# The Green Transition in Context – Cobalt Responsible Sourcing for Battery Manufacturing

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## Abstract

Responsible cobalt in the context of the green transition is a major issue on the global sustainability agenda. Spurred by concerns around child labor in artisanal mine sites in the Democratic Republic of the Congo (DRC), corporate actors adopted a myriad of strategies to tackle reputational risks and establish responsible sourcing programs. Now encompassing forced labor, corruption, and environmental degradation mining-specific, as well as community development projects constitute the core of Corporate Social Responsibility (CSR) practices in the DRC. Informed by a review of academic and industry studies, this article raises concerns regarding the limitations of responsible cobalt sourcing. We present the initiatives developed to date, based on voluntary strategies, and then introduce new technology tools developed to trace mineral in supply chains, ensuring transparency of the information on the conditions of extraction and trade. Finally, we identify five limitations to responsible cobalt sourcing strategies constituting avenues for future research.

Keywords: cobalt; green transition; batteries; supply chains; responsible sourcing

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## Introduction

The publication by Amnesty International and Afrewatch in 2016 of a report uncovering human rights abuses, in particular child labor, in the booming artisanal cobalt sector of the Democratic Republic of the Congo (DRC) resonated throughout the industry.[1] Critical to the green transition and the manufacturing of lithium-ion (Li-ion) batteries, cobalt focused the attention of corporate actors, government officials, and non-profits and is since considered a new 'hot' commodity in the race to address climate change. Companies involved in the cobalt supply chain rushed to develop Corporate Social Responsibility (CSR) programs after the first instances of salient risks were reported by international watchdogs. In this sense, cobalt is unusual in the mining industry due to the concentration of the mineral in one jurisdiction, and the level of reputational risks for companies already accused of forced labor in their suppliers' plants (Eckert, 2013; Sari, 2014). Partnering with consulting companies and non-profits, corporations have developed a plethora of strategies to address risks, secure their supply, and protect their reputation.

Research has been conducted on specific initiatives (e.g. Mutoshi Pilot Project, Better Mining) and risks (e.g. child labor, environmental pollution) promoting targeted responses without assessing the whole state of cobalt extractivism. While localized and specific research is beneficial, we argue that it is time for the industry and the academia to take a step back and assess what has been done so far. We argue that this mapping review helps bridging this gap by providing research and applied learnings to enhance responsible sourcing programs. As programs are being developed in the DRC at an increasingly rapid pace, assessing existing

[1] The DRC holds 48 percent of world's reserves of cobalt and produces an estimated 71 percent of global supply (Darton Commodities Limited, 2021; Vetter, 2018), with 15 to 30 percent of its production coming from artisanal and small-scale mining areas (World Economic Forum, 2020).

challenges and the answers provided by the industry, governments, international organizations, and non-profits is critical.

In the academic sphere, this article, informed by social sciences, business, and economics, balances between micro and macro learnings to lay out avenues for future research. As companies, governments, and non-profits implement new sourcing programs and a flurry of related frameworks (standards, guidelines, etc.), we found that research largely focused on the development of on-the-ground projects at the detriment of less obvious topics such as technology-enabled cobalt traceability, community engagement by the industry, standard development and the implementation of an auditing strategy, and low intensity opposition between government-sponsored efforts and corporate CSR narrative.

Following a contextualization of the current interest in cobalt responsible sourcing, we provide a comprehensive mapping review of in-country responsible supply chain initiatives and the deployment of technological supply chain management tools, including audits and blockchains. We discuss the effectiveness of responsible minerals schemes seeking to address the challenges linked to cobalt extraction and question the current focus on localized risks (geographically and rhetorically). Adopting a historical perspective, we illustrate the rapid development of responsible sourcing practices since the early 2000 and their implementation in the cobalt supply chain since 2015. The increasing interest in supply chain sustainability and transparency has led companies to integrate reputational factors in their strategies answering to customers, investors, and, to a lesser extent, local communities' expectations.

Importantly, cobalt responsible mining is a new and fast-evolving sector. Publications on the topic, particularly academic ones, are relatively scarce. Most of the information is provided by industry and government reports. This constitutes a limitation of this review and reflects the need to conduct more research on topics related to cobalt mining. Hence, the generalizability of the findings is limited, and interpretation should be done with caution.

Nevertheless, we provide a timely and important assessment of the current state of research on a burning topic and propose avenues for future studies.

Responsible sourcing has become an integral part of corporate strategies to address reputational risks linked to their supply chains and to an extend secure supply of critical raw commodities. In the 19th century the concept of corporate responsibility focused on the workforce and mostly followed a paternalistic approach (Smith, 2003; Rubbers, 2013). By the end of the 20th century companies faced increasing pressure from groups denouncing abusive practices within supply chains, leading companies to increasingly recognize the roles and responsibilities of the downstream sector for all sorts of negative impacts throughout their supply chains (Guo, Lee and Swinney, 2016). Sustainable Supply Chain Management (SSCM) – the "manag[ement of] all aspects of the upstream component of the supply chain to maximise triple bottom line performance" – now often includes responsible sourcing (Pagell, Zhaohui and Wasserman, 2010: 58). Combining mandatory and voluntary approaches, SSCM helps companies to adopt comprehensive policies and practices to tackle sourcing risks; yet often in ways intended to demonstrate 'corporate compliance' rather than to achieve real responsible sourcing practices (Deberdt and Jurewicz, 2019; Debert and Le Billon, 2021; Le Billon and Spiegel, 2021; Taka, 2014). While responsible sourcing is widely used as a buzzword for addressing injustices and unsustainable practices in globalized raw commodities supply chains, the term encompasses wider goals and diverse approaches (van den Brink et al.,2019: 38). Finally, concepts of due diligence have been codified in internationally accepted documents, such as the OECD *Due Diligence Guidance for Responsible Minerals Trade from High-Risk and Conflict Affected Areas* (henceforth OECD Due Diligence Guidance) (OECD, 2016). In 2018, the OECD define the concept as "the process enterprises should carry out to identify, prevent, mitigate and account for how they address these actual and potential adverse impacts in their own operations, their supply chain and other business relationships" (15).

