Validation of the certification of raw materials (CERA 4in1) assessment template: A case study of the cobalt supply chain in the DRC

F. Animah[1], G. Barakos[2], L. Förster[3], and H. Mischo[4]

[1]Virginia Tech, USA
[2]Curtin University, Australia
[3]DMT GmbH & Co. KG, Germany,
[4]T.U. Bergakademie Freiberg, Germany

INTRODUCTION

The renaissance of cobalt in recent years has been remarkable. A raw material, which in the past was only useful for coloring, as well as being considered as waste material in the mining of silver, has become one of the most sought-after commodities in the past few years[1]. The criticality of cobalt is due to its unique properties of high-temperature resilience, hardness, and process efficiency, allowing for wider usage in different applications, from rechargeable batteries to superalloys, catalysts, metal facing, and ink, and pigment[2]. The rise in cobalt demand is due to its use in lithium-ion batteries (LIBs) for electric vehicles (EVs) and the different energy storage systems[3]. Likewise, the decision of most developed nations to ban the use of internal combustion engine vehicles in the next few years, in their quest to achieve climate neutrality through energy transition and electric mobility, is driving demand for cobalt[4].

The high demand for critical raw materials puts into perspective how they are produced and cobalt is no exception. Political instability, mining law enforcement weaknesses, unregulated artisanal and small-scale mining (ASM), and human rights abuses in the Democratic Republic of Congo (DRC) have led several civil society organizations, media, and governments to question the sustainability of sourcing cobalt in the DRC[5]. These issues, coupled with the monopoly of global production by the DRC (produces over 60% of the world's cobalt) and China (produces 80% of cobalt chemicals used in LIBs), pose a significant risk in the cobalt supply chain. Indeed, a report published by Amnesty International in 2016, detailed the existence of child labor in several ASM sites and other human rights violations in the DRC[6]. A report by the Centre for Research on Multinational Corporations (SOMO) in 2016 also identified many rights violations on large-scale mining (LSM) sites in the DRC[7]. This has led to downstream and upstream companies acting quickly to ensure credibility in their supply chains.

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An influx of multi-stakeholder voluntary (cobalt) sustainability schemes and other mining standards are beginning to flood the market, as companies move to reinstate customer trust in their products.

The increasing number of sustainability schemes has created a confusing situation for the mining industry[8]. Some schemes cover the entire value chain and others cover only a portion of the value chain. Some schemes are incomplete and not valid, as they are designed without considering ASM. However, the major weakness in most schemes is the lack of transparency and accountability in their implementation to ensure compliance[9]. Thus, the complexity and lack of harmonization in sustainability schemes in the mining industry led to the formation of the Certification of Raw Materials (CERA 4in1) scheme by DMT GmbH & Co. KG. The project is named CERA 4in1 because it consists of four inter-dependent standards, which include: the CERA 4in1 Readiness Standard (CRS), the CERA 4in1 Performance Standard (CPS), the CERA 4in1 Chain of Custody Standard (CCS) and the CERA 4in1 Final Product Standard (CFS). CERA 4in1 aims to address human rights abuses and other potential risks with negative environmental, social and governance (ESG) impacts associated with the cobalt supply chain. This scheme would cover cobalt mining as well, which will guarantee sustainability in supply chains from the DRC. This research seeks to verify the CERA 4in1 assessment template that aims to assess the potential ESG impacts of mineral raw materials worldwide. The verification process focuses on the applicability of the template for cobalt ores in the DRC, by identifying and assessing corresponding risks and hazards leading to negative ESG impacts, as well as its prevention plans. The modified assessment template serves as the basis for the development of an audit check list for cobalt mining in the DRC, which is used for a CERA 4in1 pilot-certification project in the DRC. Thus, the validated or modified template in this work would contribute to the applicability of the CPS for cobalt. The copper-cobalt oxide and sulfide of the Central-Africa copper belt in the DRC were chosen as the cobalt deposit of focus in this work.

MATERIALS AND METHODS

The choice of the DRC as the study area is due to the fact that they produce over 60% of the world's cobalt (as mentioned above) and also, they possess the most reserves. In addition, the high reported risks associated with mining cobalt in the DRC makes it the perfect choice to build on a cobalt-specific modified assessment template, which would help eliminate risks in the cobalt supply chain. To verify the CERA 4in1 assessment template and to develop the cobalt audit checklist, qualitative data was obtained and analyzed. This data was primarily sourced from the already existing assessment template and other CERA 4in1 documents, technical reports of the major copper-cobalt mining companies in the DRC, sustainability reports of various institutions, existing mining standards, and national health and safety organizations of some selected countries, books, journals and websites.

