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To Chris.

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Preface

As a mining engineer and social sciences graduate coming from a resource-rich developing country, I started thinking about my thesis trying to answer a big question in my mind: Why is it that countries with large amounts of natural resources exhibit low sustainability performance? Aren't sustainability and a sustainable development path intertwined? If so, does that mean the path leads to such nations being indeed unsustainable?
Through an early review of budding literature on sustainable development of resource-rich countries, I soon realized that these questions stem from a well-known phenomenon called "the Resource Curse." In a nutshell, the phenomenon puts that, counter-intuitively, countries rich with resources have less development through time. This research was thereafter dedicated to focusing on my question and try to answer causes (chapters 1 and 2) and results (chapter 2) of this dilemma. I focused on mining resources and had the chance to travel to Western African countries that mine resources to perform case studies. I hope that the results of this thesis will, at least at a minimum, help towards the sustainability of developing countries.

Lausanne, 30 Avril 2020 T. D.

Abstract

Extractive resources are indisputably a necessary component of international sustainable development. Despite current advancements in the circular economy, world production needs for raw materials are ever increasing, and still a long way remains for it to become rather independent from mineral resources. At the same time, mining has too many negative stories in news headlines about its trade-offs for the environment and human health, which hinders sustainable growth. This thesis deals with this integral dilemma in three chapters.

In chapter 1, I have made an extensive effort to understand the socio-political aspects of the mining business, both internationally and specifically in the context of a developing country, and on the issue of the corporate social responsibility the company requires. I then continued with gathering my primary sources of data for answering my first question: *What are the primary social variables contributing to mining sustainability issues?* I derived theories from Economic Growth in the Political Economy and Institutional Void from Management Science, trying to place my findings in a broader context. I concluded this chapter with underlying sociopolitical factors interfering with sustainable mining practices. This has led to the shaping of the second chapter of my thesis.

Chapter 2 builds on the given that throughout the model of Economic Growth, technological change can happen within a shorter timeline and that new technologies lead to more efficiency in the Process Innovation. The mining industry is no exception. Yet, my quick review at the time revealed that this industry is lagging incumbent mainstream businesses in technological adoption. I therefore made my aim here to discuss conditions for transitions towards a more technologically innovative mining business. I surveyed mining firms internationally and noted the critical criteria for responsible practices. I then made what had been to my knowledge and ability, an exhaustive grouping of innovative technologies for the different sectors of mining firms. These tools granted me the ability to perform different multivariate analyses and decide on the best method for benchmarking different technology groups based on these criteria.

In the later part of my thesis (Chapter 3), having these findings in hand and all experiences and observations in place with my assumptions, I decided to take one step back to ask whether the criteria I have for measuring mining sustainability are the correct measures by looking through the question using emerging data science tools: *Are the sustainability scopes commonly discussed in the mining community the most crucial sustainability problems of this*

sector? Having the sustainability reports of all major international mining firms in hand, I evaluated around 3500 documents containing 8 million words discussing current sustainability matters pertaining to mining firms. Through implementing appropriate algorithms of Topic Modeling, I introduced five new main scopes for mining sustainability used to examine the discourse and groupings through this framework to observe any possible differences among the conventional and the generated lists. The results of my thesis are my two conceptual frameworks, technological benchmarking assessment tools, and a data-driven sustainability domains list, as well as the innovation policy recommendations for the mining community.

Keywords: Sustainability, Economic Growth, Mining, Corporate Social Responsibility, Technological Innovation.

Résumé

L'exploitation minière est incontestablement une composante nécessaire du développement durable. Malgré les techniques de recyclage, la production mondiale a encore beaucoup de chemin à parcourir avant que la production ne devienne indépendante des ressources minérales. En même temps, il y a beaucoup d'articles négatifs dans les journaux et dans nos esprits sur son impact négatif sur l'environnement et la santé humaine dans les zones minières, ce qui entrave une croissance durable. La thèse est divisée en trois chapitres.

Dans le chapitre 1, j'ai déployé des efforts considérables pour comprendre l'aspect sociopolitique des entreprises minières, tant au niveau international que dans le contexte d'un pays en développement, et la responsabilité sociale des entreprises qu'elles exigent. J'ai ensuite continué à rassembler mes principales sources de données pour répondre à ma première question : Quelles sont les principales variables sociales qui contribuent aux problèmes de durabilité de l'exploitation minière ?

J'ai formulé des théories à partir de la croissance économique dans l'économie politique et du vide institutionnel dans la science de la gestion, en essayant de donner à mes conclusions un sens plus large. J'ai conclu ce chapitre en présentant les problèmes sociopolitiques sous-jacents, en les reliant à la croissance économique. À la fin de ce chapitre, j'avais déjà ma deuxième question de thèse.

Le deuxième chapitre s'appuie sur le fait que, dans l'ensemble du modèle de croissance économique, le changement technologique peut se produire dans un délai plus court et que les nouvelles technologies conduisent à une plus grande efficacité dans l'innovation des procédés. Les entreprises minières ne devraient pas faire exception à la règle. Pourtant, mon étude rapide de l'époque a révélé que cette industrie est à la traîne par rapport aux entreprises traditionnelles en matière de technologie. C'est pourquoi je me suis fixé pour objectif de discuter des conditions de transition vers une activité minière plus innovante sur le plan technologique. J'ai mené une enquête auprès d'entreprises minières à l'échelle internationale et j'ai noté les critères importants des pratiques minières. J'ai ensuite procédé à un regroupement exhaustif des technologies innovantes pour les différents secteurs des entreprises minières, en fonction de mes connaissances et de mes capacités. Ces outils m'ont permis de réaliser différentes perspectives d'analyse multi variée, et de décider de la meilleure méthode d'évaluation comparative des différents groupes de technologies en fonction de ces

critères.
Fort de ces résultats, à la fin de ma thèse, et disposant de toutes les expériences et observations avec mon hypothèse, j'ai décidé de prendre un peu de recul, et de me demander si les critères dont nous disposons pour mesurer la durabilité de l'exploitation minière sont les bonnes mesures, en examinant la question avec les outils de la science des données. Les questions de durabilité normalement discutées dans la communauté minière sont-elles les problèmes de durabilité les plus cruciaux de ce secteur?
Ayant en main le rapport de durabilité de toutes les grandes sociétés minières internationales, j'ai évalué 3500 documents contenant 8 millions de mots traitant des questions de durabilité actuelles dans les localités où se trouvent les entreprises. En mettant en œuvre des algorithmes de modélisation thématique, j'ai introduit cinq nouveaux domaines principaux pour la durabilité minière, suggérant à la communauté d'examiner éventuellement le discours et les regroupements à travers ce cadre, afin d'observer les différences éventuelles.
La conclusion de ma thèse porte sur les deux cadres conceptuels, ainsi que sur les recommandations en matière de politique d'innovation pour la communauté minière.

Mots clefs : Innovation, exploitation minière, durabilité, innovation technologique.

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1 The Role of Institutions on the Social Impact of Mining in the Developing Countries: The case study of Large-scale Gold mining in Ghana

Abstract

The aim of this study is to shed light on the current situation of the mining sector and introduce solutions to make mining practices more sustainable. After reviewing the role of mining in the Sustainable Development Goals (SDGs), we use case studies of mining practices to better understand the factors affecting sustainability in the mining society, especially regarding locality through a social lens. Specifically, in the developing countries, mining can have both positive and negative impacts. This study tries to investigate the social implications, especially in the case of large-scale metal mining in western Africa, and propose suggestions at the country level to reduce the negative consequences. Based on our findings, this study concludes that institutional effects have a crucial impact on mining sustainability. Conducting a multi-dimensional investigation of the current situation, implementing our case study of Western Africa gold mining, we looked at the effects of mining in the area, and how social licenses influence the situation. This study starts with a general demonstration of institutions and mining in developing countries while taking the case study of Ghana and conducting a set of interviews with different stakeholders in the gold mining sector. We conclude that having strong institutions is a necessary condition for ameliorating the negative social costs of mining and moving toward sustainability. The interview aspect of the research formed a critical part of the study, demonstrating the importance of institutional infrastructure in having positive feedback on mining in society. The study seeks to contribute to the theories of institutions and economic and political growth, and it therefore concludes with suggestions of what this study calls "a supranational framework practice in mining," especially in developing countries (Marples, 1961; Robson, 2002; Thompson, 1965).

1.1 Introduction: Sustainable Development Goals

The 2030 Agenda, signed by 193 countries in September 2015, seeks to leverage the success of the Millennium Development Goals (MDGs) in improving well-being across the globe. This Agenda features the Sustainable Development Goals (SDGs) and their 169 associated targets, which focus on the three dimensions of sustainable development: the economy, society, and the environment (United Nations, 2015). The purpose of the SDGs and the 2030 Agenda is to engage governments, business leaders, and civil society organizations in transforming the world and setting it on a sustainable development pathway. The current economic, political, and social environment is faced with immense challenges in accomplishing this vision, such as eradicating poverty, inequalities of many types, and climate change.

Although mining activities can, in many cases, promote the development goals, the impact of mining on the sustainable development of countries are many times a tradeoff with regard to development. Various mining impacts affect the host countries, diminishing both the sustainability of the mining area and the operation. Therefore, it is necessary to have a comprehensive view of the social dimension of mining impacts. This study, conducted through field research in Ghana, investigates the social effects of gold mining in the region and argues how the stakeholders can manage the social impacts and the results on development in the sector.

