THE CONCEPTUAL FRAMEWORK OF LEAN SUSTAINABLE LOGISTICS

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ABSTRACT

Purpose: Logistics has an important role play in part of competitive strategies that relates logistics activities. It considers economics dimension such as cost, time and distance. Then, lean, which is well-known concept, can be applied to analyse logistics operations of companies. It uses seven wastes to identify and eliminate all of wastes in terms of value-added activities. Additionally, sustainable development is relevant logistics with three aspects comprising of environmental, social and economics for long-term benefits. So, this paper will present the linkage factors between sustainable development and lean concept on logistics activities.

Design/methodology/approach: This paper reviews on three subjects comprising of sustainable development, lean concept and logistics. It explores the factors which are related to each other. Then, it identifies the linkage factors that are the most important factors to combine these subjects. The linkage factors represent these subjects which have strong power to integrate between sustainable development and lean concept on logistics activities.

Findings: The result of this paper is the integration concept of three subjects comprising of sustainable development, lean concept and logistics. It presents the linkage factors between sustainable development and lean concept on logistics activities. Also, the sustainable wastes are the linkage factors between sustainable development and lean concept on logistics activities. They are classified into economics, environmental and social dimensions on each logistics activity.

Originality/value: The finding contributes towards the linkage factors between lean concept and sustainable development on logistics activities. These powerful linkage factors have potential to integrate these subjects and transform them into lean sustainable logistics.

Keywords: The linkage factors, Sustainable logistics, Lean Concept, Logistics Activities

Introduction

According to the Brundland Report in 1987, sustainable development is *"development that meets the needs of the present without compromising the ability of future generations to meet their own needs".* It is a concept to balance three dimensions of sustainable comprising of economics, environment and social for achieving long-term benefits. The goal of sustainable development is to concern environmental issues while responding to essential aspects of social and economics. All of businesses need to be sustainable, so they should consider economics, environmental dimensions including social dimension for long-term development. Sustainable development can analyse overall of business process in order to develop and improve industries in Thailand (Puvanasvaran et al., 2011). It can achieve competitive goal for industry through balancing sustainable dimensions. Therefore, sustainable development is one of concept that can help organization meet need of them.

Thus, sustainable logistics is a new concept to consider both sustainable development and logistics management. It is providing benefits of economics, environmental ways and making social responsibility on logistics activities. Sustainable logistics mainly considers environmental and social impacts to manage movement and storage of goods between origin point to customer point for efficiency and effectiveness. While benefits of social, environment and economic growth are direct outcomes of logistics improvement, these are goals of sustainable development. Impacts of environmental and social including economic dimensions concern business operations such as

transportation infrastructure, high costs of resources and safety and health. Sustainability has become a key success for businesses. It can help them identify target area for improvement opportunity. Then, they have high performance of business for long-term benefits that are competitive in the global level.

To manage these impacts on sustainable logistics, lean is one of concepts for business improvement. Concept of lean emphasizes on eliminating all of wastes and adding more value. Wastes on lean context involve business process such as cycle time, work area, labor and supplier. Also, values on lean context are considered productivity, customer satisfaction, business performance and achieving long-term benefits. So, lean can be applied on sustainable logistics to improve business performance for competitiveness by focusing on waste reduction.

There have been numerous research works on sustainable logistics (e.g., Fisher, 2003; Hopwood et al., 2005; Chunguang et al., 2008; Ping, 2009; Miller et al., 2010; Witkowski, 2010; Dey et al., 2011). Sustainable logistics normally combines economic and environmental impacts for increasing more efficiency. However, although many researches have focused on the idea of sustainability within transportation and warehouse (Witkowski, 2010; Dey, 2011), there is very little work done to study sustainable logistics. The previous studies that only focused on field of transportation and warehouse did not cover logistics activities. They are insufficient to understand a role play of logistics activities for moving towards sustainability on industries. Additionally, lean is a main concept that can be applied with logistics management (e.g., Jones et al., 1997; Wu, 2002; Shamah, 2013; Sternberg et al., 2013). Figure 1 shows opportunities of research that are balance of three dimensions (economics, environment and social) and cover all of logistics activities. Also, lean concept can be applied to logistics by considering all of these sustainable dimensions.

