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Integrating Human Factors into Green Logistics

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الإقرار

أنا الموقعة أدناه مقدمة الرسالة التي تحمل العنوان:

Integrating Human Factors into Green Logistics

أقر بأن ما اشتملت عليه هذه الرسالة إنما هي نتاج جهدي الخاص، باستثناء ما تمت الإشارة إليه حيثما ورد، وإن هذه الرسالة ككل، أو أي جزء منها لم يقدم من قبل لنيل درجة أو لقب علمي أو بحثي لدى أية مؤسسة تعليمية أو بحثية أخرى.

Declaration

The work provided in this thesis, unless otherwise referenced, is the researcher's own work, and has not been submitted elsewhere for any other degree or qualification.

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List of Abbreviations

ANOVA	One - Way Analysis of Variance
ATT	Attitude
COMT	Compatibility
COMX	Complexity
CP	Customer Pressure
CSCMP	Council of Supply Chain Management Professionals
DC	Distribution Center
EU	European Union
HF	Human Factors
HPM	Human Performance Model
GPS	Global Positioning System
GDP	Gross Domestic Product
GL	Green Logistics
GLI	Green Logistics Innovations
GS	Governmental Support
GSCM	Green Supply Chain Management
km	Kilometers
KPIs	Key Performance Indicators
OS	Organizational Support
PCBS	Palestinian Central Bureau of Statistics
PU	Perceived Usefulness
QHR	Quality of Human Resources
RP	Regulatory Pressure
SCM	Supply Chain Management
SPSS	Statistical Package for the Social Sciences
SMEs	Small and Medium Enterprises
WE	Work Environment
WILL	Willingness

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Abstract

The logistics industry is considered as a large consumption of energy, fuel as well as a huge source of noise and emissions. This fact has created uncontrolled environmental problems, both to meet the customers' needs and creating a commodity effectiveness utility in time and space, at the same time, which goals are conflict with the emphasis on maintaining the natural ecological balance and protection of natural resources. As a result green logistics have become an important approach in the modern logistics industry to improve and enhance the environmental performance and satisfy the organization and social purpose.

In accordance with the ultimate goal of green logistics, this study aims to examine factors that will influence the willingness to adopt green logistics innovations by Palestinian logistics companies. The determinate factors include technological, organizational and environmental dimensions. It also aims to investigate the factors that influence the impact of logistics service activities on environment such as vehicle, human factors, route planning and orders aggregation.

Considering the need for the evaluation of green practices in Palestinian logistics companies, this thesis reports the development of green logistics framework, theoretical framework about human factors that

influence the driver's performance and a conceptual green logistics model that incorporates several factors such as human factors in term of driver’s performance, vehicle selection, route planning and orders aggregation in order to support environmental sustainability and company’s goals by lowering the cost, saving fuel, reducing carbon emission and maintaining high service level throughout their operations. The model has been developed following the main aspects reported in the literature and from insights gathered from interviews. Such interviews allowed the assessment of which are the green measures adopted by each company and what procedures and policies are essential to conduct a greener logistics.

Mixed methodology of both qualitative and quantitative research approaches are used to conduct the study. Qualitative data were collected via interviews with administrative and operational managers. Besides, two questionnaires are designed to gather the pertinent quantitative data from a random sample of both employees and drivers in the targeted companies.

The analysis of collected data from the first questionnaire indicates that organizational support, governmental support, attitude and perceived usefulness are the most significant factors influencing the willingness of Palestinian logistics companies to adopt green logistics innovations. On the other hand, compatibility, quality of human resources, customer pressure and regulatory pressure are influencing the willingness in less degree. However, the complexity and the work environment have negative

influence on the willingness to adopt GLI for Palestinian logistics companies.

The second questionnaire analysis shows that most of the human factors whether they are individual, environmental, organization or job factors influencing the driver's performance, which in turn with vehicle, aggregate planning and orders aggregation exhibit an influence on cost minimization, carbon emission reduction and service level maximization.

Based on the research findings, the adoptions of green logistic innovations present an opportunity for Palestinian logistics companies to competently respond to the escalating expectation for environmental protection and to achieve environmental performance profitability. Using GL model, logistics companies can assess, monitor their activities and make improvement for future development.

Chapter One

Introduction

The research described in this thesis is concerned with the integration of human factors into green logistics systems. It investigates the importance of including human factors within green logistics models to provide more realistic and accurate plans for logistics companies.

This chapter introduces a general overview of the research title, and background. Furthermore, this chapter addresses the problem statement, research motivation, research objectives and research questions. The structure of the thesis is outlined at the end of this chapter.

1.1 Overview

Over the past decade, the traditional purchasing and logistic functions have been developed into a broader strategic approach including operation activities, materials handling, distribution and logistics management, this approach is known as supply chain management (SCM).

SCM is defined as “a system consists of all parties involved, directly or indirectly, in fulfilling a customer request. The supply chain includes not only the manufacturer and suppliers, but also transporters, warehouses, retailers, and customers themselves” (Chopra and Meindle, 2013). It means that the supply chain management coordinates and integrates all of supply chain activities into a smooth process in order to receive and fill a customer request.

So, Interest in the concept of SCM has increased when companies whether manufacturers or service providers, saw the benefits of collaborative relationships within and beyond their own organization.

With increasing awareness of environmental protection worldwide, the green trend of conserving the Earth's resources and protecting the environment is also increase, thus exerting pressure on companies to change their management ways toward being green (Chien and Shih, 2007). Today, people are more concerned and conscious with the environment and climate change; they will be asking more questions about the products they are purchasing and the services provided (Intergovernmental Panel on Climate Change, 2007). In the field of business and management, governments are making stricter environmental regulations which increase the companies' responsibilities to minimize the impact of their operation on environment in (Hart, 1995; Henriques and Sadorsky, 1999; McWilliams and Siegel, 2000; Walker et al., 2008). Zhu et al. (2008) mentioned that the government regulations and the social and customer pressures have raised the companies' awareness in order to effectively incorporate the environmental issues into their operational activities and strategies, and also to produce more environmentally friendly products. As a result, the concept of Green Supply Chain Management (GSCM) appears as new approach and becoming an important factor for company's activity today.

GSCM is defined as “integrating environmental thinking into SCM, including product design, material sourcing and selection, manufacturing processes, delivery of the final product to the consumers as well as end-of-life management of the product after its useful life” (Srivastava, 2007).

According to Gupta (1995), the environmental devastation could be minimized and environmental performance could be improved through environmental management through applying green practices, initiating new measures and developing greener technologies, processes and products.

Since logistics is an essential component in the SC which is also directly connected to the pollutant emission into the atmosphere and the overflowing waste by the impact of their processes; Green Logistics (GL) has emerged as a modeling and solution approach to introduce these environmental concerns into decisions taken in all supply chain flows. Thus, green logistics becomes a key component in achieving sustainable management (Shultz and Holbrook, 1999; Srivastava, 2007).

Green logistics is the study of logistics practices that aim to reduce the environmental impact of logistics operations and activities such as, carbon emissions, noise and accidents, in order to obtain a sustainable balance between economic, environment and social objectives (Dekker et al., 2012).

The effective implementation of GL can help a logistics company plays to gain and maintain competitive advantage, through cost and energy

consumption reduction (Zhu and Sarkis, 2004). Fuentes-Fuentes et al. (2004) argued that an improvement in company's financial performance attains when greening a product or a service. This occurs through cost reduction, market share growth and profit increase. Duber-Smith (2005) identified the reasons behind adopting green practices such as target marketing, sustainability of resources, lowered costs, increased efficiency, product differentiation and competitive advantage, competitive pressures, adapting to regulation and reducing risk, brand reputation, return on investment, employee morale, and the ethical imperative.

Within logistics companies, transportation and distribution activities are the core business. Also they are major contributors to environmental hazards, noise pollution, accidents and resource consumption that result in both large amount of emission and expenses. The emissions from transportation vehicles and related logistics companies activities contribute to air emissions that can cause environmental implications (Calef and Goble, 2007; Orsato and Wells, 2007). Using clean vehicles for distribution process has been recommended and important for logistics companies as increasing the public awareness toward the environmental concerns (Bakhtiari, 2004; Jeffers, 1978; Meng and Bentley, 2008). So, logistics companies need to transform their operations services, and strategies to become more effective from a green perspective by adopting green innovations that are more value adding to the environment. But, logistics companies should be aware that each of these innovations has their strengths and weaknesses on company's operational performance,

environmental performance, and economic performance. On the other hand, failure to do so will make it substantially more difficult for logistics companies to operate in this new era of environmental awareness and social responsibility (Berns et al., 2009).

As the heart of transportation process, it is good to understand the driver's behavior and performance that includes the identification of several Human Factors (HF) and the change in driver's performance when circumstances change either due to work conditions, surrounding environment, trends , or unexpectedly. So, driver is the key ingredient that makes most decisions in transportation process. Since transportation is the backbone of any logistics company, in-depth understanding of transportation-related HF is essential to minimize the effect of transportation activity on environment.

HF has been defined as "the theoretical and fundamental understanding of human behavior and performance in purposeful interacting socio-technical systems, and the application of that understanding to the design of interactions in the context of real settings" (Wilson, 2000).

In highly competitive logistics companies, integration of human aspects with transportation process helps to increase profitability, reduce total cost, minimize the environmental hazards and improve companies' reputation. These findings present a significant research opportunity.

1.2 Problem Statement

While environmental issues have become critical concerns all over the world, companies are constantly under pressure to develop environmentally responsible and friendly operations. So, the issues of environmental pollution must be addressed with SCM. As a result, GSCM has become an approach to enhance environmental performance.

Transportation sector and the associated logistics activities are the main sources of air pollution such as noise, congestion, accidents and carbon emissions, which have harmful effects on human health and on environment. These issues have increased the attention toward reducing the amount of emissions worldwide. Thus, many countries have set targets on reducing the carbon emissions in the near future. As a result Green Logistics (GL) has emerged as a solution approach to minimize the environmental impact and simultaneously to maintain high levels of efficiency and competitiveness.

1.2.1 Research Problem

Since logistics industry consumes remarkable natural resources and generates tremendous contaminants, more effort is needed to study environmental issues in this industry. In order to cope with environmental challenges, it is worthwhile to study the adoption of Green Logistics Innovations (GLI) for Palestinian logistics companies by identifying the factors affecting the willingness of Palestinian logistics companies to adopt GLI. An understanding of the influencing factors is essential for these

companies to best implement green innovations. So they can provide their services based on new innovations and advancement which are more environmental friendly.

If logistics companies start using GLI, they need to evaluate their green practices. A GL model is developed to allow them to identify the factors that affect the impact of their activities on the environment. To provide more realistic to GL model, Human Factors (HF) are incorporating in the model in term of driver selection. This will help other researchers to understand the ways in which different human factors may be incorporated into GL activities. Using GL model, logistics companies can assess, monitor their activities and make improvement for future development.

1.2.2 Research Motivation

With the fast growth in Palestinian economy, the demand for logistics services has been growing significantly, due to the increased number of postal items whether exported or imported (PCBS, 2013). Logistics companies provide logistics services for their customers, which include warehousing, transportation, inventory management, order processing, and packaging.

Transportation sector is considered to be the cornerstone of national economies, and the main source of pollutants such as noise, accidents and carbon emissions. So, more attention should be paid to address environmental issues in logistics, this is coupled with the widespread of the green concept all over the world.

With increasing numbers in road accident in Palestine (PCBS, 2013), applying green logistics concept which consider the driver's performance in term of HF will clearly reduce the number of road accidents and simultaneously reduced the number of injured people from these accidents, in this way the harmful impact on human will be reduced.

Also, in Palestine less attention is paid to environmental issues in both public and private sector since there are more important issues regarding the Palestinian situation. This research tries to increase the Palestinian public awareness about the environmental issues.

The importance of this research is represented in extracting the factors that help logistics companies in Palestine to adopt the concept of GL by clarifying its benefits and economic values. Since these companies provide services using the traditional way of logistics, this research can help logistics companies to stay in touch with the most recent techniques in logistics services.

On the other hand, the results of this research can help logistics companies by assessing their current situation, making further improvements and developments using a realistic model, comparing themselves with other competitors and gaining competitive advantages, through minimizing the cost, decrease the harmful impact on environment and increase the service level and company's reputation.

1.3 Research Objectives

The main objective of this thesis is to develop a GL model that helps logistics companies to evaluate their activities throughout the analysis of Key Performance Indicators (KPIs) in order to minimize energy, material usage and carbon emissions. In return the total cost will be reduced and the responsiveness will be increased. So that the adverse impacts of logistics activities on the environment will be minimized.

This can be achieved through;

- Study the current situation of using GLI by Palestinian logistics companies.
- Identify the positive and negative factors that encourage or prevent logistics companies in Palestine to adopt GLI.
- Find the relationship between those factors and how these factors can affect the adoption of GLI by Palestinian logistics companies.
- Identify the factors affecting the impact of logistics companies' activities on the environment.
- Develop a GL framework that explains the factors affecting the adoption of GLI by Palestinian logistics companies, and identifies the factors affecting the logistics companies' green logistics activities.

- Develop a theoretical framework for modeling the human factors (HF) in term of driver performance in GL by identifying these factors and the interactions between them.
- Develop a GL model to reduce carbon emission, minimize the cost and increase the responsiveness.

1.4 Research Questions

This research aims at answering the following questions:

1. Do employees and managers aware about the benefits that can be obtained as a result of applying GLI?
2. Does the development in green innovations affect the adoption of using these innovations for logistics services?
3. Do the governmental regulations and the environmental legislations affect the adoption of the applying GLI?
4. Is there any governmental support to logistics companies regarding green innovations?
5. Does the adoption of green logistics increase effectiveness of providing services?
6. How can HF affect GL?

1.5 Research Limitations

Each research is bounded with certain limitations; these limitations can be taken into consideration while addressing other related researches in the future.

Below are the key limitations that bound this research.

- Company's reluctance: Some of Palestinian logistics companies did not give information regarding the numbers of their employees and drivers.
- Lack of previous studies about green logistics in Palestine: The Palestinian studies about green logistics are reviewed, no studies related to this subject are found.
- Lack of previous studies about human factors in green logistics: The majority of modern literatures fail to consider human aspect, this research attempt to incorporate driver's behavioral factors to green logistics.
- Security issues: The managers whom are interviewed were aware about each and every word they said, as a result of security issues related to the nature of their work.
- Using a questionnaire survey: The results may suffer from the respondent bias. Respondents may answer the survey's questions in a way to be socially acceptable or to appear logical. Nevertheless, the fact that the survey was randomly distributed was may minimize this problem to some extent.

1.6 Thesis Outline

The research will be consisting of six chapters, Chapter One is the introductory chapter, which outlines and clarifies the character of the research including research objectives and questions. Chapter Two reviews the related literatures in the field of GL concepts and HF aspects in GL. Chapter Three presents the methodology and the research tools followed in this thesis. Chapter Four introduces the formation of GL and HF frameworks based on data collection and analysis. Chapter Five displays the GL model and its implementation. Finally, Chapter Six concludes the study through an articulation of the research findings and conclusion also future research directions are presented.

Chapter Two

Literature Review

This chapter presents a comprehensive review of relevant studies considering green logistics system and human factors. The literature review provides a starting point for the research, and it is an essential part of the research process, since it helps to generate ideas for research and summarizes existing research by identifying patterns, themes and issues.

This chapter reveals the variety of logistics and green logistics definitions and terminologies. It is also presents a brief explanation about green logistics system, green logistics innovations and factors affecting the adoption of green logistics innovations. Several models in green logistics are also reviewed. Human factors definition and types are also introduced besides human performance measures. In addition a verity of human factors frameworks are also reviewed. Finally the research framework is also presented.

2.1 Green Logistics

With the rapid development of social economy and the greatly enhance of the human material civilization, the resources on the earth have been dwindling and the living environment of human beings is facing with more and more threats. In this context, a wave of “green wave” is raised in the global in 1980s, and green movement are infiltrating to all areas.

Moreover, with the modernization society and the public awareness of environmental protection; logistics industry has changed the environment in all perspectives. Green logistics is concerned with the production and distributing goods in a sustainable way, reducing the energy usage and emission in logistics activities and takes account of environmental and social factors. So, governments, companies and public are more concern with green logistics. However, green logistics is a new concept and is affected by the knowledge, regulations, infrastructure, technology and personnel training. Green logistics is still a new concept to work in as its social and economic value appears considerable.

The definition of the term green logistics is difficult to pin down. The researcher thought that the key to find the correct definition of green logistics is to understand the words green and logistics of the phrase green logistics independently.

2.1.1 Definitions of Logistics

Since logistics advanced from 1950s, there were numerous researches focused on this area in different applications. In recent decades, due to the trend of globalization of business, decentralization of production, development of supply chain concepts, new emerging markets and more discerning and demanding customers; the importance of logistics management has been growing in various areas. So, logistics has become the new and most powerful force in business (Karagulle, 2012).

Logistics is the art and science of getting things exactly where and when they need to be there. It is how you reach out to new customers and new markets. It is about how to make current customers happier and how to make the supply chain more sustainable. For industries, logistics helps to optimize the existing production and distribution processes based on the same resources through management techniques for promoting the efficiency and competitiveness. For a company, logistics is a key function which affects its success. With its important role, logistical decisions become critical to gain competitive advantage. Furthermore, resources can be used economically and company can create value for its customers. As a result, logistics process is getting more and more important in almost every company's daily life.

The key element in logistics system activities is transportation, which joints the separated activities. Transportation is required in the whole production procedures, from manufacturing to delivery to the final consumers and returns. Only a good coordination between each component would bring the benefits to a maximum (Fair and Williams, 1981). Transportation influences the performance of logistics system hugely. The role that transportation plays in logistics system is more complex than carrying goods. Its complexity can take effect only through highly quality management. By means of well handled transport system, goods could be sent to the right place at right time in order to satisfy customers' needs. It brings efficacy, and also it builds a bridge between producers and consumers. Therefore, transportation is the base of efficiency and economy

in logistics and expands other functions of logistics system. In addition, a good transport system performing in logistics activities brings benefits not only to the quality of service but also to company competitiveness (Fair and Williams, 1981).

The Council of Supply Chain Management Professionals (CSCMP) defined logistics as: “Part of the supply chain process that plans, implements, and control the efficient, cost effective flow of raw materials, in-process inventory, finished goods and related information from the point of origin to the point of consumption for the purpose of conforming to customer requirements. This definition includes inbound, outbound, internal, and external movements”.

Different authors define logistics. Harrison and Van Hoek, (2008) defined logistics as “The task of coordinating material flow and information flow across the supply chain”. However, Mangan et al., (2008) summarized that logistics involves getting, in the right way, the right product, in the right quantity and right quality, in the right place at the right time, for the right customer at the right cost. In the product and service delivery process, the logistics function is one of the few functions that actually touch the customer (Ellinger et al., 2002). Then logistics management is a relevant part of customer service with its contribution to the service level and its ability to do so at least cost to the total supply chain (Christopher, 2010). In other words, logistics could be considered as the operational component of SCM, including inventory management,

transportation and fleet management, and data collection and reporting (Stank et al, 2005).

Logistics system poses a range of environmental problems. This is especially through transportation activities. These problems include noise, accidents, air pollution caused by traffic congestion and the increase in carbon dioxide and other vehicle emissions. In particular, vehicles used in cargoes transport are considered to be the main source of these problems (McKinnon et al., 1993). Balance economic and environmental performance has become increasingly important for logistics companies facing competitive, regulatory, and community pressures to minimize the impact of their activities on environment. This has called for increasing attention in recent years toward introducing a new concept called Green Logistics (GL).

2.1.2 Definitions of Green Logistics

Green Logistics is a new concept put forward in the middle of eighties (Beaman, 1999). Many researchers had different descriptions about green logistics concept.

According to Larsen et al., (2007) GL is defined as “The efforts to measure and minimize the environmental impact of logistics activities, these activities include a proactive design for disassembly”. While Rodrigue et al., (2012) defined GL as “supply chain management practices and strategies that reduce the environmental and energy footprint of freight distribution, which focuses on material handling, waste management,

packaging and transport". In other context Wu and Dunn, (1995) thought that the GL was a logistics system which cares about the environment and it included both the green forward logistics process, from handling and acquiring raw material, production, packaging, transportation, warehousing and finally the distribution to the end customer, and the reverse logistics of the waste recovery and disposal.

Previous literatures pointed that GL some time concerned with producing and distributing goods in a sustainable way, taking account of environmental and social factors (Sbihi and Eglese, 2007). Others said that green logistics is the study of practices that aim to reduce the environmental externalities, mainly related to greenhouse gas emissions, noise and accidents, of logistics operations and therefore develop a sustainable balance between economic, environmental and social objectives (Dekker et al., 2012).

Other authors mentioned that GL is the eco-efficient management of logistics activities including the forward and the reverse flows of products and information between the point of origin and the point of consumption in order is to meet or exceed customer demand (Thiell et al., 2011). Green Logistics activities include measuring the environmental impact of different distribution strategies, reducing the energy usage in logistics activities, reducing waste and managing its treatment (Sbihi and Eglese, 2007). However, Lee and Klassen, (2008) described GL as Green Supply Chain Management (GSCM) that can be defined as a organizations activity

taking into account environmental issues and integrating it into SCM in order to change the environmental performance of suppliers and customers.

From researcher point of view GL could be an attempt to measure and minimize the environmental impact of logistics activities and take the advantages of logistics resources.

From the previous discussion GL emphasizes on the environmental sustainability; furthermore, it symbolizes environmental responsibility. Therefore, in the following section, the concept of sustainability, particularly environmental sustainability is focused on.

2.1.3 Green Logistics and Sustainability

The negative impact of logistics activities on the environment has resulted in the need for sustainable development. According to the most accepted definition made by Brundtland Commission, sustainable development is “development that meets the needs of the present without compromising the ability of future generations to meet their own needs” (Karagulle, 2012).

Sustainable development can be achieved by implementation of GL activities and strategies. Sustainability consist of three pillars; economy, society and environment. These pillars are correlated. Also, they are not mutually exclusive and can be mutually reinforcing (Chittyal et al., 2013). Make a good and a proper balance between the three pillars is the main objective of sustainability. This could be achieved through balancing the

consumption of resources with the impact of that consumption on the environment (Kumar and Malegeant, 2006)**.**

The three pillars of sustainability can be applied to green logistics. The contribution of GL in value creation in both economic and social sectors is shown in table 2.1.

Table 2.1: Contribution of Green Logistics to the Creation of Economic and Social Value, source: (Kumar and Malegeant, 2006)

Creation Value	
Economic	**Social**
Improved customer satisfaction	Reduced environmental impact (such as; carbon dioxide emissions, noise levels)
Good relations with stakeholders	Better utilization of natural resources (such as; fuel, packaging)
Green image	Development in harmony with culture and available resources
Higher delivery reliability through optimized route planning and less truck downtime	Reduced social cost (such as; health problems in the communities)
Higher productivity through higher motivation of the employees	Access to clean water and clean energy
Reduced liability risk	Creation of jobs
Reduced taxes	Enhanced quality of life
Improved financial performance	

So, green logistics can be seen as methods used to achieve a good balance between environmental, economic and social objectives, and therefore ensuring sustainability (Hans, 2011).

2.2 Green Logistics System

The concept in developing green logistics should be viewed as an interconnected system. The green logistics system consists of several components as shown in figure 2.1; green transport, green warehousing, green packaging, green logistics data collection and management and waste management. (Thiell et al., 2011). Within the green logistics system modern technology and equipment are used to minimize environmental hazards and increase the utilization of the resources (Rogers and Tibben-Lembke, 1999).

As this research focuses on the environmental impact from the cargoes distribution process. Green transport is the concern.

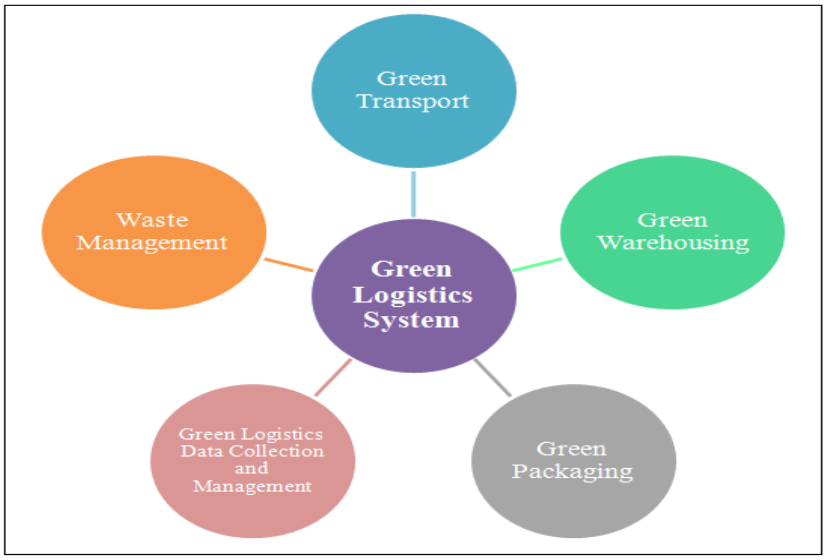

Figure 2.1: Green Logistics System

2.2.1 Green Transport

Transportation; which is a major logistics activity, has a significant influence on the environment as it is the main source of green house gases mainly the carbon dioxide which is the greatest threat. Recently the amount of carbon dioxide levels are raised, this is an indication that the green house gases emitted from the transport company raise a serious alarm in environmental consideration. For that reason, green transportation is one of the main components of green logistics (Krishna et al., 2012).

Green transport system is mainly in order to reduce traffic congestion, reduce the harmful effect on natural environment such as exhaust emissions and noise, reduce the negative impact on human heath, promote social harmony and save the transport costs.

Transportation not only leads to emitted many of toxic chemicals due to the operation of transport vehicles and construction of transport networks, but also pollutes the roads, airports, ports and rails which are often filled up with dismantled vehicles and disposal parts (Wu and Dunn, 1995).

In order to attain green transport and make transportation efficient to prevent these problems and protect the environment, many companies considering the green transportation practices ranging from modal choice, freight consolidation, using clean vehicles, reusing of pallets and containers; in order to use less, to substitute, to clean up the outputs and to turn outputs into inputs (Thiell et al., 2011).

2.3 Green logistics Innovations

Since the integration of environmental issues within the logistics sector is still in its infancy, logistics companies can take the adoption of green practices as an innovative process.

“Innovation is any practices that are new to organizations, including equipments, products, services, processes, policies and projects“(Kimberly and Evanisko, 1981; Damanpour, 1991). Distinguish between different type of innovations is necessary in order to understand logistics companies’ adoption behavior and identify the determinants of innovation in each of them.

Two types of innovations are mentioned in literatures. They are either administrative or technical innovations (Damanpour, 1991). However, environmental innovations could be grouped into administrative and technical innovations as Henriques and Sadorsky (2007) do in their study.

Administrative innovation is considered to be a management one as it occurs within organizational structure and administrative processes. While, technical innovation is considered to be process, product or service one as it is closely related to organization’s basic activities (Damanpour, 1991; Kimberly and Evanisko, 1981). Innovation can be seen as offering a new product or service to customer through the use of new technical and administrative knowledge (Afuah, 1998).

Adopting green innovations can be regarded as technical innovation process ones as it involves implementing new or modified processes and using new resources or deploying existing ones, techniques, systems and strategies to minimize the harmful impact on environment by reducing the amount of gas emissions and energy consumptions (Rothenberg and Zyglidopoulos, 2007). Therefore, GLI adoption refers to the decision of a logistics company to use green innovations to respond to environmental issues.

The green innovations that are used within the logistics industry are ranging from transport and non transport innovations, include logistics system design, collecting information on energy of carbon footprint, environmental education and training choice of partners transport management, environmental management system, shipments consolidation, waste management through waste reduction and recycling, reducing carbon footprint, reducing energy consumption, using cleaner transportation methods, and using recyclable packaging, pallets and containers (Gonzalez-Benito and Gonzalez-Benito, 2006b; Martinsen and Huge-Bordin, 2010; Murphy and Poist, 2003). While, Martinsen and Huge-Brodin, (2010) summarized the GLI that can be adopted by logistics companies into nine categorize as shown below.

- Vehicle technologies: The development in engine and exhaust systems, aerodynamic profiling, reduction in vehicle tare weight and improved tire performance can have an effect on environmental performance.

- Alternative fuels: Switching to a fuel with low carbon intensity such as bio-fuel has implications for the environmental impact.
- Mode choice and intermodal transports: Carbon intensity of different modes (road, rail, sea and air) varies and the proportion among them also varies. Thus it affects environmental impact. Intermodal transports refer to a combination of different transport modes.
- Behavioral aspects: Eco-driving and defensive training are well known measures to apply in order to lower environmental impact from transports.
- Logistics system design: This factor affects the distances that cargoes are transported. It is used to minimize the total distance travelled by a vehicle to deliver a certain amount of cargoes. Centralized versus decentralized distribution structures is one parameter that can be of importance for the environmental impact from the logistics system.
- Transport management: Occupancy or fill rate and distances of empty running vehicles are important aspects for environmental performance. Route planning and orders aggregations or freight consolidation are aspect of relevance.
- Choice of partners: Who to partner with and how to manage the relationships are two factors of interest when the aim is to lower the environmental impact of supply chains.
- Environmental management systems: Examples of these are ISO 14001 and EMAS and they can often be related to the minimum performance required by buying companies.

- Emissions and energy data: Many companies measure their own environmental impact in some way and some also monitor their suppliers. Currently, carbon dioxide emission is one common indicator to measure.

Now, logistics companies are in the position to adopt both green transport and non transport related innovations or a mix of both altogether. Moreover, logistics companies may adopt an approach based on designing an integrated package of innovations to respond to many of environmental issues at the same time and improve the environmental sustainability of services they provide.

In recent years, emissions reduction and energy saving have become a focus of attention worldwide. Since most environmental impact of logistics operations and activities arise from transportation which consume energy and produce emissions during the process of distribution, the adoption of emission reduction, cleaner transportation methods and energy saving innovations is recommended (Gonzalez-Benito and Gonzalez-Benito, 2006b).

This research focuses on reducing cost and carbon emissions and improving the service level through vehicle selection, route planning orders aggregation and behavioral aspects in term of driver selection.

2.4 Determinants of Adopting Green Logistics Innovations

Integrating environmental issues within several industries like manufacturing, sales and marketing is widely recognized in previous literature. But the involvement of environmental issues within logistics industry is still limited but expanding. This suggests that, it is necessary to integrate environmental issues within logistics industry.

Although some of guidelines about the incorporation of environmental issues in logistics can be obtained from the previous studies of green innovation adoption in manufacturing industry, but more researches within the logistics context should be done, because the attitude toward environmental issues may change relatively according to the industrial sectors (Etzion, 2007; Henriques and Sadorsky, 1999; Zhu et al., 2008).

The determinants of adopting innovations have been intensively studied. Kimberly and Evanisko, (1981), argued that individual, organizational, and contextual factors would influence innovations adoption. In the same context, Tornatzky and Fleischer, (1990) argued that the technological context, organizational context, and the external environmental context may affect the adoption of innovations.

Scant studies have been conducted to examine the influence of technological, organizational and environmental factors on green innovations adoption. Del Brio and Junquera, (2003) said that the type of management, human and financial resources, operational activities,

technical absorptive capacity and external environment may influence green innovation management. Other related study found that total quality management, customer pressure would increase the probability of adopting and using technical innovations (Henriques and Sadorsky, 2007). Meanwhile, companies' technical and human capabilities, nature of advanced technology and work environment are general factors affecting the adoption of technical innovations (Chau and Tam, 1997; Frambach and Schillewaert, 2002; Tornatzky and Fleischer, 1990). A variety of related considered the political and legal environment, the availability and quality of companies' internal resources and external knowledge and the innovation characteristics to be relevant factors for adopting technical innovations (Jeyaraj et al., 2006; Scupola, 2003; Tornatzky and Fleischer, 1990).

As discussed above, the literature review demonstrated that the adoption of technical innovations is affected by technological, organizational, and external environmental contexts.

2.4.1 Technological Factors

Technological factors are considered in literatures about the adoption of technical innovation. Several technological factors may influence technical innovation, including relative advantage, compatibility, complexity, ease of use, perceived usefulness, information intensity, and uncertainty (Frambach and Schillewaert, 2002; Jeyaraj et al., 2006; Rogers, 2003; Tornatzky and Klein, 1982). This research focuses mainly on

perceived usefulness, compatibility, and complexity because they found to be more important in influencing the adoption of green innovation (Rogers, 2003; Sia et al., 2004; Tornatzky and Klein, 1982).

- **Perceived Usefulness**

The perceived usefulness or the relative advantage is the degree to which an innovation is considered to be environmentally, socially economically beneficial. Companies are more likely to adopt an innovation which is able to generate economics gains and provide better performance (Rogers, 2003; Tornatzky and Klein, 1982).

Several organizational benefits can be obtained as a result of green innovations adoption, include conservation of energy and natural resource, reduction of waste and gas emissions, improvement in environmental and financial performance and greater responsiveness to social environmental expectation (Etzion, 2007; Hart,1995). The net benefits that the green innovation offers will serve as motivations for companies to adopt the innovations. Therefore, the relative advantage will positively affect the willingness to adopt GLI for Palestinian logistics companies.

- **Complexity**

Complexity is the degree of difficulty within an innovation; referring to the difficulty in understanding, dealing with and using an innovation. This will lead to a difficulty in sharing and diffusing knowledge within a company (Rogers, 2003). In addition, an innovative technology with high

complexity requires more financial and human efforts to learn diffuse and use (Tornatzky and Fleischer, 1990). A company will be more likely to adopt technical innovations if they are easily to be deal with, learned and shared within a company, so it is not preferable to adopt complex technical innovation. This will enhance company's management behavior including environmental management behavior (Etzion, 2007).

Within green innovations, the complexity may appear in the identification of pollutions and emissions sources and consequently in the propositional of preventive solutions (Boiral, 2002). This will make green innovations difficult to learn and diffuse within the company. Therefore, the complexity will negatively affect the willingness to adopt GLI for Palestinian logistics companies.

- **Compatibility**

Compatibility is the degree to which a technical innovation is considered as being consistent with company's existing values, experiences, needs, processes and operations (Rogers, 2003). As long as the new technical innovation fits in with company's current operations and knowledge possess, the company will be more likely to adopt it (Chau and Tam, 1997; Tornatzky and Klein, 1982; Tornatzky and Fleischer, 1990).

Compatibility is also relevant to green innovation adoption. As several green innovations are additions to companies' current technologies and processes, adopting green innovations can be described as a process of knowledge accumulation and integration. When green innovations are more

compatible with company's existing operations, they will be earlier and more easily diffused than green innovations that are more difficult to integrate within company's operations. Fit between previous experiences and environmental activities may lead to a greater environmental effectiveness (Etzion, 2007). Therefore, the compatibility will positively affect the willingness to adopt GLI for Palestinian logistics companies.

2.4.2 Organizational Factors

Organizational factors are discussed in both technical innovation and environmental management studies. A variety of organizational factors such as employees attitude, quality of human resources, top management's skills and support, organizational support, organizational culture, and organizational size have been examined their influences on technical innovation and environmental management effectiveness (Etzion, 2007; Gonzalez-Benito and Gonzalez-Benito, 2006a ; Kimberly and Evanisko, 1981; Tornatzky and Fleischer, 1990).

In general, this research focuses mainly on the employees' attitude, organizational support and quality of human resources because they are the most influential organizational factors on technical innovation, environmental performance as well as green innovation adoption (Alvarez-Gil et al., 2007; Damanpour, 1991; Hart, 1995; Jeyaraj et al., 2006; Lee, 2008; Russo and Fouts, 1997; Zhu et al., 2008).

❖ Attitude

The attitude toward using new technological advancement and perceived behavioral control are the components of theory of planned behavior. These components influence employees and managers to adopt GLI. Attitude is either positive or negative evaluation on specific thing or person (Ajzen, 1991).

Attitude is influenced by beliefs about the results obtained from applying green innovations. Company's employees should realize the benefits of GLI in order to formulate positive attitude toward using this new innovation (Lee et al., 2005). Therefore, the attitude will positively affect the willingness to adopt GLI for Palestinian logistics companies.

❖ Organizational Support

Organizational support is the degree to which a company supports its employees. The support could be moral, financial or technical support. The technical support; whether it is using a new advanced technology or a system; will influence technical innovation. Moreover, the availability and the adequacy of both financial and technical recourses and incentives have positive effects on the adoption of technical innovation (Jeyaraj et al., 2006; Lee et al., 2005).

Organizational support is essential in order to incorporate environmental issues within the organization, because this process required valuable resources. As long as the organizational support exists, the

resources will be easily available and the employees will be motivated to apply and use green innovation. Moreover, within the organizational support, the top management has an important role, as the adoption of green innovations requires collaboration and coordination between the different departments and divisions. The top management plays the cheerleader role to encourage and endorse the successful implementation of green innovations. In addition, the top management provide the support for effective acquisition and effective allocation of resources, in this way green innovations can be easily adopted to achieve environmental competitive advantage (Gonzalez-Benito and Gonzalez-Benito, 2006a). Therefore, the organizational support will positively affect the willingness to adopt GLI for Palestinian logistics companies.

- **Quality of Human Resources**

Adopting technical innovations as well as adopting green innovation requires qualified employees with competent learning abilities and innovative capabilities (Tornatzky and Fleischer, 1990).

Successful adoption and implementation of green innovations requires changes in company's existing processes and proper coordination between multidisciplinary departments (Russo and Fouts, 1997). It is also requires human resources with competence skills so that they will be easily involved in training courses which advance green innovation adoption. In this way, the company's innovative capability will be improved in accordance with improvement in employees' innovative and learning

capabilities (Del Brio and Junquera, 2003; Hart, 1995). Frambach and Schillewaert, (2002) said that the degree to which a company accept any new concepts or ideas will influence its intention to adopt innovative technologies. While, Christmann, (2000) said that the innovative capacity of a company will facilitate the successful implementation of advanced environmental strategies and technologies. Therefore, the quality of human resources will positively affect the willingness to adopt GLI for Palestinian logistics companies.

2.4.3 Environmental Factors

The environmental factors refer to the external environment in which a company works in. Several environmental factors have been discussed in previous literatures of technical innovation and environmental management such as stakeholders; whether it is customer pressure or regulatory pressure; work environment, environmental munificence, governmental support, competition and network relations (Etzion, 2007; Frambach and Schillewaert, 2002; Gonzalez-Benito and Gonzalez- Benito, 2006a ; Jeyaraj et al., 2006).

Customer pressure, regulatory pressure and work environment are considered as primary environmental factors influencing technical innovation and environmental management (Aragon-Correa and Sharma, 2003; Etzion, 2007; Jeyaraj et al., 2006; Rothenberg and Zyglidopoulos, 2007; Tornatzky and Fleischer, 1990). Also, the government affect the acquisition of resources for innovation adoption (Lee, 2008; Scupola,

2003). Thus, this research focuses mainly on the influences of customer pressure, regulatory pressure, governmental support, and work environment.

❖ Stakeholder Pressure

Stakeholders are individuals or groups who affect or affected by company's activities. Stakeholder pressure is widely involved in environmental management literature and considered to be an influential factor affecting company's strategies toward environmental issues (Buysse and Verbeke, 2003; Etzion, 2007; Gonzalez- Benito and Gonzalez-Benito, 2006a).

The stakeholder theory argued that, companies perform activities in order to satisfy their main stakeholders. Customers and regulatory pressure are considered as companies' most important stakeholders (Christmann, 2004; Etzion, 2007). Previous researches reveal that a positive relationships between companies' environmental activities and customer and regulatory pressures (Christmann, 2004; Lee, 2008). Therefore, the customer pressure and the regulatory pressure will positively affect the willingness to adopt GLI for Palestinian logistics companies.

❖ Governmental Support

Technical innovation relies to some extent on the availability of external resources. The governmental support is viewed as a main external resources affecting technical innovation adoption through encouraging

policies such as providing financial incentive, technical assistant and training programs for companies' employees (Scupola, 2003; Tornatzky and Fleischer, 1990).