As mentioned, the mining sector has been recognized as an essential contributor in advancing the achievement of the SDGs (Pedro et al., 2017; UNDP, Feb 2020). The industry can be used to drive economic growth while curbing negative externalities such as waste and emissions, and re-evaluating land and water usage, which impacts local communities, as well as the environment and gender disparities (Hinton et al., 2003; Levine, 1999). A recent UNDP investigation (2016) has undergone a mapping exercise that links the mining sector to the SDGs. This so-called "Mining Atlas" highlights significant issues—either positive or negative—where mining has an impact on each SDG (UNDP, Feb 2020). This research demonstrates that it is possible to supplement the findings of these linkages with a more direct effort. Using this approach, we detect critical spaces for decision making regarding the mining sector to positively influence progress toward the SDGs (Different areas of mining are shown in Figure 1.1).

To supplement the literature on the critical linkages between the mining sector and the SDGs, the first step of this study is a perspective that deploys a mapping exercise. Through this step, we understand whether a specific SDG target calls for changes in the governance of the mining sector. Once a relationship is established, the next stage involves describing the potential synergies and trade-offs between the mining sector and the achievement of the SDGs (Nerini et al., 2018). These synergies and trade-offs are compiled to highlight the priority areas where the mining sector can support the performance of the SDGs. Subsequently, additional insights are provided by categorizing the SDGs into key institutional domains with the help of our case study.

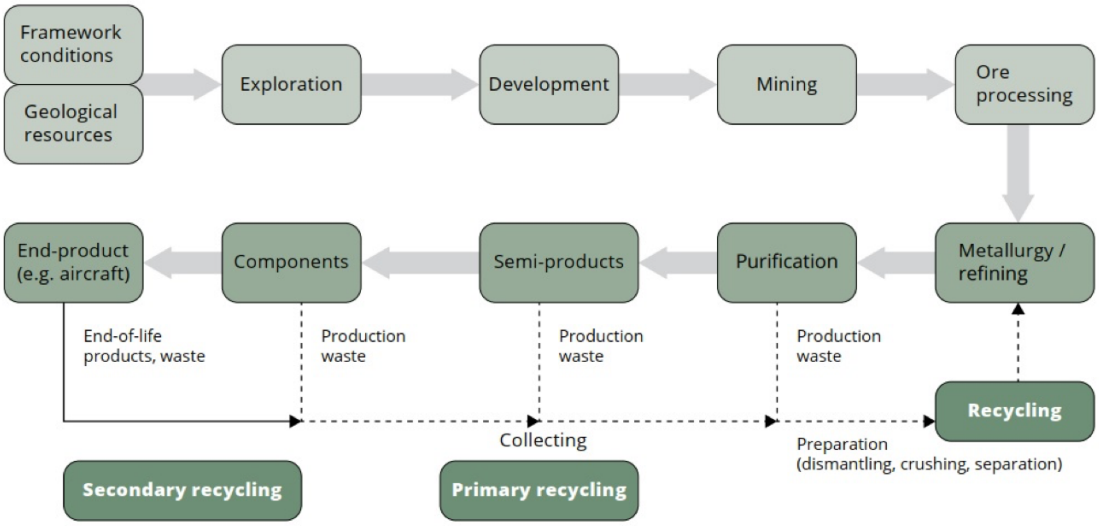


Figure 1.1 – Mining value chain

1.1.1 The Mining Sector and the developing world

The mining sector has an integral role in supporting sustainable development, especially in the developing world. Specific geographical areas or countries may require special attention. For example, a study on the mining industry in sub-Saharan Africa found that based on available data on the importance of the mining sector to a country, 8 out of the 10 top countries were labeled as 'least-developed' or 'low-income' (Yakovleva et al., 2017). This finding stresses that mining companies play a significant role in helping to advance the SDG agenda, as the host countries do not necessarily have a strong capacity to achieve the goals.

Mining revenues can be channeled into national economic development programs, domestic investments, and social security systems. As such, if appropriately managed, the mining sector can support long-term economic development. Moreover, mineral and metal inputs are needed for reaching particular SDGs. Mined resources are used in the manufacturing industry and the construction sector, creating employment, and necessary infrastructure for development (Mancini & Sala, 2018). Therefore, to ensure that the mining sector can benefit the host country and its society, sound governance practices are needed at local, national, and international levels (Pedro et al., 2017). For this reason, it is necessary to uncover how the mining sector can advance on its impact towards SDGs, as well as how different institutional domains can be supported and improved.

Previous studies (Pedro et al., 2017; UNDP, Feb 2020) have found that mining impacts all 17 of the SDGs, and is particularly relevant for Goals 1, 6, 7, 8, 9, 13, 15, and 16 (Pedro et al., 2017). While the benefits of sustainable development of the mining sector are promising, the impacts from the industry can also be detrimental. Mancini and Sala, 2018 discuss how the benefits of the mining sector are often felt at the national level through an increase of GDP from mining revenues, while the adverse effects, such as water scarcity and community changes, tend to be

prevalent in local areas. This aspect of the sector complicates current policies and decisions that attempt to curb the harmful impacts of mining.

Mining firms are experiencing challenges that hinder the sector from translating mining prosperity to social and economic development. As a notable example, mining companies must drive the agenda on the reduction of Illicit Financial Flows (IFFs) (Khanna & Palepu, 2010). IFFs are financial resources that the domestic countries lose through practices such as money laundering, tax evasion, and trade mispricing (OECD, 2014). IFFs are not necessarily illegal, but estimations show that developing countries are losing US $1 trillion every year due to these flows. One study (UNECA, 2017) indicated that in Africa, 56.2 percent of IFFs originated from the extractive industry. In addition to diverting resources needed by host countries for development, IFFs undermines governance at local, national, and international levels.

Governments at all geographical levels, private businesses, civil society organizations, and international organizations are called on to help assure the success of the SDGs. Regarding mining, there is a relevant space for each of these factors in pushing the SDG agenda. Before utilizing the capacities from these different actors, it is first necessary to understand how the mining industry relates to the SDGs, and how the mining sector can promote the sustainable development agenda. In order to advance in the most efficient way possible, priority areas must be highlighted where decision-makers can take the first actions. It is also essential to understand where there may be a conflict between the mining industry and the SDGs.

1.1.2 Artisanal and Small-Scale Mining in the Extractive Sector

Although Artisanal and Small-Scale mining is not the focus of this study, it is worth describing the ASM scope and issues briefly, as it sheds light on the whole picture of mining in Africa and our adopted main case study of Ghana. The Artisanal and Small-Scale Mining sector of the extractive industry is an essential source of livelihood for many marginalized households. The International Institute for Environment and Development (IIED) estimates in 2016 that 100 to 150 million people are supported by ASM activities (Hilson et al., 2016; UNEP IRP, 2020). ASM activities can be formal or informal, and the latter occurs when a miner does not have a license to mine or is mining on an unlicensed site. It is crucial to integrate ASM into formal supply chains to facilitate improvements across the sector.

1.2 Review of Literature: Breaking Down the Main Synergies and Trade-Offs

This perspective has shown, through a mapping exercise that evaluated synergies and trade-offs between the SDGs and the mining sector, different areas that decision and policy-makers can focus on to help push the 2030 Agenda and achieve the SDGs. The mapping exercise evaluated a large volume of published literature to provide evidence about which 169 of the

Figure 1.2 – SDGs associated with ASM in West Africa

SDG targets are relevant to the governance of the mining sector, and then further assess which targets were synergies or trade-offs with the mining sector.

The mapping of associations of the SDGs and the mining sector, as well as synergies and trade-offs between the SDGs and the mining sector, was carried out by evaluating an extensive amount of literature. Expert analysis of relevant academic papers, international organization publications, and a wide array of policy briefings firstly led to an agreement if each SDG target called for changes in the governance of the mining sector (Morgan, 2014). This approach was adopted from a similar work that mapped the synergies and trade-offs between energy and the SDGs (Nerini et al., 2018).

This mapping exercise found that 146 targets out of 169 (86%) called for changes in the governance of the mining sector. Figure 1.1 shows the results from the first step of the mapping exercise. It confirms that the mining sector can contribute to all SDGs. Moreover, every target within SDGs 1, 4, 6, 7, 8, and 13 was found to have a relationship with the mining sector. The Table showing the results of our literature review can be found in Appendix A.1.

Contingent on a target calling for changes in governance in the mining sector, this analysis continued to evaluate if there was either a synergy, a trade-off, or both a synergy and a trade-off between the SDGs and the mining sector. If a piece of evidence was found in either an academic paper or a 'grey' paper (i.e., United Nations publication), it was deemed sufficient enough to declare a target as either a trade-off or a synergy. 111 targets (66%) had synergies with the mining sector, and 51 (30%) had trade-offs.