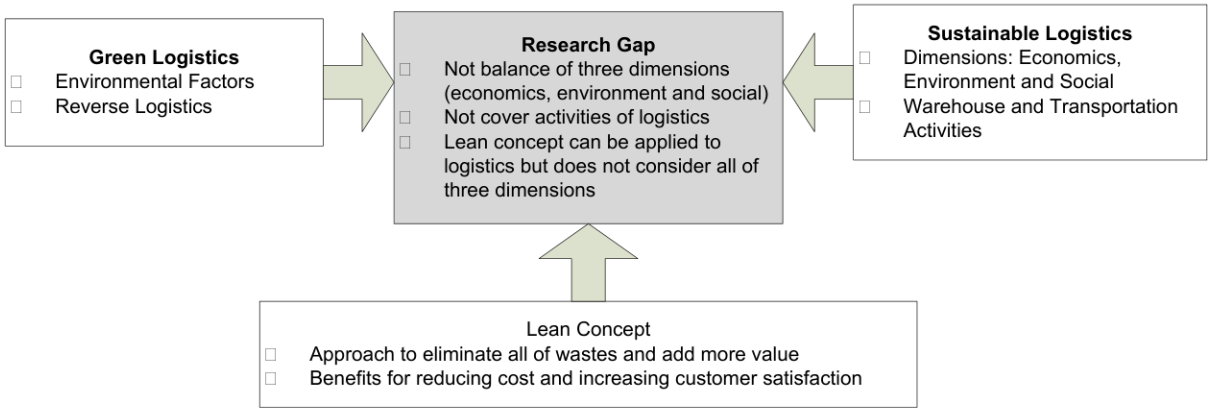

Figure 1: Opportunities of Research

There has not yet been a similar research for investigation both sustainable development and lean concept on logistics. Thus, this paper studies on sustainable development, lean concept and logistics. It aims to integrate these subjects by finding the linkage factors. They are the point of connection between sustainable development and lean concept on logistics. There are four sections in this paper. Firstly, this paper studies on sustainable logistics to understand how to apply sustainable development and logistics. Secondly, lean concept is related with sustainable logistics by studying lean concept on logistics activities and lean concept in terms of sustainability. Thirdly, this paper presents the conceptual framework of lean sustainable logistics. Final section is conclusions and the future research.

Sustainable Logistics

Traditionally, logistics involves the movement of products such as raw materials, parts, suppliers and finished goods that focuses on continuous flow of materials. Logistics management considers cost minimization objective, but environment situation is in deteriorating state. Then, sustainable development concept considers reducing the negative environmental impact and social impact, that are considering the critical fact.

Sustainable development is relevant supply chain management or logistics management with three aspects of sustainable development. However, many researches have focused on the idea of sustainable development within the logistics context (Witkowski, 2010; Dey, 2011; Monnet, 2011).

Sustainable logistics combines both cost and environmental impacts to strengthen logistics. Sustainable logistics aims to improve the logistics and business performance, reduce logistics cost and environmental impact. Logistics activities identify and eliminate inefficiencies, and reduce carbon emission for moving toward sustainability. Witkowski (2010) and Monnet et al. (2011) emphasized transport activity for implementing sustainable transport system. Transport, which is one of logistics activities, has more carbon emission and pollutants. Sustainable transport system makes a positive impact on environmental, social and economic. Indicators are defined to measure the efficiency of the global solutions for improving transport sustainability. Based on literatures, these researches apply sustainable logistics by focusing on transportation. They are explicitly results of environmental and social impacts. So, sustainable logistics is the main context of this paper. It can help organization improve business performance. Additionally, it needs to increase competitive advantage. Next section studies lean concept that is related with logistics activities and sustainable development.

