

Applicability of Lean and Green Concepts in Logistics 4.0: A Systematic Review of Literature

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Abstract - Sustainability is emerging as a main consideration throughout the industrial world due to the environmental pollution and degradation happening in a major scale as a result of industrial wastes while lean management is becoming a popular management tool in minimizing waste. Logistics industry contributes for these issues due to the wastes released in a considerable amount. Experts have highlighted that implementing lean principles in parallel to green concepts is more successful; which could lead to waste and cost reduction. A theoretical gap has been identified in the field of logistics in applying lean and green concepts in the context of Industry 4.0. A comprehensive literature review was conducted to address the identified research gap with the objective of examining the important lean practices and green concepts which are expected to enhance the operational performance of logistics functions. A key word based search, analysis of the topic and abstract, full text review were the steps followed respectively, for selecting the most relevant research papers which have been proven as valid, accepted and published to extract the knowledge for this study. As the major contribution, authors have developed a conceptual framework which focuses on the enhancement of operational performance of logistics operations by applying lean and green concepts with special reference to Industry 4.0 technologies. The results of the study will be beneficial for the LSP as it will suggest the strategies, concepts and techniques to enhance the operational performance of logistics functions.

Keywords: *Green Concepts, Industry 4.0, Lean Management, Logistics, Operational Performance*

I. INTRODUCTION

Logistics plays a major role in supply chains for integrating the material, information and financial flows among the different parties by performing functions such as transportation, freight forwarding, warehousing and distribution. Most of the logistics services are outsourced by the other businesses for gaining cost advantages and for delivering a proper service to their customers [1]. Therefore, Logistics Service Providers (LSPs) are having an increasing demand for their services in the industrial world. Hence, it is vital for LSPs to focus on the enhancement of the operational performance in order to provide a better service and to cater the increasing demand while being sustainable and competitive enough in the business.

Lean management focuses on minimizing different kinds of wastages to enhance the operational performance. Although most of the current manufacturing industries use the lean management concepts to a considerable extent, it is rarely seen in service sectors. Yet lean concepts can be applied to have benefits in service sector. The study will focus on applicability of lean concepts for the transportation

services and warehousing facilities offered by the third party (3PL) / fourth party logistics (4PL) service providers. Techniques, methods or processes based on lean concepts to minimize different kinds of wastes of transportation services and warehousing facilities will be identified [2].

Sustainability is emerging all over the world and it is becoming a vital factor for any business. Managing the waste in an environmental friendly manner while considering the sustainability of the business and community is important. The most applicable green concepts to the logistics services which are practiced in different industries will be identified through the study [3]. Realizing Industry 4.0 is becoming a critical factor for almost all the manufacturing industries existing in the world. The current manufacturing facilities which are established all over the world have to deal with critical problems which directly affect the efficiency and the profitability. Low cost-labour is becoming a rare resource to an extent which using machinery is more profitable while depending on human labour is becoming a threat due to the mass customization requirements high product quality expected by customer. Advanced technologies are trending in manufacturing industries as solutions for above-mentioned issues which lead the industries towards Industry 4.0. Importance of integrating new technology in all aspects of industry such as manufacturing, warehouse controlling and logistics is highlighted by experts to proceed further in achieving Industry 4.0. The role of logistics is critical in this scenario as inbound logistics affect the manufacturing products on time while outbound logistics affect the on time delivery and customer satisfaction. Developing suitable technologies and using advanced technological components in logistics activities along with integrated logistics systems are important in realizing the level of Industry 4.0 [3].

The study will focus on applying lean concepts for minimizing wastes generated in logistics operations and green concepts which are relevant to all three aspects: people, profit and planet; for sustainable logistics practices. Concentrating on the implementation of lean and green concepts simultaneously in logistics operations, with the objective of enhancing the operational performance is the uniqueness of this study. On top of that, suggestion of suitable Industry 4.0 technologies to execute proposed lean and green concepts successfully in a digitalized industrial setting, amplifies the novelty of the study. Finally identified lean and green concepts will be integrated along with the emerging technologies in the context of Industry 4.0 to enhance the operational performance and the sustainability of the transportation services and warehousing facilities offered by the LSPs.