Extended Abstract

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Intelligent manufacturing: A comparative study cross regional borders

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Abstract:

With the ever increasing market competition and technology advances, more and more countries or regions are placing advanced manufacturing technology on their top priorities for economic growth and social development. In Europe, for instance, Germany has announced the Industry 4.0 strategy in 2013. In the US, President Obama launched the Advanced Manufacturing Partnership (AMP) in 2011. Since then, many other initiatives have been launched, including the Advanced Manufacturing Partnership Steering Committee 2.0 (AMP 2.0) in 2013, the Nationwide Network for Manufacturing Innovation (NNMI) in 2014, and the Revitalize American Manufacturing Act signed into law by the President in December 2014. Most recently, the Chinese government published the 10-year plan and roadmap towards manufacturing the Manufacturing 2025 strategy. The largest international collaborative program Intelligent Manufacturing Systems (IMS) led by Japan is also rolling out a road map for next step with its IMS2020 vision. With all these initiatives and programs, the core technology development and implementation area is in intelligent manufacturing. To this end, key technological enablers are identified, such as Internet of Things (IoT), Cyber-physical Systems (CPS), Information and Communication Technology (ICT), etc. There is a clear trend that all regions and countries have adopted these advanced enablers, and integrate them with traditional manufacturing systems so as to create smart products and smart factories. However, the approaches and strategies in different regions vary due to variations in industrial status and market conditions. This paper will provide a comparative study on the strategies and approaches from three representative regions on intelligent manufacturing technology: Germany, US, and China. Challenges and research focus at these regions will also be addressed. The application of intelligence to manufacturing has emerged as a compelling topic for researchers and industries around the world. However, different terminologies, namely smart manufacturing (SM) and intelligent manufacturing (IM), have been applied to what may be broadly characterized as a similar paradigm by some researchers and practitioners. While SM and IM are similar, they are not identical. From an evolutionary perspective, there has been little consideration on whether the definition, thought, connotation, and technical development of the concepts of SM or IM are consistent in the literature. To address this gap, the work performs a qualitative and quantitative investigation of research literature to systematically compare inherent differences of SM and IM and clarify the relationship between SM and IM. A bibliometric analysis of publication sources, annual publication numbers, keyword frequency, and top regions of research and development establishes the scope and trends of the currently presented research. Critical topics discussed include origin, definitions, evolutionary path, and key technologies of SM and IM. The implementation architecture, standards, and national focus are also discussed. In this work, a basis to understand SM and IM is provided, which is increasingly important because the trend to merge both terminologies rises in Industry 4.0 as intelligence is being rapidly applied to modern manufacturing and human–cyber–physical systems.

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