Lean concept with logistics activities and sustainable development

Lean concept aims to identify and eliminate wastes of all processes in terms of non-value-added activities for improving business competitiveness. Generally, lean concept can help organizations improve their business competitiveness by focusing on productivity, efficiency and quality of products or services. Waste, which is not creating value for firms, prevents value-added flow of materials. Moreover, lean concept can be applied with several issues in order to improve business performance. So, this paper studies both logistics activities and sustainable development that are the main subjects to study with lean concept, as briefly reviewed below;

Lean concept on logistics activities

Logistics activities focus on internal activities and processes that involve continuous flow of materials. Nine logistics activities are classified by Grant et al. (2006), comprising of customer service and support, demand forecasting and planning, purchasing and procurement, inventory management, order processing and logistics communications, material handling and packaging, transportation and facilities site selection, warehousing and storage, and return goods handling and reverse logistics. They are considered primary activities of logistics management that can be applied to several issues, for example, performance measurement, simulation of manufacturing and decision making (Chen et al., 2002; Franzil, 2006; Banomyong and Supatn, 2011).

Logistics Activity	Types of waste	Examples
Transportation	Over Production	Increasing the salary per year of the administrative staff
	Transportation	Drive same way
	Waiting	Occurred at unloading and loading
		Unnecessary transportation
	Defects	Transport time was not observed in large quantities
	Over processing	A driver would drive back the same he came
	Resource utilization	Not planning critical resources
	Uncovered assignments	Accept all transport orders from all customers without making any profitability assessment
Inventory and warehouse	Unnecessary inventory	Unnecessary stock (finished goods)
	Defect	Hide defects
	Waiting	Changing set-up time, idle times and movement of workers

Table 1: Example of Seven Wastes in Transportation Activity

Lean concept can be applied to analyse logistics activities of companies by identifying and eliminating all of wastes as well as adding more vales. Sternberg et al. (2013) applied lean approach to identify waste in transportation activity that is one of logistics activities for potential improvement. Moreover, Bamber (2000) identifies wastes in inventory process that are WIP and finished goods. These wastes are categorized in inventory, defect and waiting wastes. To change set-up time, materials are waiting more WIP (Sullivan, 2002). Also, idle times or movement of workers caused waiting waste of inventory activity (Domingo, 2007). Table 1. shows examples of waste types in transportation and inventory activities. So, each logistics activity is related with waste contexts.

Based on literatures, lean concept is used to identify and eliminate wastes of logistics activities for their business performance. So, wastes are related with lean concept and logistics activities. They can be identified on each logistics activity in order to eliminate them. On the other hand, lean concept in term of sustainability is brief reviewed in the next section.

Lean concept in term of sustainability

Based on literatures, lean is an initiative technique that has strong basic skill for identifying and eliminating traditional organization and manufacturing waste, including environmental waste. These wastes are associated with moving toward sustainability. Achievement of business values applied lean initiative for eliminating environmental wastes (Handfield et al., 2005; Kidwell, 2006; Bergmiller, 2011; Vinodh, 2011). Lean concept and sustainable development are more important on measure of operational performance. Miller et al. (2010) has integrated lean tools and sustainability concepts by focusing on environmental impacts. Wastes are the main issue of lean concept for elimination that is considered with three of sustainable dimensions, comprising of economics, environment and social, as shown in Table 2.

Sources	Sustainable Dimensions		
	Economics	Environment	Social
Bember and Dale, 2000			✓
Kilparick, 2003; Ray et al., 2006; Ramesh, 2008; Miller et al., 2010; Taleghani, 2010; Koranda et al., 2012; Mehta, et al., 2012; Maia, et al., 2012; Maia, et al., 2013; Roosen and Pons, 2013; Tenescu and Teodorescu, 2014	✓		✓
Handfield et al., 2005; Kidwell, 2006; Kosztyó, et al., 2008; Torres and Gati, 2009; Bergmiller, 2011; Faulkner, et al., 2012; Li, et al., 2012; Müller, et al., 2013; Yusof, et al., 2013; Georgiana, 2014	✓	✓	
Vinodh et al., 2011	✓	✓	✓

Table 2: Wastes in terms of Sustainable Development

Economics dimension aims to lower costs and improve their productivity and quality. Lean wastes in terms of economics dimension follow seven wastes that are identified by Taiichi Ohno. This dimension presents waste from manufacturing process.