The mapping (Appendix A.1 for a summary of extensive literature review) evidence (seen in figure 1.3 for and 1.4) shows that synergies between the SDGs and the mining sector prevail. This finding further stresses which goals and associated targets are highlighted as having the most synergies. In particular, SDGs 1, 4, 6, 7, 8, 9, 12, and 13 are shown to have strong synergies. These findings largely overlap with the previous literature on the subject. Pedro et al., 2017 state that mining contributes most directly to SDGs 1, 6, 7, 8, 9, 13, 15, and 16. The mapping evidence indicates the crucial roles of the mining sector: eliminating poverty in all of its forms (Goal 1), ensuring availability and sustainable management of water and sanitation for all

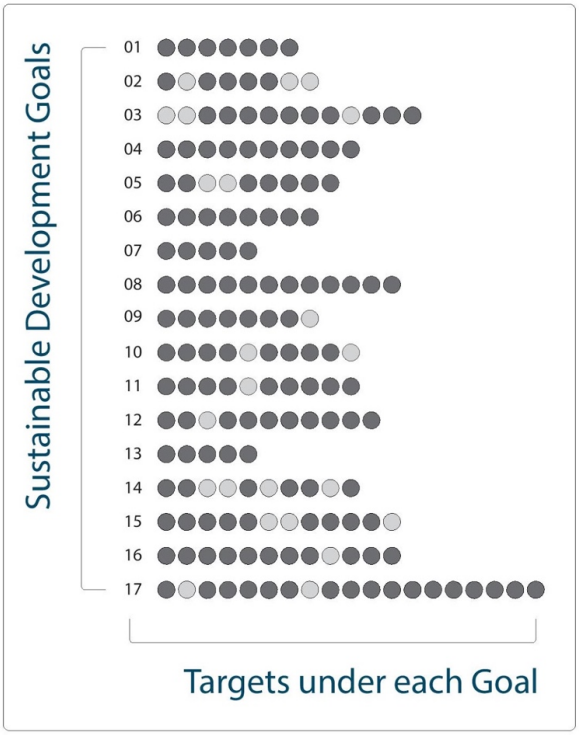


Figure 1.3 – Target under each SDG goals

(Goal 6), providing access to affordable, reliable, sustainable, and modern energy for all (Goal 7), promoting sustained, inclusive, and sustainable economic growth, full and productive employment, and decent work for all (Goal 8), and taking urgent action to combat climate change and its impacts (Goal 13).

Contrary to foreseeable synergies between the mining sector and SDGs, only four SDGs are highlighted due to their significant challenges concerning the mining sector. These SDGs are Goals 2, 5, 15, and 16. The trade-offs identified stem from the competition of land use between agriculture and mining (Goals 2, 15); gender-related disparities (goal 5), mining impacts on environmental systems and biodiversity (Goal 15); and the findings that extractive industries often play a role in initiating and sustaining conflict, the mining sector is strongly implicated in illicit financial flows, and that the mining industry still commonly discriminates against women (Goal 16).

1.2.1 Institutional Domains, the Mining Sector, and Sustainable Development

After the mapping of synergies and trade-offs between the SDGs and the mining sector, the relevant SDG targets were next categorized into three institutional domains: individual and collective aspirations of improved welfare and wellbeing, infrastructure for sustainable development, and environment and natural resources. Decisions about mining can affect,

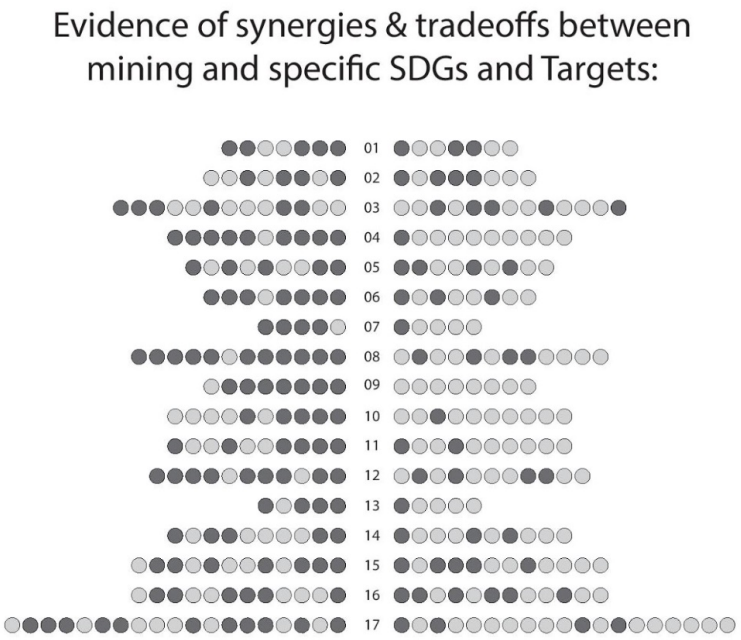


Figure 1.4 – Synergies and Trade-offs between the SDGs and the Mining Sector

positively or negatively, each of these three vital institutional domains.

The results of the institutional domains, the mining sector, and the SDGs indicate that infrastructure for sustainable development is the most relevant institutional domain category. Infrastructure for sustainable development is a crucial evidence domain for 108 targets, while individual and collective aspirations of improved welfare and wellbeing is an essential evidence domain for 67 targets, and environment and natural resources for 46 targets.

Taking a closer look at the vital domain of infrastructure for sustainable development, 87 (81%) of the targets that are categorized into this domain are synergies, and 32 (30%) are trade-offs. Not only is this domain the most prevalent isolated from this analysis, but the majority of the relations are synergetic. This finding reveals that promoting infrastructure that enables sustainable development is one of the main contributions that the mining sector can do in supporting the SDGs. Where there were trade-offs, they often focus on developmental infrastructure that could negatively impact the land or water use and quality for local communities, or, more generally, the environment. As such, the infrastructure developed to support mining development or mining communities must be designed in a way that will not avoid adding environmental pressures or drive competition for land and water use.

Repeating this process for the other two institutional domains shows that for the targets under the category of individual and collective aspirations of improved welfare and wellbeing, 51 are labeled as synergies (76%), and 27 (40%) are trade-offs. For the environment and natural resources institutional domain, 34 targets (74%) are synergies, and 21 (46%) are trade-offs.

The synergies in both cases are more influential than the trade-offs. They reveal that, after a priority focus on infrastructure for sustainable development, energy and resources can then be channeled into institutions that support individual and collective aspirations of improved welfare and wellbeing. For the mining sector, this largely coincides with institutional frameworks that ensure that the mining industry generates income in an equal manner, and promotes educational advancements, safe and decent employment options, and improved mining operations and community planning to reduce traffic accidents and connect individuals together. The trade-offs reflect the same focus areas and call on stakeholders in the mining industry to mitigate the negative impacts of the vocation in these spaces.

Finally, while this exercise has not highlighted the environment and natural resources institutional domain as the top priority area in terms of synergies, the trade-offs between the mining sector and the SDGs must be addressed. Progress towards this institutional domain does not have to be considered in isolation to the others. When developing infrastructure for sustainable development, the mining sector and related actors can ensure the progress is made in a sustainable and environmentally-friendly way. Similarly, new infrastructure should be designed and built in a way that considers land and water use. Moreover, when improving infrastructure to increase efficiencies, this can include reducing emissions and waste as part of their efforts.

1.2.2 Realized Spaces for Decision Makers

After mapping the synergies and trade-offs between the SDGs and the mining sector, certain goals have been isolated as priority areas to support to drive the synergies. The main SDGs to focus on to leverage the synergies are SDGs 1, 4, 6, 7, 8, 9, 12, and 13. To further narrow these goals down, it is suggested to focus on the goals that overlap with previous findings in the literature (see Pedro et al., 2017). In effect, the priority goals for the mining sector are SDGs 1, 6, 7, 8, and 13. For making decisions or policies, two concrete spaces have been identified by looking at these SDGs. First, the mining sector can promote economic growth and development that helps reduce poverty and inequalities through safe and decent labour and the responsible use of mining revenues. Second, the mining sector can reduce the energy and water use of the mining industry while being proactive in climate protection.

These mapping exercises have also revealed spaces where there is a need to re-evaluate current practices in the mining sector. The trade-offs between the mining sector and the SDGs show that SDGs 2, 5, 15, and 16 should be prioritized. This can be narrowed down into three suggestions for change. First, the mining sector should reduce the competition between water and land use that arises between mining operations and agricultural practices to ensure stable and sufficient food production. Second, the mining sector must advocate for women in all areas of the mining industry and work to protect women that are indirectly involved in the mining sector by living in mining communities or by interacting with mining workers as sex workers. Finally, illicit financial flows must be curbed to achieve the SDGs. Estimates show

that improving mining regulations to mitigate IFFs could generate more financial resources than overseas development aid (UNECA, 2017).

The priority areas to support are those that coincide with SDGs where there are strong synergies and those that focus on improving the mining industry where there are high trade-offs. The SDGs identified through this exercise are often complementary. For example, the five SDGs that have key synergies produce two suggestions on how to advance the 2030 Agenda. Similarly, the four SDGs that are isolated as having significant trade-offs lead to three concrete suggestions. Tapping into the key institutional domains can be a starting point for advancing sustainable development across various goals. This mapping exercise identified that the most pertinent institutional domain is a social infrastructure for sustainable development. Improving institutions not only improves capacity at all levels – local, national, international – but also facilitates reaching the Sustainable Development Goals (SDGs).

As a last note for the institutional domains, although the environmental and natural resources institutional domain connected with fewer targets, it does not diminish the importance of protecting natural resources. It could be that fewer targets are explicitly focused on natural resources, and so, therefore, the evidence is biased away from this institutional domain. This means that while supporting infrastructure, it should be done in an environmentally sustainable fashion.

The actions which are included from the analysis above include promoting inclusive and equal economic growth through decent working conditions and responsible use of mining revenues and calling on the mining sector to improve energy and water efficiency and cooperate on mitigating climate change. The other areas instead highlighted current mining sector practices that should be changed to stop blocking the SDG progress. These spheres include reducing land and water competition between mining sites and agriculture to ensure adequate food production, ensuring the participation of women in the mining industry, and protecting women who are indirectly involved with the mining industry and eliminating IFFs.

These policy spaces can firstly be addressed through the institutional domain of infrastructure for sustainable development. Efforts to have a cross-institutional approach are, moreover, key in solving multiple SDGs at once while improving capacity and institutional quality across the spectrum. This approach ensures that the mining sector moves in an environmentally sound direction while continuously enhancing the wellbeing and welfare of all.