Historically, the Sullivan Principles, adopted in 1977 and promoting corporate transparency for companies involved with the Apartheid regime, marked the first step of a new corporate social and political responsibility. They paralleled the campaign denouncing Royal Dutch/Shell for its oil supplies to South Africa in the 80s, in violation of an international embargo (see Rosen, 1986). The wide adoption of the Principles after the fall of the racist regime in 1993, promoted CSR as an effective governance mechanism (Lamb, Kumar and Wokutch, 2005) and supported the development of new "political consumerism" (Stolle and Micheletti, 2013). In the following decades, 'blood diamonds' and the establishment of the Kimberley Process Certification Scheme (KPCS) to address rebel funding in Angola and Sierra Leone (Sherman, 2000; Le Billon, 2006; Bieri, 2010) placed the corporate at the fore of conflict resolution. The 'conflict minerals' campaign at the end of the first decennia of the 21st century built on this trend. In 2010, the introduction of Section 1502 of the Dodd-Frank Act[2] acted as a catalyst for mandatory corporate due diligence in the minerals sector, specifically in the DRC (Sarfaty, 2013; Sarfaty, 2015; Kim and Davis, 2016; Dalla Via and Perego, 2018). Since then, it has been joined by Regulation 2017/821 in the European Union (Daly and Voland, 2018). Prompted by reputational concerns, the electronics sector developed responsible minerals standards[3] and minerals traceability systems[4] that ended creating an entire industry around the identification and monitoring of suppliers within global supply chains. Traceability is also occasionally expanded through pro-active responsible sourcing projects on the ground. So far, only voluntary systems seemed to have been applied to the cobalt industry; still, this article

[2] Section 1502 of the Dodd-Frank Act was enacted in 2010 and entered into force in 2013. The law covers 'conflict minerals', also known as tin, tungsten, tantalum and gold (3TG). Hence, cobalt is not included in this legal text.

[3] Here, the terms framework and standard refer to the same categories of instruments and processes allowing for suppliers identification through auditing, yet more information is provided below on the differences between these terms. These standards include, *inter alia*, the Responsible Minerals Assurance Process (RMAP), the Responsible Jewellery Council (RJC)'s Code of Practices, or the London Bullion Market Association (LBMA)'s Good Delivery List.

[4] Traceability refers here to processes enabling companies to identify their suppliers all the way back to extractive sites.

differentiates between different initiatives for responsible sourcing; a process exploring all tiers of the upstream mining sector within a supply chain for responsible production (Sedex, 2020).

Cobalt is used in a wide variety of industries, from electric mobility, energy storage, high tech, engineering, and healthcare (Cobalt Institute n.d.). The Cobalt Institute estimates that 50 percent of the world's production is used for battery manufacturing (Ibid.). While companies invest billions to develop the new generation of cobalt-free batteries (Morris, 2020), most battery compounds still derive from the Li-ion model with cobalt as a core component.[5]

Cobalt production is concentrated, with the DRC producing 70 percent of the world's supply of cobalt hydroxide (Baumann-Pauly, 2021). An estimated 15 to 30 percent of the country's output is extracted in artisanal mines – sites involving little if any mechanized tools. These mines are variously (un)formalized and often in breach with the *cadastre* (land registry) and the Mining Code[6] (Katz-Lavigne, 2019). Industrial sites provide the majority of the country's output with specific risks to the industry, including environmental pollution (Cheyns et al.,2014), violent co-existence with artisanal miners (Katz-Lavigne, 2020), high corruption potential (Resource Matters, 2019), and health impacts (Banza Lubaba Nkulu et al.,2018). In this context, securing responsible supply from the DRC – a jurisdiction known for its historical instability and poor human rights record (Stearns, 2012; Reyntjens, 2012; ICG, 2016) – answers to both economic needs and reputational risk management.

The goals of this mapping review are to explore the growing responsible sourcing field, to discuss the opportunities and challenges of traceability systems, to provide an overview of cobalt responsible sourcing, and to highlight avenues for future research and to synthetize the current industry responses. With a growing interest in the mineral driving CSR strategies, this

[5] These compounds include LCO (Lithium Cobalt Oxide), NCM (Lithium Nickel Cobalt Manganese Oxide), NCA (Nickel Cobalt Aluminium Oxide), NiMH (Nickel Metal Hydroxide), LFP (Lithium Iron Phosphate) or LMO (Lithium Manganese Oxide).

[6] DRC's Mining Code was revised in 2018 from a previous version dating from 2002. For more information see Loi n°18/001 modifiant et complétant la Loi n° 007/2002 du 11 juillet 2002 portant Code minier, col. 1.

review assesses what has been done and points to some of the future engagement possibilities. Through this article we argue that while undeniable efforts have been pursued to address some of the most salient risks, particularly at the artisanal level, independent assessments of these programs are needed. Finally, corporate interests in addressing visible risks often leads to conscious and unconscious avoidance of root causes, preventing long-term improvements.

