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The Role of Public Policies in Efficient and Green Logistics

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Abstract

Efficiencies in the supply chain have long been studied since the late '70s and led to the development of information systems (i.e., material requirements planning (MRP)). Coupled with the increased pressure of social responsibility and to be a part of a sustainable country, this paper explores the impact of government policies on efficiencies in the logistic component of a supply chain. By understanding government's sustainable policies, businesses can make strategic decisions toward green logistics when transporting goods. This paper aims to contribute to the study of green logistics by presenting various government policies and analyzing them against temporal and spatial factors that contribute to efficient logistics. Thru understanding these policies, companies can adjust their route optimization processes to include these changes and not only contribute to further efficiencies but also address green issues, such as carbon emissions and reduction of fuel consumption. Future work can also look into the adoption of alternative modes of transportation to maximize the routing of delivery in conjunction with existing trucks and the possibility of new policy recommendations to be adopted by businesses.

Keywords: Sustainable Public Policies, Green Logistics, Public Policies, Route Optimization

Introduction

According to the United Nations, the industrialization of nations has contributed to the increased production of greenhouse gases, which are partly attributed to the accumulation of carbon dioxide. Such global concerns led to the Kyoto Protocol which is an international agreement to reduce carbon emissions of committed parties (U.N., 1998). These efforts have subsequently raised several initiatives in public sectors worldwide to provide sustainable transportation options for its people.

While it is the responsibility of governments to make strides toward a sustainable world, there is a growing need to involve private sectors in the campaign as part of their social responsibility. As such, companies have started to search for ways to adapt to their environment while they are finding efficiency in their resource utilization and business processes (McChrystal, Fussell, Silverman, Collins, & Michael, 2015; McKinnon, 2010). Initiatives that comply with environmental regulations and help reduce a company's carbon footprint, energy and cost become key components of a sustainable transport network (Dave, 2013). For example, in 2014, UPS made a public announcement that their policy of "no left turn" significantly changed the route optimization of their truck drivers. According to Alan Gershenhorn, the Chief Commercial Officer at UPS, they adopted this policy into their route optimization technologies for safety reasons and to minimize the time spent at the stoplight (Ohm, 2014).

As the nations committed to the Kyoto Protocol develop new public policies for their citizens, companies also need to consider the impact of these policies on their operations. This paper aims to address this need by answering the following research questions: (RQ1) What are the sustainable policies that have been developed across nations; (RQ2) How can these policies affect organizations when they develop their logistics practices?

This paper will be organized as follows: First, it will review the existing literature regarding the sustainable public policies and green logistics. Second, it will describe the methodology for collecting the data for this study. Third, it will discuss the results of the study. Fifth, it will analyze the findings and implications. Sixth, it will conclude and discuss future recommendations.

Sustainable Public Policies

The Kyoto Protocol was an agreement of multiple nations to encourage reforms in various sectors, which include the transport sector, to promote “policies and measures which limit or reduce emissions of greenhouse gases” (U.N., 1998, p. 2). The policies and measures include the improvement in efficiencies of automobiles and traffic flows. Other cross-sectional measures relate to campaigns for active and environmentally friendly lifestyles. Several countries have come up with targets for 2020 and 2040 to account for a reduction of CO₂ emission.

Road congestion is a common issue in metropolitan cities. In some countries, like Singapore, the industrialization of their nation, led to the worsening of traffic congestion (Yuan, 1997). To address these issues, Yuan (1997) suggested that policy measures can be made from three areas, namely: the supply side of transport facilities, managing the demand side or providing alternative urban structures. Litman (2013) also showed that public policies have solved urban transportations issues in urban cities in Asia. He noted that dense urban areas combined with peak travel times have caused traffic congestion, unavailability of parking spaces, increased accidents, and pollution. To solve these, they encouraged automobile ride sharing, use of public transit, cycling and walking to reduce traffic volumes or keep them within the road capacity during the peak travel time.

