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Logistic management of trailers based on the EPCIS standard: A cross-case analysis

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ABSTRACT

The efficient management of logistic operations at port terminals is vital in developing global competition and trade and distributing cargo across geographical borders. The application of standardized approaches improves the efficiency of logistic operations. This paper presents a conceptual framework based on the Electronic Product Code Information Services (EPCIS) standard for analyzing the efficiency of logistic operations at port terminals. The paper contributes to logistics research by studying time efficiency in the management of trailers and cargo at terminals based on the adoption of the international EPCIS standard. The literature was reviewed to establish a conceptual framework and a case study was then conducted regarding time efficiency in managing the export and import of trailers and transshipments of cargo between trailers at two port terminals in the United Kingdom and one port terminal in the Netherlands. The findings show that by adopting the EPCIS standard, port operators can improve logistic management efficiency, including the arriving, transporting, receiving, inspecting, outbound staging, loading, picking-up, unloading, re-packing, and shipping operations of trailers. This paper identifies how, when managing trailers at port terminals, applying a conceptual framework based on an international standard can improve logistical efficiency so that this management is consistent with the development of a global standard used to enhance planning, traceability, and safety in the port sector.

1. Introduction

Efficiency in logistic management at port terminals plays an important role in developing global competition and trade (Kennedy, Lin, Yang, & Ruth, 2011; Rodrigue & Notteboom, 2009). As a result of the development of global trade, ports must meet new requirements when providing value-adding services (De Martino, Errichiello, Marasco, & Morvillo, 2013; Demirbas, Flint, & Bennet, 2014) and specific transport-mode services (Panayides, 2004; Tongzon, Chang, & Lee, 2009). To comply with these increased requirements, it is essential to integrate ports into supply chains (SCs) (Pettit & Beresford, 2009) because ports constitute the interface between sea and land transportation (Mangan, Lalawani, & Fynes, 2008; Stopford, 2009). Many studies indicate that ports are important logistics nodes (Bichou & Gray, 2004; Pettit & Beresford, 2009; Wang, 2011).

Researchers have proposed integrating SCs based on standardized approaches as a strategy for business managers (Kher et al., 2010; Senneset, Midstraum, Forås, Vevle, & Mykland, 2010; Stopford, 2009). Stopford (2009), for instance, emphasizes the integration of land transport systems with logistics systems at ports and terminals based on the following: 1) the application of international standards for transport units; 2) investment in efficient integrated systems developed to move cargo between different transport modes; and 3) designing vehicles that comply with international transport unit standards. Monios and Bergqvist (2015) posit that the use of a standard would facilitate the management and administration of the concession process at intermodal port terminals. Furthermore, published studies show that the adoption of the international Electronic Product Code Information Service (EPCIS) standard enhances efficiency in logistics management operations (Ringsberg & Mirzabeiki, 2013), safety (Solanki & Brewster, 2014), and transparency in food supply chains (Kassahun et al., 2014). However, prior research indicates a lack of international standards to enhance efficiency in logistics management operations at port terminals (De Langen & Sharypova, 2013). This paper presents a conceptual framework to enhance time efficiency in the management of trailers and cargo at port terminals based on the EPCIS standard (GS1 EPC Global, 2014b). Logistic operations in the management of trailers and cargo at three port terminals are explored based on the business process step vocabulary of the EPCIS standard. The findings offer valuable insights to shipping and terminal managers seeking to increase efficiency by applying standardized approaches to enhance efficiency in the management of trailers and cargo at port terminals.

The remainder of the paper is structured as follows: the next section presents a brief overview of efficiency in logistic operations at port terminals and the adoption of the EPCIS standard. This is followed by a description of the applied methodology, including the conceptual

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framework. Next, the findings are presented and discussed before ending with a presentation of conclusions and future research suggestions.

2. Literature review

2.1. Efficiency in logistic operations at port terminals.

Efficiency is defined as "the ability to do something or produce something without wasting materials, time, or energy" (Merriam-Webster Online Dictionary, 2015). Companies in the maritime industry have begun to stress efficiency in logistic operations at port terminals to minimize operational costs and financial risks, improve service quality, and increase energy efficiency. According to Bichou and Gray (2004), logistic operations in cargo management at port terminals consist of planning, organizing, and monitoring of operations. Table 1 presents a conceptual framework to enhance efficiency in logistic port terminal operations based on the review of peer-reviewed papers and of logistic operations addressed by the business process vocabulary of the EPCIS standard (GS1 EPC Global, 2014c) (Table 1).