This mapping review is based on an analysis of academic studies, and non-profits, industry, and government reports. These documents were identified using Google Scholar, Google searches, and WorldCat. A clear responsible supply chain component was necessary for their inclusion in the study, based on their abstract, introduction, and/or executive summary. As such, studies discussing related topics, such as indigenous conflicts, gender-based issues, and social and political reconfiguration linked to the mining industry were not included if not specific to sourcing concerns.

Following this Introduction, Part 2 discusses the methodology used in this mapping review. Part 3 explores the CSR strategies introduced by corporate actors to answer to the reputational risks raised by increased interests in the conditions of extraction of cobalt, especially at artisanal mine sites. Part 4 focuses on the audit culture that pervades cobalt responsible strategies, including the implementation of downstream-led cobalt sourcing standards enforced on midstream and upstream operators. Part 5 analyzes the implementation of technology-driven solutions, including blockchain systems. Finally, Part 6 discusses findings and outlines an agenda for further research.

## Methods

This mapping review does not include a formal assessment of the quality of the assessments so as to defining what documents should be selected. The current academic research on cobalt responsible sourcing is limited, especially when compared to ‘conflict minerals’ or ‘blood

diamonds' (Deberdt and Le Billon, 2021). However, our selection methodology captures a wide array of documents including reports produced by the industry, non-profits, or governments. These reports constitute the core of the available information, and this article aims at translating their findings to orient academic research. This review includes information published between 2015 (publication of the Amnesty International and Afrewatch report) and April 2021. Thus, we hope this review answers to Sovacool, Axsen and Sorell's call for novelty, rigor, and style (2018: 13).

The following search tools were used to identify documents: (1) Journal articles and book chapters: Google Scholar, UBC Library, and WorldCat; (2) Nonacademic reports: Google search and websites of relevant organizations – companies, governments, non-profits, research centers – known to the authors for publishing such documents. Keywords used to identify documents included "cobalt mining" (and *industrie minière de cobalt*), cobalt responsible sourcing (and *approvisionnement responsible en cobalt*), child labor in mining (and *travail des enfants dans l'industrie minière*), environmental risks in the cobalt industry (and *risque environnemental dans l'industrie du cobalt*). Documents was individually assessed by reading their abstract (for journal articles), introduction (for book chapters), and executive summary (for reports).

We identified a total of 7 academic articles specifically on the topic of cobalt mining and responsible sourcing, the majority of which published between 2020 and 2021. Additionally, 17 reports by non-profits, corporate actors, international organizations, and governments were published since 2015, with a clear acceleration between 2019 and 2021. Finally, additional documents include two PhD thesis and two industry specific documents (responsible sourcing standards). The analysis was completed by an in-depth analysis of media news outlets, targeting primarily large media organizations. This last component only

complemented the analysis to provide the latest information available. However, they did not provide in-depth learnings.

Table 1 below highlights the 10 responsible cobalt sourcing programs we focused on or mention in this mapping review, as well as their broad characteristics.

*Table 1: programs implemented in the cobalt responsible sourcing sphere*

| Program/Project | Type | Actors Involved | | | | |
|---|---|---|---|---|---|---|
| | | **Downstream** | **Upstream** | **Midstream** | **Service Providers** | **Other** |
| **Better Mining (cobalt only)** | Mining-specific | Volvo Cars | Congo Dongfang International Mining<br>CMOC | Huayou Cobalt<br>IXM | RCS Global Group | RMI |
| **Mutoshi Pilot Project** | Mining-specific | N/A | Chemaf<br>COMIAKOL | Trafigura | Kumi Consulting | Pact |
| **Fair Cobalt Alliance (FCA)** | Mining-specific | Signify<br>Fairphone<br>Tesla<br>Sono Motors<br>Shift | Glencore<br>CMOC | Huayou Cobalt<br>ATL<br>IXM | The Impact Facility | RCI<br>Miller Center |
| **Cobalt for Development** | Community engagement | Google<br>BMW Group<br>Samsung Electronics<br>Volkswagen Group | N/A | Samsung SDI<br>BASF | N/A | GIZ |
| **Cobalt Action Partnership (CAP)** | International forum | Global Battery Alliance (GBA) members | | | | Unicef<br>FCA<br>RMI<br>CSR Europe<br>IIED<br>IMPACT<br>NYU Stern<br>University of Geneva |
| **Responsible Minerals Initiative (RMI)** | Standard Setting | 400 industry members | | | | |
| **Responsible Cobalt Initiative (RCI)** | Standard Setting | Unknown | | | | |
| **Responsible Sourcing Blockchain Network (RSBN)** | Blockchain | Ford Motors<br>Volkswagen Group<br>Volvo Cars | Nornickel (non-cobalt) | LG Chem<br>Huayou Cobalt | RCS Global Group | IBM |
| **Circulor** | Blockchain | Volvo Cars | N/A | N/A | N/A | Circulor |
| **Re\|Source** | Blockchain | N/A | Glencore<br>CMOC<br>Eurasian Resources Group | Umicore | N/A | N/A |

## Implementation of CSR Programs in the Cobalt Sector

The development of CSR programs in the cobalt industry mirrors the heighten interests of advocacy groups in the industry. The focus on artisanal miners, particularly geared toward the issue of child labor (Sovacool, 2021; Asshton and Sturmes, 2020), has defined the actions of midstream and downstream companies in the DRC since 2015. Today, more holistic systems hope to address the challenges faced by artisanal miners.