In the same manner, the availability and the adequacy of external resources will increase the degree of integration in environmental management and in turn will affect the adoption of green innovations (Aragon-Correa and Sharma, 2003; Rothenberg and Zyglidopoulos, 2007). So, the government can raise the availability of resources by providing governmental subsidies, tax incentives, and financing for alternative environmental projects, this will promoting companies to engage in implementing such projects (Aragon-Correa and Sharma, 2003; Lee, 2008) Therefore, the governmental support will positively affect the willingness to adopt GLI for Palestinian logistics companies.

- **Work Environment**

The work environment has been viewed as the most relevant environmental factor that affects a company's decision making within the work environment; there are frequent and unpredictable changes in customer preferences, technological development, and competitive behavior perceived by the managers (Li and Atuahene-Gima, 2002).

Within uncertain environment, manager may tend to be more proactive than reactive and using more innovative strategies. So, they attempt to gather and process information frequently and rapidly to address environmental changes (Gupta and Govindrajan, 1991). Moreover, they

tend to pay more efforts on innovation and increase the rate of technical innovation to maintain a competitive advantage (Damanpour, 1991; Kimberly and Evanisko, 1981; Zhu and Weyant, 2003).

Some researchers (Aragon-Correa and Sharma, 2003; Rothenberg and Zyglidopoulos, 2007) suggested that companies are more likely to adopt environmental innovations to generate the capacity to improve a company's environmental performance in uncertain and changing environments, green innovation adoption is expected to be positively associated with the work environment. Therefore, the work environment will positively affect the willingness to adopt GLI for Palestinian logistics companies.

This research will explore the influences of technological, organizational and environmental factors on the willingness to adopt green innovations in Palestinian logistics companies. Also, the potential relationships between the proposed determinant factors will be considered in the current research.

2.5 Models in Green Logistics

Traditional logistics models either for production or for distribution have focused on reducing the total costs. But consideration of the environmental issues which are connected with green logistics results into developing new models using different methodologies.

There are several models developed which use some algorithms that translate the importance of green practices into logistics processes. The general purpose of these models is to forecasting the environmental impact of alternative decisions and to developing of green processes that minimize such impact and reduce the final cost either it is production, transportation or waste treatment. This is seen as advantages to the companies, but there also some obstructions like the cost of green infrastructures, absence of green regulations and penalties for violators and lack of well trained human resources that are able to implement green practices. In general, these models allow companies to understand their environmental impact.

In order to solve green logistics problems, numerous methodologies or approaches have been proposed, such as empirical studies, analytical models mathematical modeling approach and optimization models.

Since transportation is a key driver in service logistics and a main source of ecological hazards within the logistic system (Wu and Dunn, 1995). McKinnon, (2010) presents a framework for the decarbonisation of logistical activities based on five key freight transport parameters: freight transport intensity, modal split, vehicle utilization, energy efficiency and the carbon intensity of the energy used in logistics. In his framework, he investigated the possibility to reduce emissions by altering each of these parameters associated with the decarbonasation of warehousing operations. Finally, He concluded that the decarbonisation process may yield several benefit including financial ones. While, Iakovou et al., (2011) provided a

quantitative strategic decision support methodology for the design of green networks that identify the optimal mixture of production allocation capacity, the effect of the variability of order lead time demand and the additional effect of sustainability on network design such as carbon emission, energy use. Various "what-if" analyses are conducted in order to explore sensitivity of production, transportation and carbon dioxide emissions costs on the network design. The usage of the proposed methodology is verified through its application on various problem instances.

Reducing the number of vehicle kilometers travelled could play a significant role in reducing the carbon emission. Within this context, Elhedhli and Merrick, (2012) considered a green logistics network design problem that takes carbon dioxide emissions into account through developing a mixed integer program alongside lagrangian relaxation method, so that the relation between carbon emission and vehicle weight is modeled to reduce the amount of vehicle kilometers travelled and thereafter the combined costs of carbon emission, fixed cost to set up facility, transpiration and production costs can be minimized. The result indicates that considering carbon emission cost can change the optimal configuration of the network.

Another model is proposed by Feng et al., (2008) the model is a simple mix integer programming for distribution center location. The description of location problem for green logistics is made by extended two

factors in the model; transport mode and carbon emission. By changing the price of fuel, the locations of distribution centers and the choice of transportation mode are affected. The study showed that as the fuel price increase the profits of the whole logistics system decrease, carbon emission will also decrease to some degree, while the number of opened distribution center will increase.

Pishvaee et al., (2011) proposed a new hybrid credibility-based fuzzy mathematical programming model for designing the strategic configuration of a multistage green logistics network under uncertain conditions. In their model, they aim to minimize the environmental impacts and the total cost of network establishment simultaneously in order to make a reasonable balance between them. The carbon dioxide equivalent index is employed to measure the environmental impact of concerned logistics network. They also integrate the transportation mode and production technology selection decision in the network design. Within the model, an industrial case study is provided to show the effectiveness of its applicability in reality.

An innovative simulation green logistic model is developed based on Web technologies devoted to analyze environmental impact of the whole logistic system (Bruzzone et al., 2009). In their model the data was collected from different users including good producers, logistics operators and retailers using electronic questionnaire. A model for each user is made after evaluating his green aspect through simulation. In addition the green

model developed allows creating interactively very complex logistic system.

Ramudhin et al., (2008) tied greenhouse gases to carbon trading based on carbon market sensitive green supply chain network. They developed mixed integer program model that focuses on the impact of transportation, subcontracting, and production activities in terms of carbon footprint on the design of a green supply chain network. The model integrates carbon prices and exploits the opportunities offered by carbon market in the design of green supply chain network. In the same context, Diabat and Simchi-Levi, (2010) introduced an optimization model that integrates green supply chain network design problem with carbon emission constraint using mixed integer program. In their model the throughput capacity of the manufacturing site, storage capacity of the distribution centers and their locations considered as decision variables in order to ensure that the total carbon emission does not exceed an emission cap while minimizing the total supply chain cost. However, they found that as carbon emission allowance decrease, supply chain total cost increase.

Abdallah et al., (2011) presented a different mixed integer program in which the green procurement concept where the decision on which supplier to choose affects the overall carbon footprint of the supply chain is integrated in green supply chain network design problem to minimize traditional supply chain cost in addition to minimize the carbon emission cost.

Another related study is conducted by (Pakosy et al., 2010) who considered the green impact on a close-looped supply chain network and tried to reduce carbon emissions and encourage the customers to use recyclable products through giving a small profit. While, Wang et al., (2011) were interested in the environmental investment decision in the design of green supply chain network and provided a multi-objective mixed integer program model. The model linked the decision of the environmental investment in the planning phase with its environment influence in the operation phase, as a result the total cost and the environmental influence are minimized.

Measuring and controlling emissions across the logistics network is an important challenge for companies due to the increased concern about the environmental impact of logistics activities. Since the quantification of some logistics variables like driving style, weather conditions and congestion in order to calculate logistics emissions is difficult. Emissions from logistics are only represented as approximation (Van Woensel et al., 2001; Harris, 2007). Two methodologies are used to calculate logistics emissions. They are either fuel based or distance based methodology. In the fuel based approach, emissions are calculated by multiplying fuel consumption with the carbon dioxide emission factor for each fuel type. The fuel based emission factor is developed based on the fuel's heat content, the percentage of carbon in the fuel that is oxidized and the carbon content coefficient (Palmer, 2007).While, in the distance based approach, distance based emission factors is used to calculate emissions, when the

total distance travelled by a vehicle is available and fuel economy factors are not available. The choice between the two approaches depends on the available data (Palmer, 2007).

In this context, Daccarett-Garcia, (2009) presents an excellent summary of methods to calculate carbon emissions for transport trucks using both fuel and distance based approach. In the fuel based approach he founded that one gallons of fuel produces 10.1 kilograms of carbon dioxide, the same amount of emission is produced when the truck travelled one kilometer. The fuel efficiency of the truck type, the distance travelled and the number of trips made by the truck is considered in the model.

Another fuel based approach model used to calculate the emissions of different pollutant of a transport system is developed by Schipper et al., (2008). In their model they calculated the emission of carbon monoxide, simple sulfur oxides and carbon dioxide independently. Then the emissions are summed up for each vehicle and fuel type in the transport system. Recently, much commercial software which is able to calculate environmental impact of logistics activities in terms of carbon emissions are available (Harris, 2007).

Several models have highlighted the importance to reduce the transportation cost. Anciaux and Yuan, (2007) developed an intermodal optimization model to minimize the total transportation cost. The model also considered the total air emissions from pollutants such as carbon dioxide, sulfur oxides, hydrocarbons, and dust during product shipment.

However, Paksoy et al., (2010) presented a multi objective linear programming model of green network that reduces raw material purchasing and transportation costs. The model also imposed penalties cost for extra carbon dioxide emissions.

The literature on GL models that considers the human aspects was also surveyed. It was surprising that the model that integrates HF into GL does not exist; this represents a drawback in these models. However, most of the works on GL models do not consider HF in term of driver performance such as fatigue rate, accident rate and shipping time. Since, the majority of modern literature fails to consider HF, this research attempts to incorporate HF such as such as age, experience, weather, training and work duration to GL problems. This research will contribute to the literature of GL by extending existing models of GL beyond current capabilities. Three objective functions are considered in the proposed model. They are; cost minimization, carbon emission minimization, and service level maximization. In summary, ergonomics must be implemented concurrently with GL in order to improve GL both environmental and economic performance.

2.6 Human Factors

Human elements are the most precious resource, the most influential management and productivity at all and a primary source of organizational strength. It is a rational, human being, which runs all the activities, and whose results depend on the knowledge, abilities, skills, motivation. In this

competitive environment, people who carry out the tasks seem to remain the key to success (Womack, 1990).

Human factors, or ergonomics, has been defined as “the theoretical and fundamental understanding of human behavior and performance in purposeful interacting socio-technical systems and the application of that understanding to the design of interactions in the context of real settings” (Wilson, 2000). The Board of Certification in Professional Ergonomics (BCPE) in North America defines human factors as “A body of knowledge about human abilities, human limitations, and other human characteristics that are relevant to design”.

During the last years, the importance ergonomics is widely recognized, but the factors which affect performance are less well understood (Barrick and Mount, 1991). Many studied argued that ergonomics are working as protectors of workers, rather than creators of systems. They generally associate ergonomics with health and safety issues rather than with effectiveness of organizations (Dul and Neumann, 2009; Jenkins and Rickards, 2001; Perrow, 1983). However, it is shown that ergonomics can contribute to different company strategies and support the objectives of different business functions in the organization (Dul & Neumann, 2009).

On the other hand, many HF or ergonomics models have been developed without clear understanding of how they could be implemented in a specific system (Bulter, 2003; Hägg, 2003). Thus, the problem here

seems to be systemic. From this point of view; there is an obvious need to study the HF and to integrate them into organizational processes early, in order to determine and identify the aspects of human behaviors, its causes and characteristics and to increase the management's ability to predict and direct these behaviors toward goals achievement and profit maximization for the organization.

There are many common reasons for not considering human issues early into operational design. Some of these common objections to ergonomics are many users think that the researches in HF are too abstract to be useful, human behaviors is dynamic in nature and the relationships between them continuously evolve and change. Also humans are adaptive so it is difficult to quantify their characteristics. However, none of these are valid reasons to not consider HF early in the process design (Helander, 1999; Muduli and Barve, 2013). In contrast, Baines et al., (2005) said that several benefits could be obtained from considering HF in system design, such as, the creation of more valid models in different industries and the creation of work environment which makes appropriate fitting between the worker and the type of work.

A key challenge in green logistics research is to improve the awareness of logistics company awareness about the HF that cause variation in driver performance which in turn have an impact on logistics company activities and performance. It is particularly desirable to improve

this awareness early on the process, as many factors support the strategic objectives of a logistics company.

Given that a portion of the literature review presents aspects of general human factors, Parker et al., (2001) emphasized that a universal list of HF would probably be infinite, but categories of HF should be indentified in a theoretical framework, so that the adoption and the incorporation of HF in different industries would be possible. The challenge for this research is to create such a guide that will be specifically appropriate for drivers whom work in logistics companies which have a willingness to adopt GLI.

An extensive literature research is conducted to identify possible human factors which are most likely affect the driver performance. The literature search was carried out in a variety of areas, including supply chain management, green logistics, psychology, ergonomics, behavioral medicine, physiology, health and safety, organizational studies, industrial relations, and human resources management. A screening method is carried out by assessing many studies about either HF or theoretical framework performance models on the basis of three criteria: general relevance to logistics and green logistics, literature consistency and factors measurability (Othman, 2012). The starting point for the investigation of these factors is based on the theoretical framework of Baines et al. (2005), which has identified the majority of the human factors that cause variations in human performance measures. In fact, the Baines et al. (2005)

framework allowed for the identification of human factors affecting performance such as age, cognitive ability, skill, health, shift pattern, training, job rotation, job satisfaction and noise level. The majority of literature fail to consider HF affecting the driver performance, this research attempts to identify these HF and develop HF theoretical Framework that could be incorporated in the development of any GL model. In this research HF are divided into four categories; individual factors, environmental factors, job factors, and organizational factors.

2.6.1 Individual Factors

Individual factors existing in literature related to the person himself. They are ranging from personality, demographic, physiology, cognition, motivation and skills (Baines et al., 2005). Cognitive ability and experience can contribute directly to overall human performance in all types of work and driving is one of them (Ree et al., 1994). Schmidt and Hunter (1998) mentioned that cognitive ability and experience are the predictors of job performance. They also found that personality, biographic data and job knowledge are major factors for job development. However, personality is highly related to work performance (Viswesvaren and Ones, 2000). Personality can be defined as “the sum of physical, mental, emotional and social characteristics possessed by a person that uniquely influences his cognitions, motivations and performance in any environment” (Othman, 2012). Moreover, demographics such as age and gender are highly affected driver performance (Gambert, 2013; Nishida, 2009). In addition several

literatures studied the affect of health and diet on driving (Murray, 2014; Philip et al., 2005). So, the driver performance could be affected by several human factors.

2.6.2 Environmental Factors

The human body interacts with the surrounding environment. The environment is the place in which other components must function (Chang and Yeh, 2010). The environment should be safe and predictable, because it has a direct effect on people's performance. Research indicates that environmental factors have a significant influence on worker performance (Hatch, 1987; Sullivan, 1990). Environmental factors are temperature, humidity, lighting, noise, air quality, and vibration; these factors are highly mentioned in literature (Baines et al., 2005). Noise level and weather condition are the most influential HF on driver performance in term of accident. Goines and Hagler, (2007) studied the effect of noise pollution on road risk. Although high noise levels pose serious threats to the hearing, the effects of noise on driver general performance cannot be ignored. Another significant factor affecting the driver performance and safety on road is the weather condition (Bijleveld and churchil, 2009). Research studies indicate that environmental factors beyond the human's control have a strong influence on job performance (Porter and Lawler, 1968).

2.6.3 Job Factors

The nature of the work undertaken can clearly affect job performance. Several factors associated with the job nature mentioned in

literature including schedule, duration, job intensity, technique, and posture (Othman, 2012). Hanecke et al., (1998); Dembe et al., (2005) studied the effect of the duration of the working hours on drivers performance. While, Wang and Pei, (2014) investigated the effect of rest hours on performance and they identified the desirable amount of break that the driver needs to recover his activity. Moreover, Dembe et al., (2005) studied the effect of uniform work schedule on driver performance in term of fatigue rate.

2.6.4 Organizational Factors

Human elements are the most precious resource, the most influential management and productivity at all and a primary source of company's strength. There are many organizational factors that have an influence on the performance and the behavior of employees. Some of these factors are shift patterns, work teams, maintenance, training, job rotation communication, diversity and hierarchical structure. Alberta Human Resources and Employment, (2004) investigated the effects of shift pattern on driver performance and clarified the best time during the day for driving task. However, Peck, (2011) identified the effect of training on driver performance and the accident he made. Training can lead to improve driver capabilities which cause higher levels of performance (Mayhew and Simpson, 2002).

From the previous discussion, it can be concluded that the HF that have an influence on the driver performance who work with a green logistics companies are as shown in table 2.2.

Table 2.2: List of Human Factors within green Logistics System

#	Human Factors	#	Human Factors
1	Driver Age	8	Weather
2	Driver Experience	9	Working Hours Duration
3	Driver Attention	10	Breaks (Rest Hours)
4	Driver Sleep Pattern	11	Working Schedule
5	Driver Health	12	Working Shift Pattern
6	Driver Diet	13	Training
7	Noise Level		

In chapter four the way that these HF affecting the driver performance will be investigated through the survey analysis and the relationships among these factors will be also clarified. This will be helpful in developing HF theoretical framework for green logistics system.

2.7 Measures of Human Performance

The task of managing and measuring human performance is complex and can be a difficult challenge. Human performance indicators can be expressed in different ways. The indicators of the human factors can measure how the driver affects the green logistics system or how the green logistics system affects the driver. Human performance indicators can be rather objective or subjective. Objective indicators can be measured directly, such as productivity or quality, whereas subjective indicators are based on the planner's judgment such as loyalty or satisfaction. Human performance can be critical in green logistics system efficiency. Some human performance indicators are difficult to measure, others are easy to measure.

KPIs must reflect the company' goals, they must be the key to its success, and they must be measurable. It is important to define consistent performance indicators and set up a way to measure them. Table 2.3 shows a list of human performance indicators and their definitions. However, while all human performance measures should be considered due to their influence on the output of the green logistics process, it is critical to limit them to those factors essential to the company reaching its goals and keep them small just to keep everybody's attention focused on achieving the same performance indicators. In this research, some human performance indicators that are listed in Table 2.3 will be added to the proposed GL model in order to consider the human issues in the green logistics process. Therefore a GL model that can reduce the cost, reduce the carbon emission and reduce the total shipping time concurrently could be built.

Table 2.3: Indicators of Human Performance within Green Logistics Environment, source: (Siebers, 2004)

	Human Performance Indicators	**Definitions**
Objective	Dependently Distribution	Unexpected interruptions to the task completion
	Shipping Time	Time taken to complete a specific single task or range of tasks
	Accident Rate	Frequency of hazardous events attributable to human error
	Driver Turnover Rate	Number of employees who leave and replaced over a given period
Subjective	Stress Rate	Any influence that disturbs the natural equilibrium over a given period
	Fatigue Rate	Weariness, tiredness or lack of energy resulting from bodily or mental exertion
	Job Satisfaction	Sense of inner fulfillment and pride achieved when performing a particular job
	Conflict Size	A clash, struggle, or trial of strength involving two or more persons or groups

In this research fatigue rate, accident rate and shipping time are introduced as driver's performance measures, which cause variations in driver's performance and may lead minimize the cost, reduce the carbon emission and increase the service level if they are considered in GL model.

2.8 Human Performance Theoretical Frameworks

"Human Performance Model (HPM) is an attempt to integrate as much as the researcher could consider and study the factors and aspects influencing the performance of a human during performing a job" (Jalil et al., 2012).

Many theoretical frameworks relating human factors and performance frameworks show how the wide range of interrelated physical, physiological, psychological and psychosocial factors have been related to work performance outcomes related to the worker, the organization and the work environment. In some cases, many of human factors could be integrated within frameworks for modeling human performance in any engineering process.

Recently, more investigations and researches related to developing HF framework s in transportations were conducted; it derives from the air traffic control system, design process at the factories, train driving activities and ship navigation (Banies et al., 2005; Jalil et al., 2012; Gore and Smith, 2006; Gould, et al., 2009; Sani and Dawal, 2010).

Variety of theoretical frameworks relating human factors and performance have been developed (Bailey, 1966; Bonney et al., 2000;

Chang and Yeh, 2010; Dahn and Laughery, 1997; Furnham, 1992; Jalil et al., 2012; Lewin, 1935; Miller and Swain, 1987; Parker et al., 2001). Many of the existing frameworks are quite general in nature and have many similarities, but it is obviously that simpler ones are needed with consideration of HF in green logistics system.

One of the best known generic frameworks was provided by Lewin, (1935), in his framework the environmental context and individual characteristics were related to the behavior of the individual. Although this provides an excellent set of factors, but it cannot be used for direct application as it is ambiguous and broad. Similarly, Bailey, (1966) proposed a generic model in which three elements are required to predict human performance in general. These elements are understanding of the human, the activity being performed and the context in which it is performed. He pointed that the basic components of a human to perform the job and to reacts with the surrounding environment include a complex system of sensors, brain processing and responders. Through this model he tries to avoid considering only certain part of human and to correlate every aspect for better understanding of human performance in a general manner. Within the same context, Bonney et al., (2000) emphasized the centrality of directs workers to design outcomes in their framework but do not specify the human factors that should be considered.

On the other hand, more detailed models have been developed. Parker et al., (2001) made more specific framework. They put forward

more specific psychosocial and physical factors relating to the person and the organization, but their factors are often difficult to quantify and evaluate in practice. Moreover, more specific model that concentrates on particular specific behavioral factors is developed (Furnham, 1992). In his framework, he proposed five basic categories of individual factors; personality, intelligence, demographics, motivation and ability, that influence general behavior with no specify in each category. The framework was not accounting for effects of external factors weather they are organizational or environmental. Also the framework cannot be used to represent specific performance measures. Therefore it could be used only to represent the relationships between individual factors and performance as it is limited in scope. A regular feature of these frameworks is that they neglect to fully consider aspects of the physical environment, which can be an important consideration within many factories.

One of the most valuable theoretical frameworks is developed by Baines et al., (2005), which include the majority of the human factors that cause variations in human performance metrics from extensive literatures. In effect, the Baines et al. (2005) framework has provided a comprehensive picture of high ranked human factors which have an impact on human performance. They classified into three categories: individual factor, physical environment factors and organizational factors, such as cognitive ability, skill level, personality, noise level, ventilation, shift pattern, work teams, training and job rotation. These factors, in addition to motivation, had been previously identified by Jones, (1993) as the factors that affect job

performance. This theoretical framework is a qualitative representation of human performance where the final element of this framework is the set of functional relationships, which describe the effects on the performance measures of changes in the key factors.

In recent years several research papers have highlighted the importance of the interactions between some key human factors and the transportation system and the need to incorporate these factors early in the design stage.

Chang and Yeh, (2010) used a conceptual model of ergonomics to examine the interaction of interfaces in air traffic control, such as human, software, hardware and environment, to describe air traffic control practices and to understand the effect of human performance factors on aviation safety. He found that there is a strong relation between human and organizational interfaces and addressed importance of organizational factors to human performance. Related to this, Jalil et al., (2012) reviewed three keys human performance models, which referred as basic models of human performance (Bailey, 1966; Banies et al., 2005; Chang and Yeh, 2010). Then they compared several human factors in these models to clarify the commonality and the differences between them, in order to identify the factors affecting a driver performance.

Much work has been done in the area of HF framework for different industries. However, most work in the area of logistics and green logistics design has completely ignored. So there is a need to develop specific HF

theoretical framework for green logistics industry, which will enable the consideration of several HF in the design of GL models. Incorporating HF into GL helps to increase profitability, reduce total cost, and improve logistics companies' reputation. These findings present a significant research opportunity. Awareness and better understanding of human factors and its effects on system performance are increasing the consideration of the influential factors earlier in the design stage will enable the analysis of potentially conflicting task demands in organized and structured ways (Clarke, 2005).

2.9 Research Framework

Based on previous literature, theories and models, and exploratory interviews, the most important factors that influence the willingness of Palestinian logistics companies to adopt GLI are managed. These factors include: Technological, organizational and environmental factors.

The willingness to adopt green innovations is used as measurement of GLI adoption. Logistics companies try to adopt GLI when they have strong willingness. "Logistics companies are companies that carry out logistics activities for their customers, which include order processing, warehousing, inventory management, transportation and packaging" (Delfmann et al., 2002; Sink et al., 1996).

To develop the research framework for GLI adoption, the factors are measured according to several dimensions.The perceived usefulness is measured according to respondents' perceptions' regarding whether the

green innovations could increase the environmental and economic performance (Rogers, 2003; Sia et al., 2004). While the complexity is measured according to the degree of difficulty of using and learning green innovations (Rogers, 2003; Sia et al., 2004). In addition, the compatibility of an innovation is measured according to the degree of fitness with company's existing processes (Chau and Tam, 1997; Rogers, 2003; Sia et al., 2004).

The attitude is measured according to the degree to which an innovation is accepted. Moreover, the organizational support is measured according to company's resources support and leader's attitude toward environmental issues (Lee et al., 2005; Tornatzky and Fleischer, 1990). While, the quality of human resources is measured according to employee's environmental knowledge and innovation capabilities (Scupla, 2003; Tornatzky and Fleischer, 1990).

On the other hand, the customer pressure is measured according to their awareness and their interest regarding the environment. The regulatory pressure is measured according to the existence of environmental regulations (Gonzalez-Benito and Gonzalez-Benito, 2006b). While the governmental support is measured from the perspective of finance, technology and human resources (Lee, 2008; scupla, 2003). Moreover, customers' requirement, competitors' innovative abilities and development of environmental technologies are used to measure the work environment (Buchko, 1994; Zhu and Weyant, 2003).

Based on the previous discussion, the research hypotheses are as follows:

- **H1:** The perceived usefulness has positive influence on willingness to adopt green logistics innovations.
- **H2:** The complexity has negative influence on willingness to adopt green logistics innovations.
- **H3:** The compatibility has positive influence on willingness to adopt green logistics innovations.
- **H4:** The attitude has positive influence on willingness to adopt green logistics innovations.
- **H5:** The organizational support has positive influence on willingness to adopt green logistics innovations.
- **H6:** The quality of human resources has positive influence on willingness to adopt green logistics innovations.
- **H7:** The customer pressure has positive influence on willingness to adopt green logistics innovations.
- **H8:** The regulatory pressure has positive influence on willingness to adopt green logistics innovations.
- **H9:** Governmental support has positive influence on willingness to adopt green logistics innovations.
- **H10:** The work Environment has positive influence on willingness to adopt green logistics innovations.

Moreover, the GLI that is to be considered in this research are; Vehicle selection, driver selection, route planning and orders aggregation.

These factors also have an influence on the green activities of logistics companies. If they are well managed they will increase the logistics companies both economic and environmental performance.

Summary

At the end of this chapter, the researcher shows a wide range of details about logistics, green logistics as well as human factors. In addition the green logistics system and innovations is presented, along with determinates of green Logistics. The human factors measures and framework are also mentioned. Finally, all literature studies help in the formation of research structure which is presented at the end on this chapter. The following chapter will represent the research methodology.

Chapter Three

Research Methodology

This chapter provides an overview of the methodological approaches, and the research design used in this thesis. The chapter also explores research approach, the research framework, the sampling techniques, and sample size. In addition, this chapter discusses research tools, pilot study, research reliability and validity, and the ethical considerations.

3.1 Research Approach

The research approach selection should be according to the important decisions needed to be made. The research approach will give the researcher the opportunity to consider how each approach may contribute to the research design by realizing and explaining a specific phenomenon. It may also allow the researcher to design an approach depending on the research purpose, the nature of the research, the problem area, research questions, and research hypothesis which best satisfies the research's requirements in order to reach the desired results (Creswell, 2003; Alhamdani et al., 2006).

The research approach contains both deductive versus inductive and qualitative versus quantitative. It is better for a researcher not limit himself to a particular approach but he should use a variety of approaches, if and when required by his study (Jackson, 1994).

3.1.1 The Deductive versus The Inductive Approach

There are two theoretical approaches to form conclusions when conducting research, inductive and deductive approaches. The inductive approach depends on collecting empirical data, analyzing, and then developing theories and concepts about the phenomenon. The deductive approach aims to study known theories to formulate hypotheses on their basis, and then test these proposed hypotheses (Marcoulides, 1998).

Little known information and data about GLI adoption in Palestinian logistics companies, and little could be said about the factors that influence the spread of GLI in Palestinian logistics companies. In this stage, there was an observation which is low use of GLI, and then the data is collected by conducting exploratory interviews to formulate results and decisions about how to study this phenomenon. Inductive approach was used in this area.

The factors, the models and the theories that influence GLI adoption by logistics companies are chosen from literature and exploratory interviews. Depending on these factors and theories, the research model is designed and the research hypotheses are created to be tested to gather observations and conformations. Deductive approach was used in this area.

3.1.2 The Qualitative versus The Quantitative Approach

Qualitative approach "is to discover and encapsulate meanings once the researcher becomes immersed in the data" (Creswell, 2003)**.** Qualitative

approach seeks to understand the research problem or the phenomenon from the local population by exploring issues, opinions, behaviors, understanding phenomena, and answering research questions through using focus groups, interviews, content analysis, and evaluation.

Quantitative approach objective "is to test hypotheses that the researcher generates" (Creswell, 2003). It is based on the measurement of quantity or amount. Quantitative approach depends on numerical data and statistics to describe the phenomenon that can be expressed in terms of quantity and explore the correlations between its variables. The objective of quantitative research is to develop and employ mathematical models, theories and hypotheses relating to specific phenomena. In this case, results are expressed in quantitative terms such as numbers and can be represented in figures.

To conform to the research problem and research questions, both qualitative and quantitative approaches are used. The questionnaires and the exploratory interviews are adapted in order to collect the data and understand the GL situation in Palestine. Qualitative approach is used in this area.

To clarify the factors affecting the willingness to adopt of GLI, the factors that influence the impact of logistics activities on environment and to identify the correlations between these factors. In the case, the variations are quantified, the causal relationships are determined and the characteristics of the population are also described. In addition, the

research hypotheses are needed to be confirmed, so statistical tools and programs are used in order to extracting and categorizing responses to questions in the questionnaires with highly structured methods. Quantitative approach is used in this area.

3.2 Research Framework

This research is conducted as an attempt to integrate HF into GL, through assessing the current practices of Palestinian logistics companies, examining the factors affecting the willingness of these companies to adopt GLI, determining the factors that are responsible for environmental harmful impacts of logistics activities, and proposing a model for logistic companies to assess and improve their environmental and financial performance.

Figure 3.1 shows the research framework diagram, which represents the sequence of activities to be carried out in order to achieve the research goals. This research is initiated by determining research problem and objectives which come after topic selection; the GL related topics which form the main base for the research are reviewed. After that, the logistics companies are chosen as a representative research population. A field survey is made to choose some of these companies as a representative research sample in order to investigate the current situation of Palestinian logistics companies and to solve the research problem. Simultaneously, the exploratory interview is established to identify the factors that influence the willingness of Palestinian logistics companies to adopt GLI. Then the

research hypotheses are set based on the previous literature, frameworks, and exploratory interviews. After that, the first questionnaire is developed for employees in logistics companies in order to gather the data about the factors affecting the adoption of GLI. Next, a second questionnaire is created for drivers to explore the current practices of logistics companies and identify the factors affecting the impact of logistics activities on environment including HF. A pilot study is conducted with experts to test whether the questions are valid and easy to answer. Then the questionnaires are distributed to logistics companies and gathered after filling. Both questionnaires are analyzed using statistical tools and methodologies; Statistical Package for the Social Sciences (SPSS) is used for this purpose.

According to the results came from analysis stage and according to the related researches and observations within research environment; a HF framework, which contains information on different HF that are closely related to GL and transportation networks and affecting the driver performance is developed. Another framework is also created; a GL framework, which identifies the factors influence the willingness of logistics companies to adopt GLI based on hypotheses test and the correlation between these factors. It also identifies the factors affecting companies' green logistics activities mainly the distribution process. Finally, GL model is proposed which can be used as a roadmap by logistics companies to improve and develop their financial and environmental practices and to increase their competitive advantage using some KPIs. So, the reality of the GL will be appeared by identifying and studying the

relationships between different environmental and logistics factors in GL context and HF. At the end, the conclusions, recommendation and future studies are discussed. Throughout these stages; combinations of research methods, both quanlitative and quantitative are used.

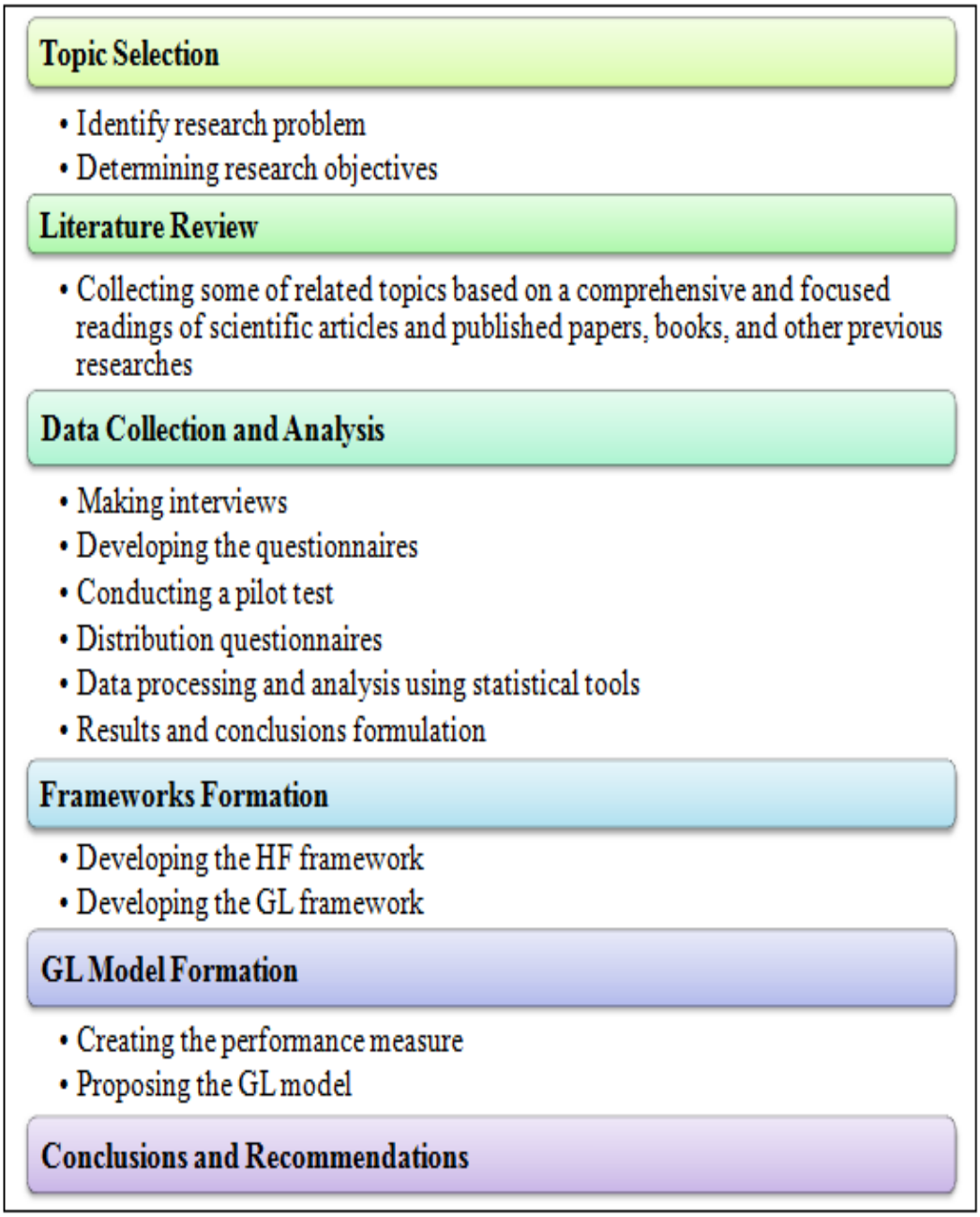

Figure 3.1: Research Framework Diagram

3.3 Sampling Technique

Statistical sampling techniques are the strategies applied by researchers during the statistical sampling process in order to make a right choice for the sample by making it representative if the population.

3.3.1 Research Population

The population is the entire pool from which a statistical sample is drawn and from which the data are collected and made the conclusions about (Roxy el al., 2008).

In this research the harmful effects of logistics activities on environment wanted to be minimized. So, the target population in this research is the small and medium size Palestinian logistics companies; that have small vehicles for the distribution processes; which are part of the transportation sector; the primary activity of these companies is the distribution of all types of cargos from their place of origin to their destination. These processes produce significant amount of air pollutants specially carbon dioxide emissions. The total amount of carbon dioxide emissions are increased year by year; the total quantity of emissions from energy sector is "3.1 million ton CO_2/year" (PCBS, 2011).

In addition, transportation sector is one of the main economic activities in Palestinian society. This activity contributes to the Gross Domestic Product (GDP); 2.1% of total GDP and provides working opportunities for a considerable number of people (PCBS, 2011).

3.3.2 Sample Size

The sample size is a group of units with specific characteristics selected from a larger group (the population). It should be representative of the population in order to make any generalizations and to draw valid conclusions about the population by studying the sample since the entire population is too large and difficult to study (Roxy el al., 2008).

It is important to determine the sample size of the research to represent the research population, and to obtain the accurate number of employees and drivers that must be randomly chosen to fill the questionnaires.

There are several statistical methods used to determine the sample size, all should fit with appropriate confidence level, and appropriate confidence interval. Therefore, the confidence interval will be 5% with 95% confidence level. The population size is 1202 employees and drivers in Palestinian logistics companies (PCBS, 2012). So, the sample size of this research is 292 samples.

To obtain statistically representative sample size of population, Thompson formula is used (Thompson, 2012).

$$n = \frac{\mathrm{N} * \mathrm{P}(1-\mathrm{P})}{\left[\left(\mathrm{N}-1\right) * \left(\frac{d^2}{z^2}\right)\right] + \mathrm{P}(1-\mathrm{P})}$$

Where:

n = the sample size.

N = the total number of population, 1202.

d = the percentage error (0.05)

P = proportion of the property offers and neutral (0.5)

z = z value is the upper $\alpha/2$ of the normal distribution (1.96 for 95% confidence level).

Both questionnaires are distributed randomly, one for the employees in logistics companies, the other is for the drivers whome driving the vehicles in those companies.

Due to the limited number of logistics companies the research focused on large and medium-sized companies because these companies are more interested in logistics advancements. So, when the amount, the complexity and the difficulty of their work increase and expand abroad the motivation factors to adopt the new GLI become more useful.

For this research, 330 questionnaires are distributed among employees and drivers of the logistics companies. However, the total number returned questionnaires is 293 questionnaires. This represented a response rate of 88.8 %. Figure 3.2 shows that the employees response rate is 87.4 % while the drivers response rate is 90.7 %.

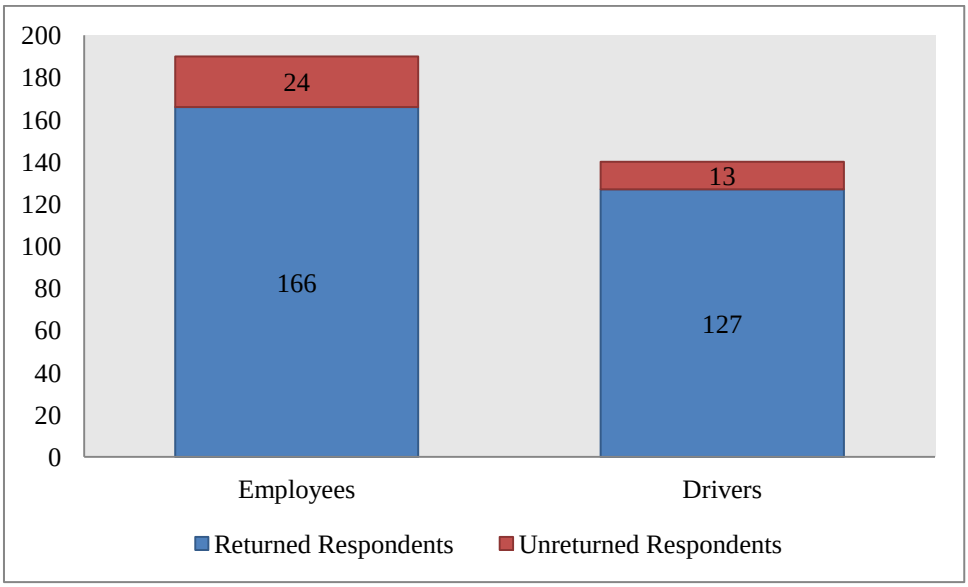

Figure 3.2: Questionnaires' Response Rate

3.4 Data Collection

Data can be collected using different numbers of data collection strategies; these include primary data and secondary data. This research makes the use of both primary and secondary data sources. Primary data is collected for the specific research problem at hand using structured questionnaires on a 5- point Likert scale and in-depth interviews with selected key person in logistics companies such as administrative managers and operational managers. On the other hand, secondary data included a literature search is gleaned from publications, documents, reports, archival records and previous researches in relation to the research subject mainly from international journals articles, books, newsletters, documentaries, internet websites and PCBS records, publications and statistics.