1.3 Natural Resource Governance and the Extractive Sector

SLO can also increase policy-making autonomy. Although states will remain forcefully in control, the policy might be controlled at a higher level (Sen & Bhattacharya, 2001). The role of supranational institutions is, therefore, essential in the policy process and maintaining the characteristics of the state (Poggi, 1990). From our observation of current literature, Policy initiation and collective decision-making can help filling up the gap.

In summary, we specifically suggest policy analysis that facilitates policy intervention and an excellent agenda for rethinking policy analysis. Simply producing more knowledge may not solve the problem. Therefore, based on the evidence we have gathered from interviews and observations, we have concluded with this diagram for policies to improve the development of research-rich countries with new practices and policies. Developing a new framework of Social Licenses based on the SDG goals I the proposition this paper gives. This Social Licenses can act as supranational institutions and norms in these countries. Some examples are collaborative dialogues in California, conflict resolution in international politics, and interactive policymaking in the Netherlands (Hajer, 2003; Knack & Keefer, 1995).

"Social License" generally refers to a local community's acceptance or approval of a company's project or ongoing presence in an area. The concept is increasingly recognized by various stakeholders and communities as a prerequisite to development. The necessity for obtaining Social Licenses to operate is to avoid costly conflicts and exposure to social risks. It is, therefore, necessary to consider the social and transitional theories to conceptualize it. This degree of connection is structural, relational, and cognitive (Boutilier & Thomson, 2011). Moreover, the concept is derived initially from what is known as Corporate Social Responsibility, or CSR, a concept defined by the European Commission for Employment and Social Affairs (2002). CSR describes how companies integrate social and environmental concerns into their business operations and in their interactions with stakeholders voluntarily. For taking such social responsibility, and also the long-term continuation of their project Aghion and Durlauf, 2005, a reasonable solution among the mining industries is to attain legal and social acceptance of the community. One of the emerging appeals in the CSR literature supports this approach if corporate interventions to address the social problems are "to be substantial and sustainable".

1.3.1 Driving Inclusivity in the Extractive Sector in West Africa

The above sections have outlined the overall issue of natural resource management in the extractive sector and specifically addressed the ASM sector. This approach calls for action to increase inclusivity within the informal ASM component of the extractive industry in West Africa. Improving the incorporation of local communities into existing supply chains will support the overall extractive ecosystem and enhance accountability and governance in the sector. Moreover, as plans to develop an SDLO are emerging, it is necessary to build capacity and provide training and knowledge to those individuals directly impacted at the local level before efforts to overhaul the existing system begin. However, it is crucial to understand the situation and the problem. This initiative proposes to start from the ground-up to prepare the community for increased participation as complementary projects begin to trickle down and simultaneously introduce better practices to reduce environmental damage and support natural resource management.

1.3.2 Mining and Sustainable Development

When examining mining and sustainable development, we must first study the essential factors which influence the growth and development of society. The governance notion is classically defined as the “fly-in, fly-out” actors (Foucault, 1978). Many of the Ghanaian communities rely heavily on the activities on large-scale mining in many aspects. In most of the communities rich in minerals, mining industries have positioned themselves as one of the leading players of governance for the public. Sometimes the mining community becomes so influential that the governance of the community depends on it. The impact of large-scale mining in the governance of the developed countries doesn't follow the same process, such as the mining in Canada or Australia; however, this would not be such an issue, primarily because of the strong institution (see Cheshire, 2007). Nevertheless, it is of much relevance to the impact of mining companies on the governance of the developing region that needs to be investigated in a case such as Ghanaian culture.

The mining industry can affect the sustainability of the country and also its governance in several ways. It is therefore essential, first of all, in the developing countries, that the governance of countries is affected by the big corporations operating in the country. The country institutions play as ‘the rules of the game’ (North et al., 1990) for such working conditions, and will demonstrate the strength of governance in the society. Other political scientists such as Bulte et al., 2005, in a separate study, demonstrated that institutional gaps hinder economic growth. Further than this, Acemoglu et al., 2005 describe how institutions affect the economic and political system of a country and indicate institutions as the most critical feature to impact the prosperity of the nations. They first explain the importance of institutions as a crucial factor for long-term economic growth and subsequently demonstrate how a change in political institutions can impact economic institutions. Following the same argument, the institutions making the rules for the mining industry can cause differences in economic outcomes afterward. At the same time, since the economic power makes the political power of the future, it is crucial to see the structure of economic power in Ghana today.

The significant historical aspect of Ghana's mining industry is the extractive institutions made in the colonial era and how the inclusive institutions succeed when compared with the extractive institution. When a region is controlled for the institutions, the effect of other variables becomes non-significant. Therefore, the settlement of Europeans is associated with the mortality rate in the area and the success of establishing institutions. These regions become the prosperous countries during the latter decades. Scholars nevertheless, interestingly, also point out that these institutions are not pre-determined, and there is the possibility to change the institutions. They use the historical example from the colonial era to show how ”extractive institutions” were much unsuccessful in comparison to the inclusive institutions (Acemoglu & Robinson, 2012). They also argue that extractive institutions leave governing problems. In the case of mining, these institutions are extractive, and therefore, it is essential to build something based on more established institutions, such as SDGs, which is what we aim to

do in this research. Although the reason for establishing such institutions remain in the past, it explains the origins of power, prosperity, or poverty. They also point out that extractive economic institutions lead to extractive political institutions (Acemoglu & Robinson, 2012). Nevertheless, a juncture can help change the equation. This juncture can be the economic origins of dictatorship and democracy in a political setting.

In the classical work of Romer, 1990, having resources is an essential factor of growth. What has hindered the development can be categorized under the umbrella term of the "resource curse", an aspect that this paper tries to address on the social and institutional level. Regarding Ghana, Amankwah-Amoah et al., 2018 points out that institutional void enables corruption in Ghana, or, in other words, prohibits sustainable development. Altogether, the research question that this paper tries to answer is as follows: What is the role of institutions in large-scale mining impacts in developing countries? What are the ways to overcome such barriers?

Acemoglu et al., 2005 posit that one cannot separate the political situation from the economic growth of the country. Institutional void is problem in conditions which lack a well-established institution to ensure the enforcement of rules and regulations.The typical examples of these are environmental issues (Hajer, 2003).[I]

There are different reasons for describing why an industry with such potential to advance the nation's economy seems to be adding no value. Political power is shaped based on institutions and political resources (Acemoglu et al., 2005). Also, in the economic theory of Acemoglu et al., 2005, a significant factor for enhancing economic growth is the institution. By elaborating on the impact of institutions in the development of countries, the drawbacks of the mining sector will be addressed.

1.4 The Theory of Institutions: Political Science Perspective

We should define what we mean by institutions. As North et al., 1990 puts it, the institutions are not the formal rules of the game, such as law and court, but the informal players. If there is no proper institutional framework, one cannot get adequate enforcement of what needs to be done. One of the norms, therefore, is to establish implementation within institutions, creating a formal law.

Institutions are a fundamental cause of long-term growth (Acemoglu & Robinson, 2012). In his classical study, North et al., 1990 posits that the "Institutions are the rules of the game in a society or, more formally, are the humanly-devised constraints that shape human interaction." He goes on to emphasize the importance of institutions stating, "In consequence, they structure incentives in human exchange, whether political, social, or economic" (North et al., 1990). Aghion and Durlauf, 2005 pose that the institutions are important in shaping the political incentives of society. They also posit that institutions are, in general endogenous, meaning that they are both influencing the institutions and, at the same time, a part of it.

[I] See: Ghanaian institutional void

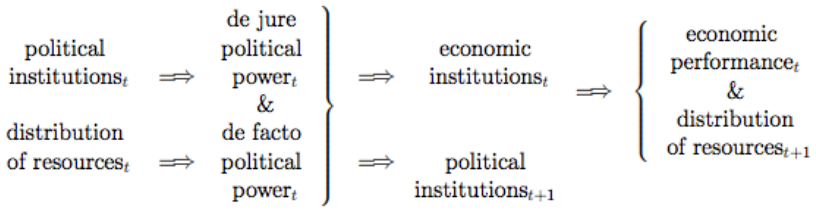


Figure 1.5 – Schematic representation from Acemoglu et al., 2005

They conclude by stating the importance of learning how the institutions are shaped and why they are different in different countries. Corrupt institutions arise due to poor groups with unrestrained political powers.

Besides, Aghion and Durlauf, 2005 posit that the economic institutions determine not only the prosperity but also the distribution of wealth in the future, stating, "Different economic institutions lead to a different distribution of resources." The groups' preferences on the choice of types of economic preferences that prevail are determined by the political power currently that is available for the institutions.

Moreover, the distribution of political power in society is also endogenous, and to get over this endogeneity, the de jure (current) and de facto (future) political power are introduced in theory. Experts posit that political institutions shape de jure political power, and the distribution of resource make de facto political power. Also, that the hierarchy of the institutions is political, followed by economic, and most importantly, that the legislative power shapes the political institutions. By examining the literature to enumerate different causes–based on resources used and the primary data collected—we can categorize the reason into three main sections of economic, social, and environmental. The proposition of Acemoglu et al., 2005 is on economic institutions. This paper poses that it is also on the social institutions for natural resources activities and that strong institutions can improve the social impact in the country (Figure 1.5).

In their political institution's theory, Acemoglu et al., 2005 posit that the institutions are built as a natural answer to needs—at least in a democracy—and that substandard institutions are not improved because of the different interests of the stakeholders. If the institutions are changed, then de jure and the facto power would also change.