Efficient and Green Logistics

Efficiencies in logistics help increase company's profitability. To further understand the interdependent factors that impact the efficiency of the delivery system we looked at a vendor managed inventory (VMI) scenario to understand the factors that affect their route optimization. It was found that logistics was largely dependent on three things: the timing (temporal) of the replenishment; the routing of vehicles (spatial) and the capacity of the vehicle (Trudeau & Dror, 1992). The fuel efficiency of the vehicle depends on several parameters such as vehicle size, type and weight, and the average vehicle speed. Trudeau and Dror (1992) developed an analytical procedure to take into account route direction, minimizing the average number of stock-out in each period, minimizing the long-run average transportation costs, route failures and their interrelations. These route optimizations allow companies to minimize the fuel consumed by a vehicle, which is proportional to the emissions of CO₂, which is in turn dependent on a variety of parameters, such as vehicle speed, load and acceleration (McKinnon 210). Improving the transportation efficiencies significantly benefit the countries by reducing energy costs, air pollution and greenhouse emissions (Knox & Scheuring, 1991).

Recently, logistics included the social and environmental factors as part of the equation (McKinnon, 2010). McKinnon (2010) predicts that by 2030 the costs of carbon and energy will drive the designs of logistics. Recent attempts have been made to identify some of the factors that can mitigate the impact the environmental costs. Zhang et al. (2014) identified 19 driving factors for adopting green logistics. The central government's legal and regulatory requirements and administrative department of local and industry policies and regulations came first and second respectively as driving factors for adopting green logistics. In the same study, Zhang et al. (2014) identified 36 green logistics practices adopted by truck fleets. Choosing the right mode of transport, optimizing transport routes, monitoring vehicle driving mileage, optimizing transport load distribution, and optimizing logistics performance are the top five green logistics practices adopted by truck fleets. In a similar study, it was found that green logistics can be obtained by reducing “the number of vehicles used, fuel consumed, distance travelled, and travel time” (Gajanand & Narendran, 2013). Faber Maunsell (2008) indicated that governments have deployed a range of policy instruments to reduce the environmental impact of freight logistics. Taxation, financial incentives, regulation, liberalization, infrastructure, and advice & exhortation are the six categories of these instruments. Without government's regulations followed by organization's policies, organizations will not take positive actions to develop green logistics.

Research Methodology

The paper commenced with a literature review of existing research on public policies to address RQ1. We identified some of the countries that signed the Kyoto Protocol and identified several papers (See Table 1) that looked at specific policies that were adopted by particular cities/ countries. We specifically looked into a purposive sample of five based on the outlined city policies of (1) Copenhagen, Denmark, which has been marketing itself as the European's green capital (Copenhagen); (2) San Francisco, CA, which is a pioneer in environmental-friendly policies and initiatives; (3) Singapore, Singapore, notable for their high taxes on cars; (4) London, UK, who adopted one of the world's first climate change adaptation strategy in 2007 (Duffield, 2007); and (5) Vancouver, Canada and Winnipeg, Canada because of its unique trade position in North America; and (6) Tokyo, Japan based on being the only Asian country that made it to the top 20 countries in The Global Sustainable Competitiveness Ranking in 2015 (Solability, 2015).

Country	Policy Document	Signed Kyoto Protocol
Canada	Planning for a Sustainable Future: A Federal Sustainable Development Strategy for Canada (Canada. Environment Canada., 1997) Winnipeg Transportation Master Plan. (Winnipeg, 2011)	YES
Denmark	Copenhagen, Solutions for Sustainable Cities (C. o. Copenhagen, 2016) Better Mobility in Copenhagen, ITS Action Plan 2015-2016(C. o. Copenhagen, 2014)	YES
Singapore	A Case Study on Urban Transportation Development and Management in Singapore. (Yuan, 1997).	NO
UK	Saving lives with Sustainable Transport (WRI, 2014) Rising to the Challenge: The City of London Climate Change Adaptation Strategy (Duffield, 2007)	YES
US	Guide To San Francisco Better Streets Plan (San Francisco County Transportation Authority, 2010) San Francisco Bicycle Plan (San Francisco County Transportation Authority, 2009)	YES
Japan	Japan's Climate Change Policy (Japan, 2014)	YES

Table 1. Reference Policy Documents by Country

Some of these countries may not be part of the countries that signed the Kyoto Protocol, however, it was interesting to include them in the study as they too are coming up with policies that address the need to improve their transportation to support a dense population (i.e., Singapore) or a business area (Winnipeg, Canada).