The need for efficiency in the management of cargo at port terminals results from the fact that companies in the maritime industry are sensitive to economic and market fluctuations (Moon & Woo, 2014). They must also meet regulatory air emission requirements, such as the European Directive (EC) 2005/33 on sulfur content in marine fuel (Directive [EC] 2005/33) and those of the International Maritime Organization, which estimate an increase in maritime CO_2 emissions of 50–250% before 2050 (IMO, 2014). In addition, the recent development of mega carriers in order to reduce the cost of shipping and greenhouse gas emissions (Kemp, 2015) has increased the demand for efficient logistics at port terminals. For example, due to the large volume being transported, mega carriers increase the loading/unloading time, as well as the risk of road congestion at port terminals. The use of megacarriers also increases the cost of the transshipment of cargo, the need for large terminal investments in IT and equipment, and damaged cargo (Kemp, 2015; Orestis & Papadimitriou, 2001).

Logistic operations efficiency at port terminals is difficult to estimate (Bichou & Gray, 2004; Kennedy et al., 2011) because it may be affected by contradicting economic interests (Bassan, 2007). To address logistic operations efficiency at port terminals, several researchers encourage measuring capacity and productivity based on time, costs, and the quality of customer service (Bassan, 2007; Kennedy et al., 2011; Moon & Woo, 2014; Sánchez et al., 2003). For example, Moon and Woo (2014) used a vessel's total time at a port (i.e., the duration of time between arrival and departure from the same buoy) to show increased efficiency based on reduced operational costs and GHG emissions. Notteboom (2006) supports these findings, positing that a delay in the ship's total time at a port due to inefficient logistic operations increases operational costs. Similarly, Mangan et al. (2008) present improved profit margins based on increased efficiency in logistic operations at ports. Meanwhile, Bassan (2007) asserts that the measurement of logistics efficiency should be based on the terminal capacity or berthing facilities at ports (i.e., the total amount of cargo processed or distributed annually).

Performance indicators used in measuring the efficiency of logistic operations at ports can be divided into two main categories: macro- or micro-performance indicators (Bichou & Gray, 2004). Macro-performance indicators refer to measurements of ports' logistics efficiency in an SC based on impacts on GDP (UNCTAD, 2013; Paik & Bagchi, 2000; Sánchez et al., 2003), the infrastructure of the port regions (Suárez-Aleman & Hernández, 2014), and global trade (Mangan et al., 2008; Sánchez et al., 2003). In comparison, micro-performance indicators include measurements of ports' logistics efficiency in an SC based on the input/output ratio at port facilities (e.g., wharfs, berths, and terminals) or the flexibility of liner-shipping services (Bassan, 2007; Bichou, 2006; Suárez-Aleman & Hernández, 2014). Measures of efficiency in logistic operations include the following: impacts on costs and time while loading/unloading cargo, a vessel's service time at a port (Bassan, 2007), the accessibility of the port, and the agility of

Table 1
Logistic operations and business process steps in trailer management at port terminals.

Logistic operation, port terminal	Reference	Business process step, EPCIS Standard*	Definition
Hauling	Kennedy et al. (2011); De Langen & Chouly (2004); Carbone and De Martino (2003)	Shipping	Indicates a final event according to outbound staging, loading, and departing operations.[a]
Towing	Carbone and De Martino (2003)	Transporting	Specifies an activity in business process of moving of an object from one location to another using a vehicle.[a]
Forwarding	De Langen & Chouly (2004)	Departing	Specifies an activity in the business process in which an object leaves its location on its way to a destination.[a]
Storing	Kennedy et al. (2011); Bassan (2007); De Langen & Chouly (2004); Carbone and De Martino (2003); UNCTAD (2013)	Outbound staging	Specifies an activity in the business process in which an object moves from a facility to an area where it will await transport pick-up.[a]
Unloading	Bassan (2007); De Langen & Chouly (2004), Sánchez et al. (2003); Carbone and De Martino (2003)	Unloading	Specifies an activity in the business process in which an object is unloaded from a shipping conveyance.[a]
Loading	Bassan (2007); De Langen & Chouly (2004), Sánchez et al. (2003); Carbone and De Martino (2003)	Loading	Specifies an activity in the business process in which an object is loaded onto a shipping conveyance.[a]
Inspecting	Bassan (2007)	Inspecting	Specifies an activity in the business process of reviewing objects to address potential physical or documentation defects.[a]
Assembling	De Langen & Chouly (2004),	Assembling	Specifies an activity in the business process whereby one or more objects are combined to create a finished product.[a]
Re-packing	De Langen & Chouly (2004); UNCTAD (2013)	Re-packing	Specifies an activity in the business process in which an object's packing configuration is changed.[a]
Consolidate	De Langen & Chouly (2004)	–	Specifies an activity in the business process that brings together (separate parts) into a single or unified whole; unite; combine.[b]
Picking	–	Picking	Specifies an activity in the business process that includes the selecting of objects to fill an order.[a]
Receiving	–	Receiving	Specifies an activity in the business process indicating that an object has been received at a location and added to the receiver's inventory.[a]
Arriving	–	Arriving	Specifies an activity in the business process in which an object arrives to a location.[a]

[a] *GS1 EPC Global, 2014c.*
[b] *The free dictionary, 2015.*