Next, procedures showing all the steps involved in cobalt mining and processing in the DRC were developed. With the help of the above-mentioned data sources, the corresponding risks and hazards related to each cobalt mining and processing production step were identified. This method adopted is very important as it is the most effective way of ensuring that no risks and hazards during mining and processing are left out during risk management of operations. Likewise, sustainability documents were gleaned to obtain ESG risks or hazards related to cobalt production. Risks and hazards connected to ASM in the DRC were considered and identified as well. In the final verification step, the already existing risks and hazards present in the assessment template before the start of this work were analyzed and carefully compared with the newly obtained risks and hazards, to ensure those related to cobalt production were maintained. Prevention plans and key performance indicators for monitoring were developed for all identified risks and hazards.

The verification process helped modify the assessment template to make it applicable to cobalt production. Hence, a complete and comprehensively developed template related to cobalt production

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will help institutions efficiently manage risks in their operations, to improve the economic feasibility of projects. Figure 1 summarises the study procedure.

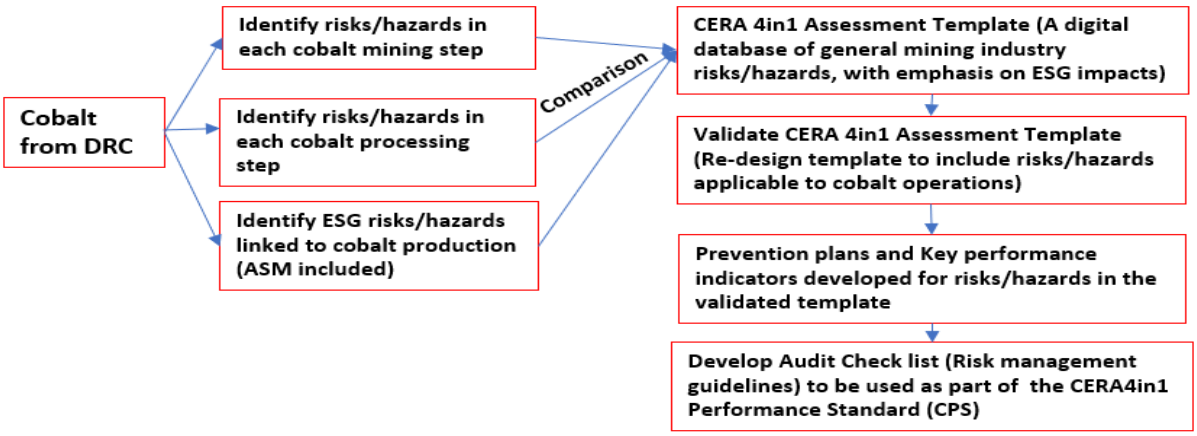

Figure 1. A summary of the methodology used to validate the assessment template.

RESULTS AND DISCUSSIONS

The results from the verification process showed that consideration given to the geographic location and the different deposit types of raw materials are very important and effective in risk management of cobalt operations. In addition, the conditions of each raw material are different and one of the best ways to monitor and eliminate risks and hazards from operations is to use a sustainability scheme that can be adapted to the specific raw material situations, especially in the case of an essential raw material like cobalt. This is evidenced by the 33 newly identified ESG risks (Table 2) obtained as a result of the validation process and highlights the issues associated with cobalt production. Also, the verification results of the assessment template proves that one of the most efficient ways of identifying and monitoring risks and hazards in operations is to consider every mining and processing production step (Table 1). It is noted that cobalt mining risks and hazards for all the steps were grouped together due to the similarities of these risks in each mining step. Finally, the identified ASM risks and hazards in Table 2 are vital in ensuring the sustainability of cobalt supply chains from the DRC. These ASM risks are not usually covered or addressed in most mining standards. Thus, the proposed preventive plans for these ASM risks in the assessment template would be used to eliminate these risks.

