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Effect of Green Logistics on Sustainability Performance in Malaysia Manufacturing Companies

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Abstract--- *Globalization and economic growth the world over resulted in the massive consumption of goods. Environmental challenges have also been evolved as a result of transportation, storage, production and consumption of these goods. This paper presents the contribution of operations research in the green logistics, which encompasses integrating environmental aspects in logistics. This paper provides present and potential developments in green logistics. The survey respondents were taken from the "Federation of Malaysian Manufacturers (FMM) directory of Malaysian Manufacturers 2017". This directory contains information of manufacturing companies (large and small) from various sectors. The population of this study consists of all medium and large manufacturing companies of Malaysia with a total of more than 35000. The number of acceptable respondents for the present study is based on krejcie and Morgan table and according to that table the sample size for this study will be 346. For this study the statistical tool used will be Smart- PLS. To achieve this study's objectives, a questionnaire was developed for measuring this study's constructs of GL practices, environmental collaboration and sustainability performance. PLS_SEM was used for data analysis and hypothesis testing by exploring the relationships between independent and dependent variables simultaneously. The two-fold aim of this paper is: (i) review of existing literature on the relationship between GL, environmental collaboration and sustainability performance and (ii) proposing and testing a conceptual model to find the relationship between these variables in the context of Malaysian manufacturing companies. The research findings will be particularly important for manufacturing companies in developing environmental collaboration with their suppliers in order to achieve sustainability performance.*

Keywords--- *Integrating Environmental, Green Logistics, Manufacturing.*

I. INTRODUCTION

In today's hi-tech environment business activities are the main contributor towards the economy of any country but on the other hand the threats it poses to the environment cannot be overlooked. These threats can be in the form of toxic wastes, carbon monoxide emission, industrial pollution and waste disposal materials (Wisner et al., 2012). These threats emerged as a source of great concern for the governments and businesses. Therefore, to tackle these

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threats, researchers came up with an environmental innovation practice, which is termed as “Green Logistics”. Having awareness about the green logistics (GL), firms will be advancing with a sense of social responsibility and adopting green logistics (GL) in an attempt to design manufacturing processes that are cleaner and that minimize risks to environment (İnce, 2013; Hishan et al., 2018, 2019; Ibrahim, Khan, Ramli, & Qureshi, 2019; Irfan, Rasli, Sulaiman, Sami, & Qureshi, 2019; Latif et al., 2018; Lim et al., 2018; Nor et al., 2018; Qureshi, Elashkar, et al., 2019; Qureshi, Qayyum, et al., 2019; Qureshi, Rasiah, et al., 2019; Qureshi, Yusoff, et al., 2019; Rahim N. S. A., 2019; Rashid M., 2019b, 2019a; Rasli, Qureshi, Isah-Chikaji, Zaman, & Ahmad, 2018; Sami, Jusoh, Md Nor, Irfan, & Qureshi, 2018; T. R. Q. M. I. Shafiq M., 2019; T. R. Q. M. I. T. J. Shafiq M., 2019; Zahid et al., 2019). Firms are already trying to reduce carbon emissions by discovering alternative resources, eliminating packaging, reverse-supply chains and distribution channels rearrangements (Alzaman, 2014). In this technological era, logistics has a vital role in the world economy. In business terms, logistics is the physical movement of goods from the supplier point to the customer point. Logistics are directly or indirectly related to daily activities and not just activities within the company.

As consumers, we also experience the impact of logistics management activities. According to Ministry of Natural Resources and Environment (NRE), Malaysia, carbon dioxide emissions from energy used in logistics showed the highest percentage. Hence there is a dire need to reduce this emission by the help of green logistics. The present study is aimed at improving the sustainability performance by the help of green logistics.

Logistics management includes inbound and outbound activities such as warehousing, materials handling, order fulfilment, and logistics network design. Therefore, all efforts to reduce ecological impacts of logistic activities including all activities of forward and the reverse flows of products, information and services between the point of origin to the point of consumption is green logistics.In this perspective, green logistics can be beneficial in improving a firm’s economic performance together with firm’s environmental image, and help in efficient use of resources, while also facilitating recycling and improving market shares (Alzaman, 2014). This study aims to establish the relationship between the concept of GL and sustainability Performance. The concepts of sustainability Performance and GL are discussed with a focus on environmental, economic and social dimensions of sustainable performance.

Problem Statement

In 2014, The Inter-Governmental Panel on Climate Change (IPPC) published their 5th Assessment report on climate change. This report was based on long-term scientific evidence. The report identified that the upsurge in greenhouse gas (GHG) concentrations (like carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O), hydro fluorocarbons (HFCs), per fluorocarbons (PFCs), and sulphur hexafluoride (SF6) over the past 100 years has mostly been caused by the human activities.

