

Human Centered AI Automation Framework for Sustainable Smart Manufacturing: Enhancing Production Intelligence While Preserving Workforce Sustainability in Industry 5.0

A. K. I. U. Aththanagoda

Faculty of Computing, Sabaragamuwa University of Sri Lanka, Sri Lanka

akiuaththanagoda@gmail.com

Abstract

The growing adoption of artificial intelligence, industrial Internet of Things and smart manufacturing technologies is improving production efficiency and operational intelligence while changing how workers interact and communicate with intelligent systems. However, existing automation approaches often prioritize productivity and process optimization with less attention to workforce sustainability, human involvement and long-term human AI collaboration. This research proposes a human centered AI automation framework for sustainable smart manufacturing within the Industry 5.0 paradigm, with particular attention to human AI communication, digital interaction and collaborative decision making. The framework integrates AI, IoT, predictive analytics, computer vision and real time decision support to support human capabilities rather than replace workers. Production, machine and workforce related data will be considered to support resource utilization, identify potential operational disruptions, balance workloads and assist human decision making. The framework will be evaluated using technical performance measures and workforce related assessments. A Human AI Collaboration Index will be developed to assess workforce acceptance, trust, communication effectiveness, collaboration quality and sustainable productivity, providing a structured measure of human AI collaboration. A mixed method approach will be employed, combining quantitative operational and production performance measures with qualitative assessments of workforce interaction, communication, trust and acceptance. Quantitative data will be analyzed using appropriate descriptive and inferential statistical procedures while qualitative data will be examined through thematic analysis to identify patterns related to human AI interaction and workforce sustainability. Framework validation will be conducted in two stages, component level testing of the proposed AI and decision support functions followed by integrated evaluation against predefined technical, communication and human centered criteria. The expected outcomes are evidence regarding the potential of the framework to support production intelligence, efficient resource utilization, workforce engagement, operational resilience and sustainable human AI collaboration. Rather than assuming these benefits before empirical validation, the study will examine their potential through the proposed evaluation process. The research contributes to Industry 5.0 by connecting AI enabled manufacturing with human AI communication and digital interaction while providing a human centered approach for evaluating collaborative automation and workforce sustainability.

Keywords: *Human Centered AI, Human AI Communication, Smart Manufacturing, Industry 5.0;, Workforce Sustainability*