Moreover, issues of ethical supply of cobalt in the DRC means that companies and host governments will have to make an extra effort to improve risk management in operations, through the use of appropriate certification schemes to achieve sustainable economic development. Therefore, this work would help operations in the cobalt industry improve approaches to risk management in their value chain, by providing prevention plans and key performance indicators to risks and hazards in the industry, in the form of the developed cobalt audit checklist.

Based on the results obtained, this paper recommends pilot testing of the modified assessment template with its risks, hazards, prevention plans and key performance indicators, and the developed audit check list in cobalt mines in the DRC. This pilot testing would guarantee the suitability of these risks, hazards and prevention plans for effective risk management. Further research is also needed on other cobalt deposit types such as cobalt in nickel sulfide ores and nickel laterite ores to produce a complete template for cobalt that is applicable worldwide.

Table 1. Final results of cobalt mining (surface and underground) production steps and their corresponding risks/hazards after the validation process

Mining Steps	Risks/Hazards
Drilling, blasting, loading, hauling	Surface water / groundwater contamination; rockfall and/or roof fall; subsidence and/or soil liquefaction; slope failure; gas mix leakage; dust; tailing dam failure; slurry pollution; mine water contamination; process water contamination; dump and heap; sump contamination; working at height; working in or close to water; dredging; irrespirable atmosphere operations; inadequate or improper installation of support systems; site decommissioning and remediation; inadequate lighting; greenhouse gas production; heat and humidity; noise emissions; high energy and material consumption; vibration emissions; slips and trips; working at heights; feeders/reclaimers (moving parts); general construction failure (structural failure); loss of communication; ***improper use of electrical tools and equipment; improper use of and working in close proximity to mobile machinery and equipment; flooding/mud; poor traffic infrastructure; person falling into void; inadequate or missing safety signs; working close to suspended loads; inadequate emergency preparedness and first aid systems; confined space; power failure.***

**Newly identified risks and hazards in bold italics text while those in default (normal) text were the initial risks/hazards in the assessment template.*

Table 2. Results of ESG risks after validation of the CERA assessment template

General Management Risks	Regional/Local Condition Risks
Archaeological heritage damage; land and asset acquisition; lack of free and accessible education and trainings; loss of cultural heritage; inadequate stakeholder/public consultation and disclosure; fatigue due to stress, psychological, drugs or alcohol; inadequate hygiene conditions; inequalities; inadequate worker rehabilitation; hazardous material; non-observation of human and cultural rights; workplace imbalance; discrimination at workplace; non-social protection of vulnerable groups or persons; socio-cultural tensions; strain on infrastructure and public nuisance; missing site security; inadequate risk and safety management; harmful air quality; ***missing freedom of association and collective bargaining rights; unfair wages; inadequate accommodations; mine site in close proximity to community; lack of social or community development projects; complexity of ownership and management structures; supply-chain risks; volatility of international prices; money laundering and tax evasion; brand damage; unstable market prices; unfair retrenchment/redundancy; law enforcement weaknesses; inadequate personal protective equipment (PPEs); working alone in remote areas; inadequate leave benefits; poor roadways; health problems; missing employment contract; inadequate waste and material assessment and management; inadequate water assessment, recycling and management; irresponsible exploitation of mineral deposit; unequal training and career development opportunities; inadequate working conditions; loss of ecosystem services; threatened and invasive/alien species; loss of legally protected and internationally recognised areas of biodiversity.***	Non-acceptance of indigenous people´s rights; non-cooperation with indigenous people; poverty, hunger and thirst that endanger healthy lives and wellbeing; forced labour and hazardous work; discrimination, harassment, violation and sexual assaults; ***missing insurance (social and health); inadequate housing; bribery and corruption; loss of access to water; forced relocations; child labour***

**Newly identified risks and hazards in bold italics text while those in default (normal) text were the initial risks/hazards in the assessment template*

Festus Animah

Ph.D. student and Graduate Research Assistant
Virginia Tech

Festus Animah is a Ph.D. student at the Mining and Minerals Engineering department at Virginia Tech. He obtained his master's degree in Sustainable Mining at T.U. Freiberg in Germany and Bachelor's degree in Geomatic Engineering at the Kwame Nkrumah University of Science and Technology in Ghana. He has research interests in mine health and safety, ventilation and sustainable development of critical minerals. His current work is focused on the monitoring and control of respirable coal mine dust to enhance miner safety. In the past, he worked at the AngloGold Ashanti Obuasi mine in Ghana and DMT Mining GmbH in Germany.