The involvement of downstream companies, sometimes in partnership with midstream suppliers, directly on-the-ground allowed for increased funding geared toward such programs. In this part we provide an overview of the current state of CSR programs in the cobalt sector. We focus on two types of programs – mining-specific programs such as the Mutoshi Pilot Project, Better Mining, and the newly established Fair Cobalt Alliance (FCA) and community engagement programs such as Cobalt for Development. As this study was conducted before April 2021, we do not explore the implementation the state-owned Entreprise Générale du Cobalt (EGC).[7]

### *Mining-specific Programs*

This sub-section discusses projects defined as mining specific. These are geared toward the improvement of the conditions of extraction at mine sites. We recognize that in economies dominated by extraction, the improvement of miners' social and economic conditions trickles down to the broader community. Nevertheless, these projects direct their funding and efforts to the extractive site, often to increase productivity, secure supply, and reduce reputational risks. The three projects are profoundly different in their structure, goals, and interventions, but respond to similar concerns.

[7] For more information, see Deberdt, 2021b.

The Mutoshi Pilot Project, developed on land owned by public company *Gécamines* and leased to mining and processing company Chemaf, demonstrates the complex web of actors involved in the definition and implementation of responsible cobalt projects. While the pilot project closed in December 2020, its goals and structure provide important information. Chemaf, a subsidiary of Emirati conglomerate Shalina Resources, partnered with Swiss trader Trafigura Group, which provided a funding line to establish the pilot project. The project was overseen by US-based non-profit Pact and assured by British consulting company Kumi Consulting. The pilot, initiated in 2018, aimed at formalizing artisanal miners under the umbrella of a Congolese cooperative, COMIAKOL, and provided technical, training, and equipment support to the miners (Johansson de Silva et al.,2019). The project relied on both Trafigura Group's 'Responsible Sourcing. Artisanal and Small-Scale Mining (ASM). Expectations', as well as the OECD's 'Due Diligence Guidance'. By creating a direct link between artisanal material extracted at the Mutoshi site and Chemaf's processing plant of Usoke, located in Lubumbashi, the companies demonstrated the possibility to integrate often unformalized artisanal mining (Vogel et al.,2018; Byemba, 2020; Hilson et al., 2017) in global supply. Mutoshi illustrated that sourcing from ASM sites could be implemented, and potentially be economically viable (Trafigura, 2020a). On average, 2,700 miners entered the site every day to extract cobalt (Johansson de Silva et al., 2019, 12). However, established at the beginning of a 60 percent decline in cobalt's market price (Calvão et al., 2021) and impacted by the COVID-19 pandemic (Trafigura, 2020b), the project suffered significant limitations.

While acting as an income stabilizer for artisanal miners through a stable buying price, the project answered to a maximization strategy. As a driver of economic benefits for the miners, but also as an incentive for Chemaf, as the buyer of the raw material, Mutoshi resulted in a 9 to 35 percent increase in productivity. In an assessment report commissioned by Trafigura Group, the authors highlight the benefits for the miners in terms of working conditions and the

decrease in harassment by authorities (Johansson de Silva et al., 2019: 22). The establishment of a free medical clinic on site also benefitted the miners' health (Ibid. 18). The repercussion of these outcomes on the local economy, while not in scope of the pilot project, also translated in increased earnings and spendings, almost double that of similar non-formalized operations (Ibid.: 27).

Better Mining, developed by Berlin-based RCS Global Group, adopts a different approach based on a monitoring and assurance system. Implemented at cobalt and 3TG artisanal mines the program embraces a standardized risk identification and incident reporting providing precise information to the concession owner and operator and supporting companies (RCS Global Group, 2019). As of April 2021, among other sites, Better Mining is implemented at two mines controlled by CongoDongfeng International Mining (CDM), a subsidiary of the world's largest cobalt refiner, Huayou Cobalt (Mancini et al., 2021). Based on incident analysis, corrective action plans (CAPs) are devised to address broader risks. The system covers seven risk categories (environment, human rights, legality, security, working conditions, community and traceability) and is geared toward informational strategies. Better Mining does not operate changes in the mine sites as this is the prerogative of the different on-site authorities (RCS Global Group, 2019: 8). Recently the program was endorsed by the RMI in a push to broaden its geographical implementation to 12 cobalt sites by 2023 (RBA, 2020).

Finally, the FCA, established in 2020, is the most recent development in the field. The FCA was founded by supply chain actors Fairphone, Signify, Huayou Cobalt and sustainability project The Impact Facility, powered by advisory firm TDI Sustainability (The Impact Facility, 2020a). The project was later joined by Glencore, Tesla, Sono Motors, the Responsible Cobalt Initiative (RCI), ATL and Shift and is implemented in the Lualaba Province (The Impact Facility, 2020b). Due to its recent implementation, information on its reach and potential

impacts on mining communities is scarce and additional research should be conducted on this initiative.