Using primary and secondary data is necessary because no one source could provide the comprehensive data required for this research. In

addition, using primary and secondary data enable the researcher to cross-check the findings and generate accurate findings thereby.

3.5 Research Tool

A research method or tool is a technique for collecting data and it can involve a specific instrument (Bryman, 2004). The choice of which to use should be guided by the research questions (Grix, 2002). According to Fellows and Liu (2003), the research methods most involve different methods such as action research, ethnographic research, survey research, case studies and experimental research.

This research is based on survey research tools. Two surveys are designed to collect the required data. The first is interviews aimed to collect data in the target logistics companies. The second is two questionnaires to get quantified results to answer the research questions and hypotheses.

3.5.1 Exploratory Interviews

Chadwick et al. (1984) defined the research interview as a two or more person conversation, manipulated by the researcher for the specific purpose of gaining related information on research by the use of specified research objectives. Interviews have three main types: Unstructured Questions, Semi Unstructured Questions, and Structured Questions (Kumar, 1999).

The structured interview questions are formulated to answer the main research questions. The largest logistics companies are contacted to check

their availability for an interview. When interviewees confirmed their availability for interviews, the researcher scheduled dates to conduct these interviews. Face to face structured interviews are then conducted with selected key persons such as administrative and operational managers as an attempt to discover the reality of the workflow of logistics systems used in Palestinian logistics companies. In many instance the structured interviews are converted to unstructured one, to hear more about the research problem without restrictions and limitations.

The interviews questions were divided into two parts:

- The first part of the interviews includes questions to explore the knowledge and perception of Palestinian logistics companies about the concept of GL and GLI and to discover the acceptance level by employees and managers for these innovations. It is also illustrated by the questions relating to the factors that have been drawn from previous studies in GL. In this way they helped in determining the most influential external and internal factors on the willingness to adopt GLI confirm their importance in Palestinian logistic companies and identify the effects of logistics activities on environment.

- The second part contains the general information in order to assess the current situation of Palestinian logistics companies and their services provided, explore how they treated their employees and find out how much infrastructure they have in term of vehicles numbers and warehouses.

The researcher briefed the interviewees about the research objectives and aims of the interviews, and also confirmed confidentiality of all company's information, (See Appendix A). The collected information is used in formulating the questionnaires. After analyzing the questionnaires outputs, interviews with some stakeholders' experts are held to enrich the research results. Interviewees are asked for explanations about the extreme results and unexpected results.

3.5.2 Questionnaire Surveys

The questionnaire survey is an inexpensive way to obtain information from the respondents. It is a written list of questions that have to be clear and easy to understand because the answers are recorded by respondents and there is no one to explain the meanings of questions. Questionnaires must translate the research objectives into questions and the answers will provide data for further research (Frankfort-Nachmias and Nachmias, 1992; Kumar, 1999).

Questionnaire is chosen as a research tool to test the research model and hypotheses which are formulated in Chapter two. Two different Questionnaires are designed with closed-end questions method to achieve the research objectives. The first one is for managers and employees to identify the most influential factors on the logistics companies' willingness to adopt GLI. The other one is for drivers only to measure how logistics services harm the environment in term of certain activities such as, vehicle selection, driver selection, rout planning and orders aggregation. A period

of one month was given to the participating companies to fill in the questionnaire. In this way specific answers are easily got, to achieve the research objectives.

The first questionnaire is designed for administrative employees in logistics companies in both English and Arabic languages (attached in Appendix A). The questionnaire comprised of questionnaire cover, which consists of four parts: purpose of the questionnaire, definition of GL, examples about GLI and letter of gratitude to participants with promises not to share their information. The rest of the questionnaire consists of three major parts.

Part one of the questionnaire mainly focuses on the demographic profile of employees to obtain information could help in understanding the nature of participants such as, the participants' gender, age, job title and level of education, in order to explore the diversity of the sample within the logistics companies as shown in research population.

Part two consists of two questions to measure if the respondents have previous knowledge about the concept of GL, and if their company has any environmental conservation practices. In part three, several statements related to the factors that influence the company's willingness to adopt GLI are selected. These statements aim to measure the factors that are determine in the research model and hypotheses. These factors are classified into three categories. Technological factors such as the perceived usefulness, the complexity, the compatibility. Organizational factors such as the

attitude, the organizational support, and the quality of human resources. Environmental factors such as the customer pressure, the regulatory pressure, governmental support and the work environment. The source of questionnaire statements depended on specific previous empirical studies, and the viewpoints of experts in GLI as mentioned in literature review.

The respondents are asked to use Likert scale to rank the importance/frequency of each statement which is created in part three. In its final form, the Likert Scale is a five (or seven) point scale; each of the responses would have a numerical value, which would be used to measure the attitude under investigation (Likert, 1932). Five points of Likert scales is selected. "1" strongly disagrees, "2" disagree, "3" neutral, "4" agree, "5" strongly agree, in order to obtain the degree of agreement to each participant.

The second questionnaire is designed for drivers in logistics companies in both English and Arabic languages (attached in Appendix A). The questionnaire comprises of questionnaire cover, which consists of two parts: purpose of the questionnaire and letter of gratitude to participants with promises not to share their information. The rest of the questionnaire contains two parts.

Part one of the questionnaire focuses on demographic profile of the drivers and other related information to obtain information could help in understanding the nature of participants such as the participant’s age, years of experience, average number of working hours, accident rate during the

year, time of occurrence for the accidents, the weather condition during the accidents occurrence, the number of working hours after which the driver feels fatigue and the rest time in minutes needed by the driver to recover his activity. Other information related to driver's vehicle such as the average vehicle age, fuel consumption rate, the number of periodic maintenance of the vehicle per year and the occupancy rate per shipment. This information needed in order to explore the relations between them and how they affect the driver's performance.

Part two composes of several statements related to the factors that influence the impact of logistics activities on environment. These statements aim to measure the factors that are determine in the research model and literatures. The factors divided into three categories HF related to driver selection, route planning and orders aggregation. The source of questionnaire statements depended on specific previous empirical studies, and the viewpoints of researcher in GL.

The respondents are asked to use Likert scale to rank the importance/frequency of each statement which is created in part two. Five points of Likert scales is selected. "1" strongly disagrees, "2" disagree, "3" neutral, "4" agree, "5" strongly agree, in order to obtain the degree of agreement to each participant.

3.6 Quality Standards for Research Tools

Two procedures are performed to assure the quality of the questionnaires, ensure the correctness of their information and make sure of their ability to achieve the research's objectives.

3.6.1 Pilot Study

A pilot experiment, also called a pilot study, is a standard scientific tool for research, allowing researchers to conduct a pretest or a preliminary analysis on a limited scale before conducting a full-blown study in order to evaluate variability, feasibility, time and cost of the study. So, the ideas or methods behind a research are sound (Saunders, 2000).

Pilot study aims to refine and improve the questionnaire, in order to determine whether the questions are comprehensible so that the participants are able to understand and interpret the questions without facing any problems. It reduces the possibility of getting incomplete answers. Generally, the number of participants should be at least ten participants (Saunders, 2000).

Research tool is reviewed by group of experts and arbitrators (See Table 1, Appendix B), starting with research supervisor, expert in statistics and questionnaire design and employees in logistics companies. Experts and arbitrators made comments on the contents, and the format of the questionnaire. Random participants who work in logistics companies whether they are employees or drivers are selected to review the

questionnaires. Discussions and comments are made about; repeated questions, clarity of the questions, and sequence of the questions. Participants made comments on the contents of the questionnaire. The participants who are involved in pilot study are excluding from the research sample and the final analysis.

All the comments and the suggestions from experts, arbitrators, and participants are discussed with the supervisor and statistical experts and then adjustments are made to modify and improve the questionnaires' contents and wordings by omitting, adding or rephrasing items. The number of statements for each variable is reduced, in order to reduce the repeated questions which can cause boredom for the participants. Questionnaires are refined and became ready for distribution.

3.6.2 Response Rate

Response rate is the main index of data quality in a questionnaire survey since it defines the extent of possible bias from non-response. Moreover, besides the response rate, data quality is affected by the accuracy and completeness of the questionnaire (Judd et al., 1991).

As mentioned above, the response rate for this research from the questionnaires is 88.8%.

3.6.3 Reliability and Validity

Reliability and validity are the yardsticks against which the adequacy and accuracy of our measurement procedures are evaluated in scientific

research. Hence, reliability and validity are most often used in all kinds of research and are both needed to assure adequate measurement of the concept of interest (Gliem and Gliem, 2003).

3.6.3.1 Research Reliability

The term reliability is the consistency or repeatability of research tools measures a concept used for testing and evaluating research tools in order to insure internal consistency and to achieve high degree of homogeneity between questionnaire statements. It is also defined as the degree to which a measurement tool produces similar outcomes when it is repeated. Reliability can be computed through different methods like test-retest reliability, internal consistency reliability, and equivalent forms reliability.

In this research, questionnaires reliabilities are checked by choosing internal consistency method. By using this method, the correlation between each item in both questionnaires could be measured through Cronbach's Alpha test. As Cronbach's Alpha increased as the inter correlations among test items increased. This known as an internal consistency estimate of reliability of test scores (Gliem and Gliem, 2003; Cortina, 1993).

In this research, all valid questionnaires are used to measure the reliability of both questionnaires by checking consistency through Cronpha's Alpha test as shown in Table 3.1.

Table 3.1: Cronbach's Alpha Internal Consistency, source: (Cortina, 1993)

Cronbach's Alpha	Internal Consistency
$\alpha \geq 0.9$	Excellent
$0.7 \leq \alpha < 0.9$	Good
$0.6 \leq \alpha < 0.7$	Acceptable
$0.5 \leq \alpha < 0.6$	Poor
$\alpha < 0.5$	Unacceptable

The results show that the Crobach's Alpha for the first questionnaire which measures the willingness of Palestinian logistics companies to adopt GLI is 0.90 whish indicates excellent consistency. The Crobach's Alpha for the second questionnaire which measures the impact of logistics companies' activities on environment is 0.93 which indicates excellent consistency. Therefore, the research tools are considered reliable.

3.6.3.2 Research Validity

The term validity refers to the extent to which a measure adequately represents the underlying concept that it is supposed to measure. In other word, it relies on what it was supposed to measure and how the test measures (Cortina, 1993).

The research validity is achieved through the following steps.

- Arbitrators and experts who are specialists in logistic services and statisticians are asked to refine the research tools. Ten, modifications

and adjustments are made and discussed deeply with the supervisor in order to assure the efficiency of research tools in achieving the research objectives.

- Multiple research methods and approaches are utilized in data collection, including quantitative methods represented by two questionnaire and qualitative methods represented by the structured interview.

- Many sources of data are used in data collection, involving primary and secondary data that are credible and reliable.

3.7 Ethical Considerations

Ethical standards and considerations are followed in all research stages. An important issue in research is to achieve confidence through preserving participants' anonymity (Smith and Quelch, 1992).

The identities of individuals who are surveyed and interviewed are kept confidential and generalized, without any without any indication to the interviewee or company name. The process of distributing the questionnaires was according to company policy as a result companies and individuals had complete willingness to participate in this study and there was not any type of coercion to participate in the study.

Summary

At the end of this chapter the research methodology is clearly evident. An overview on the research methodologies and approaches were given. Also this chapter explained the reasons behind choosing mixed approach. However, the research population and the sample size were determined in this chapter. In addition it highlights the research tools, to whom these tools were conducted and how they were analyzed. Moreover, it discusses the quality standards for research tools, the ethical considerations and the procedures for data collecting.

After implementing the research methodology in collecting data, the data were analyzed in order to attain research objectives. The next chapters show how the frameworks and the model will be developed through data analysis process.

Chapter Four
Formation of Green Logistics Framework

This chapter explores the current situation of Palestinian logistics companies through the analysis of interviews results. In addition, it presents the results that are collected via questionnaires and discusses the results of descriptive statistics with previous related studies and researches. Moreover the research hypotheses are tested in order to determine the factors that affecting the willingness of Palestinian logistics companies to adopt GLI. In addition, this chapter discusses the factors affecting green logistics activities that have an influence on environment. It also shows the creation of HF frameworks based on the factors affecting the driver's behavior and performance. Furthermore, this chapter presents GL framework in Palestine using the factors that have been obtained.

4.1 Interviews Analysis

The reality of the workflow of logistics systems used in Palestinian logistics companies is reflected through conducting several interviews. Also, more insights about the concept of GL and GLI are also investigated.

As said in chapter three, the interviews are conducted with administrative and operational managers in Palestinian logistics companies, who have good knowledge and experience in logistics services. Many findings from these interviews are summarized in the following section.

4.1.1 The Knowledge and the Perception of Palestinian Logistics Companies about the concept of GL and GLI

The most prominent issues observed and discovered through managers interviews are:

1. The GL concept is still a new one in Palestine and the usage level of GLI by Palestinian logistics companies will be limited in both quantity and quality.
2. Most of logistics companies care about environment through making periodic maintenance for their vehicles and through changing their vehicles every two or three years to reduce the amount of carbon emissions that came out from their vehicles.
3. The lack of governmental support, regulatory pressure and customer awareness will reduce or limit the willingness of logistics companies to adopt GLI.
4. Top management, managers, and employees support and encourage the adoption GLI.
5. GL concept in Palestine needs more effort to be more widely spread and used by making introductory courses and training all the employees regarding the most recent practices of GL to aware and encourage them to use it.
6. The managers and the employees realize the benefit of using and applying the modern green methods of logistics services based on

advanced techniques. They said it will enhance company's reputation and make a competitive advantage through providing environmental friendly services.

7. All interviewees explained that all factors which discussed in literature are appropriate and influence GLI adoption in Palestine. In addition, they focused on company and government roles in the adoption of GLI.

4.1.2 The Current Situation of Palestinian Logistics Companies

Since logistics companies are considered as part of Palestinian road transport sector that represents a huge responsibility on society's life quality and their development, much more attention and concern should be paid to these companies.

The interviews are held in order to analyze and explore the reality and the actuality of Palestinian logistics companies, which can be summarized as following.

❖ **Number of vehicles**

To emphasize the company's importance it is important to regard the number of vehicles they have.

- 30% of Palestinian logistics companies have more than 20 vehicles.
- 30% of Palestinian logistics companies have more than 10 vehicles but less than 20 vehicles.
- 40% of Palestinian logistics companies have less than 10 vehicles.

❖ Average Vehicle Age

The average vehicle age can be used as an indicator to identify the status of companies' vehicles.

- 50% of Palestinian logistics companies have vehicles with average age of less than 2 years.
- 20% of Palestinian logistics companies have vehicles with average age between 2 years and less than 4 years.
- 20% of Palestinian logistics companies have vehicles with average age between 4 years and less than 6 years.
- 10% of Palestinian logistics companies have vehicles with average age of more than 6 years.

❖ The Distance Travelled

In order to estimate the amount of daily work for each logistics company in Palestine, the number of kilometers (km) travelled by each vehicle per day when it is loaded could be a good indicator.

The number of empty kilometers (km) travelled by each vehicle per day could be another indicator used to measure the efficiency and the effectiveness of Palestinian logistics companies work.

- 10% of Palestinian logistics companies' vehicles travelled more than 150km per day per vehicle when it is loaded.

- 30% of Palestinian logistics companies' vehicles travelled more than 100km per day per vehicle when it is loaded.
- 60% of Palestinian logistics companies' vehicles travelled less than 100km per day per vehicle when it is loaded.
- 20% of Palestinian logistics companies' vehicles travelled more than 50km per day per vehicle when it is empty.
- 80% of Palestinian logistics companies' vehicles travelled less than 50km per day per vehicle when it is empty.

❖ **Fuel Consumption**

The amount of fuel consumed by the vehicle could be an indication about the vehicle performance. Furthermore it can be considered as a clue about the amount of work a logistics company has.

- 15% of the vehicles of Palestinian logistics companies consume more than 25000 Liter of fuel per month.
- 30% of the vehicles of Palestinian logistics companies consume more than 10000 and less than 25000 Liter of fuel per month.
- 30% of the vehicles of Palestinian logistics companies consume more than 5000 and less than 10000 Liter of fuel per month.
- 25% of the vehicles of Palestinian logistics companies consume less than 5000 Liter of fuel per month.

❖ **Environmental Awareness**

All Palestinian logistics companies said that they are caring about environment through making periodic maintenance for their vehicles by replacing or fixing the damaged parts, thus the harmful effect of the vehicle on environment will be minimized.

❖ **Employees and Drivers Training**

60% of Palestinian logistics companies make training for their employees and drivers once or twice a year; to enrich their knowledge with the latest technologies and procedures used in logistics services.

None of these companies make training regarding the green practices unless the Mother Company of the international companies located in Palestine does that or imposed them to do that type of training.

❖ **Information System**

60% of Palestinian logistics companies have internal information system regarding their employees, vehicles, cargoes, methods used, served destinations and customers.

❖ **Orders Aggregation**

90% of Palestinian logistics companies make orders aggregation for their cargoes day by day, according to geographic location of the served destination.

Depending on the nature of their work, the West Bank is classified into three zones; the northern zone, the middle zone and the southern zone. In each zone there is a hub to aggregate the cargoes destined to the same geographical location. By following this strategy, these companies can minimize both cost and delay.

❖ **Route Planning**

70% of Palestinian logistics companies determine which route their drivers should follow during the shipment process. But when unexpected situation occur on road, the driver make his own decision to select an alternative route, based on his cognitive knowledge about the geographical areas and the possible route to select in order to reach to the desired destination, taking into consideration the minimization of delay time as much as possible.

❖ **The Modern Technologies**

The development of modern technology has rapidly changed the economic and the social live, this is because the technology gives multiple ways to accomplish the tasks better and faster, and has a significant impact on the company's management ways and work flows. Therefore, logistics companies have become more focused on providing the best services to their customers through the use of the latest technological methods to gain competitive advantage among other companies.

As a result, 70% of Palestinian logistics companies use modern technologies such as vehicle tracking system to enhance their efficiency. Using the tracking system, logistics companies could observe where their drivers go during their working hours, which route they select, how many times they stop and how they manage the shipment process. In this way the wasted time during the shipment process could be reduced and cargoes could be delivered to customers on time.

Moreover, 40% of Palestinian logistics companies use another type of tracking system which is shipment tracking system. The customers or the companies themselves could follow where any cargo reach during the shipment process by entering the shipment number in company's website.

The companies whom using vehicle tracking system but do not offer the service of shipment tracking through their website, could follow the cargoes using the vehicle tracking system and then telling the customers the cargo's location using telephone or cell phone.

On the other hand, 20% of Palestinian logistics companies use Google Maps in determining which route to select during the shipment process especially in area were these maps are available. Also in this way the shipment time could be reduced as much as possible and cargoes could be reaches to their desired destination on time.

❖ **Warehousing**

90% of Palestinian logistic companies have warehouses. The cargoes are left in the warehouses to be aggregated between 12 hours to 24 hours. Following this strategy, most of Palestinian logistics companies said that no delay occurs, but if it happened the delay does not exceed 24 hours.

❖ **Customer Cooperation**

90% of Palestinian logistics companies making cooperation with their customers and taking feedbacks from them about the provided services and if they have any suggestions to improve the services regarding the delivery methods and the delivery routes. In this way both parties benefit from each other.

❖ **Quality System**

None of the Palestinian logistics companies apply recycling and waste management techniques for their wastes or try to reduce them. Moreover, none of these companies have a quality system regarding to their work. But only one company has two quality certifications regarding to the nature of its work, the first one is called Standard Operation Procedure, the second one is called Good Distribution Practice.

As it stated above, the application of the quality system in Palestinian logistics companies does not exist. So, the awareness of these companies about the importance and the benefits of application quality system should be increased to facilitate their work and improve their provided services.

4.2 Questionnaire Analysis

Statistical Package for the Social Sciences (SPSS) is used to analyze data acquired from the questionnaires and to provide answers to research questions. SPSS is a computer program used for statistical analysis. It has many feature and properties to provide the appropriate results which lead to attain research purpose. Furthermore, SPSS can give several statistics for each element in questionnaire and give causal relationships between them (Decoster and Claypool, 2004).

Many statistical descriptive and test are used to find out descriptive statistical analysis that help in answering the research questions and testing the hypotheses. Such as:

- Means, frequencies, standard deviations and percentages to represent the collected data in meaningful numbers.
- Two independent sample T- test the significance difference between two independent variables.
- One-Way Analysis of Variance (ANOVA) to indicate the significance difference between more than two independent variables and to test the hypotheses.
- Post-hoc test (LSD) to understand the difference in specific independent variable due to certain variable.
- Pearson Correlation matrix to study the relationships between the study factors.

- Regression analysis to test the research hypotheses.

As mentioned in chapter three, the Likert scale is used to rank the importance/frequency of each statement in each questionnaire. Likert item rank from "1" strongly disagree to "5" strongly agree. To analyze the findings, the average response for each domain or section in both questionnaires is calculated. These responses are classified into five intervals as shown in table 4.1 ranging from very low to very high in order to determine the estimation level of responses of both employees and drivers for each domain or section. The degrees of these intervals are calculated by subtracting the range of response "1" which corresponds to strongly disagree from "5" which corresponds to strongly agree, then dividing the result by the number of interval which is 5. (5-1/5) = 0.8. This scale is used in the research.

Table 4.1: Scaling Degree or Interval Classification

Interval	Degree
1.0 –1.8	Very Low
> 1.8 – 2.6	Low
> 2.6 – 3.4	Moderate
> 3.4 – 4.2	High
> 4.2 – 5.0	Very High

4.3 First Questionnaire Analysis

In order to achieve the research objectives, two questionnaires are designed for this purpose. The first questionnaire is designed for

administrative employees. The main objective of this questionnaire is to identify the factors that affect the willingness of Palestinian logistics companies to adopt GLI (See Appendix A).

4.3.1 Demographic and Descriptive Statistics

The total number of participants is 166 administrative employees who are working in Palestinian logistics companies, with 87.4 % as response rate. The participants are varied in term of personal attributes such as gender, age, job title and academic qualifications. These differences lead to different responses toward the knowledge of GL and its innovations and the factors that affecting GLI adoption within different companies.

The tables below clarify the distribution of the questionnaire in term of these attributes.

4.3.1.1 Personal Attributes

- **Gender**

As shown in table 4.2, the analysis of gender distribution confirms that the Palestinian logistics sector is traditionally male-dominated sector. The research sample includes 100 males who form around 60.2% of the participants, and 66 females who form around 39.8% of the participants. Figure 1 in Appendix C shows the gender distribution of the first questionnaire.

Table 4.2: Sample Distribution Attributed to Participants' Gender

Variable	Characteristic of the Variable	Frequency	Percentage %
Gender	Male	100	60.2 %
	Female	66	39.8 %
	Total	166	100 %

- **Age**

In this questionnaire, the age is divided into five intervals. Table 4.3 shows the details of age. Figure 2 in Appendix C shows the age distribution of the first questionnaire.

Table 4.3: Sample Distribution Attributed to Participants' Age

Variable	Characteristic of the Variable	Frequency	Percentage %
Age	Less than 25 years	31	18.7 %
	25 – less than 35 years	72	43.4 %
	35 – less than 45 years	45	27.1 %
	45 – less than 55 years	17	10.2 %
	More than 55 years	1	0.6 %
	Total	166	100 %

- **Job Title**

The distribution of the questionnaire in term of job title is shown in table 4.4. The job title is either director or employee to see whether there is a bias to the top management policies by the directors. Figure 3 in Appendix C shows the distribution of job title of the first questionnaire.

Table 4.4: Sample Distribution Attributed to Participants' Job Title

Variable	Characteristic of the Variable	Frequency	Percentage %
Job Title	Director	16	9.6 %
	Employee	146	88.0 %
	Other	4	2.4 %
	Total	166	100%

- **Educational Level**

Educational Level is divided into three options. Table 4.5 shows the details of educational levels. Figure 4 in Appendix C shows the distribution of educational levels of the first questionnaire.

Table 4.5: Sample Distribution Attributed to Participants' Educational Level

Variable	Characteristic of the Variable	Frequency	Percentage %
Educational Level	High School or Less	9	5.4 %
	Diploma	43	25.9 %
	Bachelor	114	68.7 %
	Master	0	0 %
	Total	166	100 %

The results of analysis personal information data illustrate the following facts:

1. The highest percentage of participants is males who form 60.2 % of respondents.
2. The highest percentage of participants is young (25 – less than 35 years) who form 43.4 % of respondents.

3. The highest percentage of participants in job title is the employee category, and their percentage in participation is 88.0 %.

4. The highest percentage of participants has bachelor degree that form 68.7 % of participants.

4.3.1.2 The Knowledge about Green Logistics

This part is mainly designed to observe the participants' awareness about GL and identify the perception of Palestinian logistics companies about the environmental protection through the application of green practices.

Respondents on this part have converged responses. In order to analyze these responses, frequencies and percentages are used as shown in the following tables.

- **The Knowledge about Green Logistics**

In this part, the participants are asked if they have a previous knowledge about the concept of GL, whether they read or heard about it. Research results include 77 respondents who have previous knowledge about the concept of GL, which forms around 46.4 %, and 89 respondents do not have previous knowledge about the concept of GL, which forms 53.6 %. Table 4.6 shows these results. Figure 5 in Appendix C shows the distribution of the responses of the green logistics knowledge of the first questionnaire.

Table 4.6: Distribution of the Sample Responses of the Green Logistics Knowledge

Variable	Characteristic of the Variable	Frequency	Percentage %
The Previous Knowledge about The Concept of Green Logistics	Yes	77	46.4 %
	No	89	53.6 %
	Total	166	100 %

From what have been stated above, there is clear evidence that more than half of employees in Palestinian logistics companies do not have previous knowledge about the concept of GL. Based on these results; the concept of GL and GLI should be more widespread within Palestinian logistics companies. So, these companies should hold induction courses to introduce the new concept of GL and its innovations to their employees. This lead to increase the employees awareness about the concept of GL, its importance and how to apply its innovations and realize the usefulness of applying them to both company and environment.

- **The Environmental Protection Practices**

In this part, the participants are asked if their companies follow or apply any environmental protection practices. 112 respondents said that their companies follow green practices, which forms around 67.5 %, and 89 respondents said that their companies do not follow any of green practices, which forms 32.5 %. Table 4.7 shows these results. Figure 6 in Appendix C shows the distribution of the environmental protection practices.

Table 4.7: Distribution of the Sample Responses of the Environmental Protection Practices

Variable	Characteristic of the Variable	Frequency	Percentage %
The Environmental Protection Practices	Yes	112	67.5 %
	No	54	32.5 %
	Total	166	100%

The results in table 4.7 return to the fact that more than half of employees in Palestinian logistics companies say that their companies apply or follow certain practices or policies to protect the environment from the hazardous effect of logistics activities. The percentage of 67.5 % needed to be increased. So, these companies should follow more green practices and participate the largest number of their employees in the application of green practices. In this way, these companies can easily adopt GLI, because GLI will become a culture within Palestinian logistics companies and their employees.

4.3.2 Factor Affecting Palestinian Logistics Companies' Willingness to Adopt GLI

Previous and related studies are reviewed in order to determine the factors that are affecting logistics companies' willingness to adopt GLI. From questionnaire responses, a clear image about the effect of these factors on the willingness of Palestinian logistics companies to adopt GLI is obtained. Moreover, the most influential factors on companies' willingness can be easily determined. In order to analyze the responses, the means, the standard deviations, and the estimation levels are calculated as shown in table 4.8.

Table 4.8: Mean, Standard Deviation and Estimation Level of the Factors Affecting Companies' Willingness

Items	Means	Standard Deviation	Estimation Level
Perceived Usefulness	4.22	0.43	Very High
Complexity	3.15	0.75	Medium
Attitude	3.95	0.43	High
Compatibility	3.55	0.63	High
Organizational Support	2.89	0.83	Medium
Quality of Human Resources	3.96	0.46	High
Customer Pressure	3.42	0.53	High
Regulatory Pressure	3.21	0.53	Medium
Governmental Support	2.55	0.66	Low
Work Environment	3.95	0.46	High
Total	**3.55**	**0.27**	**High**

From the summary of the result in table 4.8, it can be observed that the perceived usefulness has the highest value of mean (mean equals 4.22) related to other factors, while the governmental support has the lowest value of mean (mean equals 2.55). This means that 84.4% of participants think that there are several benefits to be obtained as result of applying the green innovations, while 51% of them think that there is a lake in supporting green innovations by the Palestinian government. This is due to the belief that the perceived usefulness, whether it is financial or moral from applying any new system, policy or strategy has the greatest influence on the willingness to adopt them.

The results obtained from the analysis of survey respondents illustrate the following facts:

1. The results indicate that 78.2 % of participants recognize that the GLI can provide higher economic benefits. In addition, 86.2 % of participants pointed that GLI can enhance the company's reputation.

2. 58 % of participants recognize that understanding and learning the GLI is difficult. On the other hand, 66.6 % of participants think that using the GLI needs many experiences.

3. Regarding to employees attitude, 87.4 % of participants would like to adopt GLI within their company.

4. 63.3 % of respondents think that the GLI are compatible with company's existing logistics operations. 78.2 % of respondents realize that the GLI are consistent with the company's values. In addition, 71.1 % of participants admit that integrating the GLI with company's existing system is easy.

5. 66.6 % of participants recognize that top management encourages them to learn green knowledge. On the other hand, 40.4 % of participants think that their company provides resources for the employees to learn green knowledge.

6. 76.6 % of respondents expected that they are capable of learning new technologies easily.

7. The results indicate that 53.2 % of participants recognize that the customers require the company to improve environmental performance. Moreover, 53.6% of participants admit that caring for

the environment is an important consideration for company's customers.

8. 49.2 % of respondents perceive that the government set environmental regulations for logistics operations. On the other hand, 52% of respondents recognize that the industrial associations require the company to conform to environmental regulations.

9. Regarding to governmental support, 25.6 % of participants say that the government provides financial support for adopting GLI. Also, 46.4% of participants think that the government provides technical assistance for adopting GLI. Furthermore, 46.2 % of participant recognize that the government encourages companies to propose green logistics projects

10. 74 % of respondents think that predicting the customers' preferences is difficult. While, 80.8 % of respondents realize that customers' preferences vary frequently. On the other hand, 78.4 % of participants admit that predicting the competitors' behavior is difficult. In addition, 73.6 % say that the competitors usually provide new logistics services. 84.2 % of respondent recognize that there is a quick advancement in new logistic service mode.

11. The results show that 88.6 % of respondents will use the GLI if they are adopted by their companies.

Detailed results about the mean, the standard deviations and the estimation level of each factor are attaches in (Appendix B), from table 2 to table 12.

4.3.3 Statistical Differences

This section outlines the statistical differences between participants in this research according to received questionnaires. Independent Samples Test (t-test for Equality of Means) and one-way ANOVA Test are used to explain these differences if they are presented; these two tests are used because correlations between qualitative and quantitative factors will be tested.

T-test method compares the means of two levels qualitative independent variable, while one-way ANOVA compares means of qualitative independent variable which has more than two levels. In this case, the dependent variables are quantitative.

- **Statistical Differences According to Gender**

The first questionnaire includes both genders males and females, both participated in the survey; therefore this variable has two levels, so T-test method is used.

Table 4.9 Independent Sample Test for Gender Differences Due to Gender

	Gender	N	Mean	Standard Deviation	t	Sig.*
Total Degree	Male	100	3.63	0.28	0.612	0.541
	Female	66	3.60	0.27		

* The mean difference is significant at the .05 level

The results in table 4.9 indicate that there are no statistical significant differences between male and female in recognizing each and every factor affecting the willingness to adopt GLI at (P = 0.05).

- **Statistical Differences According to Age**

According to the first questionnaire, age is collected as interval; therefore One-way ANOVA test is used to determine the correlation between participant age and other dependent variables.

Table 4.10 ANOVA Test for Age Differences among Participants

	Source of Variance	Sum of Squares	df	Mean Square	F	Sig.*
Total Degree	Between Groups	0.287	4	0.072	0.918	0.455
	Within Groups	12.594	161	0.078		
	Total	12.881	165			

* The mean difference is significant at the .05 level

Table 4.10 shows that there are no statistical significant differences between ages intervals in recognizing each and every factor affecting the willingness to adopt GLI at (P = 0.05).

- **Statistical Differences According to Job Title**

One-way ANOVA test is used to outline the statistical differences between participants according to their job title.

Table 4.11 ANOVA Test for Job Title Differences among Participants

	Source of Variance	Sum of Squares	df	Mean Square	F	Sig.*
Total Degree	Between Groups	0.039	2	0.019	0.246	0.782
	Within Groups	12.843	163	0.079		
	Total	12.881	165			

* The mean difference is significant at the .05 level

The results in table 4.11 indicate that there are no statistical significant differences between job titles in recognizing each and every factor affecting the willingness to adopt GLI at (P = 0.05).

- **Statistical Differences According to Academic Qualification**

One-way ANOVA test is also used to outline the statistical differences between participants according to their job title.

Table 4.12 ANOVA Test for Academic Qualification Differences among Participants

	Source of Variance	Sum of Squares	df	Mean Square	F	Sig.*
Total Degree	Between Groups	0.039	2	0.019	0.246	0.782
	Within Groups	12.843	163	0.079		
	Total	12.881	165			

* The mean difference is significant at the .05 level

The results in table 4.12 show that there are no statistical significant differences between academic qualification in recognizing each and every factor affecting the willingness to adopt GLI at (P = 0.05).

The results of statistical differences could be due to the fact that there is no clarification and explanation about the principles and the concept of GL in Palestinian logistics companies except few ones. So, most of respondent answer based on the general information they have about the concept of GL.

All details about statistical differences obtained from analysis the survey respondents are found in (Appendix B), from table 13 to table 17.

4.3.4 Hypotheses Testing

In order to verify whether the proposed technological, organizational, and environmental factors will affect the willingness to adopt of GLI for Palestinian logistics companies, the regression analysis is used in the research, which takes the 10 determinant factors as independent variables and the willingness to adopt GLI as the dependent variable. Table 4.13 show the results of the regression analysis and the results of hypotheses testing based on regression analysis respectively.

Table 4.13: Results of Hypotheses Testing

No.	Hypotheses	Standardized Coefficient (β)	Type of correlation	t
H 1	The perceived usefulness has positive influence on willingness to adopt green logistics innovations.	0.257	Positive	3.326**
H 2	The complexity has negative influence on willingness to adopt green logistics innovations.	-0.177	Negative	-2.104*
H 3	The compatibility has positive influence on willingness to adopt green logistics innovations	0.228	Positive	2.720**
H4	The attitude has positive influence on willingness to adopt green logistics innovations.	0.360	Positive	4.238**
H5	The organizational support has positive influence on willingness to adopt green logistics innovations.	0.379	Positive	4.485**
H6	The quality of human resources has positive influence on willingness to adopt green logistics innovations.	0.192	Positive	2.437*
H7	The customer pressure has positive influence on willingness to adopt green logistics innovations.	0.174	Positive	2.007*
H8	Governmental support has positive influence on willingness to adopt green logistics innovations.	0.183	Positive	2.216*
H9	The regulatory pressure has positive influence on willingness to adopt green logistics innovations.	0.369	Positive	4.302**
H10	The work Environment has positive influence on willingness to adopt green logistics innovations.	-0.201	Negative	-2.501*

** Regression is significant at the .01 level (2-tailed).

* Regression is significant at the .05 level (2-tailed)

❖ **Influences of Technological Factors**

From table 4.13 it can be technological factors, H1, H2, and H3, are all supported, which suggest that perceived usefulness, compatibility, and complexity of green practices will affect the willingness to adopt GLI by Palestinian logistics companies. Several papers have studied the environmental and organizational factors, while the influences of technological factors on green innovations adoption were rarely discussed in past research on environmental issues. As far as the researcher aware, this study provides evidence that technological characteristics may affect a company's green decision makings.

Palestinian logistics companies will be more likely to adopt GLI when they perceive that the innovations are more helpful for improving environmental and economic performance, more compatible to their existing business operations, and easier to learn and use. The benefits of the green innovations, including improved environmental and economic performance and better reputation, will serve as motivations for Palestinian logistics companies to engage in implementing the environmental management. Del Rio Gonzalez, (2005) suggests that economic and financial advantages are important technological characteristics that influence the adoption of clean technologies. Therefore, to advance GLI adoption, green innovation providers who provide green technologies, equipments and services for their customers should put more efforts to

make Palestinian logistics companies appreciate the relative advantage of the green innovations.

Complexity is the degree to which an innovation is perceived to be difficult to understand and use (Rogers, 2003). In order to reduce the complexity of GLI, green innovation providers can attempt to make green innovations clear in meaning to logistics companies. GLI may contain some knowledge that is inherent in identifying sources of pollution, reacting to accidental spills, and proposing preventive solutions (Boiral, 2002). An innovation containing a lot of knowledge requires laborious efforts to learn and diffuse. Increasing the clearness of green innovations is helpful for logistics companies to transfer and learn related green knowledge within the company. Also, making the innovations clear in meaning can help Palestinian logistics companies appreciating the compatibility of the GLI and consequently, make them being more able to select a green innovation that is more consistent with their existing systems, operations and processes. So that, in order to reduce the complexity and increase the compatibility, Palestinian logistics companies ought to accumulate more environmental knowledge. During the process of accumulating environmental knowledge, Palestinian logistics companies should attract more environmental experienced human resources and adjust their values and operations to be more environmental friendly, so that the complexity of GLI will be reduced and the compatibility between GLI and companies' existing operations will be attained.

❖ Influences of Organizational Factors

Organizational factors are essential in environmental management and have repeatedly been found to influence the willingness to adopt green innovations. Zhu et al. (2008) found that management support and organizational learning have positive influences on the adoption of green supply chain management. Murphy et al., (1996) have addressed that lack of top management support is a major obstacle to establishing environmental policies. Here, the hypotheses related to organizational factors, H4, H5, and H6, are all supported, which suggest that the attitude, organizational support and the quality of human resources will affect Palestinian logistics companies' willingness to adopt GLI.

The research results indicate that employees' attitude towards GLI will affect companies willingness to adopt GLI. If the employees have a positive perception about green innovation, they in turn have self motivation to apply these innovations. Also, they will accept to apply and use any of these innovations even if they are imposed to use them by their companies.

Moreover, the research results show that the organizational support is essential in adopting green innovations. Organizational support gives employees motivation and resources to adopt environmental practices. The moral organizational support gives motivation to employees to adopt green innovations. While, financial and technical supports provide the required resources to adopt green innovations. Moreover, the employees' learning

and innovative capabilities is closely related to GLI adoptions. Using and applying GLI may add complexity to logistics processes and require an amount of learning and training programs. Providing education and training for employees is important for managing environmental issues (Murphy and Poist, 2003). The training effects are positively related with human resources with competence skills. So, Palestinian logistics companies should recruit qualified employees, provide educating programs. In this way the employees will be easily involved in training courses which advance green innovation adoption.

- **Influences of Environmental Factors**

Regarding the influences of environmental factors, only hypotheses H7 about customer pressure, H8 about regulatory pressure, and H9, about governmental support, are supported. However, the hypothesis H10, about the work environment is not supported.

