**Item 2**

**Literature/Technology/Professional Environment Review**

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SDE-457

Senior Design Project I

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**Abstract**

In the Democratic Republic of Congo (DRC), a crisis of child labor, unfavorable wages and other challenges persist. This literary review explores articles that will be used to develop plans for a senior design project. Many of the articles explore various contributing factors to the growing issues in the country and introduce technologies that might impact the minerals used in certain technologies. From a survey used in this review, 150 mining communities, revealing the prevalence of child labor, the structure of the artisanal cobalting apply chain, and the disparities between traders in the DRC. The report highlights the challenges faced by children (11% of the population) engaged in mining activities, with a significant portion working in sorting, cleaning or surface roles. The surge in international demand, particularly in lithium-ion batteries, exposes regulatory gaps and oversight challenges in the supply chain. The rise in the global demand exposes environmental issues that threaten the mining communities. However, there are technological advancements that must be coupled with concerted efforts from stakeholders across industries to ensure ethical and equitable sourcing practices , presenting an opportunity for positive impact through collaborative efforts in responsible mining practice.

Currently in the Democratic Republic of Congo, there is a crisis of child labor, unfavorable wages and other major problems. There are many different intertwining factors that have been occurring for centuries. In this paper, the different factors that contribute to the growing problem in the African country and one change in technology that may change the game in which minerals are used for certain technologies.

**Results of literary review**

***Artisanal mining, livelihoods, and child labor in the Cobalt Supply Chain of the Democratic Republic of Congo -***Faber, B., Krause, B., & Sánchez de la Sierra, R. (2017, May 6). *Artisanal mining, livelihoods, and child labor in the Cobalt Supply Chain of the Democratic Republic of Congo*. EconPapers. https://econpapers.repec.org/RePEc:cdl:econwp:qt17m9g4wm

From this report, it unveils findings from surveys conducted in 150 mining communities, revealing the prevalence of child labor in the cobalt belt, the structure of the artisanal cobalt supply chain, and disparities in earnings between artisanal miners and downstream traders in the Democratic Republic of Congo. With 90% of mining labor in arsenal small-scale mining, the absence of collective labor organization in 65% of sites is noted. The study encompasses data from 2,635 households, exposing the challenges faced by children (11% of the population) engaged in mining activities, with a significant portion working in sorting, cleaning or surface roles. The report highlights the correlation between child labor in mining, household poverty, larger family size, lower education levels, and proximity to mining activities.

**Summary of key ideas/information**

The households found in the mining communities within the cobalt belt exhibit significant poverty, with an average per capita monthly income of USD 35, and two-thirds express concerns about food scarcity. Those households are vulnerable to income fluctuations, they lack effective means to save or insure against sectoral shocks within the cobalt supply chain. Child labor is prevalent, with 11% of children aged 3-17 working outside the home, 23% engaged in mining and a majority performing domestic and agricultural tasks. The characteristics of households utilizing child labor include larger sizes, lower income, lesser education, closer proximity to mines, and higher likelihood of adult mining employment. 90% of miners in the belt are engaged in artisanal mining, but they capture only a small share of downstream prices, with potential disparities as low as 6% compared to traders. Labor organization is limited, with 65% of mining sites having small, unorganized teams, potentially contributing to the low bargaining power of miners.

**Analysis of key ideas/information**

The key ideas from this report demonstrate the different factors that contribute to the conditions found in the DRC. Based on the low income in the areas of the mining communities, many households that have a larger size tend to have a higher chance that an adult works at a mining area. This leads to children having a likely chance of doing domestic or in the case of Congo, artisanal mining work.

**How information will be used in report**

This information will be used in my report as some statistics and information about the problem. The information from the report goes into some of the factors that contribute to the problems found in Congo.

**Results of technology review**

* + ***Next-generation batteries could go organic, cobalt-free for long-lasting power***.- X, S. (2024, January 18). *Next-generation batteries could go organic, cobalt-free for long-lasting power*. Tech Xplore - Technology and Engineering news. https://techxplore.com/news/2024-01-generation-batteries-cobalt-free-power.html

**Summary sentence**

Researchers have explored an earth-abundant, carbon-base cathode material, bistetraaminobenzoquinone (TAQ), as a potential replacement for cobalt in lithium-ion batteries. The TAQ based cathodes cycled over 2,000 times safely, exhibited higher energy density than most cobalt-based counterparts, and charged-discharged in as little as six minutes. While fur5er testing is required before market availability these findings offer optimism for high-energy, long-lasting, and fast charging batteries, aligning the search for renewable energy from nickel and cobalt.