Sources	Environmental wastes
Torres and Gati, 2009; Koranda et al., 2012; Vinodh et al., 2011	• Refer to unnecessary usage of resources or substance released to air, water or land • Classified into seven wastes: overproduction, over processing, waiting, transportation, defects, inventory and storage of WIP and defective parts
Bergmiller, 2011	• Environmental impact affected business operations that should be identified for waste reduction • Environmental wastes associated with moving toward sustainable business practices
Kidwell, 2006	• Environmental wastes are very significant reduction in lean manufacturing • Examples of environmental wastes are excess energy and water usage, hazardous waste, or solid waste that overlooked saving opportunity
Handfield et al., 2005	• Associated with disposal of product at the end of useful life
Kosztyó, et al., 2008; Faulkner, et al., 2012; Li, et al., 2012Maia, et al., 2012; Maia, et al., 2013; Müller, et al., 2013; Georgiana, 2014	• Unnecessary usage of energy and water from manufacturing • Carbon emission from transportation and manufacturing
Yusof, et al., 2013;	• Polarization resources

Table 3: Descriptions of Environmental Wastes

In addition, environmental wastes are important wastes to consider in business operations. Many researches described definition of environmental wastes, following as Table 3. Normally, they refer to natural resource usages that affected environmental impacts. Adding environmental wastes are significant reduction in manufacturing. Moreover, seven wastes by Ohno are defined in terms of environmental wastes.

Additionally, wastes of people associates with social dimension that focused on only employee in organization, following as Table 4. They highlight utilization of employee such as physical skills, creativities and abilities. Customers, suppliers and community are not considered on this dimension that are important for long-term development.

Sources	People wastes
Bember and Dale, 2000	Employee commitment, labor utilization
Kilpatrick, 2003	Underutilization of mental, creative and physical skills and abilities, Poor workflow, organizational culture and high employee turnover
Ray et al., 2006	Not using employees' mental, creative or physical abilities
Ramesh, 2008	Need for additional training
Miller et al., 2010	Not using people's minds and getting them involved
Taleghani, 2010	Workforce is not confident about the best way to perform tasks
Vinodh et al., 2011; Mehta, et al., 2012;	Underutilization of employee creativity
Roosen and Pons, 2013	Underutilization of people added later in development
Tenescu and Teodorescu, 2014	Waste of unused human talent

Table 4: Descriptions of People Wastes

Lean concept in terms of sustainability aims to maximize profit and minimize lead time, costs and environmental impacts. Also, wastes in terms of sustainability are the main point to connect between lean concept and sustainable development. The wastes can be identified into three of sustainable dimensions. Seven wastes, which are identified by Ohno, highlight to improve quality and productivity including reduce costs of business operations. They are related with economics dimension. Also, environmental wastes are identified to reduce environmental impacts that are environmental dimension. Additionally, people wastes refer to impacts of employee and customer. So, these wastes involve sustainability for long-term development

The conceptual framework of lean sustainable logistics

From above mentioned, this paper studies on three subjects that consist of sustainable development, lean concept and logistics. Then, it focuses on nine logistics activities comprising of customer service and support, demand forecasting and planning, purchasing and procurement, inventory management, order processing and logistics communications, material handling and packaging, transportation, facilities site selection, warehousing and storage, and return goods handling and reverse logistics. Also, sustainable development considers economics, environmental and social dimensions for achieving long-term benefits. Moreover, lean concept aims to identify and eliminate all of wastes for improving business competitiveness. Thus, this paper reviews on three subjects in order to discover the factors which are connected to each other. Then, they can be integrated by identifying the linkage factors that the most important factors to combine these subjects. The linkage factors represent these subjects which have potential to integrate between sustainable development and lean concept on logistics activities for increasing competitive advantages.