Regarding the research hypothesis H7, the regression results show that the customer pressure has a positive influence on the willingness to adopt GLI by Palestinian logistics companies. The role of customers in influencing logistics companies' green adoption behavior is relatively weak compared with its role in manufacturing companies. In manufacturing sectors, customers are important stakeholders for companies and their pressure significantly affects companies' environmental activities (Etzion, 2007; Gonzalez-Benito and Gonzalez-Benito, 2006a). The reson behind this due to the fact that most of Palestinian logistics companies provide

product delivery services for their customers who are the manufactures and consumers of the products in the supply chain, they are not directly involved in the manufacturing of products. As most of customers may perceive the environmental impact of the products they consume; Palestinian logistics companies often face less pressure than the manufacturers of the products (Buysse and Verbeke, 2003; Gonzalez-Benito and Gonzalez- Benito, 2006a). Also, most of the customers may concern more about the delivery efficiency of logistics companies and concern less about the environmental performance of logistics companies. Therefore, the positive influence of customer pressure is not significant high on the willingness to adopt GLI for Palestinian logistics companies.

The supported hypotheses H8 and H9 emphasize the role of the government in advancing green innovations adoption for Palestinian logistics companies. The regression results reveal that compared to other proposed factors, Palestinian logistics companies regard the government as an important factor influencing GLI adoption. GLI adoption is driven by both governmental push and pull effects. Both governmental support and regulatory pressure will affect green innovation adoption behavior. In addition to setting up environmental regulations, the present result suggests that the Palestinian government may put more efforts in encouraging and guiding logistics companies to adopt green practices. Most Palestinian logistics companies are SMEs and may suffer from the lack of financial and technical resources and qualified professionals. Governmental support is essential for smaller companies in developing environmental

management (Del Brio and Junquera, 2003; Lee, 2008). The Palestinian government should develop well designed environmental policies that can offer economic incentive and provide required resources for the logistics companies.

The hypothesis H10 expects that work environment has a positive influence on the willingness to adopt GLI by Palestinian logistics companies. However, on the contrary, the present finding reveals a negative relationship between work environment and green innovation adoption for Palestinian logistics companies. This result may be due to the fact that most logistics companies in Palestine are small and medium size. So, while facing highly changing environment, small companies with limited resources will be more concern about short term return on investments, and will be unlikely focus on developing long processes of competence accumulation. They will be less interesting in put an amount of resources on adopting technologies that cannot produce returns quickly. Because most green investments could produce positive economic returns only in the long term (Etzion, 2007), small companies in highly changing environments may allocate less resources to environmental initiatives (Del Brio and Junquera, 2003). Therefore, when Palestinian logistics companies perceive a high degree of uncertainty in their business environment, they may put more resources on improving their primary business activities rather than on improving their environmental performance. Investments in GLI will be delayed until other productive process changes are being made.

Most of hypotheses are supported and significant. Although some of these hypotheses derived from pervious empirical studies and the other are from the researcher point of view, but the results are realistic, logical and supporting all these empirical studies. So, they can be easily adopted.

4.3.5 Correlation Analysis

In order to determine if there is a significant relationship between the factors and whether they influence the willingness of Palestinian logistics companies to adopt GLI; the questionnaires responses are analyzed in accordance with the research. For this purpose, Pearson Correlation Matrix is used. Table 4.14 shows the results of Pearson Correlation value (ρ) and the significant value (P-value) between the study factors. In this way the research hypotheses are tested using another statistical analysis.

Table 4.14: Pearson Correlation Matrix between the Study Factors

		PU	COMX	COMT	ATT	OS	QHR	CP	RP	GS	WE	WILL
Perceived Usefulness	Pearson Correlation	1	-0.023	0.326**	0.495**	0.001	0.037	0.065	0.113	0.065	-.250**	0.467**
	Sig. (2-tailes)		0.772	0.000	0.000	0.992	0.628	0.406	0.148	0.405	0.001	0.000
Complexity	Pearson Correlation	-0.023	1	-0.050	-.373**	-0.129	-0.156	-0.130	-0.116	-0.110	-0.279	-0.221**
	Sig. (2-tailes)	0.772		0.521	0.000	0.097	0.064	0.094	0.141	0.157	0.087	0.004
Compatibility	Pearson Correlation	0.326**	-0.050	1	0.331**	0.348**	0.108	-0.013	0.030	0.125	0.105	0.298**
	Sig. (2-tailes)	0.000	0.521		0.000	0.000	0.169	0.869	0.697	0.107	0.179	0.000
Attitude	Pearson Correlation	0.495**	-.373**	0.331**	1	0.193*	0.208**	0.222**	0.096	0.081	-0.127	0.514**
	Sig. (2-tailes)	0.000	0.000	0.000		0.013	0.007	0.004	0.218	0.299	0.099	0.000
Organizational Support	Pearson Correlation	0.001	-0.129	0.348**	0.193*	1	0.202**	0.171*	0.204**	0.362**	-.159*	0.702**
	Sig. (2-tailes)	0.992	0.097	0.000	0.013		0.009	0.028	0.008	0.000	0.040	0.000
Quality of Human Resources	Pearson Correlation	0.037	-0.156	0.108	0.208**	0.202**	1	0.012	0.038	0.131	0.109	0.248**
	Sig. (2-tailes)	0.628	0.064	0.169	0.007	0.009		0.883	0.627	0.094	0.158	0.001
Customer Pressure	Pearson Correlation	0.065	-0.130	-0.013	0.222**	0.171*	0.012	1	0.086	0.095	0.272**	0.229**
	Sig. (2-tailes)	0.406	0.094	0.869	0.004	0.028	0.883		0.269	0.219	0.000	0.003
Regulatory Pressure	Pearson Correlation	0.113	-0.116	0.030	0.096	0.204**	0.038	0.086	1	0.540**	0.076	0.216**
	Sig. (2-tailes)	0.148	0.141	0.697	0.218	0.008	0.627	0.269		0.000	0.332	0.005
Governmental Support	Pearson Correlation	0.065	-0.110	0.125	0.081	0.362**	0.131	0.095	0.540**	1	-0.095	0.577**
	Sig. (2-tailes)	0.405	0.157	0.107	0.299	0.000	0.094	0.219	0.000		0.225	0.000
Work Environment	Pearson Correlation	-0.250**	-0.279	0.105	-0.127	-0.159*	0.109	0.272**	0.076	-0.095	1	-0.274**
	Sig. (2-tailes)	0.001	0.087	0.179	0.099	0.040	0.158	0.000	0.332	0.225		0.000
Willingness	Pearson Correlation	0.467**	-0.221*	0.298**	0.514**	0.702**	0.248**	0.229**	0.216**	0.577**	-0.274**	1
	Sig. (2-tailes)	0.000	0.004	0.000	0.000	0.000	0.001	0.003	0.005	0.002	0.000	

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

- **Influence of Perceived Usefulness**

The results of Pearson Correlation show that perceived usefulness of GLI has significant relationship with compatibility ($\rho = 0.362$, $P = 0.000 < 0.01$), attitude ($\rho = 0.495$, $P = 0.000 < 0.01$), work environment ($\rho = -0.250$, $P = 0.001 < 0.01$), and willingness ($\rho = 0.467$, $P = 0.000 < 0.01$).

From the previous relationships, it can be noticed that the perceived usefulness of GLI has a strong relationship with the company's willingness to adopt them which is significant at 99% ($\rho = 0.467$). Hence, Hypothesis 1 is supported. Palestinian logistics companies will be more likely to adopt GLI when they perceive that green innovations will increase their financial and environmental performance in accordance with enhancing company's reputation.

Moreover, perceived usefulness of GLI has a strong relationship with the compatibility of GLI which is significant at 99% ($\rho = 0.326$). More benefit could be obtained from the adoption of green innovations when they are more compatible with company's existing operations. Because when a company have past knowledge and experience in applying green innovations it can easily take the advantage over other companies from the application of green innovations, because it already has infrastructure to adopt GLI.

Also, the perceived usefulness of GLI has a strong relationship with the employees' attitude toward GLI which is significant at 99% ($\rho =$

0.495). Because the perceived usefulness plays as incentive to motivate the employees to adopt and apply green innovations.

In addition, the perceived usefulness of GLI has a negative relationship with the work environment which is significant at 99% ($\rho = -0.250$). In continuous changing environment fewer benefits could be obtained from adopting new innovations, because these benefits will be obtained in the long term. Due to this the moral or the financial values from adopting green innovations are reduced in highly changing work environment.

- **Influence of Complexity**

Based on Pearson Correlation analysis of hypotheses, the GLI's complexity is predicted by attitude ($\rho = -0.373$, $P = 0.000 < 0.01$), and willingness ($\rho = -0.221$, $P = 0.004 < 0.01$).

From the previous results, it is interesting to note that the complexity of GLI has a negative influence on the company's willingness to adopt GLI which is significant at 99% ($\rho = -0.221$). Hence, Hypothesis 2 is supported.

On the other hand, the complexity of GLI has a negative influence on employees' attitude toward adopting GLI which is significant at 99% ($\rho = -0.373$). The intention and the acceptance of the employees toward adopting green innovations are reduced when green innovations are considered to be complex and difficult to use, learn and apply. Because the employees who are used to do their work in a traditional manner facing more difficulty

when applying new technology which change the way of their work. Also, most of them do not like to exert much more effort in doing their work.

- **Influence of Compatibility**

Depending on Pearson Correlation matrix between factors, the compatibility of GLI with company's existing logistics operations and systems is predicted by perceived usefulness ($\rho = 0.326$, $P = 0.000 < 0.01$), attitude ($\rho = 0.331$, $P = 0.000 < 0.01$), organizational support ($\rho = 0.348$, $P = 0.000 < 0.01$), and willingness ($\rho = 0.298$, $P = 0.001 < 0.01$).

The previous results show that the compatibility of GLI with company's existing logistics system significantly influence the company's willingness to adopt GLI which is significant at 99% ($\rho = 0.298$). Hence, Hypothesis 3 is supported.

On the other hand, the compatibility of GLI with company's existing logistics system has a relationship with attitude toward GLI which is significant at 99% ($\rho = 0.331$). The intention and the acceptance of the employees toward adopting green innovations are increased when green innovations are compatible with company's existing operations and processes. Because the employees are used to apply and use technology in their work which is closely related to applying green innovations. So, they find that it is easy to such new innovations.

In addition, the compatibility of GLI with company's existing logistics system strongly influence organizational support which is significant at 99% ($\rho = 0.348$). A company will support the adoption of

green innovations if they are easily compatible with company's existing operations. Because the adoption of these innovations will not cost a lot and it will be easily done without making a radical change in company's logistics system.

- **Influence of Attitude**

The results of Pearson Correlation clarify that attitude toward GLI has significant influence on perceived usefulness ($\rho = 0.495$, $P = 0.000 < 0.01$), complexity ($\rho = -0.373$, $P = 0.000 < 0.01$), compatibility ($\rho = 0.331$, $P = 0.000 < 0.01$), organizational support ($\rho = 0.193$, $P = 0.013 < 0.05$), quality of human resources ($\rho = 0.208$, $P = .007 < 0.01$), customer pressure ($\rho = 0.222$, $P = 0.004 < 0.01$), and willingness ($\rho = 0.514$, $P = 0.000 < 0.01$).

It can be seen that the employees' attitude toward GLI has a strong relationship with the company's willingness to adopt GLI which is significant at 99% ($\rho = 0.514$). Hence, Hypothesis 4 is supported.

There is a relationship between attitude and organizational support which is significant at 95% ($\rho = 0.193$). If the employees have a positive perception and a strong believe in green innovations, this will be reflected on organization's role to support the adoption of GLI.

In addition, attitude has a relationship with quality of human resources which is significant at 99% ($\rho = 0.208$). When the employees are capable of learning and using new technologies, able to share this technology with each others, and believe that they are able to adopt and

apply green innovations, their attitude and intention toward GLI will be stronger.

Moreover, the relationship between attitude and customer pressure is strong and significant at 99% ($\rho = 0.222$). The increased pressure from customer to apply green innovations will make the employees' attitude toward applying GLI stronger if they have loyalty and affiliation to improve and develop their companies.

- **Influence of Organizational Support**

The results of data analysis explain that there are relationships between organizational support of GLI and compatibility ($\rho = 0.348$, $P = 0.000 < 0.01$), attitude ($\rho = 0.193$, $P = 0.013 < 0.05$), quality of human resources ($\rho = 0.202$, $P = 0.009 < 0.01$), customer pressure ($\rho = 0.171$, $P = 0.028 < 0.05$), regulatory pressure ($\rho = 0.204$, $P = 0.008 < 0.01$), governmental support ($\rho = 0.362$, $P = 0.000 < 0.01$), work environment ($\rho = -0.159$, $P = 0.040 < 0.05$), and willingness ($\rho = 0.702$, $P = 0.000 < 0.01$).

Organizational support of GLI has an influence on willingness to adopt GLI which is significant at 95% ($\rho = 0.702$). Hence, Hypothesis 5 is supported.

It can be observed that there is a relationship between organizational support and quality of human resources which is significant at 99% ($\rho = 0.202$). The more qualified employees a company has, the more support a company give to adopt GLI. Because the qualified and the trained employees facilitate the adoption process and minimize the cost of

adoption process, since they need less training courses and they start the application of green innovations quickly.

Furthermore, a relationship found between organizational support and customer pressure which is significant at 95% ($\rho = 0.171$). The customer pressure behaves as a pull force to drive a company to give both financial, technical, moral support toward adopting and applying GLI.

Another relationship found between organizational support and regulatory pressure which is significant at 99% ($\rho = 0.204$). The regulatory pressure force logistics companies to adopt GLI, if there are regulations and legislations related to environmental protections that impose penalties on logistics companies if they violated these laws.

Moreover, there is a significant influence between organizational support and governmental support which is significant at 99% ($\rho = 0.362$). The existence of governmental support in term of financial incentives, pilot projects, technical support and tax breaks can encourage and guide logistics companies to support the adoption of GLI.

From correlations results, a negative influence between organizational support and work environment exists which is significant at 95% ($\rho = -0.159$). In highly changing work environment, logistics companies fear to invest in such environment and they will be more careful regarding the amount of invested resources, because returns on investments are uncertain. So, there support to green innovations will be minimized.

- **Influence of Quality of Human Resources**

Based on Pearson Correlation analysis, the quality of human resources has significant relationships with perceived attitude ($\rho = 0.208$, $P = .007 < 0.01$), organizational support ($\rho = 0.202$, $P = 0.009 < 0.01$) and willingness ($\rho = 0.248$, $P = 0.001 < 0.01$).

It can be observed that the quality of human resources has an influence on company's willingness to adopt GLI which is significant at 99% ($\rho = 0.248$). Hence, Hypothesis 6 is supported.

- **Influence of Customer Pressure**

The results of Pearson Correlation analysis explain that there is a significant influence between customer pressure and attitude ($\rho = 0.222$, $P = 0.004 < 0.01$), organizational support ($\rho = 0.171$, $P = 0.028 < 0.05$), work environment ($\rho = 0.272$, $P = 0.000 < 0.01$), and willingness ($\rho = 0.229$, $P = 0.003 < 0.01$).

It can be observed that Hypothesis 7 is supported, since there is a relationship between customer pressure and company's willingness to adopt GLI which is significant at 99% ($\rho = 0.229$).

In addition, customer pressure has a positive relationship with work environment which is significant at 99% ($\rho = 0.272$). The customer pressure increase, if the customers see that there is advancement in logistics services and if they see that different companies uses new techniques to provide their services. As a result, customers exert more pressure on their

companies to adopt such new techniques especially if they had a strong loyalty to their companies. Also, when the customers see the positive effort made by their companies to use green innovation they will reward that effort by selecting their service over and above other.

- **Influence of Regulatory Pressure**

According to the results of Pearson Correlation analysis, the regulatory pressure is influenced by organizational support ($\rho = 0.204$, $P = 0.008 < 0.01$), governmental support ($\rho = 0.540$, $P = 0.000 < 0.01$), and willingness ($\rho = 0.216$, $P = 0.005 < 0.01$).

Based on the previous relationships, the regulatory pressure has an influence on the company's willingness to adopt GLI which is significant at 99% ($\rho = 0.216$). This indicates that Hypothesis 8 is supported.

Another conclusion can be made based on the relationship between regulatory pressure and governmental support which is significant at 99% ($\rho = 0.540$). If the government sets rules, regulations and legislations to protect the environment, it should increase its support whether it is financial or technical to encourage logistics companies to adopt GLI.

- **Influence of Governmental Support**

Based on the results of Pearson Correlation, the governmental support is predicted by perceived by organizational support ($\rho = 0.362$, $P = 0.000 < 0.01$), regulatory pressure ($\rho = 0.540$, $P = 0.000 < 0.05$), and willingness ($\rho = 0.577$, $P = 0.000 < 0.01$).

It is interesting to note that the governmental support has a relationship with company's willingness to adopt GLI which is significant at 95% (ρ = 0.577). As a result, Hypothesis 9 is supported.

- **Influence of Work Environment**

The results explained that there is a relationship between work environment and perceived usefulness (ρ = -0.250, P = 0.001 < 0.01), organizational support (ρ = -0.159, P = 0.040 < 0.05), customer pressure (ρ = 0.272, P = 0.000 < 0.01), and willingness (ρ = -0.274, P = 0.000 < 0.01). Work environment has a negative relationship with company's willingness to adopt GLI which is significant at 99% (ρ = -0.274). This indicates that Hypothesis 10 is not supported.

Table 4.15 summarizes these relationships between factors influencing company's willingness to adopt GLI.

Table 4.15: Correlations between Factors Influencing Company's Willingness to Adopt GLI

	PU	COMX	COMT	ATT	OS	QHR	CP	RP	GS	WE	WILL
PU			**	**						-**	**
COMX				**							-**
COMT	**			**	**						**
ATT	**	-**	**		*	**	**				**
OS			**	*		**	*	**	**	-*	**
QHR				**	**						**
CP				**	*					**	**
RP					**				**		**
GS					**			**			**
WE	-**				-*		**				-**
WILL	**	-**	**	**	**	**	**	**	**	**	

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

-**. Negative correlation is significant at the 0.01 level (2-tailed).

-*. Negative correlation is significant at the 0.05 level (2-tailed).

Based on the results of hypotheses, the researcher explains the factors affecting the adoption of GLI in Palestine as shown in Figure 4.1.

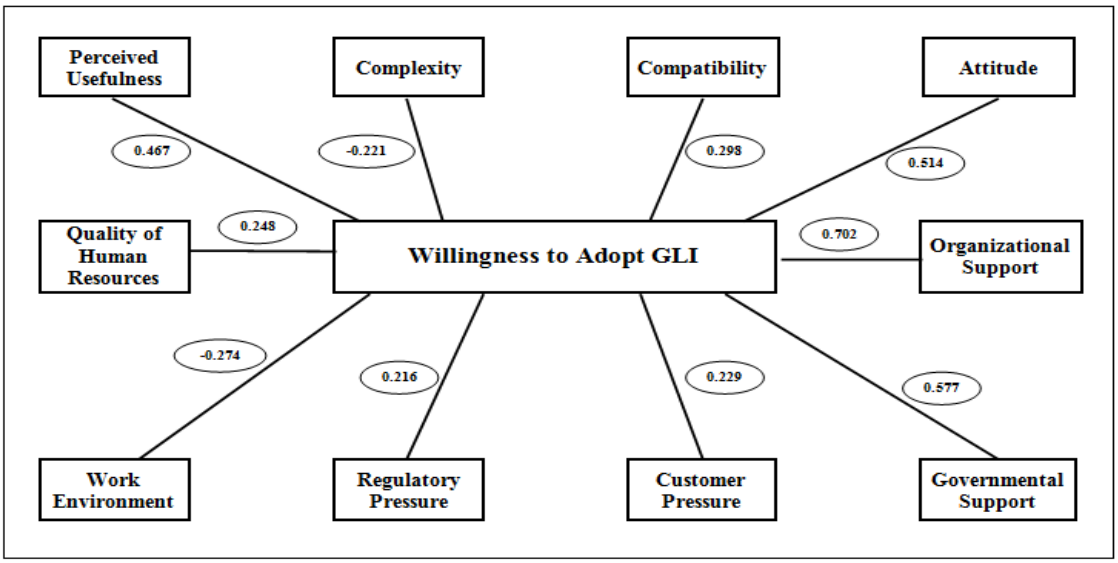

Figure 4.1: GLI Adoption in Palestine

A framework for GLI adoption can be easily developed based on the results of correlation analysis in Figure 4.1, and the results of the regression analysis. The framework includes all the factors affection Palestinian logistics companies' willingness to adopt GLI. The developed framework is shown in Figure 4.2.

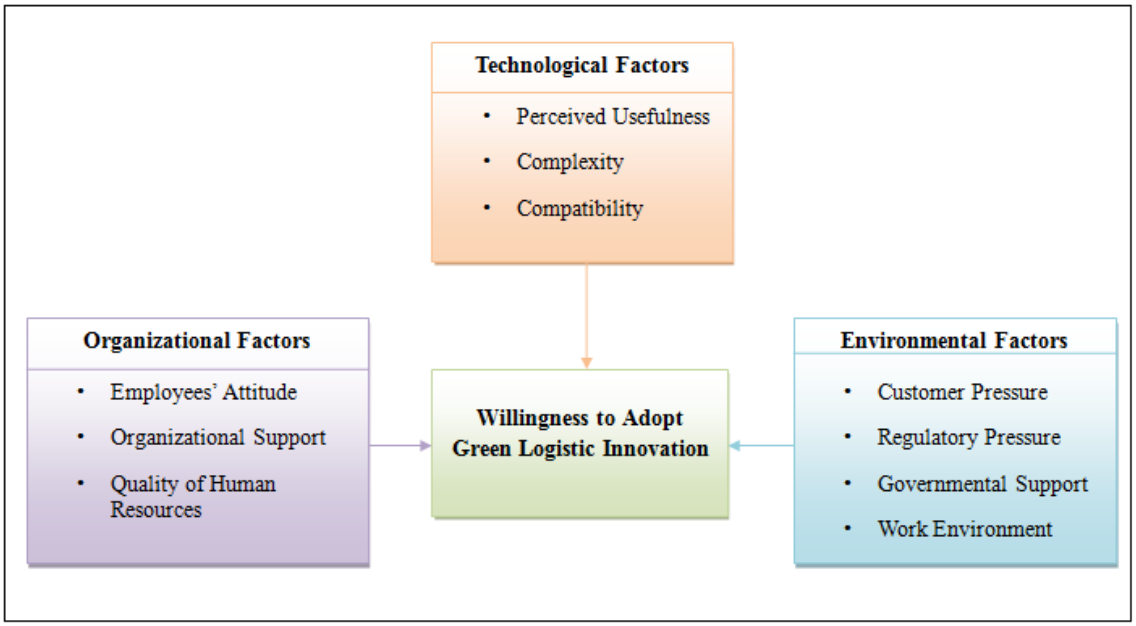

Figure 4.2: Framework for GLI adoption

4.4 Second Questionnaire Analysis

In order to achieve the rest of research objectives, a second questionnaire is designed for drivers. The main objective of this questionnaire is to identify the factors affecting logistics companies' activities in order to reduce the impact of these activities on the environment (See Appendix A).

4.4.1 Demographic and Descriptive Statistics

The total number of participants is 127 drivers who are working in Palestinian logistics companies, with 90.7 % as response rate. The participants are varied in term of personal attributes such as age, years of experience and average daily working hours. These differences lead to different responses toward the factors that affecting logistics activity. The tables below clarify the distribution of the questionnaire in term of these attributes.

4.4.1.1 Personal Attributes

- **Age**

In this questionnaire, the age is divided into six intervals. Table 4.16 shows the details of age. Figure 7 in Appendix C shows the age distribution of the second questionnaire.

Table 4.16: Sample Distribution Attributed to drivers' Age

Variable	Characteristic of the Variable	Frequency	Percentage %
Age	Less than 25 years	31	24.4 %
	25 – less than 35 years	39	30.7 %
	35 – less than 45 years	40	31.5 %
	45 – less than 55 years	15	11.8 %
	More than 55 years	2	1.6 %
	Total	127	100 %

- **Number of Experience Years**

The distribution of the questionnaire in term of experience years is shown in table 4.17. The experience years is divided into eight categories. Figure 8 in Appendix C shows the distribution of the divers' experience years of the second questionnaire.

Table 4.17: Sample Distribution Attributed to Drivers' experience Years

Variable	Characteristic of the Variable	Frequency	Percentage %
Experience Years	Less than 2 years	16	12.6 %
	2 – less than 6 years	39	30.7 %
	6 – less than 10 years	31	24.4 %
	10 – less than 14 years	18	14.2 %
	14 – less than 18 years	17	13.4 %
	18 – less than 22 years	3	2.4 %
	22 – less than 26 years	3	2.4 %
	More than 26 years	0	0 %
	Total	127	100%

- **Average Daily Working Hours**

The average daily working hours is divided into six options. Table 4.18 shows the details of the average daily working hours. Figure 9 in Appendix C shows the distribution of the average daily working hours of the second questionnaire.

Table 4.18: Sample Distribution Attributed to Drivers' Average Daily Working Hours

Variable	Characteristic of the Variable	Frequency	Percentage %
Average Daily Working Hours	Less than 2 hours	0	0 %
	2 – less than 4 hours	1	0.8 %
	4 – less than 6 hours	21	16.5 %
	6 – less than 8 hours	91	71.7 %
	8 – less than 10 hours	14	11.0 %
	More than 10 hours	0	0 %
	Total	127	100 %

The results of analysis personal information data illustrate the following facts:

1. The highest percentage of drivers who work in logistics companies is the adults (25- less than 35 years) and (35 - less than 45 years) who form 62.2 % of respondents.

2. The highest percentage of drivers has experience years between (2 - less than 6 years) and (6 - less than 10years) who form 55.1 % of participants. This indicates that most of the drivers have a good experience in their work field.

3. The highest percentage of drivers work daily between (6 - less than 8 hours) who form 71.7 % of participants. This percentage is reasonable since the daily work duration for most of Palestinian companies is around 8 hours.

4.4.1.2 Descriptive Attributes

This part is mainly designed to clarify the drivers' behaviors and reactions during their daily work. Respondents on this part have varied responses. In order to analyze these responses, frequencies and percentages are used as shown in the following tables.

- **Accident Rate per Year**

The accident rate per year is divided into seven options. Table 4.19 shows the details of the accident rate. Figure 10 in Appendix C shows the distribution of the accident rate per year of the second questionnaire.

Table 4.19: Sample Distribution Attributed to Accident Rate per Year

Variable	Class	Frequency	Percentage %
Accident Rate per Year	Zero	67	52.8 %
	1–less than 2	52	40.9 %
	2–less than 4	7	5.50 %
	4–less than 6	1	0.80 %
	6–less than 8	0	0 %
	8–less than 10	0	0 %
	More than 10	0	0 %
	Total	127	100 %

- **Time of Accident Occurrence**

Accidents occur either in the morning, in mid-day, in evening or at night. Table 4.20 shows the details of the time of accident occurrence. Figure 11 in Appendix C shows the distribution of the accident occurrence of the second questionnaire.

Table 4.20: Sample Distribution Attributed to Time of Accident Occurrence

Variable	Class	Frequency	Percentage %
Time of Accident Occurrence	The Morning	43	33.9 %
	The Mid-day	33	26.0 %
	The Evening	28	22.0 %
	The Night	23	18.1 %
	Total	127	100 %

- **Weather During the Accident**

Accidents occur during clear, rainy or foggy weather. Table 4.21 shows the details of the weather during the accident. Figure 12 in Appendix C shows the distribution of the weather during the accident of the second questionnaire.

Table 4.21: Sample Distribution Attributed to Weather during the Accident

Variable	Class	Frequency	Percentage %
Weather During The Accident	Clear Weather	1	0.8 %
	Rainy Weather	65	51.2 %
	Foggy Weather	61	48.0 %
	Total	127	100 %

- **Fatigue Time**

The working time in hours after which the driver feels fatigue is divided into six categories. Table 4.22 shows these categories and their results. Figure 13 in Appendix C shows the distribution of the working hours after which the driver feels fatigue of the second questionnaire.

Table 4.22: Sample Distribution Attributed to the Number of Working Hours After Which the Driver Feels Fatigue

Variable	Class	Frequency	Percentage %
The Number of Working Hours After Which The Driver Feels Fatigue	Less than 2	2	1.6 %
	2–less than 4	12	9.4 %
	4–less than 6	65	51.2 %
	6–less than 8	36	28.3 %
	8–less than 10	9	7.1 %
	More than 10	3	2.4 %
	Total	127	100 %

- **Rest Time**

Table 4.23 clarifies the time needed by the driver in minutes in order to recover his activity after he feels fatigue. The time is divided into eight intervals. Figure14 in Appendix C shows the distribution of the rest time in minutes needed by the driver to recover his activity of the second questionnaire.

Table 4.23: Sample Distribution Attributed to the Rest Time in Minutes Needed By the Diver to Recover His Activity

Variable	Class	Frequency	Percentage %
The Rest Time in Minutes Needed by the Driver to Recover His Activity	Less than 15	4	3.1 %
	15–less than 30	28	22.0 %
	30–less than 45	80	63.0 %
	45–less than 60	7	5.5 %
	60–less than 75	2	1.6 %
	75–less than 90	5	3.9 %
	90–less than 105	1	0.8 %
	More than 105	0	0 %
	Total	127	100 %

The results of analysis descriptive attributes illustrate the following facts:

1. 52.8% of the drivers say that they make zero accident per year, while 33.1% of them making accidents once a year.
2. The drivers responses are vary significantly regarding the time of accidents occurrence. The highest percentage 33.9% says that accidents occur in the morning, while lowest percentage 18.12% believes that accidents occur in night time.
3. Regarding the weather during which the accidents occur, the drivers' opinions are divided into two options, 51.2% think that accidents occur in rainy weather. While 48% think that accidents occur in foggy weather.
4. 51.2% of the drivers start feeling fatigue after four to six working hours. While 28.3% of them feeling fatigue after six to eight working hours.

5. The results show that 63% of the drivers need thirty to forty five minutes to recover their activity. 15% of them need fifteen to thirty minutes to feel refresh again.

4.4.2 Factors Affecting Green Logistics Activities

There are many factors affecting companies' green logistics activities mainly the distribution process. Moreover, these factors may have an influence on reducing the environmental impact of logistics activities, through the application different strategies and KPI's that measures the ecological impact and reduce it. In this research these factors are classified into four factors, vehicle selection, route planning, orders aggregation and driver selection.

4.4.2.1 Vehicle Selection

The foundation of any logistics company and its green activities lies on the vehicles it chooses. Vehicle selection impacts every aspect of vehicle cost, from fuel cost to maintenance cost to depreciation. The ability of drivers to carry out their mission - to bring products and services to customers - and operation managers to track and control expense are all ultimately functions of the vehicles a company chooses to place into service.

The overall process of vehicle selection in logistics services has not changed much over the years. Operation managers determine what job vehicles do, what vehicles might qualify, how to equip them, what they can expect each potential vehicle's costs to be and ultimately, which vehicles

are to be used. What have evolved are the vehicles themselves, the technology and equipment they offer, and even what drivers need to do their jobs. Also the pressure on operation managers has evolved in order to take full advantage of that technology and equipments (Duez, 2014).

- **Average Vehicle Age**

The average vehicle age is a useful indicator of the status of the vehicle and the status of the fleet the logistics company has. An acceptable average age depends on factors such as the types of vehicles operated, levels of utilization , operating conditions, companies polices and is sometimes influenced by legislation: in some countries the operation of vehicles over a certain age is not permitted (The World Bank Group and PPIAF, 2006).

A high average vehicle age may be due the lack of funds available for vehicles replacement, or it is some time due to the regular maintenance that allows vehicles to be operated for a long period of time. Whereas, a low average vehicle age may be due to the frequent replacement of vehicles, or may be due to poor or irregular maintenance that reduces the vehicle life. Table 4.24 shows the average vehicle age used by Palestinian logistics companies.

Table 4.24 Sample Distribution Attributed to the Average Vehicle Age

Variable	Class	Frequency	Percentage %
The Average Vehicle Age	Less than 2	65	51.2 %
	2–less than 4	26	20.5 %
	4–less than 6	25	19.7 %
	6–less than 8	2	1.6 %
	8–less than 10	2	1.6 %
	10–less than 12	2	1.6 %
	12–less than 14	3	2.4 %
	More than 14	2	1.6 %
	Total	127	100 %

The results indicate that the average vehicle age of 51.2 % of drivers' vehicles is less than 2 years. 40.2 % of drivers' vehicles have an average age less than 6 years. The lower percentages are for vehicles with average age more than 6 years. The reason behind this could be refer to a policy followed by most of Palestinian logistics companies in order to well maintain premium quality vehicles operating on their services. From their point of view this could reduce the harmful impact of vehicle emissions on environment. Since new vehicles have an improved engine in terms of minimizing the imposed emission and making them more fuel efficient. Besides, many technologies have been developed to treat the exhaust gases produced by vehicles to reduce toxic emissions. So, some of the emission reducing technologies are used in modern vehicle (Faiz et al., 1996).

- **Fuel Consumption**

The actual performance of a vehicle is determined by the amount of fuel it consumes. The energy in fuel is required in propelling the vehicle, providing power to vehicle systems such as ignition or air conditioning and to overcome various losses such as wind resistance, tire drag, and others (Faiz, 1996).

The fuel consumption is the amount of volume of fuel used by a vehicle per unit distance travelled. In this case, the lower value of fuel consumption, the more economic a vehicle is (the less fuel it needs to travel a certain distance). Other definition is the distance travelled per unit volume of fuel consumed. In this case, the higher value, the more economic a vehicle is (the more distance it can travel with a certain value of fuel). (Faiz, 1996).

Many countries impose requirements for fuel consumption, since fuel consumption by vehicles is a significant factor in air pollution. So, various measures and techniques can be taken to reduce the amount of fuel needed by a vehicle to travel a certain distance. One of these techniques could be changing the driver's behavior such as sudden acceleration and heavy braking waste energy (Buesen et al., 2009).

From the survey, the monthly amounts of fuel consumed by driver's vehicle are shown in Table 4.25.

Table 4.25: Sample Distribution Attributed to the Monthly Fuel Consumption (in Liter)

Variable	Class	Frequency	Percentage %
The Monthly Fuel Consumption (in Liter)	50-less than 100	1	0.8 %
	100–less than 150	4	3.1 %
	150–less than 200	12	9.4 %
	200–less than 250	12	9.4 %
	250–less than 300	20	15.7 %
	300–less than 350	15	11.8 %
	350–less than 400	17	13.4 %
	More than 400	46	36.2 %
	Total	127	100 %

From the previous results, it can be observed that the monthly fuel consumption of 36.2 % of drivers' vehicles is more than 400 Liter. Some of other percentages are close to each other and the monthly consumption varies between 250 Liter and 400 Liter.

These results return to the fact that most of Palestinian logistics companies have relatively the same amount of work. Since the core business of logistics companies is to cross certain distances by their vehicles in order to deliver cargoes to customers, so the amount of fuel consumed could be represent the amount of their work. The highest percentage exists since some of Palestinian logistics companies have much more cargoes to deliver and have much larger vehicles which consume more fuel. More massive vehicles have bigger engines waste more fuel to cross a certain distance, since they have bigger cross-sectional areas

leading to more air drag and have more moving parts to lose energy to friction (Khovakh and Arkhangelskii, 1971). Statistics show that 10% reduction in vehicle mass lead to 6% to 8% reduction in fuel consumption (Blanco, 2009).

- **Maintenance Frequency**

Every vehicle has its own set of individual characteristics. To keep these characteristics in good condition, every vehicle have a list of maintenance best practices and service intervals, developed by the manufacturer. The vehicle maintenance is the act of inspecting or testing the condition of vehicle subsystems such as vehicle's engine and repairing or replacing parts and fluids to avoid major damage or for safety reasons.

Regular maintenance is vital to keep the vehicle on road. The time and effort put into keeping up the vehicle with scheduled maintenance can save significant amount of money in the long run. Regular maintenance is also critical to ensure the safety, reliability, drivability, comfort and longevity of a vehicle (Wright, 2015).

The maintenance frequency of Palestinian logistics companies' vehicles according to drivers' responses is shown in Table 4.26

Table 4.26: Sample Distribution Attributed to the Vehicle's Yearly Maintenance Frequency

Variable	Class	Frequency	Percentage %
The Vehicle's Yearly Maintenance Frequency	Less than 2	26	20.5 %
	2–less than 4	71	55.9 %
	4–less than 6	16	12.6 %
	6–less than 8	10	7.9 %
	More than 8	4	3.1 %
	Total	127	100 %

Regarding to drivers' responses in accordance with maintenance frequency, 55.9 % of Palestinian logistics companies make maintenance for their vehicles twice or three times per year, 20.5 % of these companies make maintenance for their vehicles less than twice a year, the rest of companies make maintenance for their vehicles more than four times per year.

From the previous results it is interesting to note that the periodic maintenance made by Palestinian logistic company is a regular inspection of a vehicle where cleaning, oiling and general checks and maintenance such as tires balancing and rotating, light check, fluids and breaks inspection take place.

Making periodic maintenance is useful, since any minor damage in any part can reformed or repaired immediately rather than waiting till that part breaks to fix it which may result in more time downtime or higher costs of that part because it has failed and as a result caused other part to fail or ordering emergency parts will cost more. Also the time wasted by all

this means no money being made. So, periodic maintenance means cost saving, and it is seemed that most of Palestinians logistics companies use this strategy.

- **Occupancy Rate**

The occupancy rate is the percentage of vehicle's capacity that is filled with products or cargoes (Banik and Kyle, 2011). Another expression can be used instead of occupancy rate but refers to the same meaning, which is the load factor. The load factor can be defined as, the ratio of the average load to total vehicle freight capacity or the average number of cargoes occupying a vehicle (EEA, 2011).

Through this indicator, the efficiency of cargo transport can be monitored or measured. The efficiency of cargo transport can be used to determine energy and emission efficiency. Since, a higher occupancy rate or load factor means a significant increase in vehicle weight, thus more energy is used and emission increased. But, high occupancy rate is still preferable, because low occupancy rate results in a higher number of transport or shipment movements, which is generally more environmentally damaging (EEA, 2011). The occupancy rate of Palestinian logistics companies' shipments according to drivers' responses is shown in Table 4.27.

Table 4.27: Sample Distribution Attributed to the Occupancy Rate per Shipment

Variable	Class	Frequency	Percentage %
The Occupancy Rate per Shipment	Full	66	52.0 %
	Half	31	24.4 %
	Quarter	13	10.2 %
	Other	17	13.4 %
	Total	127	100 %

Based on the results in Table 4.27, 52% of Palestinian logistics companies' vehicles run full. 34.6 % of Palestinian logistics companies' shipments occupy either half or quarter of the vehicle's capacity. These results are varied depending on the amount of work a logistics company has. The variations in the results are also exists as result of changing the desired destination since not more than 24 hours delay is permitted. So, to deliver the cargoes in time; a vehicle may start its journey with low occupancy rate.

To achieve a higher occupancy rate Palestinian logistics company should make a route planning and order aggregations for cargoes to be shipped to same destinations, in other word making a network optimization, which is called decreasing vehicular traffic (Banik and Kyle, 2011). Considering this operation on the long run, the amount of fuel consumed and the shipments number will be decreased, which leads to a huge saving in cost and decreasing the amount of carbon emissions.

4.4.2.1.1 Correlation Analysis between Vehicle Selection Attributes

In order to study the relationships between the average vehicle age, fuel consumption, maintenance frequency and occupancy rate, Pearson

Correlation Matrix is used for this purpose. Table 4.28 shows the results of Pearson Correlation value (ρ) and the significant value (P-value) between vehicle selection attributes.

Table 4.28: Pearson Correlation Matrix between Vehicle Selection Attributes

		Average Vehicle Age	Fuel Consumption	Maintenance Frequency	Occupancy Rate
Average Vehicle Age	Pearson Correlation	1	0.171	0.088	0.043
	Sig. (2-tailes)		0.055	0.326	0.615
Fuel consumption	Pearson Correlation	0.171	1	0.094	0.168
	Sig. (2-tailes)	0.055		0.227	0.057
Maintenance Frequency	Pearson Correlation	0.088	0.094	1	0.076
	Sig. (2-tailes)	0.326	0.227		0.332
Occupancy Rate	Pearson Correlation	0.043	0.168	0.076	1
	Sig. (2-tailes)	0.615	0.057	0.332	

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Based on the result obtained from the analysis in Table 4.28, it is interesting to note that there are no significant influences between vehicle selection attributes. Although these results do not agree with findings in literatures but the reason behind this refers to the fact that the amount of fuel consumed depend on the amount of work a logistics company has regardless the vehicle age and the occupancy rate, because Palestinian logistics companies have different amount of work . However, there are relations between fuel consumption and occupancy rate but they are not significant.