An essential point in the Acemoglu et al., 2005, is that the distribution of de facto political power at any date is influenced to a large degree by the distribution of resources in society. Translating this to the case of gold mining in Ghana, if the framework is established, the de facto power can also change during this timing. What we need here is to provide information where buyers and sellers come together to provide and require information. Without this source of information and establishing bases of such structure, this requirement does not get delivered. It is apparent that institutional malfunctions are one of the main features in the social the developing economies also in the current discourse of the world (Amankwah-Amoah

et al., 2018). Institutional voids create space for illegal activities to occur in the supply chain.

1.4.1 Institutional Void as a Necessity to Overcome for Sustainable Development: Managerial Perspective

There has been a lot of studies discussing the role of institutions in making the economy grow (Acemoglu et al., 2001; North et al., 1990). Harold Lasswell saw the "policy orientation" as one of the most important ways of developing an academy. In the literature, one of the main prohibitions of sustainable development is the institutional void in the country. As an example, through the gaps we enumerated for deficiencies in sustainability, institutional void creates an atmosphere for illegitimate money laundering in Ghana. In such a fiscal case, institutional voids include what is called "red tape" and different types of bureaucracy, which cause problems (Amankwah-Amoah et al., 2018). Two main types of this drawback are usually discussed. First, institutional void makes space for illegitimate financial deals between firms and states (George et al., 2012; Radjou et al., 2012). This issue was seen in the bureaucratic atmosphere of Ghana. During the interviews, it was observed that these trends also appear in the context of Ghana in addition to the other developing countries. Altogether, focusing on institutional norms is essential because, based on the institutional void theory, not having the institutions makes relying on cultural values, ethics, and norms to mitigate such risks (Acquaah, 2007; Chung & Luo, 2013) when the environment faces challenges.

Policymaking often takes place in an institutional void. New policymaking entails providing solutions in aspects where established institutions have failed. However, the classical-modernist way of policymaking makes it challenging to act in a correct and timely manner. Due to this shortcoming, the people's trust in these governmental institutions has been severely damaged. As a result, the rule of standard settings should be altered.

1.4.2 Institutional Voids in Case of the Developing Countries

Institutions have always been one of the critical explanations both in classical and modern growth theories. There have been three main factors of economic growths in the developing countries' theory, and in two of them, the stunted economic growth and the depleting resources are due to the institutional gaps: one in institutions and one in government. The negative impact on institutions suggests that resource-rich countries with weaker institutions are more likely to be trapped in conditions that render such policy improvements ineffective. Institutional reform may well be a necessary condition for countries to develop.

Institutional weakness is regarded as one of the main reasons for the underdevelopment of the country. While strong institutions have many direct or indirect benefits, they inhibit the government from making frequent policy changes (see Keefer and Knack, 1997; Weingast, 1993. The institutional gaps are known as a significant contributor to developing countries' failure to attain the expected level of development. In contrary to the late 90s growth theories,

developing countries failed even farther to maximize their available resources compared to the developed world.

To elaborate on such a link, first, we need to know what institutional quality is, and indicate how to indicate it. A classical study by Keefer and Knack, 1997 describes "the institutional environment" as "the legal, political, and regulatory framework" of the country. Some of these measures include "the prevalence of the rule of law, the pervasiveness of corruption, and the risk of expropriation and contract repudiation." Institutional gaps can hinder investment in the country and interfere in translating mining externalities into the economic prosperity of the country. However, choosing the stakeholder can be regarded as, perhaps, one of the most significant adverse impacts. Also, due to corruption, weak institutions fail to collect appropriate revenues from the industry. In their classical study, Keener & Wetchman (1994) demonstrate that foreign investment or human capital accumulation should be considered proximate, but not fundamental causes, of low growth rates or failure to catch up". Specifically, it is difficult for developing countries to access the information they need for better decisions, and this results in damaging decisions via such an institutional void. Evidence from our observations (interviews) shows that some Ghanaian regions are heavily dependent on mines for the revenues and their social patronage. A similar study on Ghana's cocoa industry shows the negative impacts of the institutional void in the country (Sarkwa, 2011). Based on the observations and findings, we posit that a more communicative polity can positively change the game.

1.5 Methodology-Case Study: Gold Mining in Ghana

To investigate how to promote sustainability of mining with a focus on the developing countries, we implement the case study of Ghana. The country serves as a typical example and an ideal case study for the Gold mining in sub-Saharan Africa. Ghana shares the political and historical trends of its neighboring countries, such as political unrest and the colonial background. It, nevertheless, has a rather advanced structure to accept policy implementations more quickly in the region based on its structure (see Effah and Mensa-Bonsu, 2001). After gaining independence in 1957 and in the recent decades, Ghana has succeeded in becoming more advanced when compared to its neighboring countries in Western Africa, despite having almost the same mining resources and sharing the same volatile political context with its neighbors. The country is seen as a relatively stable West African country.

Ghana has a long history of Gold mining for around 1000 years (see Hilson, 2002). After gaining its independence from the U.K. in 1957, the nation has faced many political unrests that exists in the political culture of also other Africa countries, yet in fewer degrees than others (Haynes, 1993). Ghana has had a volatile political history during the 1990s, yet the country has seen more stability when compared to the neighboring countries in recent years. This relative stability of Ghana made it more properous through infrastructure in relation to other countries and for this country, a good source of investment (Asiedu, 2006). Other West

African countries with similar gold resources, such as Burkina Faso, Nigeria, or Togo, have far less political stability when compared to Ghana. The democracy index of Ghana is 6.62, which is higher than the other 15 West African countries (EIU, 2019). The corruption index, although in the middle zone, is still in a better international position than other West African countries (CPI, 2019). The country makes an excellent example of a case study for the impact of mining and possible ways of reducing the adverse effects. Also, notably, Ghana has a relatively reliable degree of institutionalized infrastructure in comparison to its neighboring countries. A policy space can, therefore, be implemented in this country.

Mining history in Ghana goes back to at least 100 years (Peters, 2013). The mining industry in Ghana currently contributes to 35 to 37% of total exports, of which Gold mining contributes to over 90% (USGS, 2016). The mining sector in Ghana, similar to many other African countries with mining section, can be divided into two main sections of large-scale (LSM) and Small-Scale (SSM) mining. Ghana is currently the second-largest producer of gold in Africa and the 10th in the World (USGS, 2016). Small-scale mining is labour-intensive, has a relatively lower production capacity, and causes rapid environmental degradation in urban areas. Large-scale mining is capital-intensive and involves international corporations. The focus of this paper is on the LSM in Ghana and its impact on society.

For industrial mines in Ghana, as in other neighboring countries, the LSM industry is mainly in the hands of international corporations. In 2001, Ghana had 19 operating mines and over 128 local and foreign companies with exploration licenses, mostly in the domain of gold. In Ghana, Canadian Newmont owns the corporation. In other neighboring countries such as Burkina Faso, their operating mining companies are from Russia, Canada, UK, and Australia (in 2018).

The paper begins with a review of Gold mining in Ghana and its social impacts. This analysis is followed by a view on the economic growth of the developing countries, and the structure of institutions follows. The Ghana field visit and the conclusion of the interviews are afterward presented with a comparison to other west African countries. Results from the field visits and the conversations are presented, and concluding remarks are made. Some recommendations for the social aspects of the SLOs for sustainable development governance of mining, called SDLOs, are then presented as the future steps of this study. The SDLO framework is then tested through the proposed framework for the SDLO mapping. Finally, this work concludes that 10 out of 12 targets of social institutions have synergies with the SDG goals.

1.5.1 Interview Constructs

How can mining businesses survive in an environment that lacks such institutions? What specific issues do such supranational institutions refer to in the case of a developing country with wealthy mining firms? To answer this question, we have used a set of semi-structured interviews, discussing with major players in Ghanaian mining firms. These interviews have been coded immediately and peer-reviewed. To be among the interviewees, the professionals

have had to have an experience working in government, NGO, or private sector of West African LSM.

The paper uses data from the desk study and, after that, a primary data collection. The desk study consisted of reviews from the academic papers and reports produced in and from Ghana. Our first step was to look at our lengthy, recorded, fully transcribed interviews. Thereafter, we decided to use a combination of what is called induction and deduction (Gao et al., 2017). For the inductive part, we read through the interviews using NVIVo 17 to identify patterns that best categorizes the emerging concepts for sustainability in mining.

The primary data collection involved visits to the artisanal regions in Africa. The aim of the primary data collection was to enable rural communities to take part in the data and to have a comprehensive view of the situation in the area. The participatory methodology was achieved through focus group discussions along with informal, structured, and semi-structured interviews with institutions, NGOs, and individuals in the industry.

The fieldwork took place in October 2017. Twelve interviews were conducted and recorded after getting the approval of interviewees, and this is followed by a daily reporting diary for observations. Due to the lack of full transparency, a comprehensive overview needs to include every stakeholder and realize each point of view. Following the Ghana field visit, a considerable number of online follow-ups were conducted with interviewees, which comprises government officials, NGO workers, and mine workers, aiming to fully cover the spectrum of stakeholders. Organizations included in the interviewee groups were as follows: Environmental Protection Agency Ghana[II], National Resources Governance Council (NRGC), Minerals Commission[III], Integrated Social Development Center (ISODEC)[IV], Natural Resources Governance Institute[V], United Nations center in Ghana[VI], and Africa Center for Economic Transformation (ACET)[VII]. After analyzing the interviews and observation, in February 2019, a second visit to Burkina Faso was performed through government policymakers and large scale mining practices. As a neighbor country with similar mining resources, this field visit provided insight for a better comparison and critical underlying criteria to study in identifying barriers in sustainable mining in the region.