Mining-specific programs answer to the need for formalization and improvement of working conditions at cobalt artisanal mines. These three projects, adopt different approaches, one based on technical support to the miners (Mutoshi Pilot Project) and the other adopting an informational strategy geared toward authorities on the sites and supply chain actors (Better Mining). Both follow transparency efforts to reassure buyers about the origin and conditions of extraction of minerals. However, based on standards and other internationally accepted frameworks, they raise questions regarding the adequacy of these responsible sourcing tools to effectively tackle human rights issues, OHS, and other material risks at the ASM level. For example, Mutoshi was implemented following a set of material (cobalt) and context (DRC) nonspecific tools devised in Europe and North America without the participation of those in scope of the project, Congolese miners. A similar conclusion can be drawn from Better Mining's effort at standardization across minerals and jurisdictions, a discussion we will explore in part 5, along the sustainability of these activities.

***Community Engagement Programs***

While mining-specific programs impact broader communities, their reach remain centered on mining sites. To answer to this limitation, programs are being developed to include the broader social context in which mining takes place. In this part we discuss Cobalt for Development, currently in the first stages of its implementation. The literature shows significant information gaps as information on the project's strategies, objectives, and results are limited. This situation needs to be investigated in subsequent research to provide an assessment of the environmental, social, and governance impacts on this initiative.

Cobalt for Development aims at a more holistic approach to the cobalt sourcing challenge by inserting broader Environmental, Social, and Governance (ESG) concerns. Like mining-specific projects, it builds on existing structures, centered around miners' cooperatives, and aim at increasing formalization and best practices at the mine sites. However, its reach extends to the mining communities around mine sites and dependent on the extractive industry. Research projects have focused on the development of alternative livelihoods to diversify the economic basis of households in the region (Miller Center for Social Entrepreneurship and CARF, 2020). These studies found that environmental (poor air quality, water contamination and soil degradation) and socio-economic impacts (poverty, social frustration, and land loss) constitute the core of the challenge to sustainable artisanal (and to some extend industrial) cobalt mining (Ibid. 11-12).

Cobalt for Development is funded by downstream giants BASF, Samsung Electronics, Samsung SDI, BMW Group, Google, and Volkswagen (BASF, 2020) and implemented by the German aid agency Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH. It was established in the region of Kolwezi in 2019 (BASF, 2020). The pilot project centers around "improving artisanal cobalt mining conditions as well as the living conditions for people in the surrounding communities" (Volkswagen, 2020), and to date new educational programs, income opportunities (i.e. income diversification), and training in conflict resolution have been conducted (Ibid.). Regarding the extractive part of the project, the partners expect to train miners in a total of 36 mines. By mid-2021, around 1,500 miners from 12 cooperatives should have received the training on sustainable and safe working conditions (BASF, 2020).

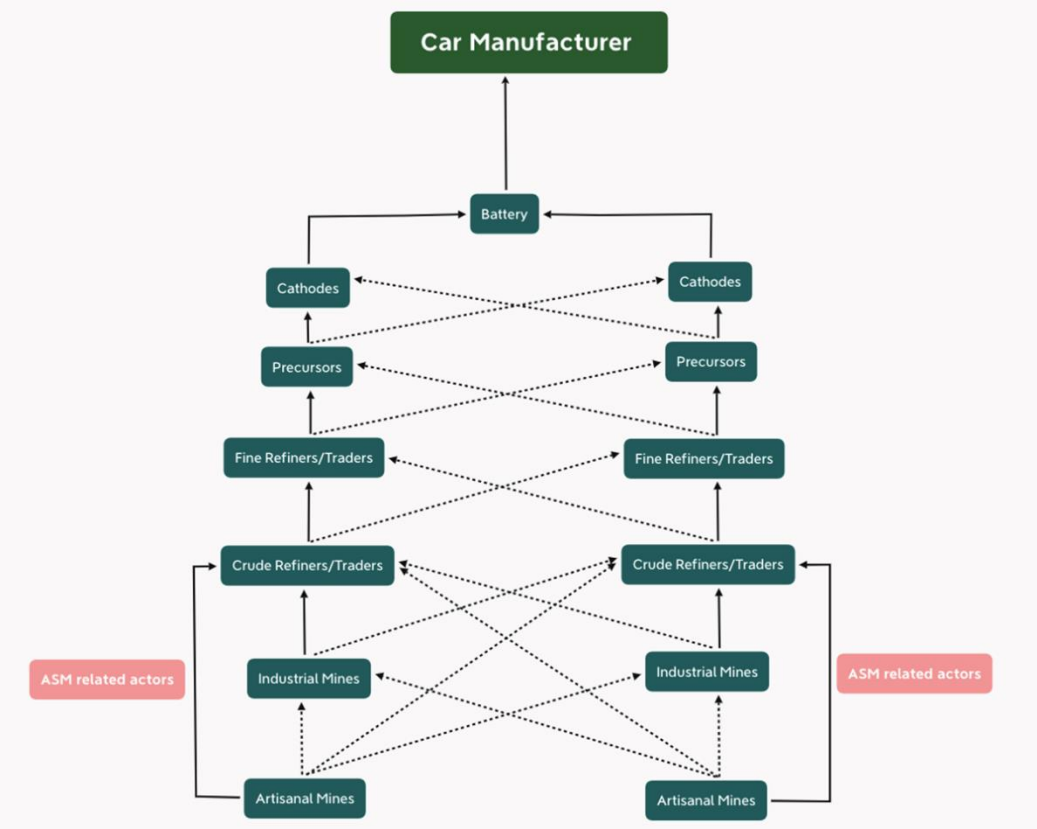
As for mining-specific projects, community engagement programs place formalization of artisanal sites at the fore. Working in partnership with Congolese authorities at the local and provincial levels, these programs aim at integrating artisanal mining in the legal framework while strengthening other revenue-generating activities, such as agriculture or trade jobs.