To support these results a correlation analysis is made between the number of working hours, vehicle age and fuel consumption. The analysis show that there is a strong negative relationship between the number of working hours and vehicle age (ρ = -0.233, P = 0.008 < 0.01) which is significant at 99%. This indicates that Palestinian logistics companies used younger vehicle more than older ones during long working time.

Another relationship found between the number of working hours and fuel consumption (ρ = 0.407, P = 0.000 < 0.01) which is significant at 99%. This is an indicator that the more work logistics companies have the more fuel consumed.

4.4.2.2 Route Planning

Route planning is a process used to compute the most effective route between two geographical locations. Route planning enables a company to identify more profitable or less costly routes. The optimal route will minimize the distance travelled or time taken with minimal stopover along the way. This route is considered to be cost effective and time efficient for distribution process (Taniguchi and Van der Heijden, 2000).

Modern computer programs, tracking and tracing technology are capable to identify the best routes. Route planning software is a computer software program designed to identify an optimal route between two geographical locations and typically used for road networks planning and design. So, it is used to calculate the smartest and optimal route using actual speed data, real time traffic information and delay maps updates. It

can provide interactive map with a suggested routes and directions that must be followed. It can sometimes also calculate the journey time and cost and display point of interest along the route.

Within logistics industry, logistics companies with large and small fleets may incorporate route planning software into their fleet management systems to optimize route efficiency and enhance profits. The results of second questionnaire analysis regarding route planning are shown in Table 4.29.

Table 4.29: Mean, Standard Deviation and Estimation Level of Route Planning

Route Planning Items	Means	Standard Deviation	Estimation Level
Is there previous determination for the served places based on geographical knowledge	4.04	0.87	High
Are there maps explaining the target destinations	3.91	0.90	High
The previous determination for the served places decreases the average delay time	4.28	0.65	Very High
The previous determination for the served places improves the shipping time	4.51	0.71	Very High
The previous determination for the served places decreases the expected arrival time	4.42	0.67	Very High
The previous determination for the served places decreases the probabilities of facing unexpected situations	4.00	1.08	High
The previous determination for the served places decreases the empty kilometers travelled	3.88	0.93	High
The previous determination for the served places increases the occupancy rate per shipment	3.89	1.11	High
Does the vehicle travel a long distance when it is empty	3.04	1.35	Medium
Total	**4.00**	**0.52**	**High**

The results obtained from Table 4.29 agree with what the mangers of logistics companies said, that most of Palestinian logistics companies make a route planning before shipping (mean equals 4.04). Moreover, these results provide evidence that the route planning helps in improving the shipping time, reducing the expected arrival time and the average delay time, decreasing the probabilities of facing unexpected situations such as congestion, accidents, snow and barriers, decreasing the empty kilometers travelled and increasing the occupancy rate per shipment. Since the estimation levels of them vary between very high and high related to the means values.

In addition the results show that Palestinian logistics companies need to improve their route planning process since many vehicles pass long distance when it is empty so that the empty kilometers travelled increase. Thus the efficiency and the effectiveness of route planning process decrease. As a result, to reduce the emission of greenhouse gas as well as to save fuel consumption, minimize the delay time and improve shipping time, efficient rout planning process is recommended (Taniguchi and Van der Heijden, 2000).

4.4.2.3 Orders Aggregation

Orders Aggregation or shipments consolidation is an environmental logistics strategy that combines two or more orders or shipments so that a larger quantity can be shipped on the same vehicle to the same destination.

In this way the transportation cost per item, per order, or per unit of weight can be reduced (Krishna et al., 2012).

The appropriate use of orders aggregation helps improve green logistics objectives in terms of less transport effort by employing fewer long-haul shipments, which results in higher occupancy rate per vehicle per year and lower total distance travelled by each vehicle. This reduced the total cost and consequently the shipment cost per unit, therefore enabling discounts to the customers. The results of second questionnaire analysis regarding orders aggregation are shown in Table 4.30.

The results obtained from Table 4.30 show consistency with what the mangers of logistics companies said, that most of Palestinian logistics companies make orders aggregations before shipping (mean equals 3.99).

Table 4.30: Mean, Standard Deviation and Estimation Level of Orders Aggregation

Orders Aggregation Items	Means	Standard Deviation	Estimation Level
Are cargoes or orders being aggregated	3.99	1.12	High
Cargoes or orders aggregation decrease the cost	4.14	0.89	High
Cargoes or orders aggregation decrease fuel consumption	4.14	0.91	High
Cargoes or orders aggregation increase the occupancy rate	4.17	0.92	High
Cargoes or orders aggregation decrease the empty kilometers travelled	4.07	0.96	High
Is there a delay in delivering cargoes or orders	2.71	1.40	Medium
Total	**3.87**	**0.77**	**High**

In addition, these results provide evidence that the orders aggregation helps in increasing the occupancy rate and deceasing cost, fuel consumption and the empty kilometers travelled. Since the estimation levels of them vary between very high and high related to the means values.

On the other hand, the results show that Palestinian logistics companies need to improve their orders aggregation process since there is a delay in delivering shipments. Thus in turn affect the quality of services provided by these companies through decreasing the responsiveness. As a result, orders aggregation is one of the best techniques that serve as costs and emissions reduction, better utilization of vehicle fleet, higher occupancy rate, less freight traffic, less environmental damages, higher logistics companies' revenues while offering lower costs to customers and providing environmental advantages to all.

4.4.2.4 Driver Selection

The driver is a person that drives as the operator of a motor vehicle. Driving is the main task in transportation, which has been described as the glue that holds all of our daily activities together. Transportation is vital to participate in daily life as it provides an access to family, friends, social activities, health care, goods and services (Carp, 1988). In addition it is used to fulfill the needs on a logistical level, by helping individuals or goods get from the point of origin to the point of destination.

Driving requires technical skill and adherence to established rule governed behaviors for the safety of one's self and others. The driver's skill set or the driving process is influenced by many variables called Human Factors (HF). As mentioned earlier in Chapter 2, there are several HF; individual, environmental, job and organizational factors; affecting the driver performance in term of fatigue rate, accident rate and shipping time. In order to examine how these factors influence each other, how they affect driver performance, how they affect the logistics companies environmental and financial performance by determine the outputs that are affected by the variations of driver performance and to confirm the reliability of these factors; means, standard deviations, estimation levels and Pearson Correlation matrix are used for this purpose as shown in Table 4.31 and Table 4.32 respectively.

Table 4.31: Mean, Standard Deviation and Estimation Level of Driver Selection

Driver Items	Means	Standard Deviation	Estimation Level
The driver's age increase his fatigue rate	4.56	0.58	Very High
The driver's experience and skills decrease the accident rate	4.59	0.53	Very High
The driver's experience, skills, and his knowledge about geographic areas, roads and traffic movements decrease shipping time	4.59	0.52	Very High
Increasing the driver's attention decrease the accident rate	4.60	0.57	Very High
Health, diet and the sleeping pattern decrease the fatigue rate	4.29	0.74	Very High
The noise level affects the accident rate	4.05	0.81	High
The Weather condition affects the accident rate	4.44	0.65	Very High
The increased numbers of working hours will increase the driver's fatigue rate	4.47	0.68	Very High
The increased numbers of working hours will increase the accident rate	4.21	0.80	Very High
The increased numbers of rest hours will decrease the driver's fatigue rate	4.25	0.83	Very High
The increased numbers of working hours will decrease the accident rate	4.08	0.81	High
Is there a uniformity in the work schedule within the company	4.02	0.96	High
The uniformity of work schedule decrease the driver's fatigue rate	4.24	0.61	Very High
The uniformity of work schedule improve the shipping time	4.29	0.83	Very High
Is there a uniformity in the shift pattern within the company	4.00	0.93	High
The uniformity of shift pattern decrease the driver's fatigue rate	4.17	0.70	High
The uniformity of shift pattern improve the shipping time	4.25	0.65	Very High
Is there training for drivers within the company	3.78	1.06	High
Training the drivers decrease the accident rate	4.13	0.79	High
Training the drivers improve the shipping time	4.22	0.70	Very High
Training the drivers reduce the maintenance cost	3.77	1.07	High
Total	**4.24**	**0.44**	**Very High**

Table 4.32: Pearson Correlation Matrix between HF

		Age	Experience Years	Working Hours	Accident Rate	Fatigue Time	Rest Time
Age	Pearson Correlation	1	0.722**	0.118	-0.174	-0.310**	0.210*
	Sig. (2-tailes)		0.000	0.185	0.052	0.004	0.019
Experience Years	Pearson Correlation	0.722**	1	0.114	-0. 216*	-0.171	0.192*
	Sig. (2-tailes)	.000		0.202	0.015	0.055	0.031
Working Hours	Pearson Correlation	0.118	0.114	1	0.207*	-0.236**	-0.111
	Sig. (2-tailes)	0.185	0.202		0.020	0.008	0.215
Accident Rate	Pearson Correlation	-0.174	-0. 216*	0.207*	1	-0.187*	-0.189*
	Sig. (2-tailes)	0.052	0.015	0.020		0.035	0.034
Fatigue Time	Pearson Correlation	-0.310**	-0.171	-0.236**	-0.187*	1	0.203*
	Sig. (2-tailes)	0.004	0.055	0.008	0.035		0.022
Rest Time	Pearson Correlation	0.210*	0.192*	-0.111	-0.189*	0.203*	1
	Sig. (2-tailes)	0.019	0.031	0.215	0.034	0.022	

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

The obtained results which are listed in Tables 4.31 and 4.32 show the following facts:

- There is a strong relationship between the driver age and number of experience years ($\rho = 0.722$, $P = 0.000 < 0.01$) which is significant at 99%. As driver get older the more experience he have.

- A negative relationship found between driver age and the number of working hours after which the driver feeling fatigue ($\rho = -0.310$, $P = 0.004 < 0.01$) which is significant at 99%. Thus the fatigue rate increases when driver become older (mean equal 4.56). Because fatigue is common among older people, it is often identified as a natural part of the aging process (Gambert, 2013).

- There is significant influence between driver age and the time needed by the driver to recover his activity ($\rho = 0.210$, $P = 0.012 < 0.01$) which is significant at 95%. Therefore, when driver becomes older he needs more time to refresh again after feeling fatigue. Because older people sleep less at night but they need longer time of breaks during day (Schubert, 2015).

- The driver experience has a significant influence with the accident rate ($\rho = -0.216$, $P = 0.015 < 0.05$) which is significant at 95%. Therefore the accident rate decreases when the driver has more experience in driving (mean equals 4.59). Nishida, (2009) argued that the level of driver performance depend on individual, but it is decline with aging. However, some time the driver experience play a critical role in improving his

performance, as the driver become older, he gain more experience that help him to control his driving manner through concentration on road and driving safety that lead to minimize the accident rate.

- As the driver has more experience in his work related to his knowledge about geographic areas, roads and traffic movements, the shipping time required to deliver a cargo decrease (mean equals 4.59). In this way the service level of a logistic company is improved.

- Increasing the driver's attention decrease the accident rate (mean equals 4.60). The driver's attention helps the driver in increasing his perception of the road environment and other road users. So, the driver will be able to understand the current situation even if it is occur suddenly, to anticipate its change and to take the right decisions in order to dynamically interact with the road environment and the other road users in order to avoid the occurrence of an accident (Bellet et al., 2011).

- Good Health, diet and the sleeping pattern decrease the fatigue rate (mean equals 4.29). Murray, (2014) said that there are many ways in which driver fatigue rate can be reduced. These can include increasing sleep hours; the lack of quantity and quality of sleep causes impairment in a number of performance tasks such as, short term memory as not remembering the last few minutes, trouble focusing, narrowing in attention, poor judgment, slower reaction time, increased the tendency of risk taking and lack of cognitive function and ability to resist sleep. So avoid driving at times of the day when the body is naturally drowsy and sleepy. Until the

driver can catch up on lost sleep he will have a greater risk of having a fatigue related accident. On average the worker requires 7.5 to 8.5 hours of sleep per day. Moreover, eating at regular time and not skipping meals may reduce the act of feeling fatigue, because lacking sufficient quantities of calories, protein or the essential vitamins and minerals may lead to symptoms of fatigue. In addition, many drivers believe that coffee, turning up the volume of the radio, smoking or even opening the window will increase their ability to fight drowsiness. However, these tricks not only do not avoid drowsiness but can give the drivers a false sense of security. So, stop making alertness tricks.

- The noise level in the surrounding road environment affects the accident rate (mean equals 4.05). Noise can be distractive and affect the ability of the driver to focus on the driving task he is performing which is a cognitive task, and on the other features of the road environment. These deficits in the driver performance can lead to errors and accidents, both of which have health and economic consequences (Goines and Hagler, 2007).

- The Weather conditions affects the accident rate (mean equals 4.44). The influence of changes in extreme weather conditions is often identified as a cause of fluctuations in road safety and the resulting numbers of crashes and casualties. The weather conditions have an impact on road safety, both in distance travelled and the risk of road travel (Bijleveld and churchil, 2009). According to drivers' responses, accidents occur more in foggy and rainy weather. According to Road Weather Management Program, (2015), the foggy weather reduced the visibility distance on

roads, which influences traffic speed by making variance in speed and changing driver performance, this lead to increase the accidents rate and travel time delay. However, the rainy weather reduced the visibility distance on roads, the pavement frictions, which influences traffic speed, the roadway capacity and changing the driver performance, this lead to increase the accidents rate and travel time delay. Based on the analysis of Booz Allen Hamilton *Ten-year averages from 2002 to 2012,* Road Weather Management Program, (2015) admitted that "On average, there are over 5870000 vehicle crashes each year. Twenty three percent (23%) of these crashes, nearly 1312000, are weather related. Weather related crashes are defined as those crashes that occur in adverse weather such as rain, sleet, snow, fog, severe crosswinds, or blowing snow/sand/debris or on slick pavement such as wet pavement, snowy/slushy pavement, or icy pavement. On average, 6,250 people are killed and over 480,000 people are injured in weather related crashes each year. The vast majority of most weather related crashes happen on wet pavement and during rainfall, seventy four percent 74% on wet pavement and forty six percent 46% during rainfall. A much smaller percentage of weather related crashes occur during winter conditions, seventeen percent 17% of during snow or sleet, twelve percent12%occur on icy pavement and fourteen percent 14% of weather related crashes take place on snowy or slushy pavement. Only three percent 3% happen in the presence of fog". These result inconsistent with the divers' responses regarding to foggy weather, because in Palestine the snow occur less frequent than in other countries.

- The increased numbers of working hours will increase the driver's fatigue rate (mean equals 4.47). Also a negative relationship found between the number of working hours and the number of working hours after which the driver feeling fatigue ($\rho = -0.236$, $P = 0.008 < 0.01$) which is significant at 99%. Research has found that driving deteriorates after two hours of continuous driving, as you become less able to concentrate, and slower to react to hazards. After four hours of driving, all of the driving performance indicators changed significantly except for depth perception the longer you drive for the more rest you need to recover driving performance. Furthermore, four in ten tiredness related crashes involve someone driving a commercial vehicle because the drivers spend longer hours at the wheel, so they are particularly at risk from tiredness (Wang and Pei, 2014).

- The increased numbers of rest hours will decrease the driver's fatigue rate (mean equals 4.25). Moreover, the number of working hours after which the driver feeling fatigue influenced by the rest time or the breaks ($\rho = 0.203$, $P = 0.022 < 0.05$) which is significant at 95%. Wang and Pei, (2014) found that, a certain amount of rest time eliminated the negative effects of fatigue. A fifteen minutes rest allowed drivers to recover from a two hours driving task. This needed to be prolonged to thirty minutes for driving tasks of three to four hours of continuous driving.

According to Alberta Human Resources and Employment, (2004), there are many causes of fatigue, one of them are work related factors that may include long work hours, long hours of physical or mental activity,

insufficient break time between shifts, inadequate rest, excessive stress or a combination of these factors.

- The increased numbers of working hours will increase the accident rate (mean equals 4.21). The number of working hours has an influence on the accident rate ($\rho = 0.207$, $P = 0.020 < 0.05$) which is significant at 95%. Because fatigue rate is not measureable, it is difficult to isolate the effect of extended work hours or lack of sleep on any changes in accident and injury rates. Many studies indicate that accidents rate influence by extended working hours and overtime. Other studies said that the accident rate is a function of hour at work and time of day, differed with regard to time of day. Researchers observed that there is an exponentially increasing in accident rate beyond 9^{th} hour at work (Hanecke et al., 1998; Dembe et al., 2005).

- The increased numbers of rest hours will decrease the accident rate (mean equals 4.08). In addition, the accident rate influenced by the rest time or the breaks ($\rho = -0.189$, $P = 0.034 < 0.05$) which is significant at 95%. Breaks are essential for the body to eliminate the negative effects of fatigue and to feel active again. By eliminating the harmful impact of fatigue on driver's body the chance of making fatigue related accidents are minimized.

- Depending on drivers' responses, there is uniformity in the work schedule within the Palestinian logistics companies (means equals 4.02).

- The uniformity of work schedule decreases the driver fatigue rate (mean equals 4.24). The scheduled work time minimize the extended working hours, so it reduced the adversely impact of working hours on health such as fatigue (Dembe et al., 2005).

- The uniformity of work schedule improve the shipping time (mean equals 4.29). Uniformed work schedules for shipments allow the cargos to be organized based on its destinations and the drivers to be informed about the amount of cargoes required to be delivered, so they will be able to organize the driving and the rest hours so that no delay occurs. In this way, the shipping time will be decreased and the service level will be increased.

- Based on Drivers' responses, there is uniformity in the shift pattern within Palestinian logistics companies (means equals 4).

- The uniformity of shift pattern decrease the driver's fatigue rate (mean equals 4.17). The body and the brain have a biological clock "circadian rhythm" that influences how alert or drowsy the body and the brain are at certain times of the day. Irregular work shifts can be a problem and affected the body clock if the driver work shifts and switch from day to night shifts without having sufficient time off in between for his body clock to adjust. Research has found shift workers are particularly high risk for fatigue related crashes. As a result, the uniformity of shifts pattern organize the access of body clock to its natural dip, so the driver fell less sleepy and able to concentrate in a better way .The most common times for drivers with normal sleep patterns to fall asleep at the wheel are early morning

(2am-6am) and early afternoon (2pm-4pm). Thus, early morning shifts and night shifts increase the likelihood to feel fatigue. This lead to conclude that the peak time for accidents is in the early hours and after lunch. Moreover, Shift workers and those working extended hours are more likely to feel fatigue and probably 6 times more to be in a fatigue related crash, whether that is at work (operating machinery or vehicles) or commuting (Alberta Human Resources and Employment, 2004).

- The uniformity of shift pattern improve the shipping time (mean equals 4.25). Uniformed shift patterns improve the driver performance, as it allow the driver to take sufficient amount of rest and sleeping hour and reduce the work pressure on driver. The driver performance reflecting through his driving, if he is feel comfortable and less fatigue he will be able to drive safely at recommended speed an deliver cargos on time. Proper work shift pattern will help logistics companies to raise their service level and profitability through minimizing the delay time.

- According to drivers' responses, there is training for drivers within Palestinian logistics companies but it is still insufficient (mean equals 3.78) because only 60% of Palestinian logistics companies make training for their employees and drivers and this type of training cannot be considered to be a green training as they said.

- Training the drivers decrease the accident rate (mean equals 4.13). New drivers, especially young ones, have extremely high accident rates. Formal instruction, which includes in-class education and in-vehicle

training, has been used as a means to address this problem. In addition training and education courses could address adequately the age and experience related factors that render young drivers at increased risk of collision. The principal goal of many of education and training courses, if not most, is to produce safer drivers, defined in terms of collision and accident involvement. Simply put, it is assumed that drivers exposed to training instructions should have lower accident rates than those who do not receive such instructions. Also the drivers who take these courses are motivated to use what they are learned to attain the beneficial effects of safety training (Mayhew and Simpson, 2002; Peck 2011).

- Training the drivers improve the shipping time (mean equals 4.22). Driver training courses can enrich the driver knowledge regarding the geographic locations of the served destinations and the potential alternative routes to select if he faces unexpected event such as, congestion, accident, barriers and check point. In this way the driver will be able to choose the best route in order to reach to the desired destination, taking into consideration the minimization of delay time as much as possible.

- Training the drivers reduce the maintenance cost (mean equals 3.77). Driver behavior has the single biggest impact on fuel consumption, maintenance and safety. Some examples for driver education is teaching drivers about tire maintenance and optimal tire pressures .This contributes to lifting the current low levels of tire maintenance and prolonging the life cycle of tires. In this way the maintenance cost to fix the tire reduced and the cost of purchasing new tire to replace the old one is also reduced.

Driver training courses can make saving in maintenance between (5-15) % (Beyond Driving, 2015).

- Another correlation found between the number of working hours after which the driver feeling fatigue and the accident rate (ρ = -0.187, P = 0.035 < 0.05) which is significant at 95%. Accident, incidents or injuries are the result of a number of factors acting in combination, fatigue being just one of them. Being fatigued significantly increases the risk of an accident. It makes the driver less aware of what is happening on the road and impairs his ability to respond quickly, drive safely, increasing reaction times, reducing attention, and reducing his ability to control the vehicle if a dangerous situation arises. This may only last a few seconds, but if it coincides with the need to perform some critical driving task such as turning the wheel or responding to a stop signal, the risk of crashing is greatly increased. As the fatigued driver makes no attempt to avoid the crash, the consequences of accidents attributed to driver fatigue are often the most serious in terms of death, injuries and damage. This is why the effects of driver fatigue are so dangerous and disastrous (Friswell and Williamson, 2008). Thus, driver fatigue has been identified as having played a significant role in a number of recent transportation and power utility disasters in term of accident rate. It is believed to contribute to more than 30% of road accidents. About 40% of fatigue related accidents involve commercial vehicles (Tucker, 2013).

Accidents caused by drivers falling asleep typically involve vehicles running off the road or into the back of another vehicle or vehicle departs

the driving lane and collides with another object, such as a tree beside the road or another vehicle.They tend to be high speed crashes, because drivers do not brake before crashing, so the risk of death or serious injury is high. Even if tired drivers don't fall asleep, they still pose a danger (Friswell and Williamson, 2008). Canada Safety Council, (2008) suggests driving tired can be as dangerous as drink driving.

The analysis of Alberta Human Resources and Employment, (2004), found that most of accidents in commercial truck have been found to peak during the early morning hours a time at which the fewest number of automobiles are on the road but when most people experience the greatest degree of sleepiness. They found that drivers in these accidents had slept an average of five and half hours during their last sleep period. This is compatible with the questionnaire results.

The area of driver selection there can enhance both the logistics company's economic and environmental performance through developing experienced drivers. This could be attained through education and training courses, which focuses on making drivers aware of fuel efficient driving and contributes to enhancing the safety of both driver and goods. This generates savings in the form of lower insurance premiums, less energy consumption and better use of resources. In other word, lower cost, less carbon emission and better service level.

Based on the results obtained from questionnaire analysis about the driver selection, as well as on what are mentioned in Chapter 2, section 2.6,

and Table 2.2 about the HF, a theoretical framework is developed. The framework relates the driver selection process with the key factors that influence the driver performance. Figure 4.3 illustrates the proposed framework.

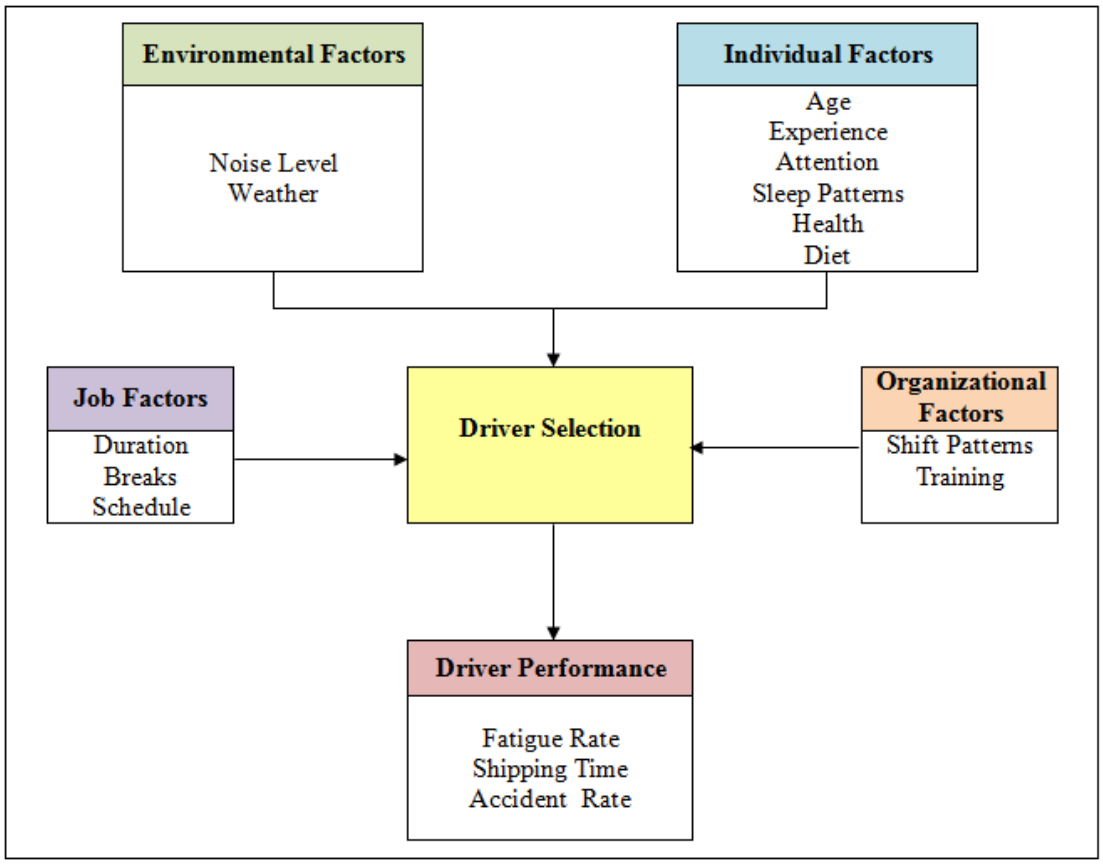

Figure 4.3: The Framework for Drivers Performance Modeling

The key factors shown in the framework provide a comprehensive picture of the factors that are most likely to influence the driver selection process and consequently the driver performance and how the variations in the performance affect green logistics system performance in term of cost, service level and amount of generated carbon emission.

This framework addresses the importance of driver selection to be considered in green logistics, by integrating every single factor affecting

the driver selection as well as the driver performance. Therefore, this framework is a realistic representation of the HF and the variation in driver performance that need to be considered in green logistics in order to improve the logistics companies' performance.

Finally, this framework sets out to develop the foundations for a modeling tool that enables the assessment of key HF early in the process of green logistics network design. Now, the challenge is rather to understand precisely where a variation in driver performance should be considered in a model of green logistics network, to appreciate the nature of such variation and the factors that affect and amplify this variation.

However, in order to link the framework of the driver performance with the green logistics system, as well as to link other factors affecting green logistics activities, a green logistics framework needs to be built. The green logistics framework is presented in next section.

4.5 Formation of Green Logistics Framework

The green logistics framework is developed based on the results of the questionnaires analysis and related researches and observations. Figure 4.4 presents the green logistics framework.

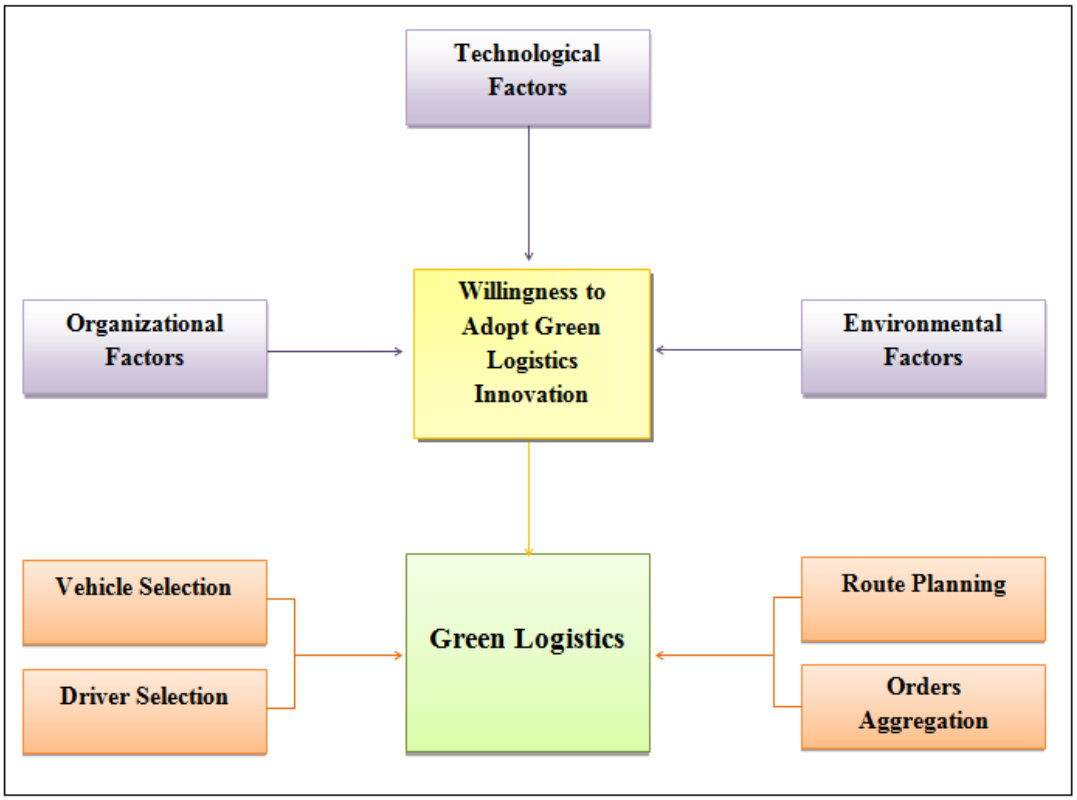

Figure 4.4: The Green Logistics Framework

The developed framework potentially gives a comprehensive and holistic picture of the factors affecting the willingness to adopt GLI. Moreover, it identifies the factors affecting companies' green logistics activities mainly the distribution process.

However, after Palestinian logistics start applying GLI in order to have green logistics system, they need to continuously evaluate their activities to sustain the green logistics system. For this purpose a GL model is developed in next chapter.

Summary

In this chapter, a comprehensive analysis of the interviews and the questionnaires are done. The statistical and the analytical approaches are used for this purpose. Arithmetic means, standard deviations, percentages and estimation level of the employees and drivers responses are obtained through SPSS program. In addition, regression analysis is used to test the research hypotheses. On the other hand, Pearson Correlation matrix is used to determine the relationships between the factors of both questionnaires.

Important results obtained from the analysis processes that help in evaluating the current situation of Palestinian logistics companies, formation of HF and GL frameworks. These frameworks help in formation of GL model as shown in the next chapter.

Chapter Five

Formation of Green Logistics Model

This chapter addresses the concept of GL and environmental footprint then applies them to the design of a conceptual model to aid Palestinian logistics companies to undertake their GL.

5.1 The Development of Green Logistics Model

Due to the increasing demand for advanced logistics services fuelled by globalization, customer orientation, environmental protection and sustainability, the role of logistics companies has started to change both when it comes to content and complexity, as it is directly connected to the pollutant emissions into atmosphere by the impact of their processes. Under these conditions, logistics companies are trying to reduce the negative impact of their activities on environment and increasing their profitability and service level. This applies that logistics companies begin to transform their operations and strategies to become more effective from a green perspective. As a result GL has emerged as a modeling and solution approach to introduce these environmental concerns into decisions taken in all logistics flows, through measuring and minimizing ecological or environmental impact and simultaneously maintaining high levels of efficiency and competitiveness.

After analyzing the previews models it is decided to develop a model that allows logistics companies to understand the real impact of their activity, which can be changed or improved, taking into consideration

ratios or KPIs. So this is an advantageous tool to logistics companies because it allows the easy access to some target indicators in a simple unique tool. In a simple way, an evaluation can be connected to the different departments in order to join the necessary efforts to make their activity more competitive and more environmental respectful. The model connects two major groups; logistics companies and customers. Logistics companies are all companies that receive requests for freight transport or cargoes transport and customers are the entities that receive the cargoes transported. In addition, the model expects a cooperation between these groups with their information systems that support decisions based on a common database resulting in a win to win partnership so that costs can be reduced and gains shared, develops partnerships in exceptions situations, fulfillment the time of customers' requests to thereby keeping high service level near customers. Moreover, the model deals with four levels of decision; vehicles selection, driver selection, routes planning and orders aggregation. The four critical levels will be presented in the next sections.

5.1.1 Information System

According to Alshawi, (2001), information system has been seen as more than resources that support various business processes. Gunasekaran and Nagi, (2003) suggested that proper use of information system will result into accurate information, better utilization of resources, measuring performance and controlling operations. Kim and Rehee, (2012) listed information system as one of the success critical factors for GSCM and GL. Other authors argued that information system is one of the factors for an

effective GL. Logistics information system could be described as the platform for green logistics as it is used to share the logistics information and raise the utilization of logistics resources (Lin and Ho, 2008).

Collaboration in GL has a common goal as well as to create transparent and visible relationships between companies and customers. Collaborative effort in GL can be in the form of information sharing, integration of information resources and using standardized database (Kim and Rehee, 2012). Moreover, the collaboration between logistics companies and customers are the drivers to reduce the environmental impacts. According to Barratt, (2004) trust, mutuality, information exchange, openness and communications are elements of collaboration. Thus, for GL to be successful, logistics partners should trust each other by exchanging information, transparent and honest with clear communication that will be mutually beneficial for all.

It is important to create and use information systems and common database that allows the integration of the different information from logistics companies and customers. This provides the logistics companies the real time information and precise monitor on logistics activities such as the product packaging, storage, transportation, distribution processing, loading and handling. This also helps to respond to the requirements of environmental development, facilitate the implementation of environmental logistics decision making and give optimized decisions. Moreover, this creates win to win partnerships to split costs and share profits between logistics companies and customers (Lau, 2011).

Logistics companies insert important information respect to vehicles ages, drivers' availability, possible routes, loaded occupancy, the destinations, probability of risk existence and cargoes types. On the other hand, customers enter information about their locations and cargoes transport necessity and type. Thus, the information systems are important in order to receive customers' requests on an easy way. Also, the information systems are vital in all companies, and logistics companies are not an exception. Information system supports all operational activities, decision making and strategies developing. Thus this strategy can reveal an important strategic position in the market.

5.1.2 Customer Role

Customers have their own requirements for green productions and green services. Green requirements are due to human attitudes towards natural environment. In real market, the green requirements are transformed into green demand. Customer demand for green production and green service is a key driver for logistics companies to do in green logistics and to convert their operations into green ones. Hence, it is clear that customers play an important role in green logistics (Vasiliauskas et al., 2013). These facts agree with the results of the first questionnaire analysis.

The role of customer is represented by the customer's green requirement that promotes a logistic company to implement green logistics. In addition, customers demanded the government to formulate green logistics rules and policies through the public voice of green trend.

5.1.3 Vehicle Selection

Over the past decades, vehicles help the humanitarian world in running business operations smoothly and aiding them to be delivered on time. Well managed vehicles help in performing duties efficiently and safely. By managing vehicles professionally, engaging to make regular maintenance and training drivers; the impact on the environment will be significantly reduced. Whilst, at the same time, increasing efficiency and reducing costs. Now, the continuous management of vehicle fleet effectively is one of the strategic priorities for a logistic company. With the existence of technological advancement, modern vehicles are available. These new vehicles with the aid of new technologies make the driving process safer, more cost efficient and more comfortable than ever before.

One of the new technologies in the modern vehicle is the new engine technology; engineers are modernizing these engines to make them as much cleanly as possible with lowest fuel consumption. These engines can boost fuel efficiency without sacrificing power. Having in mind that oil resources are running out, for future alternative sources to move transport means will be needed. Thus, this new engine will decrease the amount of fuel consumed and the amount of carbon emitted. Meanwhile, these modern vehicles will cost less regarding to maintenance cost. In addition, new engine technology uses alternative fuels ranging from ethanol to liquefied natural gas to electricity to hybrid systems, alternative fuel are powering more vehicles than ever. By using this option the carbon dioxide will be reduced. Moreover, the connectivity allows the drivers to be more

connected with the outside world, via Global Positioning System (GPS), built in Bluetooth capability, and other technology. In this way, the delay time will be reduced and the service level will be increased. Also, the internal vehicle environment and the safety features such as a comfortable and safe seat and seatbelt, well designed driving cabin, good devices for improving the vision like mirrors and screens, sensing devices and effective lights and reflectors. In this way the driver will drive more safely and comfortably. In turn the fatigue and the accident rate will be decreased and the shipping time will be improved (McKinnon et al., 2010).

As discussed in the previous chapter and the current chapter the proper selection of vehicle will help the logistics company to gain both economic and environmental advantage.

5.1.4 Driver Selection

Driving is a complex task with driver error contributing to a high number of road crashes. In the increasingly complex and crowded roads, even experienced drivers need to update their driving skills and be safer drivers. Meanwhile, as the climate change is getting more and more visible through global warming and since transportation is estimated to contribute to energy related carbon dioxide emissions; the driving process should be more environmental friendly by updating the driver driving skills to be more environmentally efficient through training.

As it is obviously discussed in the previous chapter, there are several HF that affect the driver selection process as well as affect the driver

performance in term of fatigue rate, accident rate and shipping time. The driver performance has the single biggest impact on fuel consumption, maintenance and safety. The driver performance could be improved through training. This leads to minimize the cost of maintenance, fuel and shipping; reduce the carbon dioxide emitted through the transportation process and improve the service level through decreasing the delay time.

Good training makes good driving which in turn makes good business sense. It does not only protect the staff and saves money; it also enhances reputation with customers and business associates (Rakha and Ding, 2003). While, Ang and Schroeer, (2002) argued that more saving can be obtained from developments and improvements in operations activities, loading and maintenance of vehicles than from acquiring new vehicles with technical advances. Logistics companies can apply various fuel conservations methods that reduced the amount of fuel consumed per distance travelled. One of the most cost effective methods within logistics industry is driver training.

As shown in Figure 5.1, driver training can be done with four simple steps and it is suitable for all drivers in any business.

Figure 5.1: Driver Training Steps, source: (The New Zealand Automobile Association, 2015a)

The first step is assessing driving risk; companies' drivers are evaluated to identify those who need training. In this way companies can save money through filter out those drivers who do not need training from those who do need it. The assessment could be done in vehicle. Vehicle assessment allows to identify the specific training needs of drivers who are at risk through instructor who observes the driver during his normal driving routine at work. The second step is analysing training needs; after assessing and identifying drivers who need training, the specific training needs of each and every drivers are analyzed. The third step is driver training; high quality professional training programs and coaching are provided. These programs focus on the specific needs of drivers to improve control skills, behaviour and safety. The fourth step is evaluating progress; in this step a company can see results and a return on investment. So, to achieve long

term benefit from this training, companies should regularly monitor the driving performance for their drivers and promote them to continue driving safely and fuel efficiently through giving rewards (The New Zealand Automobile Association, 2015a).

There are two types of driver training; defensive training and eco-driving training. Defensive training teaches the drivers how to detect problems earlier, be alert, understand their own abilities, assess the attitudes of other road users and be aware of the environment around them. So they can take the right action and control their vehicles. In this way, the drivers will be much safer on road and aware of risk with their new and improved driving skills. Meanwhile, the drivers will learn to appreciate the factors that influence their performance and how to cope in stressful driving situations. In addition, they will believe that safer driving is not just about how successfully a driver can operate a vehicle, it is about how to behave correctly when they are driving on road, also it is about how well they interact with other road users (The New Zealand Automobile Association, 2015b).