The various policies were qualitatively analyzed by assigning similar themes using an open coding technique (Corbin & Strauss, 2015). Marginal notes were incorporated in the transcripts of the interviews to be able to easily go back to these coded segments. MaxQDA was used to keep track of all the coded

themes that were similar or followed a particular pattern. The codes allowed the researchers to easily retrieve the data which was then analyzed. These common areas were then put into categories based on the literature on the elements that impact logistics.

To address RQ2, and clarify the policy initiatives, two semi-structured interviews were conducted, one from a Transit Planner employed in the City and County of San Francisco in California, U.S. and the other was a Project Manager from Kobenhavn Kommune in Denmark. Prior to conducting these, data gathered from industry reports, environmental agencies and government entities that describe country-specific policies were used to inform the research and come up with interview questions. These two interviews were then conducted to achieve the following outcomes: (1) clarify policies that have been used by certain cities/countries; (2) understand how the public sector involved the private sector in coming up with the policies; and (3) find out how the public sector encouraged the private sector to implement some of these policies.

Discussion

This paper looked at several cases wherein government policies were implemented in various cities as part of their efforts to obtain sustainable cities. From all the individual case studies, the policies were analyzed into the common themes. Table 2 summarizes the policy recommendations we found in the literature review and specific policy papers with their descriptions and rationale.

Policy Recommendation	Applicable Country	Description	Reason of the policy
Sidewalk expansion	Canada Denmark Japan US	Design lands adjacent to the network for pedestrian accessibility	<ul style="list-style-type: none"> Active transportation for user
Crosswalk and Pedestrian Signals	US Japan	guidelines for standard marked crosswalks	<ul style="list-style-type: none"> Safety of the pedestrians
Cycling network	Canada Denmark Japan US	Support localized neighborhood travel	<ul style="list-style-type: none"> Alternative for moderate and long distance trip
Rapid Transit Services	Canada France Denmark Japan	Enhance transit system with real-time information tools	<ul style="list-style-type: none"> Efficient and effective base transit Create reliable, competitive and convenient alternative to driving
Dial-a-ride	Canada	On-demand system for low ridership areas	<ul style="list-style-type: none"> Provide local travel needs in neighborhoods that integrate with other transportation services

Fixed-route bus system	Canada France Denmark Japan	Suburban feeder to mainline transit network	<ul style="list-style-type: none"> • Provide local travel needs in neighborhoods that integrate with other transportation services
Traffic Flow/Signal Management	Canada Denmark	Optimize traffic light and reduce stops on Priority Road Network	<ul style="list-style-type: none"> • Address traffic management problems; • Increase reliability of travel time prediction • Increase flow of traffic in the direction of dense car traffic areas
Road network improvement	Canada Singapore	Modification to replace transportation infrastructure	<ul style="list-style-type: none"> • Mitigate congestion problems • maximizing the capacity • reduce travelers' needs for moving from one place to another • improve the public transportation quality • Controlling the demand of car usage.
Key trade corridors and truck routes	Canada	Effective transportation infrastructure for goods movement	<ul style="list-style-type: none"> • Balanced, multimodal transportation system that minimizes impacts to residential and commercial development
Railway networks for goods transport	Canada	Effective transportation infrastructure for goods movement	<ul style="list-style-type: none"> • Balanced, multimodal transportation system that minimizes impacts to residential and commercial development
Aerospace Freight hubs	Canada	Effective transportation infrastructure for goods movement connected to other networks	<ul style="list-style-type: none"> • Balanced, multimodal transportation system that minimizes impacts to residential and commercial development
Parking	Canada	Adjacent development to facilitate access for bicycle and motor vehicle	<ul style="list-style-type: none"> • Provide parking where it is needed and integrated with urban landscape
Recharging Infrastructure for Electric Vehicles	US Japan Denmark	Build efficient infrastructure to promote next-generation vehicles	<ul style="list-style-type: none"> • Promote the use of vehicles with lower environmental impact