However, driven by CSR strategies built around transparency efforts and reputational risks, concerns surrounding the sustainability and long-term prospects of these programs should be explored.

## Audit Strategies

Inspired by previous efforts on 'conflict minerals' (Young, 2018), industry actors developed cobalt-specific auditing systems. These systems aim at identifying all suppliers from the final battery product to the mine site through a cascading down audit (audits through which each supplier provides a list of its own suppliers). Graph 1 summarizes the structure of the cobalt supply chain for battery manufacturing.

*Graph 1: Basic structure of the cobalt supply chain for battery manufacturing*




This graph summarizes the cobalt supply chain for one battery manufacturer with two different cathode suppliers. It is a simplified version and supply chains account for hundreds of suppliers. Full lines represent direct relationships while dotted lines represent potential sourcing. Graph designed by Farnaz Gholami.

The RMI and its Chinese counterpart, the RCI, introduced a cobalt standard in, 2018, with minor revisions a year later (RMI, 2021a). The standard is geared toward crude and fine refiners, adopting choke point approach. The smelters or refiners (SoRs) are the concentration point between the extractive sector and the final product, after which identifying the origin of the raw material becomes almost impossible. A wide range of tools support the audit system. For example, downstream companies use the Cobalt Reporting Template (CRT) to survey their suppliers to identify all SoRs in their value chain (RMI, 2021b).

The auditing system implemented by the RMI and the RCI is aligned with the OECD Due Diligence Guidance and allows for the mapping of cobalt supply chains. However, the focus on fine refiners[8] constitutes a system weakness as pointed out by an OECD report:

> "In the cobalt supply chain, the control point is the fine refiner […]. However, concentrators, processors and crude refiners also play an essential role for upstream supply chain due diligence, and so audits of the fine refiners would necessarily involve in-depth checks of concentrators and processors due diligence systems, findings and plans." (OECD, 2019: 8)

The authors also note the need to improve mine site visibility in these audits and note that "only a few processors and refiners seem to have made efforts to increase transparency over their supply chain beyond the *dépôts*" (Ibid.: 32).

The benefits of supply chain due diligence in assessing, identifying, and addressing material risks exceed the financial burden of audit programs. Van den Brink et al., address risks in the cobalt sector and support that "the risks for supply chain disruptions are high" (2020: 1). As they argue:

[8] Fine refiners are overwhelmingly located in Asia, including China, South Korea and Japan while crude refiners are plants located in the DRC.

> "The combination of the geographic map and the network analysis create a comprehensive picture of the upstream cobalt supply chain. This includes information on the company level and geographic level on the diversity of the production, the production of companion minerals (copper or nickel mines) and on the supply of the mineral by risk countries or risk suppliers" (Ibid.: 9).

Many downstream consumers of cobalt have embraced such approach, mapping their supply chains and using the RMI/RCI standard or other auditing systems.

Auditing has shaped the approach of downstream companies in engaging with their suppliers on human rights abuses. In the cobalt supply chain, specific tools have been developed but do not reflect the on-the-ground reality in the DRC, where the risks are located. Hence, they provide supply chain mappings, but suffer from limitations to their upstream reach and the lack of supply transparency in the Congolese mining industry. Auditing has been criticized for their accounting approach to deep and complex risks (Strathern, 2003). In the cobalt sphere, more research needs to be conducted to properly assess the positive and negative impacts of audit practices. For example, while companies perform audits on hundreds of suppliers, the ASM industry keeps growing with new illegal sites opening, but few companies recognizing that part of their feed originates in these mines. Nevertheless, auditing strategies are not the only tools deployed to address these risks, as we will explore in the next section.

## Technology Solutions

The responsible sourcing of minerals, and in particular cobalt, spurred the development of technology-based traceability schemes organized around blockchain. Blockchains have been developed in minerals supply chains for the past five to eight years. The Natural Resource Governance Institute (NRGI) defines blockchain as "a system in which transactions are linked together, creating an immutable chain that logs all transactions. This irreversible log is often

called the "ledger." Nodes form the infrastructure of the blockchain […]" (NRGI, 2020: 2). Used in various sectors, from banking (Guo and Liang, 2016) to halieutic resources (Visser and Hanich, 2018), and extractive industries (Hongfang et al., 2019), blockchain applications "significantly improve the management level, efficiency, and data security" (Ibid: 1). In the cobalt sector, the increasing need for transparency throughout the supply chains, without the ability to corrupt the information provided at the on-the-ground level, led to the introduction to blockchain as responsible sourcing mechanisms. The attractivity of blockchain in the Congolese industry lies in the ability of the Distributed Ledger Technology (DLT) to store and secure information about working conditions, child labor, or other risks. The incorruptible nature of the information provides another layer of confidence in an environment marked by corruption. This information is then cascaded down the supply chain, following the raw material through its transformation, all the way to the final user and its customers. As downstream expectations of blockchain systems center around informational access, linked to regulatory requirements (including the UK Modern Slavery Act of, 2015) and public scrutiny, providers must combine information gathering and securitization of this information through DLT (RCS Global, 2017).