Coding the Transcripts: Evidence from the Interviews

Our objective is to ascertain the political institutions' theory and its gaps in the case study of gold mining in Ghana. To achieve our aims, we conducted interviews, which is one of the most used methods for gathering information about the events when obtaining data via other means is difficult (see Kvale, 2008). Having literature in hand, and based on such interviews, we aim

[II] www.epa.gov.gh
[III] http://www.mincom.gov.gh/
[IV] https://www.publishwhatyoupay.no/en/participant/integrated-social-development-centre-isodec
[V] https://resourcegovernance.org/our-work/country/ghana
[VI] https://unu.edu/about/unu-system/inra#overview
[VII] https://acetforafrica.org/

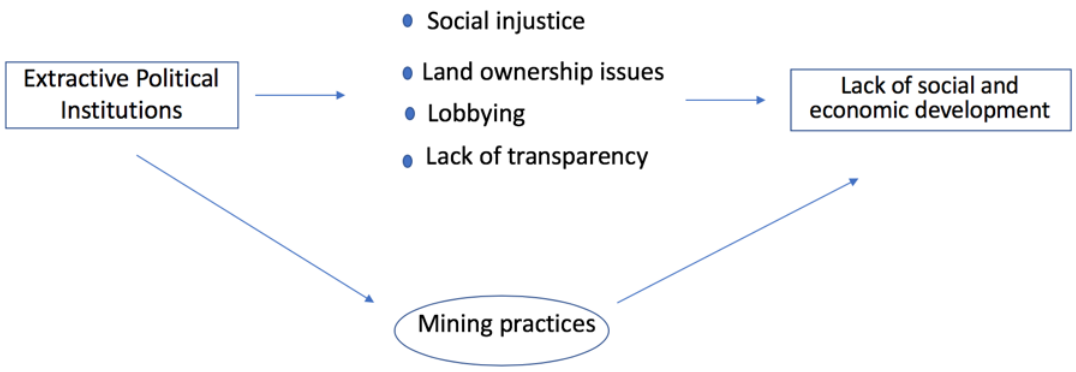


Figure 1.6 – Interview schematic summary

to define and cluster problems which are needed to be addressed through such supranational institutions. An analysis of the institutional setting of Ghana in comparison to gold extraction is provided below. The social issues concluded from the interviews can be grouped into the four categories below as main emerging keywords within interviews. The interview results are depicted in Figure 1.6, and the complete NVivo mapping of transcripts emerging themes can be found in Appendix A.2.

1. Discrimination & social justice
2. Land ownership
3. Lobbying
4. Lack of transparency

1.5.2 Interpreting the Interviews

There are different methods for analyzing the data derived from the transcript, using a mixed methodology. Observations were also all noted. The study followed the three-stage analysis of Burnard, 1991[VIII]. Following this analytical method, for stage 1, the main notes were observed, as in the appendix. I have also included "memos" on how I have categorized the data and the factors that are given priority these interviews in the Appendix. For stage two, I have read the transcripts. In this stage, the central "theme" of the interviews have emerged and been discussed. In the third stage, it has been aimed that the main concept of the interview will be grasped in this part. Step four decides to establish a causal link between the mining atmosphere, different categories, and the mining storyline. In stage five, the recurrent headings are merged to produce the final list. Next, different colors were attributed to the categories of definition, current issues, and avenues for changes.

[VIII] To be seen if other methods for interpreting the transcripts are available.

Figure 1.7 – Word map query of word frequencies in interviews transcripts

In addition, the coding was identified with a program using the word processor for each category. Some examples of coding are listed below, and the full list is available in the appendix. For this, brackets are added to the sentence to grasp the precise meaning of the text. After this level, the selected respondents are asked to check for us to ascertain the correctness of the conveyed message. At the final stage, we asked the experts outside of the interviewees to review the coding schemes. The 'word frequency cloud' from the total transcript sum can be found below (The figure is designed using NVivo 12, and the details of the query can be found in Appendix A.2).

1.6 Policy Derivation in the Context of the Developing Countries

Without the presence of national or supranational institutions, it is evident that the institutional void becomes a recurrent theme in mining sustainability discourse (Interviews, 2018 & 2019). A deliberative approach that can help here is to give an insight that would help in explaining how a discursive polity can hold, how governance without government might actually work, and also what it requires to be both successful and legitimate through potential supranational organizations.

Based on this approach, institutions can ultimately shape the economic and political situation in a country. In essence, we aim to argue the same theory about political institutions in the

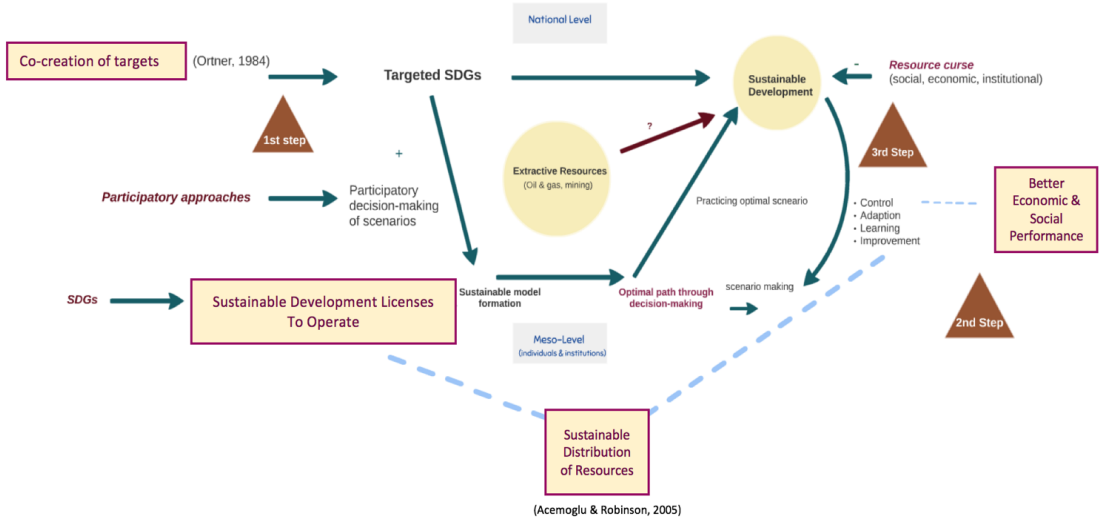


Figure 1.8 – Conceptualizing SDLOs and their impact on Sustainable Development Mechanism

country in relation to the impact of the mining industry. Based on this theory, here is our proposition:

Proposition. "We propose that the change of institutions can change the distribution of political and economic power, and thus, contribute to growth in the society."

Based on the discussion above, and the proposition made, the Acemoglu & Robinson model of economic growth can be re-shaped for mining sustainability discourse in developing countries as such:

The cause of divergence in economic institutions is explained by the social conflict view. One of the issues also raised in the observations was a lack of property rights. In Acemoglu et al., 2005 theory, the institutions are the bodies that help in enforcing property rights.

Another suggestion which this paper makes is multi-level governance (Marks et al., 1996). In a nutshell, to overcome the absence of institutions which we have identified through our study, we propose the Coleman's Bathtub model (2008) above (Figure 1.8), Sustainable Distribution at the micro (or perhaps firm) level contributes to overturning 'resource curse' in developing countries. What we propose as the solution to this void is supranational organization based on internationally agreed SDGs. Through such an institution, the co-creation of values (Ortner, 1984) is possible without the sector lagging behind due to the absence of an institutional framework in the country.

Having supranational institutions in place can increase policy-making autonomy. Although states will remain forcefully in control, the policy might be regulated at the national or international level. Therefore, the role of supranational institutions is essential in the policy process and maintaining the characteristics of the state (Poggi, 1990). Besides, policy initiation and collective decision-making can help in filling up the gap. We can transfer technology and build

factories (Garcia & Calantone, 2002); however, maintaining the culture and norms of the host community and building trust and shared understandings is a complicated and slow process. This is why I started my studies with this step. With the SDLOs, we can initiate and attain such interactive policymaking via supranational organizations.

1.7 Conclusion

The deduction from the conducted interviews reveals that the Institutional Gap is one of the leading players of sustainability that raises social issues in the mining areas as a result of excavating activities. In this paper, we first identified four issues related to the social aspects of mining based on the literature, observation, and interviews available. We then compared them to institutional theory to determine why these are the case and identify the causes.

Our observations from both literature and field interviews substantiated the importance of institutions in the sustainability of the mining sector. These mining companies are obliged to make positive differences in the community in which they operate. This process begins with both local people and mining organizations regarding the sector as a way to develop the economy. In the non-democracies, people may opt for institutions which optimize their income. The drawback to this approach is that, based on the context, the communicative approach might not work well. Nevertheless, a framework for establishing a collective action based on international norms and institutions can be a good starting point for addressing institutional void in these countries.

This paper presents a preliminary attempt to investigate problems of advancement through mining, concluding with presenting the idea of the SDLO. The study looks at the new form of governance in the mining communities, which is the governance and patronage of the mining companies.

Throughout our studies, the institutional void in mining in Ghana was made evident. We suggest a practical plan for rethinking policy analysis in a manner that facilitates policy intervention. Only producing more knowledge may not solve the problem. Therefore, based on the information gathered from interviews and observations, we have concluded with this diagram for policies that will better the development of research-rich countries with the new practices. The development of SDLOs is one that we have suggested for this aim[IX].