Applying transport pricing reforms	Singapore UK	Changes in the pricing structure of public transportation	<ul style="list-style-type: none"> • encourage people to use different transportation modes such as public transportation • Decrease traffic, parking congestion, accident and pollution emission in the urban cities.
Taxes, Fees or Fines Increased Car	Singapore Denmark UK US	Impose taxes or fines on cars that use city roads to limit car usage such as: carbon emissions-based vehicle scheme(Singapore); car tax (Singapore, Denmark); congestion charges(UK); road tolls (US)	<ul style="list-style-type: none"> • encourage people to use different transportation modes such as public transportation • To reduce car usage that caused traffic, and raised concerns about the environmental negative impacts such as air pollution.
High Occupancy Vehicles (HOV)/Carpool lanes	US	Dedicated lanes for HOV/Carpool lanes	<ul style="list-style-type: none"> • Encourage ride sharing
Efficiency of Logistics Systems and Modal Shifts	Japan	Use of larger trucks with separable containers	<ul style="list-style-type: none"> • Promote cooperative delivery by logistic operators • Strong partnership between owner of goods and logistics

Table 2. Policy Recommendations

As these cities begin to implement the policies, they encourage the participation of private sector in multiple ways. In Copenhagen, they ask for a public request for proposal from the private sector to bid for the implementation of these projects. Once they private party implements the service, they are responsible for advertising the availability of these alternate modes of transportation to the public. For example, when they implemented City Bikes, a program where you can take a bicycle from the Metro stations or S-trains and use the same metro card to pay for the rental of the bicycles. This program makes it easier for the people to go into areas that is not serviced by public transportation. Once they are done with the bicycle, they can return it to the nearest station.

In California, the transit planner said that they sometimes ask special interest groups for their inputs in the design. For example while working on increasing the bicycle lane in San Francisco, they made a critical decision to replace some of the parking spaces with bicycle lanes based on the needs of the community. They also look at the traffic situation and conduct studies that look at the accidents at a particular section, traffic patterns to implement one way or no left turns during certain hours of the day to allow continuous flow of traffic. Once a year, they launch a “Bike to Work Day” to promote the awareness of the community to alternative modes of transportation. All buses in the city are equipped with special bicycle racks in front of the buses so that they can use them for longer distances. On these days, they offer a special service to the community where they can dial-a-ride at no cost to the people when these bikers end up going home late and it has become unsafe to ride a bicycle home.

Cities that have implemented the policies found that while the population living or entering the cities have grown, there has been a decrease in the number of cars entering the cities (Vancouver, 2012). Some of these policies aim to reduce their carbon footprint by increasing the percentage of their population to take trips using sustainable alternatives. For instance, the most of these policies impact these the transportation of people and others can easily be identified as policies that impact the logistics of goods.

However, based on the literature reviewed, changes in the policies and measure may also indirectly impact the routing of delivery trucks. Therefore, it is also important for companies to examine policies so that they can make effective changes to the routing of their delivery trucks.

Based on several policy recommendations from governments that support sustainable projects, we evaluated the impact to a delivery truck in terms of time, space and whether the policy directly impacted the movement of goods. Table 3 lists the different policies in relation to time and space constraints as well as whether these policies impact logistics.

