PROPOSAL FOR THE 9TH IFAC TRIANNUAL CONFERENCE ON MANUFACTURING MODELING, MANAGEMENT AND CONTROL (MIM 2019) INVITED SESSION, BERLIN GERMANY.

PANEL DISCUSSION

TIME SLOT: 90 MINUTES

THEME: MANUFACTURING MODELING, MANAGEMENT AND CONTROL: DIGITAL, RESILIENT AND SUSTAINABLE MANUFACTURING 4.0

TITLE OF SESSION: APPLICATIONS OF THE 4TH INDUSTRIAL REVOLUTION IN RAIL MANUFACTURING

1. Summary and Background to the Session

The quest for a robust industrial revolution has triggered innovation advances in the area of Industry 4.0 relating to automation and robotics (Mikusz, 204; Zhang *et al.,* 2017) Additive Manufacturing (AM) and 3D printing (Reidl *et al.,* 2014; Bordel *et al.,* 2017), Cyber-Physical Systems (CPS), Physical Internet (PI) and Internet of Things (IoT) in the logistics and transportation area (Meech and Paireira, 2011; Merat and Waard 2014) as well as Artificial Intelligence (AI) and digital solutions in the informatics field (Bostrom 2014; Klumpp 2017a). These have brought about a tremendous growth and innovation potential for global value chain setups. The proposed special session will focus on the application of the Fourth Industrial Revolution (4IR) characterized by emerging digital technologies and cyber physical systems in solving some challenges in the rail car industry. For instance, Artificial Intelligence (AI) find applications in process planning and optimization, decision making, system control as well as pattern recognition involving automatic incident detection, image processing for traffic data collection and for identifying cracks in rail structures (Armstrong *et al.,* 2016; Silver et al., 2017). The rail car manufacturers are increasingly testing the potential of additive manufacturing (AM) to break creative barriers within the three major trends driving the industry namely product innovation, high-volume direct manufacturing and fuel efficiency with increased performance (Kosir and Strle 2017; Klumpp 2017b). Also, the use of monitoring systems will help in diagnosing the technical conditions of the various components of a rail car, and its tracking using the online mode (in real time) enhance the maintainability and reliability of the rail car system (Montreuil 2011; Gunsekaran and Ngai 2014; Zhang *et al.,* 2014). In response to these industry challenges, digital signaling and rail car control solutions are able to offer significant passenger and freight benefits at a lower cost, relative to wholly conventional based solutions (Frazzon et al., 2013). Various emerging technologies driving the Fourth Industrial Revolution and the breadth of their impact necessitate the development of innovative approaches that will ensure smart and just-in-time manufacturing of a rail car system.

Keywords: Additive Manufacturing, Digital solutions, Optimization, Rail car, Robotics

2. Purpose and Relevance

Robotic solutions for assembly, maintenance and repair applications in the railway maintenance is essential for performing activities such as welding, grinding, cleaning, and painting. In the same vein, artificial intelligence can be explored in a rail car manufacturing for nonlinear prediction relating to traffic demand, the deterioration of rail infrastructure as a function of traffic, construction, and environmental factors. In addition, the 3D multi-material printer will open up new design possibilities that would help meet the challenges. Also, the use digital solutions in rail car manufacturing as well as monitoring systems with low-cost sensor networks and smart algorithms are always needed due to the increasing need for cost effectiveness, process improvement, reliability and safety in the railway industry.

3. Expected Outcome

The Fourth Industrial Revolution can be applied to solve problem as they can provide satisfactory and acceptable solutions for many complex problems in the rail industry. If adequately deployed, it has the potential to revolutionize the operation of rail car systems, leading to a transformation in the smart development of rail car system as well as maintainability and reliability of the rail car. In doing so, the proposed special session will deliver benefits to the rail industry and users as well as the wider economy, including the presentation of innovative approaches that could increase capacity and capability of the rail car system in meeting the customers' requirements, improve the rail car system performance and enhance the safety of rail car passengers and workers. This means that while the rail industry will be able to save cost considerably at increased efficiency and delivery; many passengers will be able to enjoy less crowded, more frequent and more reliable rail car than they experience today.

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