

Barriers to Industry 4.0 in Furniture SMEs: A Cross-Regional Analysis of Malaysia, Southeast Asia, and the USA

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Structured Abstract

Background: Industry 4.0, characterized by digitalization, automation, and data-driven processes, offers transformative potential for manufacturing sectors. However, small and medium-sized enterprises (SMEs) in furniture manufacturing face significant barriers to adopting these technologies. This study examines the challenges hindering Industry 4.0 adoption among SMEs in Malaysia, Southeast Asia, and the USA, focusing on economic, regulatory, and skill-related obstacles. By comparing regional differences, the research highlights the need for tailored strategies to enhance competitiveness and sustainability in a globalized market.

Literature Review: Industry 4.0 provide transformation for furniture manufacturing through technologies such as IoT, advanced robotics, additive manufacturing, and big data analytics, which enhance efficiency, customization, and sustainability. However, SMEs face systemic barriers: high upfront costs for technology acquisition and training, persistent skill gaps in automation and cybersecurity, fragmented regulatory frameworks, and limited awareness of long-term benefits. Regional analyses reveal distinct challenges. Malaysian SMEs face stringent regulations, labor shortages, and inadequate technical training, while Southeast Asian nations like Thailand and Vietnam struggle with inconsistent policy implementation, financial instability, and underdeveloped infrastructure. In contrast, U.S. manufacturers face intense market competition, legacy system compatibility issues, and stringent data compliance requirements. Government initiatives—such as Malaysia’s Industry4WRD, Southeast Asia’s tax incentives, and U.S. public-private partnerships—highlight the critical need for policy coherence, financial support, and cross-sector collaboration to bridge adoption gaps. Collectively, the literature underscores the interplay of technological, economic, and institutional factors shaping Industry 4.0 adoption, necessitating region-specific strategies to address heterogeneous barriers.

Conclusion: Common barriers to Industry 4.0 adoption persist globally, but regional nuances demand context-specific solutions. Strategies include fostering public-private partnerships, enhancing workforce training, and streamlining regulatory frameworks. Governments must prioritize financial incentives and policy clarity to support SMEs. Addressing these challenges is vital for fostering innovation, sustainability, and competitiveness in the furniture industry. The study underscores the importance of cross-regional collaboration and adaptive strategies to navigate the digital transformation landscape effectively.

Keywords: Industry 4.0, Furniture Manufacturing, SMEs, Technology Adoption, Comparative Analysis

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