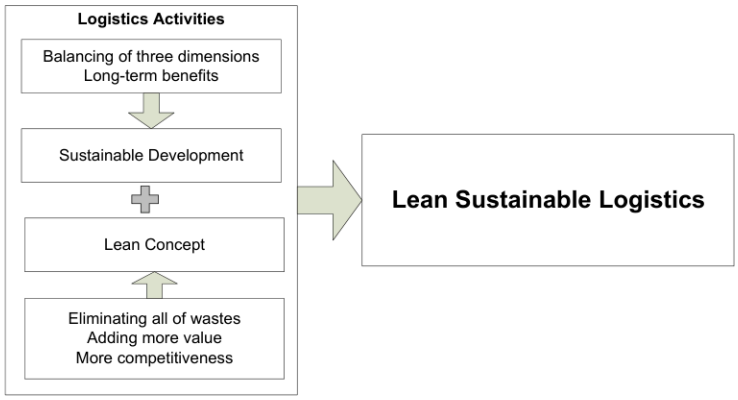

Figure 2: Concept of Lean Sustainable Logistics

Based on literature review, to integrate sustainable development, lean concept and logistics activities, the linkage factors are explored. The linkage factors are wastes that are classified into economics, environmental and social dimensions on each logistics activity, following as Figure 3. Wastes on economics dimension are identified by seven wastes that consist of overproduction, motion, waiting, over processing, transportation, inventory and defects. It mainly considers cost and time. In addition, environmental wastes refer to unnecessary resource usages such as energy, water, electric, and land including hazard waste. They affected environmental impacts. So, they have to be reduced on each logistics activity. Also, people wastes are categorized into two groups comprising of industrial context and community. On one hand, wastes on industrial context are underutilization of labor involving suppliers and employees. On the other hand, wastes on community consider health and safety of customer and community. So, these wastes are measured by people satisfactions that are affected social impact. Then, these wastes consider economics, environmental and social dimensions that used to identify on each logistics activity. Therefore, the linkage factors between sustainable development, lean concept and logistics activities are the sustainable wastes. They are important context to implement on lean sustainable logistics.

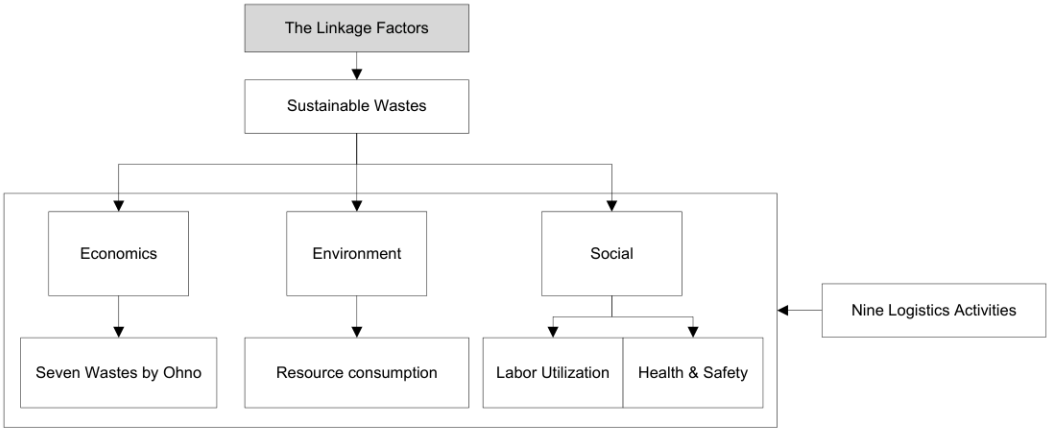

Figure 3: The Linkage Factors between Sustainable Development and Lean Concept on Logistics Activities

So, sustainable wastes are the linkage factors that are classified into economics, environmental and social dimensions on each logistics activity. They are the important factors to connect sustainable development, lean concept and logistics. Then, they are validated by statistical methods in the future research.

Conclusions and Future Research

This paper presents the integration concept of sustainable development, lean concept and logistics. Firstly, sustainable development considers balancing of economics, environmental and social dimensions for achieving long-term benefits. Secondly, under logistics context, this paper focuses on nine logistics activities. Finally, lean concept aims to add value creation by identifying and eliminating

all of wastes. So, these subjects are integrated by finding the linkage factors. They are the essential factors between sustainable development and lean concept on logistics activities. As a result, the linkage factors are the sustainable wastes based on literature review. They are classified into economics, environmental and social dimensions on each logistics activity.

The linkage factors have potential to integrate these subjects and transform into lean sustainable logistics. To implement lean sustainable logistics, sustainable wastes are identified and eliminated on each logistics activity. Then, they can be applied to modify tools and methods of lean for implementing lean sustainable logistics. These linkage factors will be validated by survey instruments in the future research. They are interviews and questionnaires by the logistics experts and green industries. Next, the linkage factors will be used in statistical methods to prove factors clearly. So, the linkage factors can be used to develop tools and methods of lean for implementing lean sustainable logistics.

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