While, eco-driving training means smarter and more fuel efficient driving, as the annual vehicle fuel consumption will be reduced. Eco-driving is described as a new driving way or culture that makes best use of advanced vehicle technologies, while improving road safety and environmental performance. Eco-driving is considered to be an influential component in sustainable mobility, as it contributes to environment protection and pollutions reduction. Simple techniques can be introduced to

enable drivers to reduce their fuel consumption without increasing journey times, as well as reductions in carbon dioxide emissions and noise levels. By lowering driving speeds, avoiding accelerating, breaking and stops and decelerating smoothly produces fewer emissions (Rakha & Ding, 2003). Studies found that eco-driving training reduces fuel consumption by 5% - 10%, reduce maintenance cost by 5%-15% and reduce the accidents by 30% (Kostiainen, 2012).

When a logistics company implement the four steps for driver training, several measurable benefits can be obtained such as, reduction in road risk and accidents through improved driver awareness, skills and behaviors. Also, increasing drivers' compliance to regulations and company policies, reduction in insurance premiums and cost, reduction in sick pay, lost productivity, driver downtime and legal cost, identifying hazards and how to respond to them, coping with road conditions and handling the vehicle. Moreover, understanding better routing and navigation, improving fuel efficiency through better driving, reduction in vehicle maintenance costs through less wear and tear and create safer environment for road users. In addition, improving staff moral as drivers appreciate any investment in them through training, and improving company reputation.

Finally, every driver whether he is novice or experienced; would benefit from an opportunity to improve his driving skills, behaviors and knowledge. Driver training is not designed to teach the drivers how to drive, but how to apply a specific system to their driving that will make

them safer, more confident on the road and save money. Even the most experienced drivers can learn how to drive more safely and economically.

5.1.5 Route Planning

Traffic flows, allocation of customers' locations, road infrastructure plays considerable role in emission reducing. The results obtained from the analysis of the second survey indicate that a good route planning helps to avoid traffic jams, run fewer kilometers to deliver cargoes. Thus in turn, improving the shipping time, reducing the expected arrival time and the average delay time and increasing the occupancy rate per shipment. In addition, carbon dioxide emissions are reduced as the cargoes are delivered with fewer transport trips.

5.1.6 Orders Aggregation

The results obtained from the second survey analysis show that orders aggregation helps to use transport more efficiently, delivering more cargoes with one transport trip. Deliveries with half empty vehicle are economically not useful. Logistics Company earns more money, delivers more cargoes and reduces the cost of both fuel and cargoes cost per kilograms with the use of orders aggregation technique. At the same time the amount of carbon dioxide emitted is reduced as the number of vehicle to be used for delivering the same amount of cargoes is reduced. This leads to a considerable reduction of travel time for vehicles, person working hours and total costs.

Route planning and aggregate planning are considered to be smart or strategic logistics. They both have a great advantage over technological choices that the costs are limited and they will often remain as an integral part of the company processes over a long period of time, while technology often has to be replaced after some years to have the newest or best available technology.

5.2 Key Performance Indicators (KPIs)

A good green logistics system relies on its performance. Neely et al., (1995) defined a performance measure or indicator as a metric that is used to quantify the efficiency and/or effectiveness of an action. “Effectiveness is the extent to which a customer’s requirements are met. While efficiency measures how economically a company’s resources are utilized when providing a pre-specified level of customer satisfaction” (Shepherd and Gunter, 2006).

Establishing suitable performance indicators is essential in designing and analyzing green logistics operations. In the analysis of green logistics system’s performance indicators are used to determine the efficiency and the effectiveness of certain logistics system or to compare different competing logistics systems. In design of green logistics system, they are used to determine the values of the decision variables to reach to the most desirable levels of performance (Beamon, 1999).

It is essential to evaluate and assess the green logistics in a numerical manner, as the logistics companies can benchmark themselves

against their competitors, so they can continuously improve and adjust their KPIs. Although a number of performance indicators appropriate for traditional logistics have been developed, these existing indicators are sometime inadequate for use in the green logistics. The existing indicators are inadequate in capturing the objectives of economic efficiency and environmental protection. This identifies a need to develop new and more comprehensive indicators to describe green logistics performance through environmental impact analysis and assessment, continuous measurement, targets and monitoring procedures (Beamon, 1999).

Potter, (2002) proposed a list of potential performance indicators for sustainable distribution. They explained that most of the proposed measures have a high correlation to both environmental and financial indicators. While Aronsson and Brodin, (2006) discussed that a commonly suggested performance indicator for the environmental performance of the logistics system is emissions. Wu and Dunn, (1995) also stated that emissions are important but also noise. In the same context, Beamon, (1999) said that green logistics should be environmentally assessed according to emissions. In the same context, Aronsson and Brodin, (2006) pointed out that the emissions are primarily related to the number of kilometers travelled by the vehicle and to a lesser extend to the weight of cargoes. Therefore, increasing the fill rate reduces the number of vehicle kilometers travelled but not necessarily the number of ton kilometers traveled.

However, it is important to match these KPIs to green logistics and then to determine whether or not these KPIs are suitable to apply within green distribution, if not, it will be necessary to develop a new set of KPIs to evaluate the green performance of logistics companies.

Therefore, it is essential to logistics companies to develop a method which allows them to identify the factors that affect the impact of their activity on the environment. Most of such factors can then be changed or improved from adequate analyses grounded on monitoring an adequate set of KPIs. In this way, analysts can measure progress toward green goals, providing that KPIs are quantifiable. It is also important to set targets to each KPI.

The performance evaluation should occur through the analyzing of performance indicators in order to facilitate decision making, simplifying the management of human resources and vehicles fleet (location, cargo, average speed, locals and times of starting and stopping routes) and to save such data within the information system (Psaraftis and Panagakos, 2012).

As cargoes distribution typically accounts for logistics related carbon emissions, it is hardly surprising that it is the main focus of carbon mitigation efforts. These efforts can be targeted on some green KPIs that can be calculated as shown below (McKinnon et al, 2010; Lau, 2011).

The vehicle allocation to a specific route is subject to several decision variables so it is extremely important to make a careful analysis of vehicle before selection. Thus, there are some aspects that should be taken

into account in order to minimize vehicles environmental impact as shown next.

- The average vehicle age is the ratio between the summations of vehicles ages a logistics company own to total numbers of vehicle.

$$Average\ Vehicle\ Age = \frac{\text{vehicle age}}{\text{Total vehicles}} \quad (5.1)$$

- The empty kilometers travelled is the ratio between the distances in kilometers traveled by a vehicle when it is empty to total distance travelled in kilometers.

$$\%\ Empty\ km\ Travelled = \frac{\text{Empty km Travelled}}{\text{Total km Travelled}} \times 100\% \quad (5.2)$$

- Fuel efficiency, defined as the ratio of fuel consumed to total kilometers travelled. It is a function mainly of vehicle characteristics, driving behavior and traffic conditions.

$$Fuel\ Efficiency = \frac{\text{Total Fuel Consumed in litre}}{\text{Total km Travelled}} \quad (5.3)$$

- Carbon intensity is the amount of carbon dioxide emitted per unit of energy consumed.

$$Carbon\ Intensity = \text{Fuel Emission Factor} \times \text{Total Fuel Consumed} \quad (5.4)$$

Where, the fuel emission factor of road transport is [62 gm of carbon dioxide/ tone.km] (McKinnon and Piecyk, 2010)

The drivers are one of the main pillars to acquire a green logistics because they are the responsible for several decisions making. Therefore, their training is very important in several aspects such as road and freight

safety, speed adaption, cargo accommodation and performs preventive maintenance. There are some KPIs listed below; that can be used to measure the impact of drivers and their training to ensure green innovations in logistics.

- Accidents rate is the ratio between the accidents the driver makes to total number of trips.

$$Accidents\ Rate = \frac{\text{AccidentsNumber}}{\text{Total Trips}} \quad (5.5)$$

- Fulfillment rest hours are the ratio between a driver rest hours to recommended rest hours.

$$Fulfillment\ Rest\ Hours = \frac{\text{Rest Hours}}{\text{Total Recommended Rest Hours}} \times 100\% \quad (5.6)$$

- Cost saving is the percentage of reduction in the cost of ton shipped due to applying GL.

$$Cost\ Saving = \frac{\text{Initail Cost of Ton of Cargoes}}{\text{New Cost of Ton of Cargoes}} \times 100\% \quad (5.7)$$

The routes planning are subject to several decisions which are reflected in a logistics. It is important to take into account the cargos destination and the vehicle selection. Also, it is also important to detect risk conditions in order to avoid traveling on congested roads, road with traffic bottlenecks due accidents, roads constructions and strikes. Usually these conditions can result in a high fuel consumption, decrease responsiveness and road safety. Some measures should be taken into consideration as shown below.

- Shift time which is considered to be a measurement of delay

$$Shift\ Time = \frac{\text{Actual Time Travel}}{\text{Standard Time Travel}} \tag{5.8}$$

- Cargo Intensity; this is the ratio of cargoes movement usually expressed as amount of cargoes to kilometers travelled.

$$Cargo\ Intensity\ = \frac{\text{Amount of Cargoes Shipped}}{\text{Total Distance Travelled}} \tag{5.9}$$

Orders aggregation is considered to be a strategy within logistics companies whom follow the green trends as it minimizes the cost and saves fuel. Within orders aggregation, it is imperative to obtain a high rate of occupancy rate or load factor.

- Vehicle utilization is how much vehicle traffic is required to handle a given amount of cargoes movement. If the vehicles are well loaded on outbound and return trips this ratio is minimized.

$$Vehicle\ Utilization = \frac{\text{Vehicle trips}}{\text{Amout of Cargoes}} \tag{5.10}$$

- Occupancy rate is the percentage of vehicle's capacity that is filled with products or cargoes

$$Occupancy\ Rate\ \boldsymbol{or}\ Load\ Fcator = \frac{\text{Capacity Occupied}}{\text{Total Capacity}} \times 100\% \tag{5.11}$$

The customers are an important element in logistics companies and their decisions and behaviors can also help to ensure a green logistics. So it is also important to improve the services provided to them.

The reliability of the road cargoes transport can be an important performance indicator that can be measured by KPIs as shown next.

- Service level is a measurement of logistics companies' performance. It is also an indication of customers' satisfaction.

$$Service\ Level = \frac{\text{Number of Services Satisfied}}{\text{Total Number of Services}} \times 100\% \qquad (5.12)$$

- Cargoes conditions is also an indication of customer satisfaction and reliability of logistics companies

$$Cargoes\ Conditions = \frac{\text{Number of incidents in a shipping amount}}{\text{Total Amount Shipped}} \times 100\% \quad (5.13)$$

After identifying the KPIs to each level, now a logistics company can easily evaluate their activities in order to minimize fuel consumption and carbon dioxide emission, increase the responsiveness and reduce the total costs, which include fuel and maintenance costs and the costs per ton transported. So that the company's both environmental and economic performance will be improved. The next section gives a simple and comprehensive picture about GL model.

5.3 Green Logistics Model

The green logistics model is developed based on the results obtained from the surveys analysis with the aid of previous studies obtained from extensive literature review. Figure 5.2 presents the developed GL model.

From the figure below, it can be seen that using of information system within logistics companies is essential as it provides real time information and precise monitor on logistics operations and allows a proper collaborations between logistics companies and customer through exchanging, sharing and integrating different information. Also, proper

feedbacks are made from both logistics companies and customer about the logistics operations and about the services provided.

The developed model integrates all factors affecting the green logistics activities together in one model and adding a new factor in term of driver selection, this represent an advantage over the previous literatures. Meanwhile, these factors could be considered as GLI if they are well managed, because the outputs of GL model are more efficiency and responsiveness and less carbon emissions.

Within vehicle selection process, logistics companies must be aware of the average vehicle age of their vehicle, as well as the maintenance frequency they made, as each vehicle type with different average age consumes different amount of fuel to travel a certain distance, thus it emits different amount of carbon dioxide emissions. Also, the maintenance frequency affects both, the amount of fuel consumed and the amount of carbon dioxide emitted. In the area of driver selection, logistics companies should make training for their drivers to ensure safety, save money and reduce the carbon dioxide emissions. Since all of these are outputs of driver performance. While in route planning, logistics companies should predetermine the destinations of the served customers taking into consideration the different risks on road such as accidents, snow or congestions to avoid them as they will cause a delay in the distribution process and reduce the service level. Moreover, orders aggregation based on cargoes type will facilitate the identifications of cargoes and increase the occupancy rate, this will improve the service level and minimize the

distance and carbon dioxide emissions emitted and consequently reduce the total cost.

To ensure model validity, arbitrators and experts who are specialists in logistic services are being asked to refine the developed GL model. They agreed that the developed GL model can be easily applied within Palestinian logistics companies operations, as it allows the easy access to some target indicators in a simple unique tool.

The result of applying a strategy for green logistics to logistics companies is a cost reduction and a shorter delivery time, which is positive ultimately to the customer and the companies themselves. The society also wins because of the decrease of the environmental impact of the logistics activities. The logistics companies have much to gain in the implementation of a green logistics service. Besides being the only possible path to follow, it is the right thing to do; it is more efficient, more competitive and allows society to walk on the path of environmental sustainability in the benefit of all.

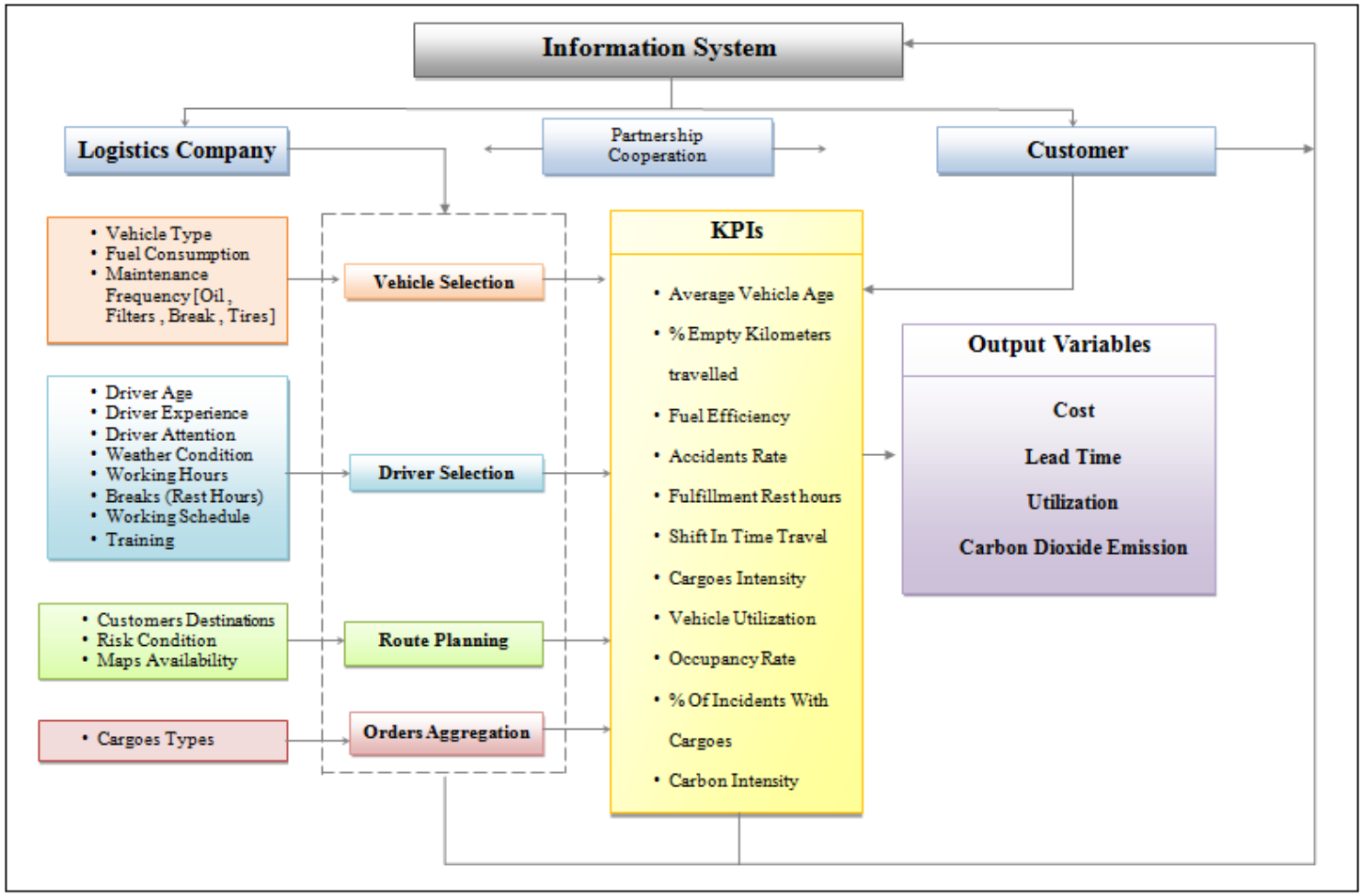

Figure 5.2: Green Logistics Model

The model serves as roadmap to help Palestinian logistics companies. It improves and develops their financial and environmental performance and increases their competitive advantage using some KPIs by minimizing the cost, reducing the carbon emission and increasing the responsiveness. In the next chapter, conclusions and recommendation are presented.

Chapter Six

Conclusions and Recommendations

This chapter briefly overview the research results where the main conclusions are explained. It also focuses on the recommendations based on research results in order to adopt and apply GLI. In addition, this chapter discusses the research contribution to current literature and the suggestions of conducting future studies.

6.1 Conclusions

Environmental issues have become critical concerns all over the world, so that the sustainable development can be achieved. Thus, logistics companies are under pressure to develop environmental responsible and friendly operations and regard commitment to the natural environment as an important variable within the competitive environment.

Palestinian logistics companies carry out logistics activities for their customers, including warehousing, transportation, order processing, and packaging. During logistics operations; energy consumptions, emissions emitted and waste disposal often cause serious environmental problems. In order to overcome these problems, Palestinian logistics companies needs to incorporate environmental issues within their operations and consequently taking the standard of logistics imperatives for efficient, effective, and fast handling and movement of cargoes into consideration.

To meet these challenges, this thesis aim is to develop a GL model that helps logistics companies to evaluate their activities throughout the analysis of KPIs, in order to minimize energy, material usage and carbon emission. In return the total cost will be reduced and the responsiveness will be increased. So that the adverse impacts of logistics activities on the environment will be minimized.

Research framework is conceptualized via reviewing related literature and related previous studies in the design process.

The research utilized both qualitative and quantitative research methodology. Qualitative data are collected via interviews with administrative and operational managers of Palestinian logistics companies. Furthermore, the quantitative data are gathered from a random sample of n=330 from Palestinian logistics employees and drivers via two questionnaires that were developed for this purpose. A number of 293 questionnaires are retrieved with response rate of 88.8 %.

The research questionnaires are collected, coded, and entered in to SPSS in order to examine factors affecting the willingness to adopt GLI by Palestinian logistics companies and to investigate the factors affecting green logistics activities. Various statistical analysis tools were employed such as frequency, means, percentages, regression and correlation, in order to answer and test the research questions and hypotheses.

According to the research results of the first questionnaire, the factors affecting the adoption of GLI are divided into technological,

organizational, and environmental factors. The perceived usefulness, attitude, compatibility, organizational support, quality of human resources, customer pressure, regulatory pressure and governmental support have significant positive influences on the willingness to adopt green innovations for Palestinian logistics companies. While the complexity and the work environment have negative influences on the willingness to adopt green innovations for Palestinian logistics companies. Based on the research results, it is found that higher complexity of green innovations make it difficult to transfer any new technological knowledge, practices or strategies within the company and consequently cannot raise the willingness to adopt green innovations. More compatibility of green innovations can make the logistics companies have more related knowledge to adopt green innovations. Logistics companies themselves need to sustain more organizational support to increase their progress in green innovations by motivating their employees to use GLI, making organizational resources easily available for their employees, training and educating their employees to become environment friendly workers and accumulating more environmental knowledge. Also, the top management support can give employees motivation to adopt green innovations. In addition, the positive attitude of the employees toward green innovations makes the adoption process more easily. High quality of human resources means that employees are able to adopt and implement GLI. The government could provide sufficient financial incentives, pilot projects, technical support and education resources to stimulate the adoption of green innovations for

Palestinian logistics companies. In other word, governmental support can encourage and guide logistics companies to adopt green innovations.

In addition, while most of Palestinian logistics companies are SMEs; they can hardly adopt GLI to cope with the environmental challenges due to limited technical, financial and human resources. As a result, the Palestinian's government with the aid of Palestinian's logistics companies administration should develop a program to help logistics companies adopt environmental innovations and to provide them with sufficient technical, financial, and educational resources to improve their environmental performance.

The analysis results of the second questionnaire indicate that the correct selection of vehicle could help in minimizing the total cost of both fuel and maintenance. Moreover, route planning and orders aggregation could be considered as considered as companies' smart green logistics strategies. As both are integral part of companies operations, they are considered to be low cost techniques used to reduce the emission of greenhouse gas as well as to save fuel consumption, minimize the delay time and improve shipping time. In addition, the driver plays an important role in green logistics, because his performance has strong influence on reducing the maintenance and fuel cost, minimizing the carbon emission, reducing the accident rate and improving the service level. The driver performance can be improved through making a suitable training for him after accessing his needs. An understanding of the influencing factors is

essential for logistics companies to best implement green innovations, and for researchers to best understand what issues need to be addressed.

In general, green innovations help to enhance environmental performance, minimize waste and emissions pollution, reduce the cost and promote efficiency.

Now, GL can no longer be discarded by stakeholders in Palestinian logistics companies as a methodology which prevents them in having a competitive edge with their fellow players in the market. They should realize that GL can reduce the ecological impact of logistic activities without sacrificing quality, cost, reliability, performance or energy utilization thus leading overall economic profit. In logistics systems, transportation is the biggest contributor towards environmental pollutions and hazards. The vehicles used for transportation not only emit toxic green house gases like carbon emission but also cause noise pollution. That is why logistics companies are being asked to respond to the challenges of GL by implementing more environmentally sustainable strategies. Applying the GL model in the distribution process within the logistics system, through vehicle selection, driver training, route planning and orders aggregation can make a huge difference to the environment by minimizing carbon emission and to the company by minimizing the cost and improving the service level.

Embracing the notion of adopting GLI and applying GL model requires a change in company’s cultures, values, human resources and the

management way. Ashford, (1993); Hart, (1995) argued that management, research and development, marketing and production all must be involved and committed if a company is to implement a policy or a strategy of using clean technologies. While, Groenewegen and Vergrat, (1991) said that the application of green innovations may add complexity to companies operations and requires employees with improved capabilities and skills at all levels of the company. As a result, the process of adopting GLI and applying GL model thus builds commitment and cross functional integration within the company and increases employee skills and participation, which are considered to be the primary resources in the modern competitive environment (Russo and Fouts, 1997).

So far, from the researcher point of view, it appears that the focus of environmental issues researches have been almost exclusively on manufacturing sectors. Little attention was paid to service sectors, like the logistics industry. Environmental researches specific to logistics industry were limited despite the fact that these companies have assumed a more critical role influencing the environment. Therefore, in order to meet the challenges of energy conservation, pollution abatement, wastes reduction and consequently in order to reduce the environmental risks, logistics companies should consider improving their environmental performance through trying to green their logistics activities which ultimately enable them to build common approaches to carbon emission reduction and operational efficiencies. Thus GL is becoming an integral part of an environmentally conscious logistics companies.

6.2 Recommendations

The research introduces the following recommendations that can be implemented in course of logistics industry development. The recommendations can be summarized as the following:

- Palestinian logistics companies should undertake significant efforts towards adopting GLI, taking into consideration the drivers and the barriers to greening their services.
- Increase public awareness about protecting the natural environment, through making environmental awareness campaigns supported by government or even by privet sector and media oriented. Also, increasing the awareness regarding to the quality of services provided by logistics companies and regarding to new ways of delivering services.
- The government should develop and update the legislation relating to environmental protection. Also, set targets for carbon dioxide reduction, so that the contribution of different sectors to greenhouse gas emissions is minimized.
- The government may provide funding initiatives to help companies that are leading the way in green product and service development.
- Increase logistics companies' awareness about the benefits gain from adopting GLI as these innovations enhance their competitiveness

through improvements in both environmental and economic performance.

- Palestinian logistics companies may provide adequate financial resources to invest in logistics technologies because technological advancement can help them to change the way they operate their activities so a competitive advantage can be achieved.

- Palestinian logistics companies may change their fleet every three years. Since modern vehicle have an improved engine which reduce both the amount of fuel consumed and the carbon emission imposed. Moreover, they may make a regular maintenance for their vehicle to minimize the maintenance cost in long run as mentioned in the manufacturer manual.

- Palestinian logistics companies may use alternative energy based vehicle designs including full electric vehicles, hydrogen fuel cell vehicles and hybrids vehicles. In addition, they may start to fuel their transportation vehicles with bio fuels and compressed natural gas, which are considered as alternative energy source. Each of these technologies has their strengths and weaknesses on various dimensions such as operational, environmental and economic dimensions.

- Palestinian logistics companies may improve their route planning process using GPS tracking capability and advanced reporting features which enable drivers to prevent unplanned stops, reduce empty kilometers travelled, and plan more fuel efficient routes. In this way, a high occupancy rate may be achieved.

- Palestinian logistics companies may improve their drivers' performance through making either defensive or eco-driving training for their drivers.

6.3 Research Contributions

The importance of this research is its contributions to green logistics problem by extracting the factors that help logistics companies in Palestine to adopt the concept of GL, incorporating the human factors as being an integral part of the logistics system, identifying factors that affect logistics activities and representing the actual situation of logistics industry in Palestine.

So, the results of this research are of great importance to researchers and to logistics companies in developing logistics industry in Palestine from many aspects. Therefore, this research is considered to be a significant contribution in many areas, these contributions lie in:

- Giving a clear assessment about GLI adoption level by Palestinian Logistics companies.
- Giving a clear understating of employees and managers perceptions and awareness toward the concept of GL in Palestine.
- Determining factors influencing Palestinian companies' willingness to adopt GLI.
- Developing GL framework which increase the level of adopting GLI in Palestine.

- Creating theoretical framework for driver performance which provide a clear understanding of how to integrate the human factors into green logistics for better performance of logistics systems.
- Determining the factors affecting the impact of logistics companies' activities on environment and introducing ways to reduce that impact using GLI.
- Developing GL model which can effectively improve logistics companies' environmental and economic performance.

Finally, this research will help logistics companies by assessing its current situation, making further improvements and developments using a realistic model, comparing themselves with other competitors and gaining competitive advantages, through minimizing the cost, decreasing the harmful impact on environment and increasing the service level and company's reputation. Also, this research is one of the first attempts to bridge the gap between logistics and human factors literatures.

6.4 Future Work

This section identifies the direction that other researches could take to support the progress of research in the green logistics area. Since green logistics is one of the vital concepts today, every logistics company must adopt and apply its principles in order to cope with environmental challenges. So, it is a rich subject to be studied and explored in different researches.

The following topics could be studied in the future, which may contribute in development of green logistics in Palestine:

- Studying the relationships between the adoption of green innovations, environmental performance and the supply chain performance.
- Other research may explore the adoption of green innovations such as, using recyclable packaging and green purchasing.
- The developed GL framework and model in this thesis can be of use to researchers for further studies of green supply chain management practices and their relationships with other organizational processes and outcomes like competitive advantage, supply chain performance, and organization performance.
- The developed HF theoretical framework provides the basis for modeling tool that facilitates the assessment of key human factors early in the process of designing a transportation network for logistics system that minimize the cost, reduce the carbon emission and increase the service level, is a great research opportunity.
- The developed GL model and framework should be approved and validated by implementing it in a real and actual case in research environment - Palestine.
- The developed GL model could be used considering intermodal transportation choice to minimize the carbon emissions.

- There are some sub topics under the research title which need in depth study due to their importance and to overcome its weaknesses that have appeared during this research. That sub topics are green warehousing, green purchasing and green packaging.

- It is clear that human factors and green logistics integration have much more research opportunities, and the path is still open to making a mathematical model that incorporate HF in term of driver's performance such as fatigue rate, accident rate and shipping time, which can be a promising area of work for future research.

- Transportation integrating environmental management and logistics services has become an important topic to study for the logistic industry.

The topic green logistics is a new topic within the Palestinian environment, more studies and researches shall be exerted in this regard.

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Appendices

Appendix A: Interview and Questionnaires

The interview

Al-Najah National University

Faculty of Graduate Studies

Engineering Management Program

Integrating Human Factors into Green Logistics

By

Lana “Mohammad Amin” Shahbari

This interview is submitted in Fulfillment of the Requirements for the Degree of Masters of Engineering Management, Faculty of Graduate Studies at An-Najah National University, Nablus- Palestine.

This interviews aims to answering the following questions:

Part one:

1. What is the definition of Green Logistics (GL)? (As applied within the company)
2. What is the impression about the benefits that can be obtained as a result of applying green logistics?
3. Do the prevailing culture of environmental protection and using green practices in the community have great influence on the use of green logistics system?
4. Do the governmental regulations and the environmental legislations affect the adoption of the applying green logistics?
5. Does the adoption of green logistics increase effectiveness of the providing services? How and Why?
6. What is the attitude of the top management, employees and drivers toward applying green logistics?
7. What are the most important external and internal factors that are affecting the adoption of GLI?

Part two:

1. The number of vehicles and vehicles average age in the company?
2. Total distance travelled during specified period of time, when vehicles are filled of cargo?
3. Total empty distance travelled during specified period of time, when vehicles are out of cargo?
4. Average fuel consumption for all vehicles during a specified period of time?
5. Does the company care about gases emissions during transportation? Does it try anything to reduce emissions in order to be more environmental friendly?
6. Does the company do recycle techniques and waste management? And how does the company reduce the amount of waste?
7. Does the company have any kind of quality system?
8. Does the company have any environmental certifications?
9. Does the company make training for their employees and drivers? Does it make training toward using green logistics innovations?
10. Is there a comprehensive information system within the company?
11. Does the company make shipments aggregation?
12. Could the company and the customer tack the order during transportation? And how?

13. Does the company make route planning before shipping? And how?
14. Does the company use advanced techniques during route planning such as Google maps?
15. Is there cooperation between company and customer to specify these tracks?
16. Does the company have its own warehouse system? If yes, describe. For how long can cargo be stored in the warehouse?

Thank You

جامعة النجاح الوطنية – نابلس

كلية الدراسات العليا

برنامج ماجستير الإدارة الهندسية

دمج العوامل البشرية في مجال الخدمات اللوجستية الخضراء

اسم الباحثة

لانا "محمد أمين" شحبري

هذه المقابلة هي جزء من المتطلبات اللازمة للقيام باعداد اطروحة الماجستير – برنامج ماجستير الادارة الهندسية ، جامعة النجاح الوطنية – نابلس

تهدف هذه المقابلة الى الاجابة عن الاسئلة التالية و المكونة من جزئين:

الجزء الأول :

1. ما هو تعريف الخدمات اللوجستية الخضراء ("Green Logistics "GL) ؟ (حسب ما هو مطبق داخل الشركة)
2. ما هو الانطباع حول الفوائد التي يمكن الحصول عليها نتيجة لتطبيق الخدمات اللوجستية الخضراء ؟
3. هل الثقافة السائدة في المجتمع حول أهمية البيئة و المحافظة عليها و معرفة المفاهيم الخضراء لها تأثير كبير على استخدام و تطبيق مبادئ الخدمات اللوجستية الخضراء ؟
4. هل وضع قوانين و تشريعات بيئية من قبل الحكومة يؤثر على اعتماد استخدام الخدمات اللوجستية الخضراء ؟
5. هل اعتماد تطبيق الخدمات اللوجستية الخضراء يؤثر على زيادة فعالية و تحسين نوعية الخدمات المقدمة من قبل الشركة ؟ كيف و لماذا؟
6. ما هو موقف الإدارة العليا، الموظفين و السائقين نحو استخدام و تطبيق الخدمات اللوجستية الخضراء؟
7. ما هي العوامل الخاجية و الداخلية الأكثر أهمية التي تؤثر على تبني الممارسات اللوجستية الخضراء ؟

الجزء الثاني :

1. عدد مركبات النقل و متوسط اعمارهم في الشركة ؟
2. المسافة الكلية المقطوعة خلال فترة زمنية معينة و المركبات مليئة بالحمولة ؟
3. المسافة الكلية المقطوعة خلال فترة زمنية معينة و المركبات فارغه من الحموله ؟
4. معدل استهلاك الوقود لجميع المركبات خلال فترة زمنية معينة ؟
5. هل تبدي الشركة اي اهتمام لانبعاثات الغازات اثناء النقل ؟ و هل تم تجربة طريقة ما للتقليل منها بحيث تكون صديقة للبيئة ؟
6. هل تطبق الشركة اساليب اعاده التدوير و ادارة المخلفات ؟ و كيف تعمل على التقليل من المخلفات ؟
7. هل يتم تطبيق اي نظام للجودة داخل الشركة ؟
8. هل حصلت الشركة على اي شهادة للبيئة ؟

9. هل يتم عمل تدريب للموظفين و السائقين ؟ هل يتم عمل تدريب على استخدام و التعامل مع الممارسات الخضراء؟

10. هل هناك نظام شامل للمعلومات داخل الشركة؟

11. هل يتم تجميع للشحنات المتحهة الى نفس المنطقة؟

12. هل يمكن للشركة و الزبون تتبع الطلب او الشحنة أثناء عملية النقل؟ و كيف؟

13. هل تقوم الشركة بعملية تخطيط للمسارات قبل نقل الشحنة؟ و كيف ؟

14. هل تستخدم الشركة تقنيات حديثة في عملية تحديد المسارات متل خرائط جوجل؟

15. هل هناك تعاون مع الزبائن في تحديد هذه المسارات؟

16. هل تمتلك الشركة مستودعات و مخازن خاصة بها؟ في حال وجودة كيف تصفه. الى متى تبقى الشحنات محفوظة في المستودع؟

شكراً لتعاونكم

Questionnaire of

Factors Affecting the Willingness of Green Logistics Companies to Adopt Green Logistics Innovations

Dear Sir/ Mrs.

The researcher aims in this questionnaires to investigate Factors Affecting the Willingness of Palestinian Logistics Companies to Adopt Green Logistics Innovations (GLI), and then introduce Green Logistics (GL) adoption framework which can help the Palestinian logistics companies to spread this developed and new concept among Palestinian logistics companies and help them develop their services based on GLI to increase their competitive advantages.

Green Logistics defined as a form of logistics, but its main objective is to measure, monitor and minimize the environmental impact of logistics activities. This includes all activities of forward and reverse flow of raw materials, products, information and services between the point of origin and the point of consumption to meet or exceed customer demand. GLI could be using alternative sources of energy, reducing the amount of gases emissions from vehicles, using the recycled materials, reducing waste and managing its treatment and measuring the environmental impact of different distribution strategies.

We believe that you are the best source to reach the required information, which serve our community and its development. We all hope to find cooperation from you through answering the questions contained in this survey. We pledge not to enclose the identity of participants, as well as only use this information in scientific research.

Best Regards,

Researcher: Lana Shahbari

❖ **Part One: Personal Information**

Gender ☐ Male ☐ Female

Age ☐ Less than 25 years ☐ 25 – 35 years ☐ 35 – 45 years ☐ 45 – 55 years ☐ 55 – 65 years ☐ More than 65 years

Job Title ☐ Manager ☐ Employee ☐ Other: ……

Academic Qualification ☐ High School or Less ☐ Diploma ☐ Bachelor ☐ Master ☐ PhD

❖ **Part Two : The Knowledge About Green Logistics**

Do you have a previous knowledge about the concept of Green Logistics? ☐ Yes ☐ No

Does your company follow any practices of environmental conservation? ☐ Yes ☐ No

_____ ——————————————————————————————

❖ **Part Three: Please select the appropriate choice that best describe your perception.**

Factors		Strongly Agree	Agree	Natural	Disagree	Strongly Disagree
Perceived Usefulness	GLI can provide better environmental performance					
	GLI can provide higher economic benefits					
	GLI can enhance the company's reputation					
	The perceived usefulness of GLI enhance its acceptance by staff					
	The perceived usefulness of GLI enhance the company's willingness to adopt it					
Complexity	Understanding and learning the GLI is difficult					
	Using the GLI needs many experiences					
	The complexity of GLI decrease the company's willingness to adopt it					

Complexity	The complexity of GLI decrease the perceived usefulness from adopt it					
	The complexity of GLI decrease its acceptance by the staff					
Attitude	Perceived usefulness of GLI increases the interest to adopt it					
	Lack of staff acceptance of GLI is proof that system is not easy to use and complex					
	Staff acceptance of GLI is a proof to their willingness to achieve company's goals					
	I would like to adopt GLI within the company					
Compatibility	The GLI are compatible with company's existing logistics operations					
	The GLI are consistent with the company's values					
	Integrating the GLI with company's existing system is easy					
	The compatibility of GLI increase the company's willingness to adopt it					
	The compatibility of GLI increase the staff acceptance					
Organizational Support	Top management encourages the employees to learn green knowledge					
	The company provides rewards for employees' green behavior					
	The company provides resources for the employees to learn green knowledge					
	Top management can help employees dealing with environmental issues					
	Organizational Support encourage the staff to adopt GLI					
Quality of Human Resources	Employees are capable of learning new technologies easily					
	Employees are capable of sharing knowledge with each other					
	Employees are capable of using new technologies to solve problem easily					
	Employees are capable of providing new ideas for the company					
	The quality of human resources enhance the willingness to adopt GLI					
	The quality of human resources increase the organizational support of GLI					
Customer Pressure	The customers require the company to improve environmental performance					
	Caring for the environment is an important consideration for company's customers					
	The customer pressure on company increase the company's willingness to adopt GLI					

	The customer pressure on company enhance its support to GLI					
	The customer pressure enhance regulatory pressure towards GLI					
	The customer pressure enhance the governmental support of GLI					
Regulatory Pressure	Government set environmental regulations for logistics operations					
	Industrial associations require the company to conform to environmental regulations					
	The regulatory pressure increase the company's willingness to adopt GLI					
Regulatory Pressure	The regulatory pressure enhance the government to support GLI					
	The regulatory pressure enhance the organizational support of GLI					
Governmental Support	Government provides financial support for adopting GLI					
	Government provides technical assistance for adopting GLI					
	Government helps training manpower with green logistics skills					
	Government encourages companies to propose green logistics projects					
	The governmental support increase the willingness to adopt GLI					
	The governmental support increase the organizational support of GLI					
Work Environment	Predicting the customers' preferences is difficult					
	customers' preferences vary frequently					
	Predicting the competitors' behavior is difficult					
	Competitors usually provide new logistics services					
	The advance in new logistics service modes is quickly					
	The work environment increase the willingness to adopt GLI					
Willingness	The perceived usefulness and the compatibility of GLI increase the willingness to adopt GLI					
	The quality of human resources and their attitude enhance the willingness to adopt GLI					
	The customer pressure, regulatory pressure and the governmental support increase the willingness to adopt GLI					
	I will use The GLI if they are adopted by the company					

What are the most barriers Facing the adoption of green logistics innovations within the company?

Thanks for your corporation

استبانة حول

العوامل المؤثرة في تبني الخدمات اللوجستية الخضراء من قبل مزودي الخدمات اللوجستية

الاخ الفاضل / الاخت الفاضلة: تحية طيبة وبعد،

تسعى الباحثة في هذه الاستبانة الى الوصول لنموذج لتبني تطبيق الخدمات اللوجستية الخضراء من قبل مزودي الخدمات اللوجستية، من خلال التعرف على العوامل المؤثرة في تبني تطبيق الخدمات اللوجستية الخضراء ومن ثم تحليلها والخروج بتوصيات ونتائج تساعد مزودي الخدمات اللوجستية في تطوير تطبيق الخدمات اللوجستية الخضراء وزيادة مستوى تقبل هذا المفهوم الجديد داخل هذه الشركات.