Policy	Time	Space	Directly impact Logistics
Sidewalk expansion	Y	Y	N
Crosswalk and Pedestrian Signal	Y	N	N
Cycling network	N	N	N
Rapid Transit Services	N	N	N
Dial-a-ride	N	N	N
Fixed-route bus system	N	N	N
Optimize traffic light	Y	Y	Y
Road network improvement	Y	Y	Y
Key trade corridors and truck routes	Y	Y	Y
Railway networks for goods transport	Y	Y	Y
Aerospace Freight hubs	Y	Y	Y
Parking	N	Y	Y
Limit car usage	Y	Y	N
HOV /Carpool lanes	Y	N	Y
Efficiency of Logistics Systems and Modal Shifts	N	Y	Y

Table 3. Impact of Policy Recommendation to Time and Space Parameters in Logistics

Similar to Knox & Scheuring's (1991) findings, this study found that there while the government makes various policy recommendations to protect its citizens from the effects of greenhouse gases, these policies may also have a consequence on the economy. From table 3, it can be seen that while the policies do not specify directly that the impact is on logistics, the policy can make a significant difference to the route optimization based on vehicle movement patterns, events, road conditions which will impact planning, timing and routing of delivery trucks.

In this particular study, it was found that policy recommendations affect the time, space and capacity requirements in logistics. If organizations find efficient ways to deliver goods and reduce carbon emission, they can also benefit from the reduction of time involved in the routing of trucks. However, some of the policies and measures negatively impact the logistic of goods. It was found that if the policy is reduces the space on the roads, it can be anticipated that there also can be a possibility of increasing the time trucks are on the roads because of measures that prohibit trucks from using the roads. For instance, if we can see from this list that a sidewalk expansion means that roads can be narrow and could potentially impact the time it takes to deliver a product in certain areas. In this particular scenario, while trucks don't use sidewalks, its expansion may mean narrow roads that can increase the traffic congestion and accordingly it may impact the roads that the trucks are on. While it was found that not all the policies directly impact logistics, changes in road conditions impact the ability of a company to be efficient in their supply chains. Therefore, once governments implement these sustainable policies, companies are then presented with the dilemma of whether they should adjust to their environments and develop new green routing optimization practices. Instead of waiting for the governments to put the sustainable policies in practice, this paper contributes to the identification of route optimization impact from the sustainable policies.

Conclusion and Future Directions

This paper looks at the role of public policy in efficient and green logistics. It aims to address the following research questions: (RQ1) What are the sustainable policies that have been developed across nations; (RQ2) How can these policies affect organizations when they develop their logistics practices?

This paper used a qualitative study to identify sustainable government policies from various countries that signed the Kyoto Protocol and have scored high in the Global Sustainability Index. The paper applied a purposive sample to evaluate the policies of countries in terms of impact on logistics. In particular, these policies were then coded and evaluated against the temporal and spatial constraints that impact the route optimization of truck drivers who are part of the logistics. Additionally, certain scenarios were applied to each policy to understand the impact on logistics.

The paper found that while not all the policies directly impact logistics, changes in road conditions impact the ability of a company to be efficient in their supply chains. Therefore, once governments implement these sustainable policies, companies are then presented with the dilemma of whether they should adjust to their environments and develop new green logistics practices.

The study suggests that while corporate social responsibility drive companies to adopt green logistics, being a part of a sustainable city that adopted government policies are forced to make necessary changes to the logistic component of its supply chain. By understanding government's sustainable policies ahead of time, businesses can make strategic decisions that incorporate green logistics when transporting goods.

This paper has contributed to the study of green logistics by presenting various government policies and matched them up against temporal and spatial factors that contribute to efficient logistics. Thru understanding these policies, companies can adjust their route optimization processes to include these changes and not only contribute to further efficiencies but also address green issues, such as carbon emissions and reduction of fuel consumption.

Future work can look into the green routing logistic problems that optimize a delivery truck is scheduled to deliver products to a vending machine in a particular location, real-time information about inventory levels can be communicated and drivers can deliver additional replenishment run while a truck is en route. This reduces the amount of trips a driver has make to deliver the same amount of products, which leads to increased fuel efficiency. Additionally, companies can also look into the adoption of alternative modes of transportation for deliveries to maximize the routing of delivery in conjunction with existing trucks and the possibility of new policy recommendations to be adopted by businesses.

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