Resilient and Ethical Raw Material Sourcing in the Automotive Industry: An Industry 5.0 Case Study of BMW's Cobalt Sourcing

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Abstract.
As the automotive industry accelerates its shift toward electric vehicles (EVs) and sustainable innovation, raw material sourcing has become a strategic and ethical priority. This paper examines BMW's cobalt supply chain under Industry 5.0 principles, emphasizing human-centricity, resilience, sustainability, and ethical responsibility. A four-step methodology comprising supply chain mapping, risk identification, quantitative resilience assessment, and evaluation of alignment with Industry 5.0 principles reveals critical vulnerabilities, including reliance on high-risk regions, limited traceability, and ethical challenges in artisanal mining in the Democratic Republic of the Congo (DRC). Key risks include child labor, human rights violations, inadequate material traceability, and political instability. BMW demonstrates strong recovery speed and agility through early digitalization and flexible contracts, although supply diversity and full traceability remain limited. The study proposes an evaluation tool to support continuous improvement in ethical practices, resilience, and human-centric innovation. The paper provides actionable recommendations for integrating digital traceability technologies, enhancing transparency, and promoting responsible, ethical, and sustainable sourcing.

Keywords: BMW's cobalt supply chain; Automotive industry; Ethical Sourcing; Industry 5.0; Resilience.