly in the future. This implied that the logisticians will only consider paying more attention in tackling environment issues in the future. In other words, they do not consider environmental issues as serious issues.

Logistics and transportation can be deemed as one of the largest components in terms of energy consumption and overall green house gas emissions among the industry (Kuhl and Zhou, 2009). Most of the negative impacts on the environment are indeed come from the transportation sector whereby vehicle used fuel that will emit useless and harmful gasses. As shown in Fig. 4, the focus area of taking environmental initiatives is transportation. Transportation is referring to the transport used by the logistics services to distribute goods and vehicles used in the operation. There was a consensus that innovations (vehicle technologies and environmental fuels) can contribute to reduction of environmental impacts, most importantly reduction of air emissions. Nevertheless, it does not pose as a bottleneck to environmental progress in most cases (APFFP, 2007). While minimum number of focus area is on more efficient planning through IT tool using of tool does not mean to

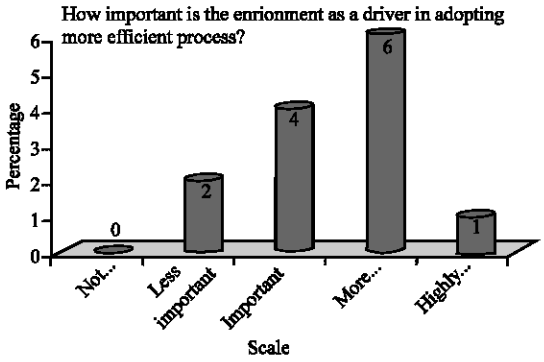

Fig. 7: Important of environment in adopting more efficient processes

be the only direct need to be environmental friendly. In addition, well development of warehouse is needed to complement environmental initiatives. Other examples are using of recycled rain water and solar energy to save electricity usage.

Figure 5 shows type of technology that will bring most environmental benefits. Accordingly, most of the responding firms consider transport management system is the most environmental benefits to logistics firms. It almost same like freight forwarding software, warehouse management system and E-shipping. While biological technology, monitoring technology and supply chain planning softwares are being perceived as bringing the least environmental benefits. This means that these outcomes of softwares do not meet the expectation in regard to the environmental benefits in the eyes of logisticians. There are to-date three most established technology innovations, namely information and communication, biological and monitoring (Chang and Qin, 2008). These are the potential areas that need to be upgraded in order to achieve better system or process among the service providers thus to enhancement their competiveness with others. The information and communication technology includes transport management system, freight forwarding software and warehouse management system which is of paramount importance as it will bring the most environmental benefits. Biological technology on the other hand is more related to seeking alternative fuel for vehicles that will bring most environmental friendly.

Figure 6 shows the importance concern of the environment issues in firm's startegy. Majority of the responding firms agreed that environmental concern is important to the firm's startegy. Although, few responding firms deemed environmental concern as less important in firm's startegy, most of the responding firms agreed that environmental concern will act as an important driver in efforts to adopt more efficient processes (Fig. 7). Conversely, there are only few responding firms

considered environmental concern is less important in adopting more efficient processes. From the preceding analyses, it can thus be summarized that environmental concern plays an important role in firms initiatives for the adoption of more efficient processes as well as for the development of firm's startegy.

CONCLUSION

From this study, it is evidently clear that there is a need for integrating logistics into a sustainable development process. In this respect, two general approaches for reducing the environmental impact has been suggested by Aronsson and Brodin (2006), the first relies on new and more energy efficient technology while the second relies on how firms will restructure their processes. In the logistics literature, two methods have been extensively adopted for the reduction of the environmental impact for the industry. First, it can be achieved through introduction of more energy efficient technology and second, it can be achieved through organising 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 the arising pressures to protect the environment, it is imperative that green innovation in logistics services approach is to be 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 being classified into two broad groups, namely technical/ technological and administrative/non-technological. The former refers to technologies for data acquisition, information management, warehousing and transportation while the latter refers to changes in structures, business processes, customer and supplier relationships management and knowledge management issues that can lead to innovation.

As being emphasized by Nagarajan and White (2007), logistics innovation is 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.

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