RCS Global Group implements the Responsible Sourcing Blockchain Network (RSBN) in partnership with miner Glencore, refiner Huayou Cobalt, battery maker LG Chem, and vehicle manufacturers Ford, Volkswagen Group and Volvo. The platform uses IBM Hyperledger Fabric to provide incorruptible auditing information throughout the supply chain (Volkswagen, 2019). Similarly, Minespider initially sought to tackle the issue of conflict minerals before turning to other raw materials, including cobalt. In a press release, the company describes its process as follows:

> "Digital "Certificates" are created at certified mineral sources, such as mines or recyclers, which are then encrypted with the company's public key and posted in a

publicly accessible database. As mineral shipments are sold, responsibility data of the new owner is added to the certificate which is re-encrypted with the public key of the new owner, creating a layered encryption like a "Russian doll." This ensures that only the owner is able to access the supply chain data, even though it is in a verifiable, immutable public data store, enabling supply chain transparency without sacrificing data security" (Minespider, 2019).

Blockchain systems in the minerals industry began with the diamond industry and the narrative surrounding 'blood diamonds.' However, as Chohan (2018: 4) underlines, the complexity of the cobalt supply chain raises significant issues. One of these is the ethical dilution of 'clean' cobalt mixed with material from dubious origin. Processes exist to limit the contamination of supply chains considered clean, including a mass balance approach, but the integrity of the system remains determined by the quality of the information first gathered. This limitation, linked to the difficulties of on-the-ground monitoring in conflict-affected and high-risk areas (CAHRAs), constitutes the main challenge of blockchain-enabled transparency. In this sense, the NRGI's efforts to underline the need to combine technology-based solution to development and governance reforms, is critical to grasp the real and imagined benefits of blockchain systems (NRGI, 2020: 8).

Blockchain systems are not yet fully effective in the cobalt sector but represent an interesting avenue for future research and transparency in an industry marked by its opacity. In 2021, Circulor partnered with Volvo Cars to facilitate the traceability of a batch of cobalt from the DRC. The same year, Glencore, CMOC, ERG and Umicore partnered with the development of Re|Source. Nevertheless, the proliferation of blockchains have not yet proved their ability to adequately tackle human rights abuses and sourcing risks. The challenges faced by the industry do not always allow for the implementation of these technology-based responses.

While risks are concentrated at the artisanal level, blockchains are complex to implement in a context of very limited formalization, rendering most of the ASM operation illegal. This is significantly different than the industrial sector in which extraction is performed in a more controlled environment and recognized by legal texts. Additionally, based on audit systems most often ignoring ASM, information provided by blockchains is inherently limited. The development of blockchains by Glencore, CMOC, ERG, and Umicore, all extracting or sourcing from industrial mines, will likely have no impact on the main challenge of cobalt responsible sourcing, the artisanal sector. Studying these limitations is needed to define the technical orientations that these blockchain systems should embrace to effectively participate in the establishment of clean cobalt supply chains.

## Discussion and Future Research

The plethora of programs and pilot projects developed or in development reflects the increasing pressure that companies, all along the supply chain, receive to both secure supplies and ensure that (mostly reputational) risks are mitigated. The current structure of responsible cobalt sourcing raises questions, many of which should be the topic of more research to ensure lasting and meaningful impacts and not only secure corporate reputation. From this mapping review, we identified five limitations that might prevent the successful inclusion of Congolese miners and nearby communities in a just[9] and sustainable green transition. It is important to reiterate that this review is based on a limited literature of a new field of inquiry. Hence, while we provide avenues to explore for future research, we also warn the reader against adopting a generalization approach based on this mapping review. In the years and decades to come, more research will be needed to identify and assess limitations in the responsible cobalt industry and

[9] The concept of justice applied to the extraction of cobalt in the DRC is best exemplified by a lawsuit filled in, 2020 in the United States District Court for the District of Columbia on behalf of 14 Congolese individuals and against Apple, Alphabet (Google's parent company), Microsoft, Dell, and Tesla.

bring to light the dynamics shaping them. Each one of the five limitations we identified should be explored by in-depth and on-the-ground ethnographic research. The ethnographic nature of these inquiries is important to include the often-overlooked perspectives of Congolese communities. Additionally, the industry and the academia need to increase the role of Congolese researchers (Deberdt, 2021a). We hope that by rendering visible these broad avenues for research, on-the-ground research will tackle the intricacies of cobalt artisanal mining to devise better interventions to the profit of Congolese communities.

First, the reliance on Western service providers and aid agencies appears to be a constant in the implementation of responsible cobalt sourcing programs. This is a pervasive critique of development and aid projects often implemented by non-profits, United Nations agencies and aid organizations (Booth, 2012; Hasselskog et al., 2017). In this sense, the lack of local ownership in the definition and implementation of responsible sourcing programs constitutes a barrier to their long-term sustainability (Donais, 2009; Bennett et al.,2011). Despite hiring Congolese personnel, decisions almost always originate far from the field, negotiated in Europe, North America, and increasingly China between implementers and their corporate backers. Programs by large multinational enterprises are defined in CSR and procurement departments, with often a primacy of the latter (Martin-Ortega, 2018) and widely adopt a supply security and reputational risk management approach. This pattern highlights the significance of supply security, instead of ESG strategies, as procurement follows streamlined growth-based approaches.

Second, the low local ownership translates into skepticism from Congolese actors. A survey by CARF and the Miller Center conducted in the DRC found that "[t]he consensus among respondents was that these initiatives are not useful, do not benefit the population, and are actually counterproductive in potentially exacerbating community poverty and conflict" (2020, 13). This skepticism results, at least in part, from the lack of local ownership,

publicization at the local level, and tangible long-term progress. It is also suffering from the continuation of policies exacerbating conflicts between ASM and LSM operations, as we have seen in 2019 when the Congolese army was mobilized to remove more than 10,000 miners operating on industrial concessions (ICG, 2020).

