Integrating IoT, AI, and Data Analytics in Food Machinery Production: A Digital Innovation Model for SMEs

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ABSTRACT

The Tecnomulipast case study of a Southern Italian, small firm in the food processing machinery manufacturing industry exemplifies the company's planned digital renewal, made possible by managerial practices founded in innovation and backed by regional co-financing programs, such as those of Regione Puglia. At the heart of the change is the integration of a new Industry 4.0-compatible laser welding system into the company's infrastructure of ERP. Based on Internet of Things (IoT) technology, the system receives, transmits, and makes available both batch-level and real-time visual observations, creating a cyber-physical space for high-end manufacturing. Underpinning the change is a data analytics capability that can process both sensor measurements, KPI, as unstructured data, i.e., images, to facilitate monitoring in real-time, early anomaly, and workflow optimization. Scalable in engineering, the architecture makes possible the integration of artificial intelligence (AI) in the future to augment decision-making by predictive as well as prescriptive analytics. Beyond the overhaul of the technology, the change from the old to the new industry paradigm, Industry 4.0, was supported by a strategic model of managerialism that emphasizes organizational agility, data-driven governance, and continuous learning. Tecnomulipast's case provides the template for replicable emulation by SMEs, in general, and by companies in the digitally under-served regions, in the first instance, to demonstrate how targeted investment, leadership by innovation, and system-level integration can narrow the gap in the distance from technological capacity to operational performance in the move to Industry 4.0.

Keywords: Digital Transformation, Industry 4.0, Innovation Management, IoT in Manufacturing, Smart Manufacturing