1.8 Discussion

The first step considers the mechanism of how these gaps affect the social impacts of mines. Next, we identify how to ameliorate this mechanism of influence. Since social institutions are both soft and hard institutions, building a framework is the most viable approach as it

[IX] Some similar examples are collaborative dialogues in California, conflict resolution in international politics, and interactive policymaking in the Netherlands (Hajer, 2003)

doesn't need reform in politics, making it is tangible to achieve. Moreover, based on what has been done through interviews, we suggest adding a supranational institution such as SDGs to bridge this gap.

We believe that having the same incentives can make the significant institutions advocate for improvement. But how can these be built? In other words, how can the slices of pie be fair in the eyes of all stakeholders? We should also take into consideration that mining itself can impact the institutions in the long run. We could then investigate the impact of both sides. Based on this analysis, we do not consider the change of the institutions in the long-run, as the impact of institutions on mining activities will be higher.

Concerning the interview aspect of the study, we believe that this set of interviewees is a valuable set of academic and business leaders as a comprehensive set of stakeholders. They are selected to ensure a considerable degree of transparency. However, the research centers' results are not directly translated to the policymaking, due to a lack of proper institutions to put policies into action.

In addition to the SDGs, there are development plans, such as the Ghana National Development Planning Commission (NDPC), which can serve as an indicator of sustainable growth based on mining as further research of this study, measuring the advancement towards development goals. Also, the mining mapping for the SDGs indicates substantial positive impacts in the case of institutions. Moreover, stakeholders feel more reliant on investing in these countries. The problem with not having institutions is that the overall business potential of the countries would not be achieved. What this paper proposes is a set of a framework based on communications for the two SDGs that are most relevant to the social aspects. This study also suggests a set of guidelines based on sustainability and universal acceptance to overcome the social issues of mining.

Establishing a framework as a form of social institutions depend on its acceptability. In the SDLO framework, we introduce the process of having mining contribute to the SDG goals. Taking into consideration the institutions' definition used for this paper, the SDLO can both serve as an institutional framework and add to the existing institutions.

After realizing the mechanism, the SDLO tries to investigate the mechanism that can be used to solve the problems (Pedro et al., 2017). The paper follows the first step of the project in establishing a sustainable development license to operate. Besides, the SDLO is based on the SLO basing for sustainable development goals. The framework can be a change from the existing system, which can bring the developing world closer to achieving the development goals. In this step, the SDLO framework can help as a quasi-natural experiment for future case studies to see whether having SLOs based on SDGs can help countries to overcome their institutional void. When trying to explain based on Acemoglu and Robinson's model, the de facto model can change as a result of such juncture.

Furthermore, the traditional idea advocates placing policymaking in the hands of the respon-

sible authorities and established traditional institutions. Yet, with the dynamism of today's world, this would not be the case in what is called the "classical-modernist" approach (Hajer, 2003). As discussed concerning the new governance in developing countries, the structure of governance can be described as a participatory need. Therefore, the form of policies and implementations should be different. By basing Social Licenses on SDGs goals (Pedro et al., 2017), this goal can be achieved through basing it via such a supranational organization.[X] This study suggests that the shortcomings of the institutions be resolved by international mandates such as SDG implementations. These modern polities can guide what should be done when the efficient institutions for enforcement of sustainability regulations are lacking, especially in a context of a developing country.

[X] This chapter has contributed to the academic part of International Resource Panel (IRP) of United Nations Environmental Program (UNEP) of Natural Resources Governance: https://www.resourcepanel.org/reports/mineral-resource-governance-21st-century

2 The Role of Innovative Technologies in the Sustainability of the Mining Sector: Considering a Sustainable Development Approach

Abstract

The mining sector is one of the most important contributors to economic development. It is, however, one of the most challenging sectors for sustainable development. This research identifies and benchmarks innovative technologies in the mining sector based on interviews and survey analysis, with the application of multi-criteria decision making approaches. The study first selects sustainability criteria from the literature and expert interviews. Mining experts are asked about innovative technologies in their area and their impact on sustainability criteria. These results are then used to provide each technology with a benchmarking scale using survey analysis methods and, subsequently, multicriteria decision analysis. In addition, through Principal Component Analysis, different technologies are categorized into diverse groups, and finally, different innovative technologies in the mining sector are determined. The findings are useful for mining firms in establishing strategies to identify the best technology options and to help them move toward sustainability.

2.1 Introduction

Mining has always been a major contributor to the sustainable development of the world's economy. Nevertheless, this sector's impact has always served as both a synergy and a tradeoff to sustainable development goals. This study aims to improve the sustainability of mining practices in a timely manner. The mining sectors considered for this study can be found in the Appendix. Eslamishoar et al. discuss the different issues impacting mining sustainability. The authors conclude that some aspects, such as institutions, require a lengthy period of time to embrace change (Eslamishoar et al., 2018). The issues facing the mining industry are challenging due to the nature of the enterprise and the finite resources associated with it

(The Economist Intelligence Unit, 2019). Nevertheless, one aspect that impacts efficiency is technological change, which can be implemented within a more reasonable time frame.

Historical evidence shows that technological innovation has a significant impact on business competencies. In some cases, even modest changes to existing technology can result in dramatic consequences on their competitiveness (Henderson & Clark, 1990). Moreover, emerging technologies can often be associated with unexpected success, uncertainty, or considerable confusion in business corporations (Henderson & Clark, 1990). Opting for the right or wrong strategy, therefore, may result in either success or failure after these innovations challenge the industry.

Many pieces of research have examined the relationship between technological innovation and business competencies (Abernathy & Clark, 1985; A. N. Afuah & Bahram, 1995; Benner, 2010; Benner & Tripsas, 2012; Henderson & Clark, 1990; R. S. Kaplan, 1996; Kelly & Kranzberg, 1975; Tripsas & Gavetti, 2000). Based on these studies, innovation is viewed as a sequence of activities involving the acquisition, transfer, and utilization of information. Previous research works have examined the impact of technologies in process efficiencies and, consequently, on sustainability. Many new options, such as reducing, restructuring, and recycling materials, as well as improving the life cycle of material has been made possible through technology (see Khalil and Shankar, 2000). For the aim of this paper, we define innovation as devices or processes that change the status quo, and innovative technologies as technologies that have been introduced in the mining sector during the past three decades. We observe two perspectives: the company and the firm.

From a firm's viewpoint, the essential aspects of the relationship between innovation and competition are mentioned in the literature (Kline and Rosenberg, 2010; Nelson, 1993; Porter, 1983; Rosenbloom, 1974). While some other works focused on the barriers to sustainability within the mining sector and methods for improving sustainability in this industry (see Pedro et al., 2017; Scherer and Ross, 1990), discussing the role of technology as something that can be changed within a timely manner has so far been underdeveloped. To fill this gap, we develop a conceptual framework to evaluate technologies and pave the way for a better implementation of these technologies. This study also reveals the elements from and beyond cognition, being noticeably relevant in the mining sector, such as external or mining-specific criteria, that precludes technological adoption in the mining sector.

From a sustainability measurement viewpoint, weighing different criteria can be based on the viewpoints of different stakeholders. In this study, the viewpoints of mining firms are requested and assessed. The ultimate goal of this assessment is to benchmark innovative technologies that best contribute to sustainability. Using information from the first round of interviews, we have categorized these characteristics into two domains: first, the technology domain, and second, the criteria that affect the sustainability side. The possible predictions are that the technologies would make changes or make prior technologies obsolete. We conducted interviews based on the Dillman et al., 2014 method.

We derive criteria for assessing sustainable development from different aspects. First, a review of the literature and relevant material to assess the benchmarking for sustainability is researched among the academic literature and mining reports. Next, the main challenges for sustainability are reviewed and discussed in the interviews and suggested for benchmarking exercises.

2.1.1 Definition of Concepts and Technologies

In management literature, technology does not possess a universally agreed definition. Also, the technology impact in different parts of the industry may differ (Abernathy and Clark, 1985). In contrast to the bulk of economic analysis, the work of technologists and behavioral scientists has focused on what goes on inside the "black box" of technology (Abernathy and Clark, 1985). Therefore, innovation is regarded as a sequence of activities involving the acquisition, transfer, and utilization of information.

Sustainable development concept has enormously thrived in international development scopes, such as SDG goals (Sustainable Development Goals, 2015). Looking at the sustainability aspect, to analyze the role of technologies in sustainability, one must first define the concept. United Nations Environmental Program (UNEP) defines sustainability as "development that meets the needs of the present without compromising the ability of future generation to meeting their own needs" (United Nations Environmental Program, 2019). Sustainable development concept has emerged mostly at international development scopes, such as SDG goals.

Management literature posits that technology is not a unified phenomenon, and its impact at different parts of an industry may differ (Abernathy and Clark, 1985). Historical evidence shows that technological innovation has a significant impact on business competencies and making business breakthroughs. In some cases, introducing even modest technologies can result in dramatic consequences on their competitiveness (Henderson and Clark, 1990).

A corpus of literature discusses the impact of technology in increasing efficiency in process innovation of firms, and subsequently, in sustainability (Cash et al., 2003; Kemp, 1994). Therefore, based on arguments from the literature above, we have considered that implementing innovative technologies helps in achieving sustainable development.

The criteria for assessing sustainable development emerges from different aspects. First, a review of the literature and relevant material to assess the benchmarking for sustainability has been researched using academic literature as well as large mining firm's sustainability reports. Next, the main challenges for sustainability are reviewed in the interviews and suggested for benchmarking exercises. As different kinds of innovations require different kinds of organizational structure, the technologies considered sustainable are based on these criteria, which are chosen and used for such a definition of sustainability.

