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Title of the doctoral dissertation: *Implementation of the blockchain method in a responsible supply chain in the metallurgical industry on the example of a vertically integrated project - the Luna Smelter Ltd. - a tin metal smelter in Rwanda*

English language abstract

This dissertation presents an implementation-focused doctoral study situated at the intersection of supply chain governance, digital traceability, and regulatory compliance for critical raw materials. As global demand for critical minerals accelerates amid the energy and digital transitions, responsible sourcing from conflict-affected and high-risk areas (CAHRAs) has become a strategic and ethical imperative. The research critically engages with international legal frameworks, including the EU Regulation 2017/821 and the U.S. Dodd-Frank Act, and examines the potential of blockchain technology to operationalise traceability within these evolving governance structures.

The central thesis posits that *blockchain, when embedded within institutional and regulatory infrastructures, enables effective control and verification across mineral supply chains*, fulfilling due diligence obligations under OECD, EU, and U.S. guidelines. Empirical analysis is grounded in a qualitative case study of LuNa Smelter Ltd. in Rwanda, a vertically integrated tin-processing operation serving as a practical model for blockchain-enabled traceability in high-risk sourcing environments.

The study introduces an operational framework for blockchain implementation in mineral supply chains, grounded in Management and Quality Sciences. It offers original theoretical insights into trust-building, sociotechnical integration, and system design under regulatory pressure and uncertainty.

Through document analysis, expert consultations, and stakeholder validation, the dissertation contributes new empirical evidence on the role of blockchain as a compliance-enabling and trust-enhancing mechanism. Its findings have been applied in practice within the Luma Holding Group and inform international initiatives such as the EPRM Tin Link Project, reinforcing the dual academic and operational value of this research.