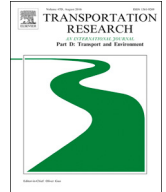




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Dynamics of supply environment and information system: Integration, green economy and performance

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ABSTRACT

The resource wastage in supply chains may be reduced by proper supply chain integration (SCI). SCI may be able to provide the additional means in assuring economic growth while protecting the environment. The hauliers provide the primary linkage between shippers and consignees and logistics service providers in the inland container supply chain. This empirical investigation aims to ascertain the supply environment factors and information system which affect SCI and whether SCI affect operational and environmental performance. Data collected from 110 haulier companies were analysed using partial least squares, structural equation modeling (PLS-SEM) methodology. Supply environment which represents transaction attributes affects SCI which in turn positively affects operational and environmental performance. Information system reduces information asymmetry between transacting organizations and by this, moderate the effect of supply environment on SCI. Results provide evidence that SCI is dependent on the context of the supply environment. Opportunistic behavior due to information asymmetry could also be curtailed by proper information system. Therefore, practitioners and stakeholders need to align SCI to the context of supply environment to reap the maximum benefit of SCI. Concurrently, opportunistic behavior needs to be curtailed in supply chain to improve operational and environmental performance.

1. Introduction

The bottlenecks between technological separable interfaces in a supply chain lead to the wastages of resources. One possible way of reducing these wastages and furthering sustainable development is through supply chain integration (SCI) (Green et al., 2008; Singh et al., 2016). The efficient transfer or exchange of goods, materials or services between organizations when they transact in a supply chain may help reduce the wastages of resources. Evidence suggests that SCI relates to better organizational performance (Panayides and Song, 2008; Leuschner et al., 2013).

Global supply chains are the backbone of international trade and commerce (Arvis et al., 2014). An important element to the global supply chains are the container supply chain of the participating countries. The global container supply chain is the driver for economic globalization (Bernhofen et al., 2012) which handled 16.1% of global freight movement in 2015 [1]. The inefficient logistics reduces the potential for global supply integration (Arvis et al., 2014). Findings suggest that the well-connected linkage between the hauliers and depots increases national logistics performance (Wong et al., 2016) which affects global container supply chain. This study investigates the SCI between inland container hauliers (hauliers) and empty containers depot operators (depots)

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which is one of the principle components in the container supply chain.

The main actors in this study are the hauliers as they provide the primary linkage in container supply chain. The container supply chain has its problems and one of the most pressing issues is the delays in the pick-up and drop-off of containers at the depots. Trucks waiting to be unloaded or loaded are one of the main causes for the inefficient use of resources (Fearne and Fowler, 2006). Similar waiting time problems are faced in sea port operations as well (Cheon and Deakin, 2010). The same perennial problem is faced in the linkage between the depots and hauliers (Wong et al., 2016). This problem increases the operating cost and therefore the haulier's organizational performance (OP) is affected.

From the environmental front, road transportation is one the most significant contributors emitting CO₂ impacting the environment (Wadud et al., 2008) and is the only sector that has increased its emissions yearly (European Commission, 2009; UIC, 2009) which contributes one fourth of all green-house-gas (GHG) emission (Stead, 2006). Sadegehi et al. (2010) found that emissions from the transportation sector are inclined to increase continuously and will play a central role in reducing GHG emissions. Improvement in the efficiency of logistics network and transportation processes may have the potential in reducing GHG emissions while sustaining economic growth (Leonardi and Baumgartner, 2004). Scholars have suggested various strategies in reducing truck emissions in the container supply chain (Giuliano and O'Brien, 2007) which includes “virtual” container yards (Chang et al., 2008) and terminal appointment system (Namboothiri and Erera, 2008). However, there is no evidence that appointment system reduces queuing or transaction times and reduces truck emission (Giuliano and O'Brien, 2007). SCI may provide another avenue to reduce truck waiting and queuing time. A stronger SCI between the hauliers and the depots may lead to the reduction of waiting and queuing time of the hauliers at the depots and subsequently minimizes the use of resources such as diesel and GHG emissions.

The exchange of containers between depots and hauliers has been known to cause long queues and waiting time of prime movers at the depots (AMH, 2016). The loading or off-loading time normally exceeds 45 min and in most cases up to 2 h (AMH, 2016). Besides this, other operational issues at the depots, such as containers are not ready, container seals not provided, non-acknowledgement when a container is not available, and the inability to provide the correct type of container in a timely manner are common. These problems increase the monitoring and operating cost, and the productivity of prime movers deteriorates due to this. Above all, the service levels are also affected. This study investigates the haulier-depot interface which causes long queues of prime movers at the depots. These problems are; (i) hauliers are not able to achieve the targeted trips, (ii) more prime movers are required to handle the same volume of containers and hence more resources are required, (iii) drivers wages are affected, (iv) increase in GHG emissions by the prime mover engines and (v) delays in container delivery to the customers.

The above discussion prompts 3 questions. (1) Does the supply environment of the depots affect SCI between depots and hauliers? (2) Does SCI between hauliers and depots affect the haulier's organizational performance? and (3) Does information system interface between transacting organizations moderate the effect of supply environment on SCI?

In summary, this research investigates the factors of supply environment of the depots which affect SCI between the depots and hauliers and subsequently how SCI affects the haulier's organizational performance. This paper is organized as follows, Section 2, literature review; Section 3, methodology; Section 4, results and Section 5, research findings and discussion.

2. Literature review

2.1. Theoretical foundation and conceptual framework

The predicted relationships between the variables are based upon Transaction Cost Economics (TCE). The supply environment contains four dimensions (Cannon and Perreault, 1999). These are supply dynamism, availability of alternatives, supply importance and supply complexity. These four dimensions of supply environment embody TCE's transaction attributes. Supply dynamism represents the uncertainty, supply importance and availability of alternatives represents asset specificity and supply complexity represents the complexity aspect of TCE. Of the four attributes of TCE (Williamson, 1989; Shelanski and Klein, 1995), the frequency of transaction has been intentionally set aside as it was not applicable in this study context.

The role of SCI can be seen “where transaction occurs when good and service is transferred across a technologically separable interface. One stage of activity terminates and another begins” (Williamson, 1989). Williamson (2008) also suggests, that “transactions which differ in their attributes, are aligned with governance structures, which differ in their adaptive strengths and weakness, so as to accomplish a transaction cost economizing result”. Based on these suggestions, the SCI aspect of this study addresses the interface of exchange of containers between the depots and hauliers. The most economizing transaction way and its accompanying cost will affect organizational performance. As such, supply environment will affect SCI and SCI subsequently affect organizational performance of the hauliers.

TCE assumes that humans as agents to an economic organization have bounded rationality, opportunistic and are likely to distort information to gain higher rents from the transaction (Williamson, 1989). Bounded rationality of the humans as agents to the organizations is due to the lack of information (Williamson, 1989), hence a well-established information system may enable buyer and seller to acquire, gather and process information more quickly and efficiently to make better judgment on the transaction (Brown et al., 2009). Hence, it could be said that information system helps to increase the rationality in making transaction decision. Information asymmetry can be a source of rents in which due to it, transacting organizations may be tempted to be opportunistic (Patnayakuni et al., 2006). This study proposes the theoretical framework in Fig. 1.

The definitions of research constructs used in this study are described in Table 1

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