

# Combining Industry 4.0 with Lean Healthcare to Optimize Operational Performance of Sri Lankan Healthcare Industry

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**Abstract** — Healthcare is one of the industries that requires the highest quality services for the wellbeing of the society. Today, the demand for healthcare growing rapidly with increasing aging population, rapid urbanization, changing diets, inactive lifestyles and rising obesity levels. The Industry 4.0 technologies and lean techniques can be used to enhance the operational performance of the healthcare supply chain and the patient flow. This paper examines the factors contributing for the inefficiencies in Sri Lankan Healthcare sector and how the operational performance can be optimized through pre-medical diagnosis of diseases by incorporating Industry 4.0 technologies and lean techniques. Based on a systematic review of literature and feedback of healthcare professionals, the paper identifies the inefficiencies in the current healthcare system. A conceptual framework has been developed by considering the direct impacts from lean management practices and Industry 4.0 technologies on improving operational performance through pre-medical diagnosis of diseases.

Thus, patients can take preventive actions and be more health conscious while the healthcare providers and other related parties can plan their medical services and supporting services for arising health requirements making the healthcare industry much more efficient.

**Keywords**— Healthcare, Lean Management, Industry 4.0, Operational Performance, Pre-medical diagnosis of diseases

## I. INTRODUCTION

Industry 4.0 is an industrial concept which influences individualization and virtualization across different industrial domains where most companies and operations tend to be service oriented rather than product oriented[1].

It is not a well-known concept in the Sri Lankan manufacturing or service sectors. This is mainly due to the lack of infrastructural facilities and knowledge base required for the implementation of Industry 4.0. However, Industry 4.0 technologies are widely used in many developed countries.

Industry 4.0 is the current trend in automation and data exchange in manufacturing technologies. Industrial revolution started from factory production using steam power, water power and mechanization (Industry 1.0) and then moved into mass production, assembly line and electricity (Industry 2.0). The third industrial revolution started with computerization and automation. The fourth is the move towards digitization.

The four key components in Industry 4.0 are Cyber-Physical Systems (CPS), Internet of Things (IoT), Internet of Service (IoS) and Smart Factory[2]. In the smart factories the CPS monitor the physical processes of the factory and

make decentralized decisions. The physical systems become IoT, communicating and cooperating both with each other and with human in real time via wireless web[3].

When Industry 4.0 is applied in the healthcare sector, it is known as Health 4.0[4]. Some of the applications of these technologies in the healthcare sector are, connecting sensors and body area networks where doctors can access patient data online using internet independent of the patient's location for disease management, smart pharmaceuticals, networks connecting general practitioners, nurses, patients, pharmaceutical companies etc., personalized medicine and patient centered care. With these new technologies combined with the healthcare industry, a number of benefits such as, maximum resources usage and efficiency, access to real time data when making strategic decisions, efficient maintenance, new product development, customization of products to meet the customer demand and competitive advantage over competitors can be achieved.

Lean is a set of tools and techniques for improving processes. Lean production is about doing more with less by eliminating non-value adding activities from production processes to maintain the efficiency, flexibility and profitability[5]. With Industry 4.0, new technologies are available for combining automation technologies with Lean production to achieve maximum productivity with the minimum resources available, by promoting the continuous improvement in the process. Lean healthcare implies evaluation of processes specifying the value desired by the user, identifying the value stream, eliminating non-value added steps and making the value from beginning to end based on the needs of the patient.

With lean healthcare, the operations of the healthcare systems can be optimized by reducing wastage, improving the value adding activities while enhancing the overall operational performance. Management of the operational performance in a timely manner is a critical function in an organization, whether it is a manufacturing or a service oriented business where you manage the processes of manufacturing a product or delivering a service by effectively utilizing the resources.

The unhealthy lifestyles have become the source to many of the Noncommunicable Diseases (NCD) like heart diseases and diabetes. Nowadays, these diseases spread among the younger generation without being diagnosed. There's a higher prevalence of NCD among urban inhabitants than rural inhabitants in Sri Lanka. Each year, nearly 38 million people die from NCD in the world, mainly due to cardiovascular diseases, diabetes, cancer and chronic respiratory diseases[6]. With the higher demand for