Air pollution can be caused by various sources, such as factories, power plants, dry cleaners, vehicles and even windblown dust and wildfires. It was testified that in the past five years, the three main sources of air pollution in Malaysia are mobile sources, stationary sources, and open burning sources. Mobile sources accounts for 70 to 75% of total air pollution while, stationary sources contribute 20 to 25% and open burning sources contribute 3 to 5% in

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air pollution. This was confirmed by the high emission from motor vehicles and oil and gas related work, of unburnt hydrocarbons and the emission of SO2 due to high sulphur fuel reliance for industrial production and electric power generation (Makmom et al., 2012).

Therefore, the level of awareness and sensitivity performance among those involved in the industry must be measured first, which in turn leads to the use of technology that is more environmentally friendly and has less impact on the environment. Awareness of these issues and changes for practice GL not only impacts environment but also on the business performance and development phase itself. Therefore, the present study is intended to create an awareness of logistics among the firms in improving their sustainability performance.

II. LITERATURE REVIEW

The term "green logistics" (GL) can be defined as practices and strategies related to supply chain management that can reduce the environmental and energy imprint of freight distribution. GL emphases on handling of material, management of waste, as well as packaging and transport. As mentioned earlier, companies in the past, synchronized their logistics activities including freight transport, warehousing, packaging, materials handling and data collection and management to meet customer requirements at minimum cost. (Nowakowska-Grunt, 2008). In the present research, transportation, warehouse, and packaging has been targeted to study that what is their impact on sustainable performance.

Previous studies have shown that firms that implemented green awareness and better environmental programs will have better performance. The other studies that have been conducted suggests that green awareness needs to be systematically integrated into the green logistic practices of the enterprise (Choi Y, 2012). In any logistics system, transportation is an operation that can contribute most in terms of negative environmental impact (Wu and Dunn, 1995). Freight emissions account for roughly 8 per cent of worldwide energy-related CO2 emissions, whereas warehousing accounts roughly 2 per cent (McKinnon, 2010).

Pazirandeh A and Jafari H (2013) asserted that majority of the firms which have concerns about sustainability in their strategic plans, they concentrate on greening their transportation. Such type of firms were able to improve their logistics performance, both from an effectiveness perspective as well as an efficiency perspective, by greening their transportation purchasing procedures.

According to Fritz Institute (2008) warehouse is a planned space for the storage and handling of goods and material. There are few types of warehouse such as commercial, government or state, transit, bonded warehouse, open storage, owned and managed by organisation and pre-fabricated warehouse. Warehouses are eventful places. Inbound and outbound deliveries have to be dealt with in the warehouse as well as the movements of items from location to location. Now many companies are aware to look into warehouse operations at an area where they can make environmentally sound decisions. Companies are concentrating on three areas to help them in this endeavour; reduce, reuse and recycle (Brădescu, 2014).

Packaging is one of the activities in logistics system. It can be defined as the technology of enclosing or protecting products for distribution, sale, storage and use. Packaging also refers to the process of design, evaluation

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and production of packages. Both products' loaded package and logistics' package consume a large amount of resources and produce large amounts of solid waste. Thus, the impact of packaging to environment is very large. For instance, solid waste pollution, liquid and gaseous pollution, the spread of bacteria and pets are kinds of pollution generated by packaging. Therefore, green packaging which can also called ecological package or environmentally friendly package has been offered in green logistics. Zhang and Zhao (2011) define green package as environmentally friendly package which is totally made by natural plants and it can be recycled or degradation, reused and does not give harm for human and pollute the environment during the product life cycle.

Proposed Conceptual Model

The proposed model shown in the figure.1 depicts the relationship between GL practices, environmental collaboration and sustainability performance. The GL practices were conceptualized to include Transportation, Warehouse and Packaging. The three dimensions of sustainability performance were investigated from the perspectives of economic, environmental, and social.