**Analysis of key ideas/information**

Based on the potential found in TAQ, it is a valuable alternative to cobalt. The increased use of this mineral may detur companies from using all cobalt based technologies and allow the mining operations to provide better working conditions for 5the miners.

**How information will be used in report**

This information will be used in the report to showcase some possible alternatives to cobalt in the future.

**Results of literary environment review**

***Toxicity in the supply chain: Cobalt, Orthopaedics, and the Democratic Republic of Congo* -** Williams, J. T., Vangu, A. M., Mabiala, H. B., Msngungulu, H. B., & Tissingh, E. K. (2021, June). *Toxicity in the supply chain: Cobalt, Orthopaedics, and the Democratic ...* The Lancet Planetary Health . https://www.thelancet.com/journals/lanplh/article/PIIS2542-5196(21)00057-7/fulltext

**Summary sentence**

The DRC dominates over two-thirds of global cobalt supply, raising concerns about exploitative mining practices, human rights abuses, and child labor. With increasing international demand, particularly lithium-ion batteries, regulations and oversight challenges in supply chains are highlighted. The artisanal mining prose environmental impacts, and scrutiny on technology and automotive companies contrasts with keas attention in medical implant firms. International guidelines stress human rights criteria.

**Summary of key ideas/information**

The global cobalt supply, predominantly sourced from the Democratic Republic of the Congo (DRC), faces significant concerns related to exploitative mining practices, human rights abuses, and child labor. The surge in international demand, particularly for lithium-ion batteries, exposes regulatory gaps and oversight challenges in cobalt supply chains. Artisanal mining in the DRC raises environmental issues and involves child labor. While technology and automotive companies face scrutiny, medical implant firms receive comparatively less attention. International guidelines emphasize the need for strict human rights criteria, and the Responsible Minerals Initiative (RMI) encourages voluntary compliance, with limited participation from orthopedic implant manufacturers. Although medical devices perform well in reporting on 3TG metals, there is a call for increased and comprehensive cobalt due diligence reporting. The collective responsibility of stakeholders across industries is emphasized to ensure ethical and equitable sourcing, presenting an opportunity for positive impact through collaborative efforts in responsible mining practices.

**Analysis of key ideas/information**

The information from this article demonstrates how disruptive cobalt mining is to the health of the people of DRC. With the current regulations in place for artisanal mining occurring has lead to many death , injuries, and permanent damages to the communities.

**How information will be used in report**

This information will be used in this report to showcase the violations of human rights in the mining of cobalt. It will be used as supporting evidence.

**Results of professional environment review**

***A Model for Information Assurance: An Integrated Approach -*** Macinachy W., Schou C. ,Ragsdale, D., Welch D. *A Model for Information Assurance: An Integrated Approach.*

**Summary sentence**

This article discusses an extension of John McCumber’s 1991 model for Information Systems Security (INFOSEC) to adapt the evolution of the field into Information Assurance (IA). McCumber’s original framework remains sounds, but the growth of IA necessitates changes. The extended model incorporates three temporal measures and highlights the multi nature of IA. The model emphasizes the dynamic nature of IA over the System Development Life Cycle, offering structured framework for understanding and teaching IA topics.

**Summary of key ideas/information**

The paper presents an extended model for Information Assurance (IA), building upon John McCumber's 1991 framework for Information Systems Security (INFOSEC). The extension accommodates the transformation of INFOSEC into IA, recognizing the multidimensional nature of IA. The model includes Information States, Security Services, Security Countermeasures, and Time as key dimensions. It emphasizes the dynamic nature of IA throughout the System Development Life Cycle, providing a structured framework for understanding and teaching IA topics. The integration of components is highlighted, emphasizing the interaction of different elements rather than viewing them in isolation.

**How information will be used in report**

The information will be used in the report to guide the thought process needed to develop a project for this course.

**Conclusion**

In conclusion, the issues surrounding cobalt mining in the Democratic Republic of Congo are complex and multifaceted, involving child labor, poverty, and environmental impacts. The realities of the reports on artisanal mining underscores the urgent need for comprehensive and sustainable solutions to address the humanitarian and economic challenges faced by the communities in this African country. The explored of the promising TAQ-based cathode for lithium-ion batteries, offers a glimpse into potential paths for reducing the dependency on cobalt and improving conditions for miners. However, these technological advancements must be coupled with concerted efforts from stakeholders across industries, including medical implant manufacturers, to ensure ethical and equitable sourcing practices. As the global community strives to navigate the growing demand for cobalt in various sectors, collaboration is imperative to drive responsible mining policies to protect human rights in the DRC.