تعرف الخدمات اللوجستية الخضراء بأنها شكل من أشكال الخدمات اللوجستية لكنها تهدف لقياس و متابعة و التقليل من أثر أنشطة الخدمات اللوجستية على البيئة. و هذا يشمل جميع الأنشطة من نقل المواد الخام، المنتجات و المعلومات في الإتجاهين بين نقطة المنشأ و نقطة الإستهلاك لتلبية احتياجات الزبون. أي أنها تهدف لعمل تكامل بين أهداف البيئة و أهداف الشركة. و من الأمثلة على الممارسات اللوجستية الخضراء استخدام مصادر الطاقة البديلة، التقليل من انبعاثات الغازات من المركبات، استخدام المواد المعاد تدويرها، التقليل من المخلفات و ادارة معالجتها و قياس الأثر البيئي لإستراتيجيات التوزيع المختلفة .

وحيث نؤمن انكم خير مصدر للوصول الى المعلومات المطلوبة، نتوجه اليكم وكلنا أمل ان نجد التعاون من قبلكم، وذلك من خلال الإجابة على الاسئلة المحتواه في هذه الاستبانة والتى نتعهد لكم بالمحافظة على عدم اظهار هوية المجيب عنها وعدم استخدامها في اي مجال غير مجال البحث العلمي.

ولكم جزيل الشكر والتقدير.

الباحثة : لانا شحبري.

جامعة النجاح الوطنية – ماجستير إدارة هندسية.

❖ **الجزء الاول: المعلومات الشخصية**

الجنس ☐ ذكر ☐ انثى

المؤهل العلمي ☐ ثانوية عامة أو أقل ☐ دبلوم ☐ بكالوريوس ☐ ماجستير

العمر ☐ أقل من 25 سنة ☐ 25 – أقل من 35 سنة ☐ 35 – أقل من 45 سنة

☐ 45 – أقل من 55 سنة ☐ أكثر من 55 سنة

المسمى الوظيفي ☐ مدير ☐ موظف ☐ غير ذلك (حددها رجاءً):.....

❖ **الجزء الثاني: المعرفة بالخدمات اللوجستية الخضراء**

هل لديك/ي معرفة سابقة بمفهوم الخدمات اللوجستية الخضراء ؟ ☐ نعم ☐ لا

هل تتبع الشركة اي من مبادئ المحافظة على البيئة ؟ ☐ نعم ☐ لا

❖ **الجزء الثالث: أرجو اختيار الدرجة التي تتناسب مع تصوراتك عن الخدمات اللوجستية الخضراء.**

		أوافق بشدة	أوافق	محايد	أعارض	أعارض بشدة
الفائدة المرجوة	الممارسات اللوجستية الخضراء تعمل على تحسين الأداء البيئي للشركة					
	الممارسات اللوجستية الخضراء ترفع الفوائد الاقتصادية للشركة					
	الممارسات اللوجستية الخضراء تعزز من سمعة الشركة					
	تعزز الفائدة المرجوة للخدمات اللوجستية الخضراء موقف الموظفين لقبولها					
	تعزز الفائدة المرجوة للخدمات اللوجستية الخضراء استعداد الشركة لتبنيها					
درجة التعقيد	من الصعب فهم و تعلم الممارسات الخضراء					
	استخدام الممارسات اللوجستية الخضراء يتطلب خبرات عديدة					
	درجة تعقيد الممارسات اللوجستية الخضراء تقلل من استعداد الشركة لتبنيها					
	درجة تعقيد الممارسات اللوجستية الخضراء تقلل من الفائدة المرجوة من تبنيها					
	درجة تعقيد الممارسات اللوجستية الخضراء تقلل من قبول الموظفين بها					
الموقف	تزيد الفائدة المرجوة للخدمات اللوجستية الخضراء من اهتمامي بها داخل الشركة					
	عدم قبول الموظفين لتبنيي الخدمات اللوجستية الخضراء دليل على ان النظام غير سهل الاستخدام و معقد					
	قبول الموظفين لتبني الخدمات اللوجستية الخضراء هو دليل على رغبتهم لتحقيق أهداف الشركة					
	أرغب في تبني الخدمات اللوجستية الخضراء داخل الشركة					
التوافق	الممارسات اللوجستية الخضراء متوافقة مع العمليات اللوجستية الموجودة داخل الشركة					
التوافق	الممارسات اللوجستية الخضراء متناغمة و متلائمة مع قيم الشركة					
	تتكامل الممارسات اللوجستية الخضراء بسهولة مع النظام الحالي للشركة					
التوافق	توافق الممارسات اللوجستية الخضراء يزيد من استعداد الشركة					

	لتبنيها					
	توافق الممارسات اللوجستية الخضراء يزيد من قبول الموظفين بها					
دعم الشركة	تشجيع الإدارة العليا الموظفين على تعليم المفاهيم البئية الخضراء					
	تقوم الشركة بإعطاء حوافز للموظفين على السلوك البيئي					
	تقوم الشركة بتزويد الموظفين بالدعم و المصادر اللازمة لتعلم المفاهيم البيئية الخضراء					
	تساعد الإدارة العليا الموظين للتعامل و حل القضايا و المشكلات البيئية					
	دعم الشركة للممارسات الخضراء يشجع الموظفين لقبولها					
نوعية الموارد البشرية	الموظفون قادرين على تعلم تكنولوجيا جديدة بسهولة					
	الموظفون قادرين على مشاركة المعلومات مع بعضهم البعض					
	يمتلك الموظفون المهارات و الامكانات اللازمة لحل المشاكل باستخدام التكنولوجيا الجديدة					
	الموظفون قادرين على اعطاء افكار جديدة للشركة					
	جودة الموارد البشرية تعزز من استعداد الشركة لتبني الممارسات اللوجستية الخضراء					
	جودة الموارد البشرية تزيد من دعم الشركة للممارسات اللوجستية الخضراء					
ضغط العملاء	العملاء يطلبون من الشركة تحسين اداءها البيئي					
	يزداد الإهتمام بالقضايا البيئية من قبل العملاء					
	ضغط العملاء على الشركة يزيد من استعدادالشركة لتبني الممارسات اللوجستية الخضراء					
	ضغط العملاء على الشركة يغزز من دعم الشركة للممارسات اللوجستية الخضراء					
	ضغط العملاء يغزز الضغط التشريعي اتجاة الممارسات اللوجستية الخضراء					
	ضغط العملاء يغزز الدعم الحكومي اتجاة الممارسات اللوجستية الخضراء					
الضغط التشريعي	تقوم الحكومة بوضع قوانين وتشريعات بيئية للعمليات اللوجستية					
	الجمعيات الصناعية تطلب من الشركات مطابقة القوانين البيئية					
	الضغط التشريعي يعزز من استعداد الشركة لتبني الممارسات اللوجستية الخضراء.					
	الضغط التشريعي يعزز الدعم الحكومي اتجاة الممارسات اللوجستية الخضراء.					
	الضغط التشريعي يغزز من دعم الشركة للممارسات اللوجستية الخضراء					
الدعم الحكومي	توفر الحكومة الدعم المالي لتبني الممارسات الخضراء					
	توفر الحكومة المساعدة التقنية لتبني الممارسات الخضراء					
	تقوم الحكومة بتدريب القوى العاملة لإكتساب المهارات اللوجستية الخضراء					

	تشجع الحكومة الشركات بتقديم اقتراحات تتعلق بالشاريع اللوجستية الخضراء					
	يزيد الدعم الحكومي من استعداد الشركات لتبني الممارسات اللوجستية الخضراء					
	يزيد الدعم الحكومي من دعم الشركة للممارسات اللوجستية الخضراء					
بيئة العمل	من الصعب توقع رغبات العملاء					
	رغبات العملاء تتنوع و تتغير باستمرار					
	من الصعب توقع سلوك المنافسين					
	غالبا ما يستخدم المنافسون خدمات لوجستية جديدة					
	هناك تقدم و تطور سريع في مجال الخدمات اللوجستية					
	بيئة العمل يزيد من استعداد الشركة لتبني الممارسات اللوجستية الخضراء					
الاستعداد	تزيد الفائدة المرجوة و توافق اللممارسات اللوجستية الخضراء استعداد الشركة لتبنيها					
	تعزز جودة و نوعية الموظفين و موقفهم من استعداد الشركة لتبني الممارسات اللوجستية الخضراء					
	يزيد ضغط العملاء و الضغط التشريعي و الدعم الحكومي من استعداد الشركة لتبني الممارسات اللوجستية الخضراء					
	أنوي استخدام الممارسات اللوجستية الخضراء في حال تبنيها من قبل الشركة					

ما هي اكثر المعيقات لتطبيق الخدمات اللوجستية الخضراء داخل الشركة ؟

.....

.....

<u>نشكركم على حسن تعاونكم</u>

Questionnaire of
The Effects of Logistics Activities on Environment

(For Drivers)

Dear Sir/ Mrs.

The researcher aims in this questionnaires to investigate the effects of logistics activities provided by Palestinian logistics companies on environment by identifying the factors affecting these activities and analyzing them in order to research results and recommendations that help the Palestinian logistics companies in developing the application and the using of Green Logistics Innovations (GLI) in their services to increase their competitive advantages.

We believe that you are the best source to reach the required information, which serve our community and its development. We all hope to find cooperation from you through answering the questions contained in this survey. We pledge not to enclose the identity of participants, as well as only use this information in scientific research.

Best Regards, Researcher: Lana Shahbari

❖ **Please Answer the Following Questions:**

1- Age

☐ Less than 25 years ☐ 25 – less than 35 years ☐ 35 – less than 45 years
☐ 45 – less than 55 years ☐ More than 55 years

2- Number of Experience Years

☐ Less than 2 years ☐ 2- less than 6 years ☐ 6 - less than 10 years
☐ 10 - less than 14 years ☐ 14 - less than 18 years ☐ 18 - less than 22 years
☐ 22 - less than 26 years ☐ More than 26 years

3- Average Daily Working Hours

☐ Less than 2 Hrs ☐ 2- less than 4 Hrs ☐ 4 - less than 6 Hrs
☐ 6 - less than 8 Hrs ☐ 8 - less than 10 Hrs ☐ More than 10 Hrs

4- Accident rate during the year

☐ Zero ☐ 1- less than 2 ☐ 2 - less than 4 ☐ 4 - less than 6
☐ 6 – less than 8 ☐ 8 - less than 10 ☐ More than 10

5- Accidents occur more during?

☐ The Morning ☐ The Mid-day ☐ The Evening ☐ The Night

6- Accidents occur more when the weather is?

☐ Clear Weather ☐ Rainy Weather ☐ Foggy Weather

7- The number of working hours after which the driver feels fatigue?

☐ Less than 2 ☐ 2- less than 4 ☐ 4 - less than 6 ☐ 6 - less than 8
☐ 8 - less than 10 ☐ More than 10

8- The rest time in minutes needed by the driver to recover his activity?

☐ Less than 15 ☐ 15- less than 30 ☐ 30- less than 45 ☐ 45- less than 60
☐ 60- less than 75 ☐ 75- less than 90 ☐ 30- less than 105 ☐ More than 105

9- The average vehicle age?

☐ Less than 2 ☐ 2- less than 4 ☐ 4- less than 6 ☐ 6- less than 8
☐ 8- less than 10 ☐ 10- less than 12 ☐ 12- less than 14 ☐ More than 14

10- The monthly fuel consumption (in Liter)?

☐ 50-less than 100 ☐ 100-less than 150 ☐ 150-less than 200 ☐ 200- less than 250
☐ 250-less than 300 ☐ 300-less than 350 ☐ 350-less than 400 ☐ More than 400. Specify: ……..

11- The number of periodic maintenance for the vehicle during the year?

☐ Less than 2 ☐ 2-less than 4 ☐ 4-less than 6 ☐ 6-less than 8
☐ More than 8

12- Occupancy rate per shipment?

☐ Full ☐ Half ☐ Quarter ☐ Other:…….

❖ **Please select the appropriate choice that best describe your perception.**

Factors		Strongly Agree	Agree	Natural	Disagree	Strongly Disagree
The Driver	The driver's age increase his fatigue rate					
	The driver's experience and skills decrease the accident rate					
	The driver's experience, skills, and his knowledge about geographic areas, roads and traffic movements decrease shipping time					
	Increasing the driver's attention decrease the accident rate					
	Health, diet and the sleeping pattern decrease the fatigue rate					
	The noise level affects the accident rate					
	The Weather condition affects the accident rate					
	The increased numbers of working hours will increase the driver's fatigue rate					
	The increased numbers of working hours will increase the accident rate					
	The increased numbers of rest hours will decrease the driver's fatigue rate					
	The increased numbers of working hours will decrease the accident rate					
	Is there a uniformity in the work schedule within the company					
	The uniformity of work schedule decrease the driver's fatigue rate					
	The uniformity of work schedule improve the shipping time					
	Is there a uniformity in the shift pattern within the company					
	The uniformity of shift pattern decrease the driver's fatigue rate					
	The uniformity of shift pattern improve the shipping time					
	Is there training for drivers within the company					
	Training the drivers decrease the accident rate					
	Training the drivers improve the shipping time					
	Training the drivers reduce the maintenance cost					

		Strongly Agree	Agree	Natural	Disagree	Strongly Disagree
Route Planning	Is there previous determination for the served places based on geographical knowledge					
	Are there maps explaining the target destinations					
	The previous determination for the served places decreases the average delay time					
	The previous determination for the served places improves the shipping time					
	The previous determination for the served places decreases the probabilities of facing unexpected situations					
	The previous determination for the served places decreases the expected arrival time					
	The previous determination for the served places decreases the empty kilometers travelled					
	The previous determination for the served places increases the occupancy rate per shipment					
	Does the vehicle travel a long distance when it is empty					
Orders Aggregation	Are cargoes or orders being aggregated					
	Cargoes or orders aggregation decrease the cost					
	Cargoes or orders aggregation decrease fuel consumption					
	Cargoes or orders aggregation increase the occupancy rate					
	Cargoes or orders aggregation decrease the empty kilometers travelled					
	Is there a delay in delivering cargoes or orders					

Thanks for your corporation

استبانة حول

مدى تأثير أنشطة الخدمات اللوجستية على البيئة (للسائقين)

الاخ الفاضل: تحية طيبة وبعد،

تسعى الباحثة في هذه الاستبانة الى دراسة مدى تأثير أنشطة الخدمات المقدمة من قبل مزودي الخدمات اللوجستية على البيئة، من خلال التعرف على العوامل المؤثرة في تلك الأنشطة ومن ثم تحليلها والخروج بتوصيات ونتائج تساعد مزودي الخدمات اللوجستية في تطوير تطبيق الخدمات اللوجستية الخضراء وزيادة مستوى تقبل هذا المفهوم الجديد داخل هذه الشركات.

وحيث نؤمن انكم خير مصدر للوصول الى المعلومات المطلوبة، نتوجه اليكم وكلنا أمل ان نجد التعاون من قبلكم، وذلك من خلال الإجابة على الاسئلة المحتواه في هذه الاستبانة والتى نتعهد لكم بالمحافظة على عدم اظهار هوية المجيب عنها وعدم استخدامها في اي مجال غير مجال البحث العلمي.

ولكم جزيل الشكر والتقدير.

الباحثة : لانا شحبري.

جامعة النجاح الوطنية – ماجستير إدارة هندسية.

❖ **أرجو الإجابة عن الأسئلة التالية .**

1- العمر

☐ أقل من 25 سنة ☐ 25 – أقل من 35 سنة ☐ 35- أقل من 45 سنة

☐ 45 – أقل من 55 سنة ☐ أكثر من 55 سنة ☐

2- عدد سنوات الخبرة

☐ أقل من سنتين ☐ 2 – أقل من 6 سنة ☐ 6 – أقل من 10 سنة

☐ 10 – أقل من 14 سنة ☐ 14 – أقل من 18 سنة ☐ 18- أقل من 22 سنة

☐ 22 – أقل من 26 سنة ☐ 26 سنة فأكثر

3- متوسط عدد ساعات العمل يومياً (بالساعة)

☐ أقل من 2 ☐ 2 – أقل من 4 سنة ☐ 4 – أقل من 6 سنة

☐ 6 – أقل من 8 سنة ☐ 8 – أقل من 10 سنة ☐ أكثر من 10

4- معدل الحوادث خلال السنة

☐ صفر ☐ 1- أقل من 2 ☐ 2 - أقل من4 ☐ 4 – أقل من 6

☐ 6-أقل من 8 ☐ 8- أقل من 10 ☐ أكثر من 10

5- تكثر حالات وقوع الحوادث

☐ صباحاً ☐ منتصف النهار ☐ مساءاً ☐ ليلاً

6- الحوادث تحدث أكثر في طقس

☐ صافي ☐ ماطر ☐ ضبابي

7- بعد كم ساعة عمل يبدأ السائق بالشعور بالإجهاد

☐ أقل من 2 ☐ 2 - أقل من4 ☐ 4 – أقل من 6 ☐ 6 – أقل من 8

☐ 8- أقل من 10 ☐ أكثر من 10

8- المدة الزمنية التي يحتاجها السائق حتى يستعيد نشاطه و التي تمثل فترة الراحة (بالدقائق)

☐ أقل من 15 ☐ 15 - أقل من30 ☐ 30 – أقل من 45 ☐ 45 – أقل من 60

☐ 60 – أقل من 75 ☐ 75- أقل من 90 ☐ 90- أقل من 105 ☐ أكثر من 105

9- متوسط عمر المركبة بالسنوات

☐ أقل من 2 ☐ 2 - أقل من4 ☐ 4 – أقل من 6 ☐ 6 – أقل من 8 ☐ 8- أقل من 10

☐ 10 – أقل من 12 ☐ 12- أقل من 14 ☐ أكثر من 14

10- معدل استهلاك الوقود بالشهر (بوحدة الليتر).

☐ 50- أقل من 100 ☐ 100- أقل من 150 ☐ 150- أقل من200 ☐ 200- أقل من 250

☐ 250- أقل من 300 ☐ 300 – أقل من 350 ☐ 350- أقل من 400 ☐ أكثر من 400 (حدد).....

11- عدد مرات الصيانة الدورية للمركبة بالسنة

☐ أقل من 2 ☐ 2 - أقل من 4 سنة ☐ 4 - أقل من 6 سنة

☐ 6 - أقل من 8 سنة ☐ أكثر من 8

12- حمولة المركبة للنقلة الواحدة

☐ كاملة ☐ نصفها ☐ ربعها ☐ غير ذلك:.....

❖ **أرجو اختيار الدرجة التي تتناسب مع تصوراتك.**

		أوافق بشدة	أوافق	محايد	أعارض	أعارض بشدة
السائق	يزيد عمر السائق من معدل الإجهاد لديه					
	خبرة و مهارة السائق تعمل على التقليل من معدل الحوادث					
	خبرة و مهارة السائق و معرفته بالمناطق الجغرافية و الطرق و حركة السير تعمل على التقليل من وقت النقل / الشحن					
	زيادة انتباه السائق يقلل من معدل الحوادث					
	نمط الغذاء والنوم و الصحة الجيدة يقلل من معدل الإجهاد لدى السائق					
	مستوى الضوضاء و الضجيج يؤثر على معدل الحوادث					
	حالة الطقس تؤثر على معدل الحوادث					
	كلما زادت عدد ساعات العمل زاد معدل الإجهاد لدى السائق					
	ازدياد عدد ساعات العمل يزيد من معدل الحوادث					
	ازدياد عدد ساعات الراحة يقلل من معدل الإجهاد لدى السائق					
	ازدياد عدد ساعات الراحة يقلل من معدل الحوادث					
	هل هناك انتظام في جدول العمل داخل الشركة					
	انتظام جدول العمل يقلل من معدل الإجهاد لدى السائق					
	انتظام جدول العمل يحسن من وقت النقل / الشحن					
	هل هناك انتظام في ورديات العمل داخل الشركة					
	انتظام ورديات العمل يقلل من معدل الإجهاد لدى السائق					
	انتظام ورديات العمل يحسن من وقت النقل / الشحن					
	هل يتم عمل تدريب للسائقين داخل الشركة					
	تدريب السائقين يقلل من معدل الحوادث					
	تدريب السائقين يحسن من وقت النقل / الشحن					
	تدريب السائقين يقلل من كلفة صيانة المركبة					

		أوافق بشدة	أوافق	محايد	أعارض	أعارض بشدة
تخطيط الطريق	هل يتم عمل تحديد مسبق للأماكن المراد خدمتها بناءً على المعرفة الجغرافية بالمناطق					
	هل توجد خرائط توضح الوجهات المراد النقل اليها					
	التحديد المسبق للأماكن المراد خدمتها يقلل من معدل ساعات التأخير					
	التحديد المسبق للأماكن المراد خدمتها يحسن من وقت النقل					
	التحديد المسبق للأماكن المراد خدمتها يقلل من الوقت المتوقع للوصول					
	التحديد المسبق للأماكن المراد خدمتها يقلل من احتمالية التعرض لمواقف غير متوقعة					
	التحديد المسبق للأماكن المراد خدمتها يقلل من المسافة المقطوعة و المركبة فارغة من الحمولة					
	التحديد المسبق للأماكن المراد خدمتها يزيد من حمولة المركبة للنقلة الواحدة					
	هل تقطع المركبة مسافة كبيرة و هي فارغة من الحمولة					
تجميع الشحنات	هل يتم عمل تجميع للشحنات او النقليات					
	عمل تجميع للنقليات / للشحنات يقلل من الكلفة					
	عمل تجميع للنقليات / للشحنات يقلل من استهلاك الوقود					
	عمل تجميع للنقليات / للشحنات يزيد من حمولة المركبة للنقلة الواحدة					
	عمل تجميع للنقليات / للشحنات يقلل من المسافة المقطوعة و المركبة فارغة من الحمولة					
	هل هناك تأخير في وقت تسليم الطلبيات					

<u>نشكركم على حسن تعاونكم</u>

Appendix B: Tables

Table 1: Arbitrators and Experts Who Reviewed the Questionnaire

Name	Position	Organization Name
Dr. Mohammed Othman	Assistant Professor	An-Najah University
Dr. Ayham Jaaron	Assistant Professor	An-Najah University
Dr. Yehya Saleh	Assistant Professor	An-Najah University
Mr. Abdulsalam Younis	Statistical Expert	
Mr. Raed Aqqad	Manager	Mirsal for Logistics Services
Mr. Riyad Al-Shahid	Statistical Expert	
Miss. Hadeel Mahmoud	Human Resources Manager	Al-Barq for Commercial Distribution

Table 2: Mean, Standard Deviation and Estimation Level of the Perceived Usefulness

Perceived Usefulness Items	Means	Standard Deviation	Estimation Level	Percentage
GLI can provide better environmental performance	4.46	0.62	Very High	89.2%
GLI can provide higher economic benefits	3.91	0.72	High	78.2%
GLI can enhance the company's reputation	4.31	0.56	Very High	86.2%
The perceived usefulness of GLI enhance its acceptance by staff	4.12	0.47	High	82.4%
The perceived usefulness of GLI enhance the company's willingness to adopt it	4.27	0.59	Very High	85.4%
Total	**4.22**	**0.43**	**Very High**	**84.4%**

Table 3: Mean, Standard Deviation and Estimation Level of the Complexity

Complexity Items	Means	Standard Deviation	Estimation Level	Percentage
Understanding and learning the GLI is difficult	2.90	0.86	Medium	58%
Using the GLI needs many experiences	3.33	0.93	High	66.6%
The complexity of GLI decrease the company's willingness to adopt it	3.43	0.84	High	68.6%
The complexity of GLI decrease the perceived usefulness from adopt it	2.85	1.09	Medium	57%
The complexity of GLI decrease its acceptance by the staff	2.26	0.94	Low	45.21%
Total	**3.15**	**0.75**	**Medium**	**63%**

Table 4: Mean, Standard Deviation and Estimation Level of the Attitude

Attitude Items	Means	Standard Deviation	Estimation Level	Percentage
Perceived usefulness of GLI increases the interest to adopt it	4.08	0.56	Very High	81.6%
Lack of staff acceptance of GLI is proof that system is not easy to use and complex	3.36	0.94	Medium	67.2%
Staff acceptance of GLI is a proof to their willingness to achieve company's goals	3.99	0.63	High	79.8%
I would like to adopt GLI within the company	4.37	0.57	Very High	87.4%
Total	**3.95**	**0.43**	**High**	**79%**

Table 5: Mean, Standard Deviation and Estimation Level of the Compatibility

Compatibility Items	Means	Standard Deviation	Estimation Level	Percentage
The GLI are compatible with company's existing logistics operations	3.18	0.85	Medium	63.3%
The GLI are consistent with the company's values	3.91	0.77	High	78.2%
Integrating the GLI with company's existing system is easy	3.57	0.74	High	71.1%
The compatibility of GLI increase the company's willingness to adopt it	4.18	0.51	Medium	83.6%
The compatibility of GLI increase the staff acceptance	4.06	0.48	Low	81.2%
Total	**3.55**	**0.63**	**High**	**71%**

Table 6: Mean, Standard Deviation and Estimation Level of the Organizational Support

Organizational Support Items	Means	Standard Deviation	Estimation Level	Percentage
Top management encourages the employees to learn green knowledge	3.33	1.15	Medium	66.6%
The company provides rewards for employees' green behavior	1.86	0.96	Low	37.2%
The company provides resources for the employees to learn green knowledge	2.02	0.97	Low	40.4%
Top management can help employees dealing with environmental issues	3.04	1.01	Medium	60.8%
Organizational Support encourage the staff to adopt GLI	4.21	0.80	Very High	84.2%
Total	**2.89**	**0.83**	**Medium**	**57.8%**

Table 7: Mean, Standard Deviation and Estimation Level of the Quality of Human Resources

Quality of Human Resources Items	Means	Standard Deviation	Estimation Level	Percentage
Employees are capable of learning new technologies easily	3.83	0.75	High	76.6%
Employees are capable of sharing knowledge with each other	3.86	0.66	High	77.2%
Employees are capable of using new technologies to solve problem easily	3.91	0.70	High	78.2%
Employees are capable of providing new ideas for the company	3.73	0.75	High	74.6%
The quality of human resources enhance the willingness to adopt GLI	4.24	0.47	Very High	84.8%
The quality of human resources increase the organizational support of GLI	4.19	0.58	High	83.8%
Total	**3.96**	**0.46**	**High**	**79.2%**

Table 8: Mean, Standard Deviation and Estimation Level of the Customer Pressure

Customer Pressure Items	Means	Standard Deviation	Estimation Level	Percentage
The customers require the company to improve environmental performance	2.66	0.96	High	53.2%
Caring for the environment is an important consideration for company's customers	2.68	0.96	High	53.6%
The customer pressure on company increase the company's willingness to adopt GLI	4.0	0.75	High	80%
The customer pressure on company enhance its support to GLI	3.93	0.80	High	78.6%
The customer pressure enhance regulatory pressure towards GLI	3.70	0.85	Very High	74%
The customer pressure enhance the governmental support of GLI	3.56	0.87	High	71.2%
Total	**3.42**	**0.53**	**High**	**68.4%**

Table 9: Mean, Standard Deviation and Estimation Level of the Regulatory Pressure

Regulatory Pressure Items	Means	Standard Deviation	Estimation Level	Percentage
Government set environmental regulations for logistics operations	2.46	0.98	Low	49.2%
Industrial associations require the company to conform to environmental regulations	2.60	0.93	Low	52%
The regulatory pressure increase the company's willingness to adopt GLI	3.78	0.82	High	75.6%
The regulatory pressure enhance the government to support GLI	3.37	0.96	Medium	67.4%
The regulatory pressure enhance the organizational support of GLI	3.82	0.93	High	76.4%
Total	**3.21**	**0.53**	**Medium**	**64.2%**

Table 10: Mean, Standard Deviation and Estimation Level of the Governmental Support

Governmental Support Items	Means	Standard Deviation	Estimation Level	Percentage
Government provides financial support for adopting GLI	1.28	0.97	Very Low	25.6%
Government provides technical assistance for adopting GLI	2.32	1.00	Low	46.4%
Government helps training manpower with green logistics skills	1.79	0.98	Very Low	35.8%
Government encourages companies to propose green logistics projects	2.31	1.00	Low	46.2%
The governmental support increase the willingness to adopt GLI	3.75	0.96	High	75%
The governmental support increase the organizational support of GLI	3.85	0.87	High	77%
Total	**2.55**	**0.66**	**Low**	**51%**

Table 11: Mean, Standard Deviation and Estimation Level of the Work Environment

Work Environment Items	Means	Standard Deviation	Estimation Level	Percentage
Predicting the customers' preferences is difficult	3.70	0.85	High	74%
customers' preferences vary frequently	4.04	0.64	High	80.8%
Predicting the competitors' behavior is difficult	3.92	0.74	High	78.4%
Competitors usually provide new logistics services	3.68	0.87	High	73.6%
The advance in new logistics service modes is quickly	4.21	0.78	Very High	84.2%
The work environment increase the willingness to adopt GLI	4.12	0.64	High	82.4%
Total	**3.95**	**0.46**	**High**	**79%**

Table 12: Mean, Standard Deviation and Estimation Level of the Willingness

Willingness Items	Means	Standard Deviation	Estimation Level	Percentage
The perceived usefulness and the compatibility of GLI increase the willingness to adopt GLI	4.27	0.60	High	85.4%
The quality of human resources and their attitude enhance the willingness to adopt GLI	4.21	0.54	High	84.2%
The customer pressure, regulatory pressure and the governmental support increase the willingness to adopt GLI	4.14	0.65	High	82.8%
I will use The GLI if they are adopted by the company	4.43	0.58	High	88.6%
Total	**4.26**	**0.49**	**Very High**	**85.2%**

Table 13: Descriptive of Statistical Differences among Participants According to their Academic Qualification

						95% Confidence Interval for Mean			
Factors	**Academic Qualification**	**N**	**Mean**	**Standard Deviation**	**Standard Error**	**Lower Bound**	**Upper Bound**	**Min**	**Max**
PU	High School or Less	9	4.2222	.56075	.18692	3.7912	4.6533	3.00	5.00
	Diploma	43	4.2884	.39594	.06038	4.1665	4.4102	3.60	5.00
	Bachelor	114	4.1947	.43352	.04060	4.1143	4.2752	2.80	5.00
	Total	166	4.2205	.43072	.03343	4.1545	4.2865	2.80	5.00
COMX	High School or Less	9	3.3333	.72801	.24267	2.7737	3.8929	2.00	4.80
	Diploma	43	3.3070	.56627	.08636	3.1327	3.4812	2.00	4.80
	Bachelor	114	3.0895	.81885	.07669	2.9375	3.2414	1.00	5.00
	Total	166	3.1590	.75975	.05897	3.0426	3.2755	1.00	5.00
COMT	High School or Less	9	4.0833	.58630	.19543	3.6327	4.5340	3.00	4.75
	Diploma	43	3.9709	.41263	.06293	3.8439	4.0979	3.25	5.00
	Bachelor	114	3.9386	.42795	.04008	3.8592	4.0180	2.50	5.00
	Total	166	3.9548	.43195	.03353	3.8886	4.0210	2.50	5.00
ATT	High School or Less	9	3.8889	.64550	.21517	3.3927	4.3851	3.00	5.00
	Diploma	43	3.6357	.62069	.09465	3.4446	3.8267	2.00	5.00
	Bachelor	114	3.5029	.63686	.05965	3.3848	3.6211	1.00	5.00
	Total	166	3.5582	.63693	.04944	3.4606	3.6558	1.00	5.00
OS	High School or Less	9	2.8811	.74237	.24746	2.6405	3.0817	2.00	4.40

	Diploma	43	2.9609	.93314	.14230	2.8338	3.3081	2.00	5.00
	Bachelor	114	2.8428	.79723	.07467	2.6749	3.1707	1.60	5.00
	Total	166	2.8949	.83825	.06506	2.7872	3.2441	1.60	5.00
QHR	High School or Less	9	4.1481	.66898	.22299	3.6339	4.6624	3.00	5.00
	Diploma	43	3.8837	.41394	.06312	3.7563	4.0111	3.33	5.00
	Bachelor	114	3.9810	.46019	.04310	3.8956	4.0664	3.00	5.00
	Total	166	3.9649	.46269	.03591	3.8940	4.0358	3.00	5.00
CP	High School or Less	9	3.4259	.58399	.19466	2.9770	3.8748	2.83	4.50
	Diploma	43	3.4690	.44582	.06799	3.3318	3.6062	2.00	4.67
	Bachelor	114	3.4137	.56714	.05312	3.3085	3.5190	2.00	5.00
	Total	166	3.4287	.53664	.04165	3.3465	3.5110	2.00	5.00
RP	High School or Less	9	3.2000	.48990	.16330	2.8234	3.5766	2.40	4.20
	Diploma	43	3.2279	.44845	.06839	3.0899	3.3659	2.20	4.60
	Bachelor	114	3.2088	.56843	.05324	3.1033	3.3142	1.80	5.00
	Total	166	3.2133	.53309	.04138	3.1316	3.2949	1.80	5.00
GS	High School or Less	9	2.5739	.35464	.11821	2.4533	3.0985	2.17	3.33
	Diploma	43	2.6295	.62940	.09598	2.5358	3.1232	2.00	5.00
	Bachelor	114	2.4602	.69272	.06488	2.3317	2.8888	1.50	5.00
	Total	166	2.5545	.66150	.05134	2.4858	2.9885	1.50	5.00
WE	High School or Less	9	3.8148	.35789	.11930	3.5397	4.0899	3.00	4.17
	Diploma	43	3.9690	.40541	.06182	3.8442	4.0938	2.33	4.83
	Bachelor	114	3.9547	.49246	.04612	3.8633	4.0461	2.33	5.00
	Total	166	3.9508	.46394	.03601	3.8797	4.0219	2.33	5.00
WILL	High School or Less	9	4.2222	.63053	.21018	3.7376	4.7069	3.00	5.00
	Diploma	43	4.1744	.44164	.06735	4.0385	4.3103	3.00	5.00
	Bachelor	114	4.3070	.50225	.04704	4.2138	4.4002	3.00	5.00
	Total	166	4.2681	.49510	.03843	4.1922	4.3439	3.00	5.00
Total	High School or Less	9	3.7069	.28886	.09629	3.4849	3.9289	3.00	3.92
	Diploma	43	3.6615	.27245	.04155	3.5776	3.7453	3.03	4.42
	Bachelor	114	3.5976	.28060	.02628	3.5456	3.6497	3.09	4.69
	Total	166	3.6201	.27941	.02169	3.5773	3.6629	3.00	4.69

Table 14: Descriptive of Statistical Differences among Participants According to their Age

						95% Confidence Interval for Mean			
Factors	**Age**	**N**	**Mean**	**Standard Deviation**	**Standard Error**	**Lower Bound**	**Upper Bound**	**Min**	**Max**
PU	Less than 25	31	4.1226	.51297	.09213	3.9344	4.3107	3.00	5.00
	25 – less than 35	72	4.1750	.34549	.04072	4.0938	4.2562	3.40	5.00
	35 – less than 45	45	4.2978	.48733	.07265	4.1514	4.4442	2.80	5.00
	45 – less than 55	17	4.3412	.37259	.09037	4.1496	4.5327	3.80	5.00
	More than 55	1	5.0000	.	.	.	.	5.00	5.00
	Total	166	4.2205	.43072	.03343	4.1545	4.2865	2.80	5.00
COMX	Less than 25	31	3.0903	.78288	.14061	2.8032	3.3775	2.00	4.80
	25 – less than 35	72	3.2000	.74607	.08793	3.0247	3.3753	1.20	5.00
	35 – less than 45	45	3.2222	.83036	.12378	2.9728	3.4717	1.00	4.80
	45 – less than 55	17	3.0118	.54987	.13336	2.7290	3.2945	2.00	3.80
	More than 55	1	2.0000	.	.	.	.	2.00	2.00
	Total	166	3.1590	.75975	.05897	3.0426	3.2755	1.00	5.00
COMT	Less than 25	31	3.8468	.52709	.09467	3.6534	4.0401	3.00	5.00
	25 – less than 35	72	3.9861	.34316	.04044	3.9055	4.0668	3.25	5.00
	35 – less than 45	45	3.9944	.48409	.07216	3.8490	4.1399	2.50	5.00
	45 – less than 55	17	3.8824	.42498	.10307	3.6638	4.1009	3.25	4.75
	More than 55	1	4.5000	.	.	.	.	4.50	4.50
	Total	166	3.9548	.43195	.03353	3.8886	4.0210	2.50	5.00
ATT	Less than 25	31	3.5484	.52032	.09345	3.3575	3.7392	3.00	5.00
	25 – less than 35	72	3.5926	.68341	.08054	3.4320	3.7532	1.00	5.00
	35 – less	45	3.5704	.52523	.07830	3.4126	3.7282	2.67	4.67

	than 45								
	45 – less than 55	17	3.3137	.80338	.19485	2.9007	3.7268	2.00	5.00
	More than 55	1	5.0000	.	.	.	.	5.00	5.00
	Total	166	3.5582	.63693	.04944	3.4606	3.6558	1.00	5.00
OS	Less than 25	31	2.4474	.75486	.13558	2.2005	2.8543	2.00	5.00
	25 – less than 35	72	2.4222	.96913	.11421	2.1945	2.6500	1.60	5.00
	35 – less than 45	45	3.1956	.73545	.10963	2.9746	3.4165	1.80	5.00
	45 – less than 55	17	3.2000	.60415	.14653	2.8894	3.5106	2.40	4.40
	More than 55	1	3.2000	.	.	.	.	4.20	4.20
	Total	166	2.8930	.83825	.06506	3.1872	3.4441	1.60	5.00
QHR	Less than 25	31	4.0323	.52603	.09448	3.8393	4.2252	3.00	5.00
	25 – less than 35	72	3.8912	.42713	.05034	3.7908	3.9916	3.17	5.00
	35 – less than 45	45	3.9370	.46641	.06953	3.7969	4.0772	3.00	5.00
	45 – less than 55	17	4.1667	.36799	.08925	3.9775	4.3559	3.33	5.00
	More than 55	1	5.0000	.	.	.	.	5.00	5.00
	Total	166	3.9649	.46269	.03591	3.8940	4.0358	3.00	5.00
CP	Less than 25	31	3.3602	.59799	.10740	3.1409	3.5796	2.00	4.67
	25 – less than 35	72	3.4907	.50806	.05988	3.3714	3.6101	2.50	5.00
	35 – less than 45	45	3.4222	.57362	.08551	3.2499	3.5946	2.33	5.00
	45 – less than 55	17	3.3333	.44876	.10884	3.1026	3.5641	2.67	4.50
	More than 55	1	3.0000	.	.	.	.	3.00	3.00
	Total	166	3.4287	.53664	.04165	3.3465	3.5110	2.00	5.00
RP	Less than 25	31	3.2194	.55703	.10005	3.0150	3.4237	2.20	4.80
	25 – less than 35	72	3.1861	.56201	.06623	3.0540	3.3182	1.80	5.00
	35 – less	45	3.2444	.45104	.06724	3.1089	3.3800	2.20	4.20

	than 45								
	45 – less than 55	17	3.1882	.58511	.14191	2.8874	3.4891	1.80	3.80
	More than 55	1	4.0000	.	.	.	.	4.00	4.00
	Total	166	3.2133	.53309	.04138	3.1316	3.2949	1.80	5.00
GS	Less than 25	31	2.4387	.65473	.11759	2.3986	2.6789	2.00	4.83
	25 – less than 35	72	2.4594	.77659	.09152	2.6370	3.0019	1.50	5.00
	35 – less than 45	45	2.4407	.51610	.07694	2.4857	2.7958	1.67	4.00
	45 – less than 55	17	2.4314	.45284	.10983	2.3984	2.6642	2.00	3.67
	More than 55	1	3.0000	.	.	.	.	3.00	3.00
	Total	166	2.5540	.66150	.05134	2.6858	2.8885	1.50	5.00
WE	Less than 25	31	3.9731	.53072	.09532	3.7784	4.1678	3.00	4.83
	25 – less than 35	72	4.0185	.42658	.05027	3.9183	4.1188	3.33	5.00
	35 – less than 45	45	3.9444	.36756	.05479	3.8340	4.0549	3.33	4.83
	45 – less than 55	17	3.6373	.62148	.15073	3.3177	3.9568	2.33	4.33
	More than 55	1	4.0000	.	.	.	.	4.00	4.00
	Total	166	3.9508	.46394	.03601	3.8797	4.0219	2.33	5.00
WILL	Less than 25	31	3.9032	.59047	.10605	3.6866	4.1198	3.00	5.00
	25 – less than 35	72	4.2813	.44984	.05301	4.1755	4.3870	3.25	5.00
	35 – less than 45	45	4.4667	.35992	.05365	4.3585	4.5748	3.75	5.00
	45 – less than 55	17	4.3676	.48507	.11765	4.1182	4.6170	3.25	5.00
	More than 55	1	4.0000	.	.	.	.	4.00	4.00
	Total	166	4.2681	.49510	.03843	4.1922	4.3439	3.00	5.00
Total	Less than 25	31	3.5648	.31463	.05651	3.4494	3.6802	3.00	4.20
	25 – less than 35	72	3.6421	.29880	.03521	3.5719	3.7123	3.05	4.69
	35 – less	45	3.6305	.23583	.03516	3.5597	3.7014	3.10	4.20

	than 45								
	45 – less than 55	17	3.5794	.22890	.05552	3.4617	3.6971	3.20	3.92
	More than 55	1	3.9727	.	.	.	.	3.97	3.97
	Total	166	3.6201	.27941	.02169	3.5773	3.6629	3.00	4.69

