Six-Sigma and Industry 4.0: a Synergy

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Abstract

The six-sigma methodology has been proven effective for complex problem-solving to reduce product and process variability. However, lately its popularity has been overshadowed by digitalization and technology-based initiatives, Industry 4.0. Some maybe asking whether Industry 4.0 is replacing the six-sigma methodology, or it is complementing each other. This presentation aims to clarify this confusion by promoting Industry 4.0 technologies as the enablers, and the six-sigma methodology is as a pathway in moving forward. It begins by revisiting and comparing between the six-sigma methodology and the Industrial 4.0. The six-sigma problem solving phases namely, Define, Measure, Analyze, Improve and Control (DMAIC) are highlighted. The extension of Six-sigma into Lean Six-sigma (LSS) is elaborated where the lean system focuses on waste reduction while the six-sigma focuses on variation reduction. Waste attributed to overproduction, overprocessing, unnecessary movement (motion), inventory and wasted waiting are related to poor productivity. The enabling technologies for Industry 4.0 such as cyber physical system, internet of things (IoT), robotics, big data, cloud manufacturing and augmented reality have extended the manufacturing system beyond its traditional boundaries. Meanwhile, the tools and techniques of the six-sigma methodology including the traditional statistical techniques need to be enhanced and digitalized. Considering data as the new gold in the era of Industry 4.0, the presentation emphasizes the importance of industrial measurement system where real time data collection and continuous online monitoring enable real time decision making. The integration between the six-sigma methodology and Industry 4.0 could be promoted and popularized through the framework of Quality 4.0. In Quality 4.0, industrial sensors play an important role to enable devices to get connected among themselves. Devices are interacting each other which lead to real time data lake, information transparency, predictable and self-adaption. Sensors are embedded in devices to enables real time analytics. Machine learning and pattern recognition technologies are integrated with the traditional statistical process control for self-diagnosis and real time decision making. As such, it is critical to have effective alignment between these complementing methodologies where the six-sigma methodology prepares a pathway and the Industry 4.0 provide enabling technologies toward achieving defect-free quality (3.4 defects per million opportunities). The synergy between these two powerful methodologies is expected to facilitate Industry 4.0 adoption which will finally benefit the society.

Keywords
Six sigma, Industrial 4.0, Synergy, Quality 4.0

Biography

Adnan Hassan is an Associate Professor in the School of Mechanical Engineering, Universiti Teknologi Malaysia (UTM). He is a Professional Technologist (Ts) registered with the Malaysia Board of Technologist (MBOT). He earned B.Sc. (Hons: Cum Laude) in Industrial Engineering from the University of Miami, Florida, U.S.A (1986), M.Sc. in Industrial Measurement Systems from Brunel University London, U.K. (1992), and Ph.D. in Mechanical Engineering from UTM (2002). From 2006 to 2009, he was the Head of Manufacturing and Industrial Engineering Department at UTM and from 2009 to 2011 he was the Chairman of Industrial Engineering Department, King Abdulaziz University, Rabigh, Saudi Arabia. His research interests include lean six sigma, quality engineering, pattern recognition for process monitoring, and supply chain. He is a professional member of the IEOM Society International.