

Chapter 20

A Comprehensive Review on Advanced Maintenance Strategies for Smart Railways

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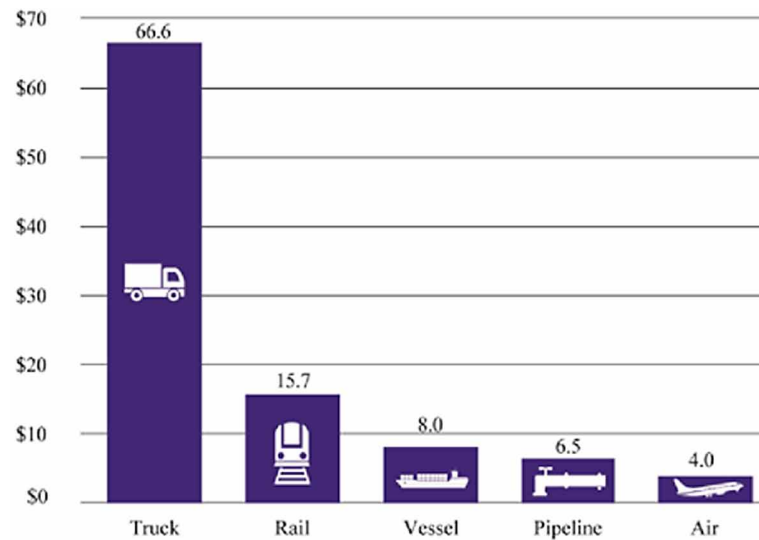
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ABSTRACT

Recently, energy efficient and sustainable supply chain has attracted a great deal of attention. To achieve sustainability, it is of paramount importance to use environmentally friendly procedures in each stage of the supply chain including suppliers, production/manufacturing, and transportation. Transportation plays a critical role in supply chain since the suppliers and customers are typically distributed in large geographical areas. Nowadays, railway is considered as a primary mode of transportation. Railways are considered as complex systems that are subject to degradation and failures. To avoid failures, tremendous efforts should be invested on preventive maintenance (PM) for performing optimal maintenance actions. Proper PM actions such as condition-based maintenance (CBM) play a major role in keeping the supply chain from crumbling down and working with high efficiency. This chapter reviews promising research works in the application of state-of-the-art CBM strategies that contribute to the advancement of smart transportation system via fault diagnostics/prognostics.

Figure 1. North American freight by mode of transportation (“Bureau of Transportation Statistics,” n.d.)



INTRODUCTION

It is widely accepted that transportation plays an undeniably critical role for uneventful operation of supply chain networks. Considering the fact that transportation is one of the main sources of environmental pollution within the supply chains (Wu & Dunn, 1995), it is significantly important that the transportation logistics and planning agencies devise innovative, economic and environmentally friendly transportation solutions. Although trucking remains the major and dominant mode of freight transportation due to its high accessibility, shifting freight away from trucks is more appealing from economic and environmental points of views considering the desire to reduce the overall carbon emissions. Potential shift to more efficient and safe modes of transportation such as trains addresses the issues related to increasing costs associated with maintenance of highway infrastructure, pavement damage, the cost of fuel, and specially carbon emission. Therefore, nowadays railways are considered as the dominant and popular alternative mode of transportation to trucking. For instance, in the United States (“Bureau of Transportation Statistics,” n.d.), railways are one of the major modes of freight transportation constituting the largest network within any single country at 140,000 miles of Class 1 tracks. The network is predominantly focused on freight traffic with the exception of key passenger corridors along the eastern seaboard and in the upper Midwest. According to recent North American freight statistic shown in Figure 1, railways are the second largest mode of transportation after trucking, moving \$150 billion or 14.5 percent of imports and exports during January 2018 to October 2018. Such statistics, therefore, increase the pressure on railways to maintain a high level of quality service during their operation.

Railway networks (RWN) consist of multiple complex mechanical and electrical systems with hundreds of thousands of moving parts. The embedded components and equipment deteriorate over time since they are operating under certain stress or load in the real environment. In order to make the railway systems more reliable and safer, the railway network must be monitored and maintained continuously over time. If proper maintenance actions are not taken into consideration in due time within the operation of railway transportation systems, catastrophic failures could occur leading to a variety of severe

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