Table 15: Descriptive of Statistical Differences among Participants According to their Job Title

						95% Confidence Interval for Mean			
Factors	**Job Title**	**N**	**Mean**	**Standard Deviation**	**Standard Error**	**Lower Bound**	**Upper Bound**	**Min**	**Max**
PU	Director	16	4.4375	.53276	.13319	4.1536	4.7214	2.80	5.00
	Employee	146	4.1890	.40804	.03377	4.1223	4.2558	3.00	5.00
	Other	4	4.5000	.57735	.28868	3.5813	5.4187	4.00	5.00
	Total	166	4.2205	.43072	.03343	4.1545	4.2865	2.80	5.00
COMX	Director	16	2.7875	.88384	.22096	2.3165	3.2585	1.00	3.60
	Employee	146	3.1932	.74627	.06176	3.0711	3.3152	1.20	5.00
	Other	4	3.4000	.23094	.11547	3.0325	3.7675	3.20	3.60
	Total	166	3.1590	.75975	.05897	3.0426	3.2755	1.00	5.00
COMT	Director	16	3.9531	.51816	.12954	3.6770	4.2292	2.50	4.50
	Employee	146	3.9606	.42618	.03527	3.8909	4.0303	3.00	5.00
	Other	4	3.7500	.28868	.14434	3.2907	4.2093	3.50	4.00
	Total	166	3.9548	.43195	.03353	3.8886	4.0210	2.50	5.00
ATT	Director	16	3.9167	.55109	.13777	3.6230	4.2103	3.00	5.00
	Employee	146	3.5251	.63347	.05243	3.4215	3.6287	1.00	5.00
	Other	4	3.3333	.76980	.38490	2.1084	4.5583	2.67	4.00
	Total	166	3.5582	.63693	.04944	3.4606	3.6558	1.00	5.00
OS	Director	16	3.0100	.66733	.16683	3.0044	3.8056	2.40	4.40
	Employee	146	2.8137	.86268	.07140	2.3726	3.1548	1.60	5.00
	Other	4	2.8500	.25166	.12583	2.4496	3.2504	2.60	3.20
	Total	166	2.8912	.83825	.06506	3.1872	3.4441	1.60	5.00
QHR	Director	16	4.2188	.45833	.11458	3.9745	4.4630	3.67	5.00
	Employee	146	3.9452	.45701	.03782	3.8705	4.0200	3.00	5.00
	Other	4	3.6667	.38490	.19245	3.0542	4.2791	3.33	4.00
	Total	166	3.9649	.46269	.03591	3.8940	4.0358	3.00	5.00
CP	Director	16	3.2813	.29008	.07252	3.1267	3.4358	2.67	3.83
	Employee	146	3.4418	.56003	.04635	3.3502	3.5334	2.00	5.00
	Other	4	3.5417	.34359	.17180	2.9949	4.0884	3.17	3.83
	Total	166	3.4287	.53664	.04165	3.3465	3.5110	2.00	5.00
RP	Director	16	3.2500	.37594	.09399	3.0497	3.4503	2.60	4.00

	Employee	146	3.1932	.54604	.04519	3.1038	3.2825	1.80	5.00
	Other	4	3.8000	.16330	.08165	3.5402	4.0598	3.60	4.00
	Total	166	3.2133	.53309	.04138	3.1316	3.2949	1.80	5.00
GS	Director	16	2.4008	.52661	.13165	2.2902	2.7514	1.67	3.67
	Employee	146	2.4785	.68148	.05640	2.3671	2.8900	1.50	5.00
	Other	4	2.7847	.19245	.09623	2.5604	2.9729	3.00	3.33
	Total	166	2.5546	.66150	.05134	2.6858	2.8885	1.50	5.00
WE	Director	16	3.7708	.30353	.07588	3.6091	3.9326	3.00	4.17
	Employee	146	3.9943	.44005	.03642	3.9223	4.0663	3.00	5.00
	Other	4	3.0833	.86603	.43301	1.7053	4.4614	2.33	3.83
	Total	166	3.9508	.46394	.03601	3.8797	4.0219	2.33	5.00
WILL	Director	16	4.4688	.36372	.09093	4.2749	4.6626	4.00	5.00
	Employee	146	4.2449	.50895	.04212	4.1616	4.3281	3.00	5.00
	Other	4	4.3125	.23936	.11968	3.9316	4.6934	4.00	4.50
	Total	166	4.2681	.49510	.03843	4.1922	4.3439	3.00	5.00
Total	Director	16	3.6641	.17982	.04495	3.5683	3.7599	3.31	3.97
	Employee	146	3.6163	.28991	.02399	3.5689	3.6637	3.00	4.69
	Other	4	3.5822	.23840	.11920	3.2029	3.9615	3.34	3.79
	Total	166	3.6201	.27941	.02169	3.5773	3.6629	3.00	4.69

Table 16: Descriptive of Statistical Differences among Participants According to the Green Logistics Knowledge

						95% Confidence Interval for Mean			
Factors	**Job Title**	**N**	**Mean**	**Standard Deviation**	**Standard Error**	**Lower Bound**	**Upper Bound**	**Min**	**Max**
PU	Yes	77	4.2597	.43172	.04920	4.1618	4.3577	2.80	5.00
	No	89	4.1865	.42937	.04551	4.0961	4.2770	3.00	5.00
	Total	166	4.2205	.43072	.03343	4.1545	4.2865	2.80	5.00
COMX	Yes	77	2.9481	.79565	.09067	2.7675	3.1286	1.00	5.00
	No	89	3.3416	.68038	.07212	3.1983	3.4849	2.00	5.00
	Total	166	3.1590	.75975	.05897	3.0426	3.2755	1.00	5.00
COMT	Yes	77	3.9123	.43257	.04930	3.8142	4.0105	2.50	5.00
	No	89	3.9916	.43046	.04563	3.9009	4.0823	3.00	5.00
	Total	166	3.9548	.43195	.03353	3.8886	4.0210	2.50	5.00
ATT	Yes	77	3.5498	.73103	.08331	3.3839	3.7157	1.00	5.00
	No	89	3.5655	.54681	.05796	3.4504	3.6807	2.00	5.00
	Total	166	3.5582	.63693	.04944	3.4606	3.6558	1.00	5.00
OS	Yes	77	2.9208	.72590	.08272	2.8060	3.1855	2.00	5.00
	No	89	2.8647	.91890	.09740	2.7312	3.0783	1.60	5.00
	Total	166	2.8927	.83825	.06506	2.7872	3.1041	1.60	5.00
QHR	Yes	77	4.0130	.48120	.05484	3.9038	4.1222	3.00	5.00
	No	89	3.9232	.44456	.04712	3.8296	4.0169	3.00	5.00
	Total	166	3.9649	.46269	.03591	3.8940	4.0358	3.00	5.00
CP	Yes	77	3.4416	.59896	.06826	3.3056	3.5775	2.00	5.00
	No	89	3.4176	.47945	.05082	3.3166	3.5186	2.00	5.00
	Total	166	3.4287	.53664	.04165	3.3465	3.5110	2.00	5.00
RP	Yes	77	3.2078	.50517	.05757	3.0931	3.3225	1.80	5.00
	No	89	3.2180	.55893	.05925	3.1002	3.3357	1.80	4.80
	Total	166	3.2133	.53309	.04138	3.1316	3.2949	1.80	5.00
GS	Yes	77	2.5579	.63731	.07263	2.4432	2.8325	1.67	5.00
	No	89	2.5465	.68534	.07265	2.4421	2.8309	1.50	5.00
	Total	166	2.5522	.66150	.05134	2.4858	2.8385	1.50	5.00
WE	Yes	77	3.9740	.40561	.04622	3.8820	4.0661	3.00	5.00
	No	89	3.9307	.51050	.05411	3.8232	4.0382	2.33	5.00
	Total	166	3.9508	.46394	.03601	3.8797	4.0219	2.33	5.00
WILL	Yes	77	4.2792	.43862	.04999	4.1797	4.3788	3.25	5.00
	No	89	4.2584	.54153	.05740	4.1444	4.3725	3.00	5.00
	Total	166	4.2681	.49510	.03843	4.1922	4.3439	3.00	5.00
Total	Yes	77	3.6177	.26410	.03010	3.5577	3.6776	3.10	4.69
	No	89	3.6222	.29349	.03111	3.5604	3.6840	3.00	4.42
	Total	166	3.6201	.27941	.02169	3.5773	3.6629	3.00	4.69

Table 17: Descriptive of Statistical Differences among Participants According to the Environmental Protection Practices

						95% Confidence Interval for Mean			
Factors	**Job Title**	**N**	**Mean**	**Standard Deviation**	**Standard Error**	**Lower Bound**	**Upper Bound**	**Min**	**Max**
PU	Yes	112	4.2196	.41326	.03905	4.1423	4.2970	2.80	5.00
	No	54	4.2222	.46891	.06381	4.0942	4.3502	3.00	5.00
	Total	166	4.2205	.43072	.03343	4.1545	4.2865	2.80	5.00
COMX	Yes	112	3.0125	.79334	.07496	2.8640	3.1610	1.00	5.00
	No	54	3.4630	.58254	.07927	3.3040	3.6220	2.20	5.00
	Total	166	3.1590	.75975	.05897	3.0426	3.2755	1.00	5.00
COMT	Yes	112	3.9442	.40229	.03801	3.8689	4.0195	2.50	5.00
	No	54	3.9769	.49112	.06683	3.8428	4.1109	3.00	5.00
	Total	166	3.9548	.43195	.03353	3.8886	4.0210	2.50	5.00
ATT	Yes	112	3.7143	.53666	.05071	3.6138	3.8148	2.33	5.00
	No	54	3.2346	.70823	.09638	3.0413	3.4279	1.00	5.00
	Total	166	3.5582	.63693	.04944	3.4606	3.6558	1.00	5.00
OS	Yes	112	2.7743	.80324	.07590	2.6139	3.0147	2.00	5.00
	No	54	3.0074	.83233	.11327	2.7802	3.2346	1.60	4.40
	Total	166	2.8908	.83825	.06506	2.6872	3.0441	1.60	5.00
QHR	Yes	112	4.0387	.46766	.04419	3.9511	4.1263	3.00	5.00
	No	54	3.8117	.41594	.05660	3.6982	3.9253	3.00	5.00
	Total	166	3.9649	.46269	.03591	3.8940	4.0358	3.00	5.00
CP	Yes	112	3.4092	.53687	.05073	3.3087	3.5098	2.33	5.00
	No	54	3.4691	.53892	.07334	3.3220	3.6162	2.00	4.50
	Total	166	3.4287	.53664	.04165	3.3465	3.5110	2.00	5.00
RP	Yes	112	3.1643	.55554	.05249	3.0603	3.2683	1.80	5.00
	No	54	3.3148	.47201	.06423	3.1860	3.4436	2.40	4.80
	Total	166	3.2133	.53309	.04138	3.1316	3.2949	1.80	5.00
GS	Yes	112	2.5649	.67582	.06386	2.4883	2.6914	1.67	5.00
	No	54	2.5433	.63444	.08634	2.4302	2.6465	1.50	4.50
	Total	166	2.5541	.66150	.05134	2.4658	2.6885	1.50	5.00
WE	Yes	112	3.9673	.45235	.04274	3.8826	4.0520	3.00	5.00
	No	54	3.9167	.48967	.06664	3.7830	4.0503	2.33	5.00
	Total	166	3.9508	.46394	.03601	3.8797	4.0219	2.33	5.00
WILL	Yes	112	4.2522	.47517	.04490	4.1633	4.3412	3.00	5.00
	No	54	4.3009	.53724	.07311	4.1543	4.4476	3.00	5.00
	Total	166	4.2681	.49510	.03843	4.1922	4.3439	3.00	5.00
Total	Yes	112	3.6320	.27674	.02615	3.5801	3.6838	3.09	4.69
	No	54	3.5955	.28591	.03891	3.5175	3.6735	3.00	4.35
	Total	166	3.6201	.27941	.02169	3.5773	3.6629	3.00	4.69

Table 18: Results of Regression Analysis

Dependent Variable : Willingness to Adopt Green Logistics Innovations			
Independent Variables	**Standardized Coefficient (β)**	**t**	**Sig.**
			Technological Factors
Perceived Usefulness	0.257	3.326**	0.004
Complexity	-0.177	-2.104*	0.041
Compatibility	0.228	2.720**	0.009
			Organizational Factors
Attitude	0.360	4.238**	0.000
Organizational Support	0.379	4.485**	0.000
Quality of Human Resources	0.192	2.437*	0.029
			Environmental Factors
Customer Pressure	0.174	2.007*	0.047
Regulatory Pressure	0.183	2.216*	0.036
Governmental Support	0.369	4.302**	0.000
Work Environment	-0.201	-2.501*	0.024
R^2		0.405	
Adjusted R^2		0.367	

** Regression is significant at the .01 level (2-tailed).

* Regression is significant at the .05 level (2-tailed).

Table 19: Pearson Correlation Matrix between the Study Factors

		PU	COMX	COMT	ATT	OS	QHR	CP	RP	GS	WE	WILL
Perceived Usefulness	Pearson Correlation	1	0.023	0.326**	0.495**	0.001	0.037	0.065	0.113	0.065	-.250**	0.467**
	Sig. (2-tailes)		0.772	0.000	0.000	0.992	0.628	0.406	0.148	0.405	0.001	0.000
Complexity	Pearson Correlation	-0.023	1	-0.050	-.373**	-0.129	-0.156	-0.130	-0.116	-0.110	-0.279	-0.221*
	Sig. (2-tailes)	0.772		0.521	0.000	0.097	0.064	0.094	0.141	0.157	0.087	0.004
Compatibility	Pearson Correlation	0.326**	-0.050	1	0.331**	0.348**	0.108	-0.013	0.030	0.125	0.105	0.298**
	Sig. (2-tailes)	0.000	0.521		0.000	0.000	0.169	0.869	0.697	0.107	0.179	0.000
Attitude	Pearson Correlation	0.495**	-.373**	0.331**	1	0.193*	0.208**	0.222**	0.096	0.081	-0.127	0.514**
	Sig. (2-tailes)	0.000	0.000	0.000		0.013	0.007	0.004	0.218	0.299	0.099	0.000
Organizational Support	Pearson Correlation	0.001	-0.129	0.348**	0.193*	1	0.202**	0.171*	0.204**	0.362**	-.159*	0.702**
	Sig. (2-tailes)	0.992	0.097	0.000	0.013		0.009	0.028	0.008	0.000	0.040	0.000
Quality of Human Resources	Pearson Correlation	0.037	-0.156	0.108	0.208**	0.202**	1	0.012	0.038	0.131	0.109	0.248**
	Sig. (2-tailes)	0.628	0.064	0.169	0.007	0.009		0.883	0.627	0.094	0.158	0.001
Customer Pressure	Pearson Correlation	0.065	-0.130	-0.013	0.222**	0.171*	0.012	1	0.086	0.095	0.272**	0.229**
	Sig. (2-tailes)	0.406	0.094	0.869	0.004	0.028	0.883		0.269	0.219	0.000	0.003
Regulatory Pressure	Pearson Correlation	0.113	-0.116	0.030	0.096	0.204**	0.038	0.086	1	0.540**	0.076	0.216**
	Sig. (2-tailes)	0.148	0.141	0.697	0.218	0.008	0.627	0.269		0.000	0.332	0.005
Governmental Support	Pearson Correlation	0.065	-0.110	0.125	0.081	0.362**	0.131	0.095	0.540**	1	-0.095	0.577**
	Sig. (2-tailes)	0.405	0.157	0.107	0.299	0.000	0.094	0.219	0.000		0.225	0.000
Work Environment	Pearson Correlation	-0.250**	-0.279	0.105	-0.127	-0.159*	0.109	0.272**	0.076	-0.095	1	-0.274**
	Sig. (2-tailes)	0.001	0.087	0.179	0.099	0.040	0.158	0.000	0.332	0.225		0.000
Willingness	Pearson Correlation	0.467**	-0.221*	0.298**	0.514**	0.702**	0.248**	0.229**	0.216**	0.577**	-0.274**	1
	Sig. (2-tailes)	0.000	0.004	0.000	0.000	0.000	0.001	0.003	0.005	0.002	0.000	

Appendix C: Figures

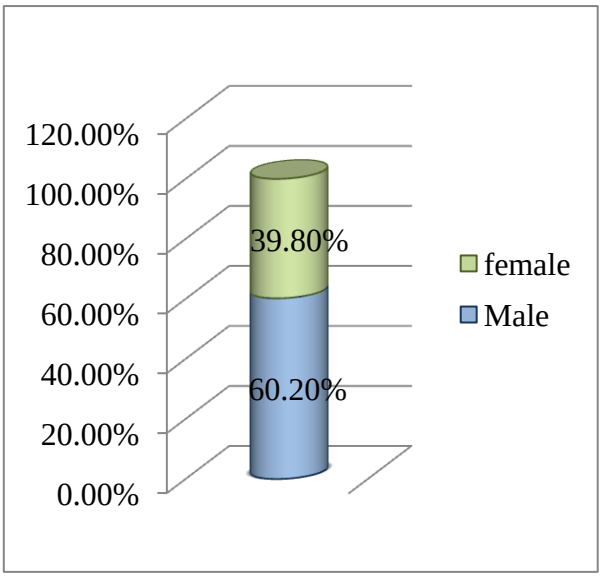

Figure 1: The Gender Distribution of the First Questionnaire

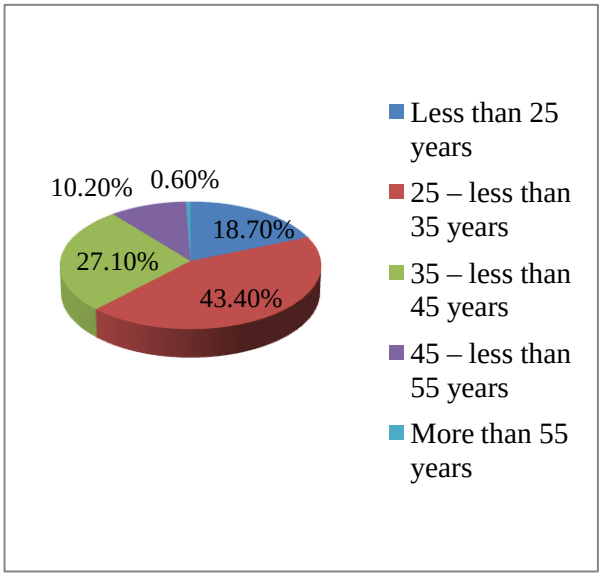

Figure 2: The Age Distribution of the First Questionnaire

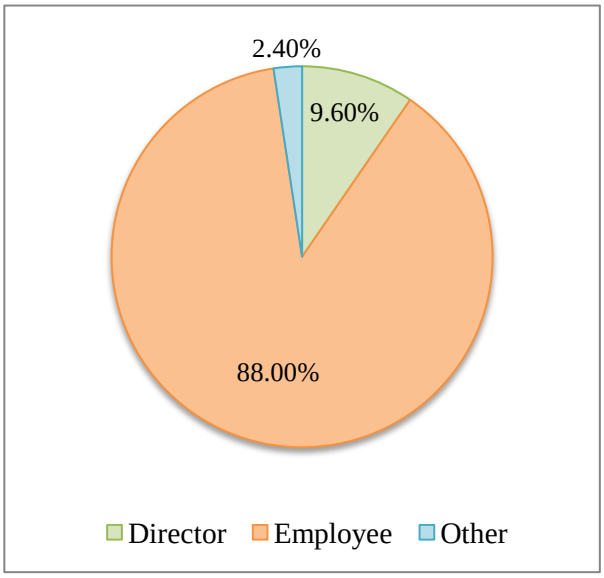

Figure 3: The Job Title Distribution of the First Questionnaire

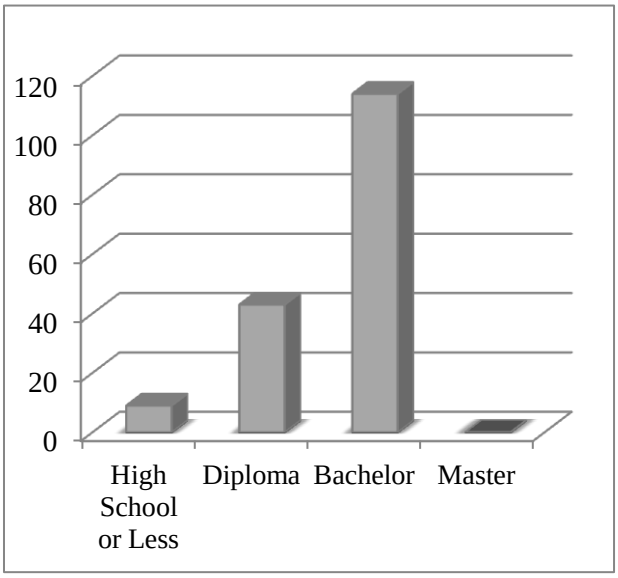

Figure 4: The Educational Level Distribution of the First Questionnaire

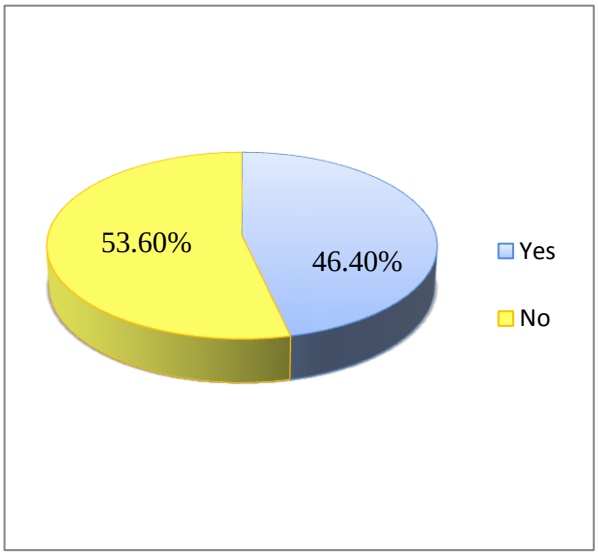

Figure 5: Green Logistics Knowledge Distribution of the First Questionnaire

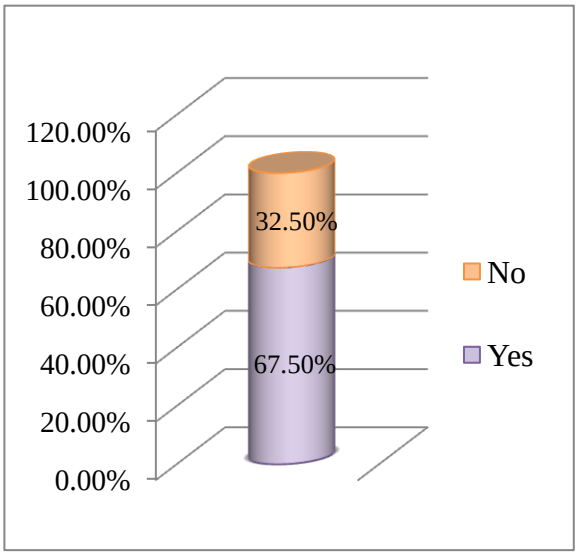

Figure 6: Environmental Protection Practices of the First Questionnaire

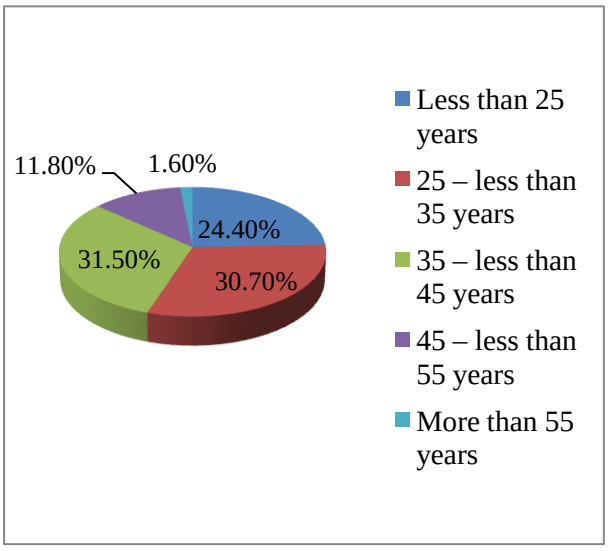

Figure 7: The Age Distribution of the Second Questionnaire

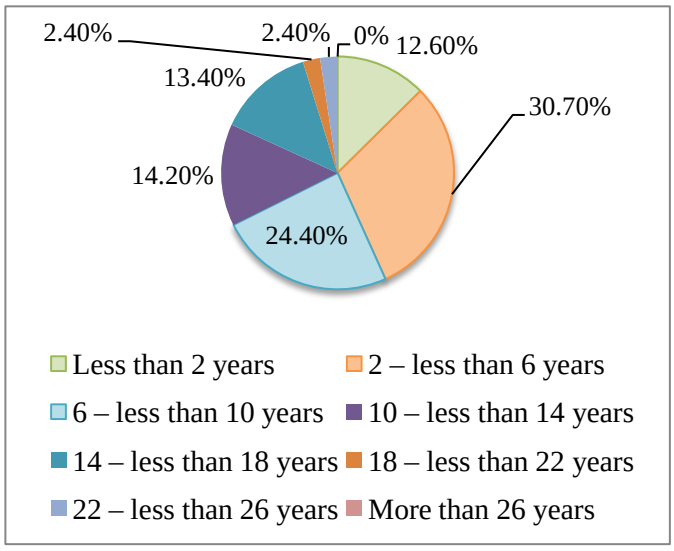

Figure 8: The Experience Years Distribution of the Second Questionnaire

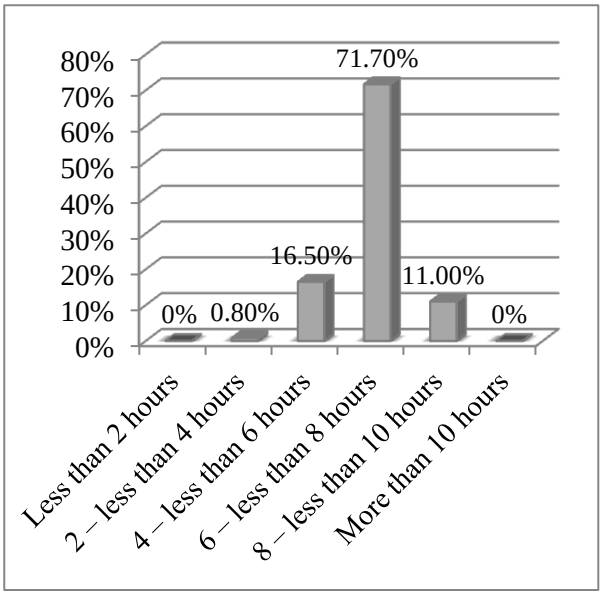

Figure 9: The Average Daily Working Hours Distribution of the Second Questionnaire

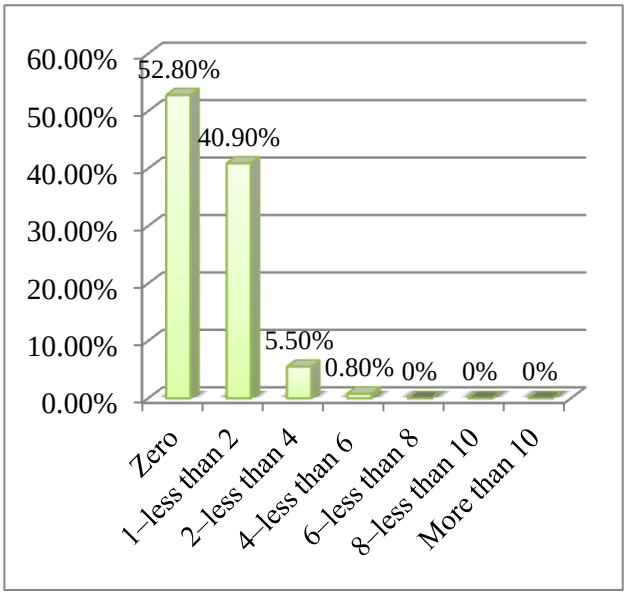

Figure 10: The Accident Rate per Year Distribution of the Second Questionnaire

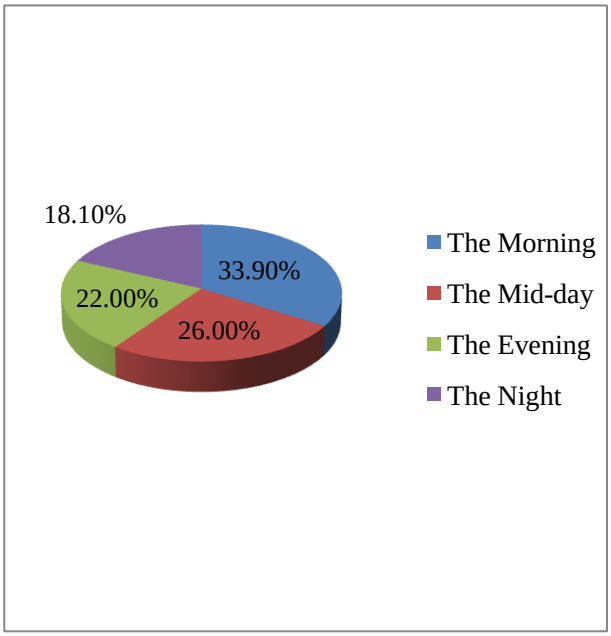

Figure 11: Time of Accident Occurrence Distribution of the Second Questionnaire

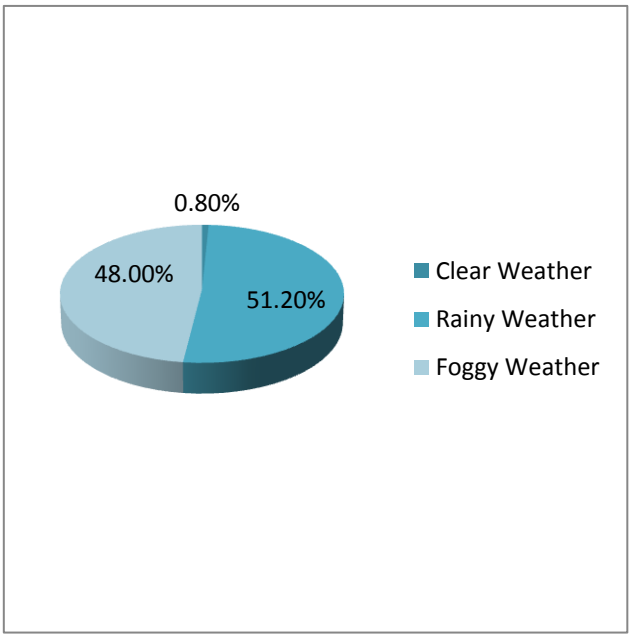

Figure 12: Weather during the Accident Distribution of the Second Questionnaire

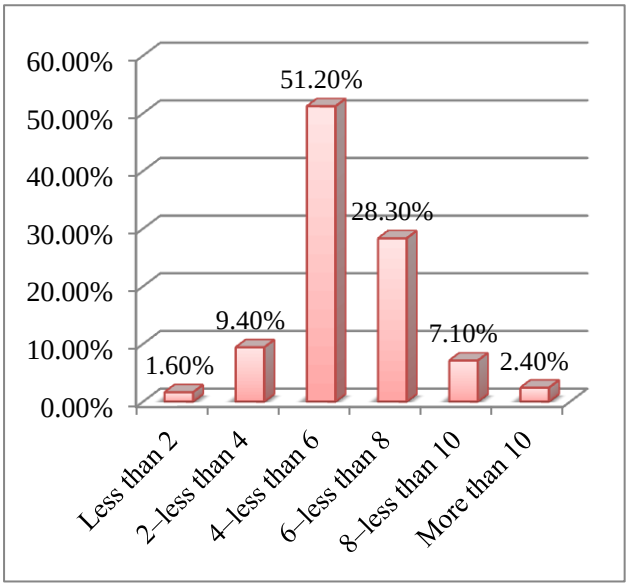

Figure 13: The Number of Working Hours After Which the Driver Feels Fatigue Distribution of the Second Questionnaire

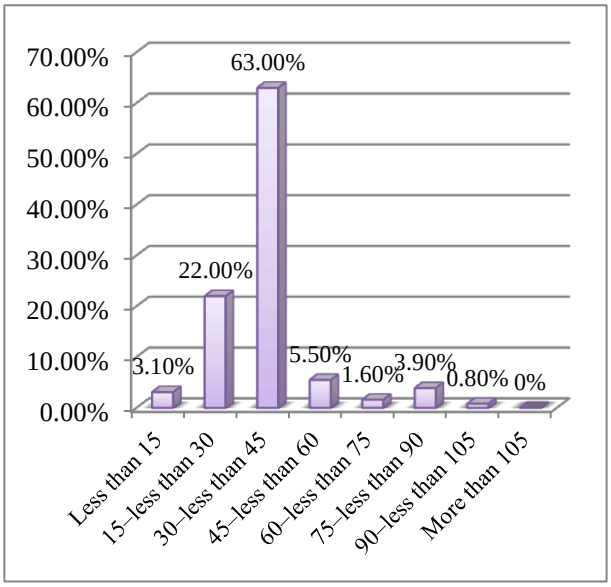

Figure 14: The Rest Time in Minutes Needed by the Driver to Recover His Activity Distribution of the Second Questionnaire

جامعة النجاح الوطنية
كلية الدراسات العليا

دمج العوامل البشرية في مجال الخدمات اللوجستية الخضراء

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قدمت هذه الأطروحة إستكمالاً لمتطلبات الحصول على درجة الماجستيرفي الإدارة الهندسية
بكلية الدراسات العليا في جامعة النجاح الوطنية في نابلس ، فلسطين
2015

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الملخص

يعتبر قطاع الخدمات اللوجستية بمثابة مستهلك كبير للطاقة و الوقود. بالإضافة إلى كونه مصدر للإنبعاثات الكربونية و الضوضاء. هذا الواقع أدى إلى خلق مشاكل بيئية لا يمكن التحكم بها و ذلك من اجل تحقيق متطلبات ورغبات الزبائن وزيادة فعالية ومنفعة شركات الدعم اللوجستي. في نفس الوقت هذه الأهداف تتعارض مع الحرص على حفظ التوازن البيئي وحماية المصادر الطبيعية. نتيجة لذلك ظهر مفهوم الخدمات اللوجستية الخضراء على أنه نهج مهم ضمن قطاع الخدمات اللوجستية الحديثة. وذلك من أجل تحسين و تعزيز الأداء البيئي لشركات الدعم اللوجستي تلبية للأهداف المؤسسية والإجتماعية.

تماشياً مع أهداف الخدمات اللوجستية الخضراء، تهدف هذه الدراسة إلى تحديد العوامل المؤثرة على رغبة شركات الدعم اللوجستي الفلسطينية لتبني الممارسات اللوجستية الخضراء. هذه العوامل تتضمن؛ عوامل تكنولوجية، مؤسسية وبيئية. بالإضافة إلى ذلك فإن الدراسة تهدف ايضاً إلى تحديد العوامل المؤثرة على أنشطة الخدمات اللوجستية الخضراء، كإختيار المركبة والسائق، وتخطيط الطريق و تجميع الشحنات.

مع الأخذ بعين الإعتبار الحاجة لتقييم الممارسات اللوجستية الخضراء في شركات الدعم اللوجستي الفلسطينية، تم تطوير إطار نظري للممارسات اللوجستية الخضراء و إطار نظري للعوامل البشرية المؤثرة على سلوك السائق بالإضافة إلى بناء نموذج للخدمات اللوجستية الخضراء و ذلك من أجل دعم الإستدامة البيئية و تحقيق أهداف شركات الدعم اللوجستي. واستند تطوير هذا النموذج على مراجعة ما توصل إليه العلم في هذا المجال وعلى مشاهدات ومعلومات تم جمعها من خلال مقابلات. سمحت مثل هذه المقابلات بتقييم الممارسات اللوجستية

الخضراء المتبناه من قبل كل شركة، وتحديد الإجراءات و السياسات الواجب عملها من أجل تحقيق خدمات لوجستية أكثر إهتماما بالبيئة.

لإجراء هذا البحث، إستخدمت منهجيات البحث الكمية والنوعية على حد سواء. تم جمع البيانات النوعية عن طريق عمل مقابلات مع مدراء إداريين و تنفيذيين. إضافة إلى ذلك، تم جمع البيانات الكمية عن طريق تصميم إستبيانتين وتوزيعهما على عينة عشوائية من الموظفين و السائقين في الشركات المستهدفة. وقد أعيدت 293 استبيانة مكتملة من مجموع 330، حيث بلغت نسبة الاستجابة 88.8% من العينة المستهدفة.

بعد تحليل المعلومات الواردة من الإستبيانة الأولى، أظهرت النتائج أن الدعم المؤسسي، والدعم الحكومي، والموقف، والفائدة المرجوة هي أهم العوامل المؤثرة على رغبة شركات الدعم اللوجستي الفلسطينية لتبني الممارسات اللوجستية الخضراء. كما بينت النتائج ان التوافق، وجودة الموارد البشرية، وضغط العملاء والضغط التشريعي تؤثر على الرغبة ولكن بدرجة أقل درجة من العوامل الاخرى. بينما، درجة تعقيد الممارسات وبيئة العمل لها أثر سلبي على رغبة شركات الدعم اللوجستي الفلسطينية لتبني الممارسات اللوجستية الخضراء.

بعد تحليل المعلومات الواردة من الإستبيانة الثانية، أظهرت النتائج أن العوامل البشرية سواء كانت فردية أو مؤسسية أو بيئية أو عوامل متعلقة بسير العمل لها تأثير على أداء السائق. ولذلك فإن إختيار المركبة والسائق، والتخطيط الكلي و تجميع الشحنات لها دور في التأثير على خفض التكاليف، والحد من الإنبعاثات الكربونية و تحسين مستوى الخدمات المقدمة.

إستناداً على نتائج البحث، فإن عملية تبني الخدمات اللوجستية الخضراء تمثل فرصة لشركات الدعم اللوجستي الفلسطينية للإستجابة بكفاءة لواقع الحماية البيئية و تحقيق الربحية من خلال تحسين الأداء البيئي. ولذلك فإن استخدام نموذج الخدمات اللوجستية الخضراء يمكّن شركات الدعم اللوجستي الفلسطينية من تقييم ومراقبة أنشطتها والعمل على تحسينها وذلك تطويرها في المستقبل.