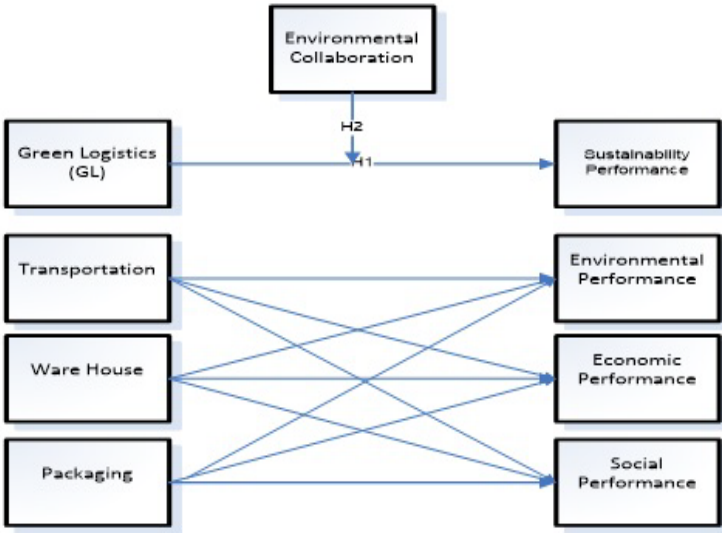

Fig. 1: Proposed Conceptual Model

Green logistics/transportation, is about delivering goods directly to user site, using alternative fuel vehicles and grouping orders together, rather than in smaller batches (Ninlawan et al., 2010), investing in vehicles that are designed to reduce environmental impacts, and planning vehicle routes (Holt D, Ghobadian A, 2009). As per Laosirihongthong et al. (2013), GL is about reverse logistics, which includes collecting packages and used products from the customers for the purpose of recycling, it is also about returning the products and packaging to the suppliers as well for reusing them and also it requires the supplier to collect the packaging material. The GL practices interact with each other and help the organization in sustainability performance. Researchers like Ninlawan et al.,2010; have recommended that some of the important performance indicators of sustainability performance are economic performance, environmental performance and social performance. From the above discussions researcher posits the following hypothesis:

H1: GL practice is positively related to sustainability performance.

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The benefits that can be derived from environmental collaboration have been recognized in the GSCM literature. Many researchers emphasized the direct relationship between GL practices and sustainable performance. Holt and Ghobadian (2009) used external GL to see the impact of environmental collaboration on firm performance. Relationship between sustainable supply management and sustainability performance. Environmental collaboration in the GL includes a direct involvement of an organization with its suppliers or customers to jointly develop environmental solutions (Rao, 2006). In this context, environmental collaboration as a key relational capability that could be advantageously positioned to facilitate the GL strategic formulation and execution. Therefore, the following hypothesis is proposed:

H2: Environmental collaboration moderates the relationship between GL practice and sustainability performance.

III. METHODOLOGY

The potential survey respondents are drawn from the "FMM directory of Malaysian Manufacturers 2013". The directory contains information of manufacturing companies (large and small) from various sectors, locations, name of company, year of establishment, contact information, email address, annual sales, number of employees, etc. The population of this study consists of all medium and large manufacturing companies of Malaysia with a total of 37,694.

The number of respondents acceptable for this study depends upon the statistical tool used – structural equation modeling (SEM). SEM is a large sample technique and the sample size required is more than 200. To meet the objectives of this study, a survey questionnaire was adopted and adapted from the previous studies the measurement scale of environmental collaboration was taken from the study of Vachon et al., (2008). To measure the constructs of sustainability performance the already validated scale by Erol et al., (2011) were used. SEM is used to test H1 and H2 in a single, systematic, and comprehensive analysis by exploring the relationships among multiple independent and dependent constructs simultaneously (Anderson & Gerbing, 1988).

IV. RESULTS AND FINDINGS

In data analysis, validity and reliability of the measurement model was calculated which was followed by the validation of structural model. In measurement model results point out that all the items which were used to represent the construct were having internal consistency reliability, as shown in table 1, all CR and CA values are greater than 0.8 or 0.9.

Table 1: Reliability Test

	(CA)	*(AVE)*	*(CR)*
Green Logistics	0.859	0.640	0.899
Sustainable Performance	0.839	0.562	0.883

Convergent validity is acceptable when Average Variance Extracted value of the construct is at least 0.5. Table 2 given below shows that all AVE values lay within the range from 0.50 to 0.65. This result shows that the measurement model has acceptable convergent validity.

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Table 2: Coefficient of Determination Value

	R^2	*Result*
Sustainable Performance	0.287	Significant

Higher R^2 value is desired as the main aim of PLS-SEM is to explain the variance in dependent variable by independent variable. As depicted in the table 2, R^2 value for AC is 0.287. It shows that 28.7% variance in sustainable performance is significantly explained by the independent variable green logistics GL.

Evaluation of path coefficient value helps in assessment of the structural model. Table 3 given below shows the path coefficients, t-value and p-value as well as significance level for all paths. Acceptance or rejections of the proposed hypotheses are determined from the results of path assessment. Hypotheses are supported at a significance level of 0.05.

