Innovation based on sensor architecture

Industry 4.0 (I4.0), also known as the Fourth Industrial Revolution, Advanced Manufacturing, or Smart Industry (Silva et al., 2019; Sacomano et al., 2019), provides important innovations in traditional manufacturing processes through the application of smart technology (Karmaker et al., 2023). This marriage between the old and the new creates a more simplified and efficient system, whose operation is heavily based on data.

Research in production management has focused on the possible impacts of technologies linked to the I4.0 phenomenon, with several studies on the interaction between technologies and activities relevant to Production Management. In the area of PCP, for example, there are studies on the impacts of I4.0 technologies on systems such as ERP, Just in Time (JIT), and TPC (Farhang, Ehtesham, Gharakhani, 2023; Saad et al., 2023). All other production management activities can benefit from the innovations provided by digital technologies, which can positively impact any of the five variables associated with production systems, whether in terms of cost, quality, deadlines, flexibility, and/or reliability (Geng et al., 2024; Hsieh, 2023).

I4.0 is strongly interconnected with data flows from sensors and smart machines installed in industrial facilities. Failures can disrupt production and lead to malfunctions in the supply chain ecosystem. Therefore, maintenance strategies are necessary to safeguard the continuous operation of production lines, minimize supply chain disruptions, and improve sustainability indicators (Mallioris, Aivazidou, Bechtsis, 2024).

Connections between people, objects, and systems form dynamic, self-organizing networks, managed in real time, which promotes greater autonomy for production systems. Decision-making skills can be transferred from an organized, hierarchical system to a decentralized system, with decisions made autonomously or semi-autonomously by the network of machines, equipment, operators, and mobile devices. On the other hand, supply chain management activities may face new challenges. Increased data volume and real-time availability require new infrastructures and approaches to handling information.

In this context, production management systems can be directly impacted by these new technologies (Farajpour et al., 2022; Govindan et al., 2022). Thus, the set of data obtained, both from internal processes and the external environment, has become one of the most valuable assets for any company seeking to gain a competitive advantage in the industry (Javaid et al., 2022; Taranto-Vera et al., 2021). Companies seek to exploit available data to make data-driven decisions and achieve gains in productive performance and market

performance (Zeng et al., 2022; Abou-foul et al, 2021; Verhoef et al, 2021; Saleem, et al, 2020).

Sensor network technology is essential for various industries, providing vital information on parameters of interest to control and improve production processes. In this regard, sensor manufacturers have made steady progress in the accuracy, reliability, response times, robustness, miniaturization, communications, and efficiency of sensors with the spread of sophisticated electronic control systems. Thus, today's sensors enable possibilities for innovation and technological advances in Industry 4.0.

I4.0 integrates the various physical operations of “cyber-physical environments” through calculations based on data provided by device architectures, which can be quite complex. These architectures can use sensor networks, increasing their performance, functionality, and application flexibility. Sensor networks provide real-time information to managers, developers, and engineers in support of production management, and can improve any of the five variables associated with production systems, whether in terms of cost, quality, lead time, flexibility, and/or reliability.

Sensor network technology is essential for various industries, providing vital information on parameters of interest to control and improve production processes. In this regard, sensor manufacturers have made steady progress in the accuracy, reliability, response times, robustness, miniaturization, communications, and efficiency of sensors with the spread of sophisticated electronic control systems. Thus, today's sensors enable possibilities for innovation and technological advances in Industry 4.0.

This letter to innovators offers a glimpse of the innovations resulting from the fusion of sensors and associated concepts, offering options for flexible fusion system architectures that allow the exploration of fusion potential in a given environment, especially for the I4.0 environment and its cyber-physical systems.

Any effort to design fusion systems should therefore be to explore the spectrum of possibilities for a given application before deciding on a specific approach. A combination of these fusion opportunities may indeed be the answer in any I4.0 application.

The effort to design the fusion system should be to explore the scope for increasing the benefits of fusion through feedback from the centralized fusion processor.

Ensuring that the fusion system architecture has the ability to integrate contributions from local decision makers who may not have the full range of

decision choices faced by the global decision system are prerequisites for an innovative sensor architecture.

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Further Reading

Silva, O.R., Silveira, M.A. (2024). Inovação com base em arquiteturas de fusão de sensores na indústria 4.0. International Journal of Scientific Management and Tourism: https://doi.org/ 10.55905/ijsmtv10n6-020

Tang, Q., Liang, J., & Zhu, F. (2023). A comparative review on multi-modal sensors fusion based on deep learning. Signal Processing, 213(1), 109165. https://doi.org/ 10.1016/j.sigpro.2023.109165