Third, the unproductive formalization discourse opposes wageless and waged workers, and illegal and legal operations. As Calvão et al. (2021) argue, corporate-led strategies hide the fluidity of artisanal workers. They support that "formalization efforts reinforce a specific narrative of legal and illegal extraction that excludes vulnerable *creuseurs* and reinforces the role of private security forces, industrial companies, and due diligence schemes as legitimate guarantors of 'legal' mineral extraction", and add that "ASM and industrial miners work alongside, at times in opposition, but never fully outside the purview of industrial extractions in the DRC" (9). The formalization process needs to be reconceptualized to avoid the dichotomy between artisanal/industrial, legal/illegal, formalized/unformalized (for a redefinition of formalization, see Spiegel and Veiga, 2009; Deberdt, 2021c).

Fourth, there is a risk for social audit programs to become 'ticking box' exercises. In their assessment of corporate human rights due diligence in the context of the Australian Modern Slavery Act, Ford and Nolan (2020) find that social audits have little impacts to effectively address the root causes of modern slavery and prove to be a limited reporting tool. In the context of cobalt mining in the DRC, the RMI/RCI audit covers exclusively the crude and fine refiners, both in and outside Congo. However, most of the risks reside at the extractive level where environmental pollution, human rights, and OHS incidents occur. While the RMI is partnering with Better Mining to address this gap at the ASM level, more needs to be done to effectively promote a long-term, continuous assessment of practices at mine sites. The snapshot given by audits, only lasting one or two days, suggests that this approach fails to provide a full picture of the risks, thereby endangering the ethical integrity of the whole supply

chain. Including community impacts and the beneficiation of mining operations for members of the community not directly involved in the extraction is a work-intensive but necessary step if the industry wishes to bring positive outcomes to the Congolese people.

Fifth, the above concerns are inscribed in the broader issue of long-term economic and social development, which often clashes with the short-term corporate strategies. It is revealing that some companies engage in the reorientation of the supply from the DRC, while at the same time being involved in responsible sourcing projects in the country (Els, 2020). Additionally, the narrative surrounding the development of new extractive industries, such as Deep Sea Mining (DSM), is built in opposition with the sourcing risks in the DRC, while not accounting for the economic role of ASM for millions of people (van der Grient and Drazen, 2021; McKie, 2021). The sustainability of responsible sourcing projects raises concerns as financing is likely to dry up or being significantly decreased. Finally, as Mancini et al.,(2021) argue, the inclusion of these projects exclusively in trade and commercial logics weakens their long-term sustainability due to price fluctuations on the global markets.

## Conclusion

The diversification of industry and governmental responses to the challenge of cobalt mining shows the potential for innovation to secure 'clean' cobalt, particularly from artisanal sources. From blockchain systems to on-the-ground monitoring and the audit of supply chains, a plethora of programs are flourishing. Despite the COVID-19 pandemic and its profound impacts on mining communities[10] and global trade, responsible sourcing programs remain at the fore of the Congolese cobalt sector. However, criticisms should be explored in subsequent research. These include the over-reliance on Western service providers and aid agencies, the

[10] For a global perspective see Crawford et al., 2020. For an African-focused study, see Muthuri, Judy N. et al., 2021. "The impact of Covid-19 on gold and gemstone artisanal and small-scale mining in sub-Saharan Africa: The case of Ghana and Kenya." *African Journal of Management* 7, no. 1: 121-147.

lack of appropriation by Congolese actors, the skepticism around traceability systems, assurance schemes and technology solutions, the limited scope allowed by audit programs, and the lack of long-term vision.

While some of these concerns appear to slowly be considered by the industry and governments, the increasing supply security strategies adopted by brand companies raise question the intent of ESG programs. The avoidance strategy adopted by some companies has been to reorient their supply chains toward jurisdictions considered less risky, Morocco and Australia, or potentially DSM. The long-term impacts of these policies on the Congolese mining industry, and in particular the economic sustainability of artisanal mining, should be explored more in-depth in the future.

Finally, new developments in the field will likely profoundly change the nature of cobalt mining in the DRC. In, 2020, the Congolese government announced the establishment of the Entreprise Générale du Cobalt (ECG), an entity operated by state-owned Gécamines, and acting as the sole buyer of artisanally-produced cobalt in the country (Bokondo Mukuli and Cihunda, 2020). The centralization of the production, paralleled with formalization processes, is expected to boost the adoption of responsible sourcing practices. Similarly, at the international level, the creation of the Cobalt Working Group, as part of the Global Battery Alliance (GBA), a project of the World Economic Forum (WEF, 2020), answers to a need to raise the profile of cobalt mining challenges and fully inscribe the industry in a green and sustainable transition. This transition from responsible sourcing-focused approach to broader ESG policies reflect the trend started in the past decades for downstream companies to assume responsibility over their supply chains. The cobalt sector in this sense, represents an excellent example of the involvement of these brand manufacturers at the extractive level, in partnership or not with midstream and upstream companies. Nevertheless, despite the level of investments, the sustainability of responsible sourcing programs remains questionable. As corporate actors

work on a different timeline than development policies, the current stronghold that private companies have developed on cobalt responsible strategies should be integrated in governmental efforts.

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