Table 3: Path Coefficient Values

	Original Sample (O)	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	P Values	2.5%	97.5%
Packaging -> Economic Performance	0.095	0.027	3.542	0.000	0.044	0.150
Packaging -> Environmental Performance	0.542	0.027	20.038	0.000	0.486	0.592
Packaging -> Social Performance	0.410	0.029	14.105	0.000	0.356	0.472
Transportation -> Economic Performance	0.272	0.034	7.962	0.000	0.198	0.335
Transportation -> Environmental Performance	0.278	0.033	8.300	0.000	0.217	0.347
Transportation -> Social Performance	0.139	0.031	4.470	0.000	0.080	0.199
Ware House -> Economic Performance	0.453	0.029	15.855	0.000	0.401	0.507
Ware House -> Environmental Performance	0.029	0.027	1.092	0.276	-0.023	0.082
Ware House -> Social Performance	0.089	0.028	3.121	0.002	0.033	0.146
Environmental Collaboration -> Sustainable Performance	0.088	0.030	2.910	0.004	0.043	0.162
Environmental Collaboration Moderator -> Sustainable Performance	0.191	0.031	6.244	0.000	0.151	0.264
Green Logistics (GL) -> Sustainable Performance	0.227	0.030	7.626	0.000	0.170	0.288

S. E= Standard Error, T Value = t statistic value, P value= Probability value

Results of the structural model are used to test the research hypotheses of the present study. Hypothesis can be tested on the basis of results of path coefficients, p values and t values; significance level is 0.05 as shown in table 4 given above. The path coefficient assessment shows that almost all relationships are accepted except Ware House -> Environmental Performance this relationship. Ware House -> Environmental Performance this relationship have found insignificant because of t and p values. On the basis of path analysis the present study established significant and positive relationship between Green Logistics GL and Sustainable performance. This study also establish the

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moderation effect of environmental collaboration in the relationship between GL and Sustainable performance.

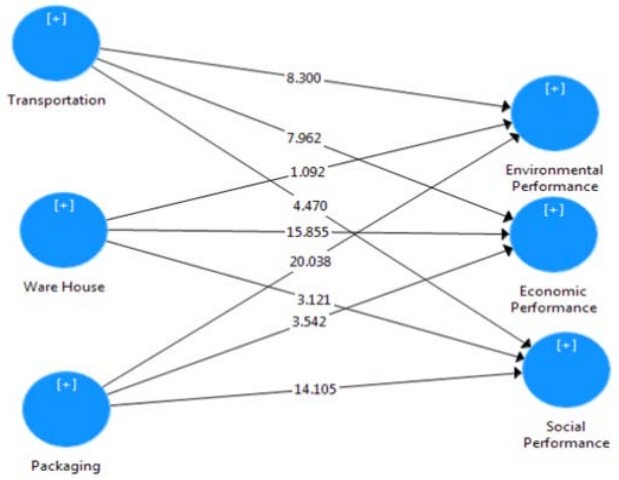

Fig 2: Indirect Path between Green Logistics Daimenssions and Sustaiable Performance daimenssions

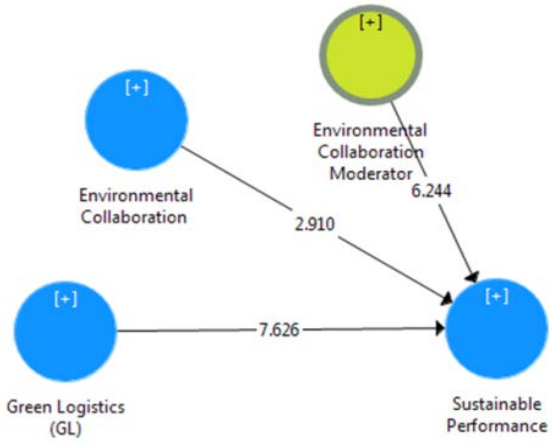

Fig 3: Environmental Collaboration Moderating Effect Bootstrapping Image

This research paper proposed and tested two main hypothesis, H1 was based on the direct relationship of GLA and Sustainability performance, H2 proposed and tested a moderating role of environmental collaboration in the relationship between GLA and Sustainability performance. Both the hypothesis has been found significant and accepted.

V. Discussion and Conclusions

From the Malaysian perspective this study can be very helpful and important because as stated by Ministry of Natural Resources and Environment (NRE), Malaysia, carbon dioxide emissions from energy used in logistics showed the highest percentage in the last few years, therefore, sustainability performance of the manufacturing sector is at high risk. Findings of this study will help manufacturing sector to reduce this emission by the help of green logistics. The present study is aimed at improving the sustainability performance by the help of green logistics. As the manufacturing sector is the main contributor in Malaysian economy therefore, in order to increase

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this contribution of manufacturing sector in the economy the concept of green logistics can be beneficial in enhancing the sustainability performance of the manufacturing sector.

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