This study is divided into three parts. In section 2.2, we discuss the criteria for clustering

technologies and the competitive significance of each technology in the mining business. How much these technologies are innovative or the level at which they disrupt technologies gauges their significance. In section 2.3, we illustrate such points through different groupings and relate them to the pattern of emerging technologies. Particular emphasis is placed to identify the impact of each technology group in the sustainability industry. We then move forward to discussing the impacts on a quantitative term. We benchmark different technologies based on the sustainability and technical criteria that we located in the earlier sections. In section 2.4, concluding remarks are given with a discussion on implications for practices, and section 2.5 discusses the possible paths of further research.

2.1.2 The Transilience Map of Technological Innovation

Framing and benchmarking technologies provide distinctions which help in choosing how to react in each of the different situations that may lead to subsequent success or failure after these innovations challenge the industry. In categorizing technology, we use mainstream literature, which discusses the categorization of technologies based on their impact on the industries, since the revolutionary mode of innovation is dominated by technology push. Inspired by Abernathy and Clark, 1985, we got interested in the impacts of technological development and sustainable indicators advancement for the mining sector. An innovation in the initial market introduction of a new product or process whose design departs radically from past practices (Abernathy and Clark, 1985) and creates new markets, requires different managements. The quadrants above demonstrate different managerial environments.

One of the main discourses in technological innovation adoption was developed by Abernathy and Clark, 1985, where they discuss technological adoption based on market pressure. We relate to their discourse on how technological innovations challenge and change mining firms. We also refer to Schumpeter's idea of "creative destruction" to understand which technology can change the mining business and indicate significant technologies that can serve as creative destroyers (A. Afuah and Tucci, 2003). Looking at technologies with this lens, we contribute to the body of work on cognition and technological innovation literature (for example, Eggers and Kaplan, 2009; S. Kaplan and Tripsas, 2008; Tripsas and Gavetti, 2000). Abernathy and Clark challenges and complete the view of Schumpeter (1942)'s theory of technology being either disruptive or not when applied to the firm. They extend the categorization of technological innovation based on the process (Figure 2.1). The categorization is such that different types of innovation have different imposed changes. Understanding this distinction in technological innovations Rosenberg and Nathan, 1982 at different levels helps to learn and anticipate the changes in different aspects when implementing the technology. Looking at innovation through the lens of their model, decision-makers for the firm can depict current and future strategies for innovation to lead the firm's successful change. Mapping this quadrant for the mining sector would help achieve the objective of categorizing technologies based on their impact on mining firms.

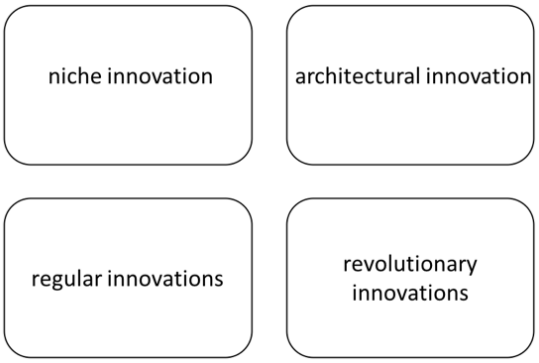


Figure 2.1 – A framework for defining innovation (Abernathy and Clark, 1985).

Since this study holds a sustainability focus, we complement our categorization practice with attributing technologies through sustainability and technical weighted criteria, which are also discussed with mining sustainability experts. The technologies that are considered sustainable are based on the criteria which are chosen and used for the definition of sustainability.

2.2 Methodology

The methodology used for data collection is known as expert view surveying. This survey method is widely used for policy analysis, especially when obtaining data via other means is difficult. In our case, since the integration of technology is a new phenomenon, and the analysis is based on the experience of experts in mines, obtaining data from a face-to-face survey is one of the best ways to achieve the results comprehensively.

The first step of the semi-structured interviews has been fully transcribed promptly after interviews and coded using NVivo 12 software. The data is interpreted based on previous literature, and then, following Yin, 2009, used to triangulate the interview data, building more robust interpretations. This replication logic fosters the emergence of a testable theory that reduces researcher bias (Eisenhardt, 1989). Moreover, all collected transcripts have been reviewed by at least three researchers, and when possible, by colleagues external to our research. At least two different coders have independently coded the interviews. When relevant, different participants have reviewed field notes to assure the completeness and reliability of the collected data. Moreover, interviews are transcribed promptly.

General comments of interviewees from the initial, open-ended interviews were used to improve questionnaire qualities. Therefore, to ensure the answers are from the correct resources, with a few exceptions, we have mainly targeted the three groups below:

- Sustainability managers of mining: These groups can help to figure the mining reports and how important each of the criteria is for each mine.

- Academics: Academics, especially in each of the specific sectors, have a scientific, comprehensive, and neutral view in the business sense for each of the technologies.
- Mining engineers: Mining engineers have the privilege to work closely with the mines and know the positive points and pitfalls behind their implementations. This approach will help in examining the concept altogether.

The experts for the study have been contacted from a different location and various mining sites. Moreover, the interviews have been conducted in two phases. Approaching the experts for interviews is implemented following Dillman's method for interviewing (Dillman, 2011). The reason for choosing this interview method is that they provide a flexible means to access information that one might not obtain via other sources (Robson, 2002). The experts have been contacted a few weeks prior to the interview to notify them that the interview will hold from December 2018 to October 2019. After carefully transcribing all open, unstructured interviews, we have used SurveyGizmo, 2019 to make the survey instrument for elaborating more on interesting findings—the interview instrument can be found in the Appendix B.3. The domains for investigating of the expert view consists of technologies in mining, mining process innovation, and sustainability definition for mining. Sustainability-technology relation for mining is also put into question. A pilot test has been performed to measure the understandability and practicality of the designed survey. In cases where some respondents did not provide answers for the creative destroyers' section, we have not included them for the calculation of the creative destroyers. The results helped in shaping the followed structured questionnaires. This round of unstructured interviews resulted in identifying innovative technologies for each mining sector, as well as weighted criteria grouping for sustainable and efficient mining. The results are discussed in the following sections.

2.2.1 Innovative Technologies in Mining Sector

The summary of what experts considered as located recent innovative technologies are listed below (Table 2.1). These technologies, when used properly, would give mining firms competitive advantages in comparison to their other competitors. Through interviews and literature review, we identified the technologies listed below (Table 2.1).

For the second round, the technologies are clustered in coherent groups to ensure a timewise subsequent questionnaire, which is discussed in the following sections. These technologies have been categorized at the end of the survey to make it more convenient for the interviewees to respond and attain a higher response rate. Average scores are based on the results of the nine-point scale questionnaire.

2.2.2 Questionnaires and Structured Survey Instrument Design

The second part of the interview comprises of three instruments: transilience map location, criteria weighing, identifying creative destroyers, and a pairwise comparison matrix. The

Table 2.1 – Recent innovative technologies (last 30 years) in mining based on mining expert views

Exploration	UAV/Drones Remote sensing & Airborne Geophysics Image analysis Deep drilling Nano, Bio & Gas geochemistry Mobile laboratory
Excavation & RockMechanics	Automated transport system and vehicles Renewable energy sources for power generation Surveying technologies Data science (simulation and integration) Robotic technologies Instrumentation technologies
Mineral Processing	Lab-made minerals Internet of things (IoT) Underground preconcentration Bio and Phyto mining Insitu Mining
Water, Environment & Safety	Portable detectors and analyzers Personnel tracking & Fatigue measuring Sensors and monitoring systems Covers, Liners & Filters technologies Dust collectors and air quality instruments
Remediation & Reclamation	Wetland technologies Covers, Liners & Filters technologies Phytoremediation technology CO2 collection & sequestration Water treatment and water reuse technologies Geo-tourism technologies after mine closure

instruments are found in the Appendix B.4 through B.7. All instruments have gone through pilot testing and revised several times through interviews. As discussed in section 2.2.1, for the first step, the crucial factors for sustainability, as well as emerging technologies in mining in current decades, have been located. In the second step, the technologies and criteria are categorized based on the data from the first interview round, which helped in creating the structured questionnaire in the second interview round. The same group of experts was contacted for the second interview round, and an approximate 65 percent response rate was obtained. We first question the performance of each technology. Next, we asked them about the importance of each technological decisions; then we do a pairwise comparison and scoring. The scores for each number is the average of the scores given by each expert.

A total number of 34 interviews have been successfully conducted for this part of the study. The experts have been contacted a few weeks prior to the interview for getting notified about the interview from December 2018 to October 2019. The interviews were conducted in Western African, England, and Iranian gold mining, and mining firms with headquarters in the UK and Switzerland, during minefield visits, conferences, and individual meetings. Since the purpose of the survey is explained to the interviewee, such face-to-face surveys have been credited as one of the best methods for collecting qualitative surveys. Only in a few cases that the face-to-face interview was not possible, the interviews have been performed by online means, of which these talks have also been recorded.

Regarding the number and the far distances of mines, the experts have covered the sites for the major mining areas of the world. The ranking logic has also been discussed with each expert to ascertain the numbers and be as descriptive as possible. Afterward, the data obtained from the surveys are iteratively analyzed with the mining expert. The expert view surveying has been continued until a consensus in open-ended questions is reached.

2.3 Structured Questionnaire Results and Analysis

2.3.1 Creative Destroyer Technologies

Among the located technologies, we identified those that had the most significant impact on the mining business. For these sections, the interviewees were precisely asked whether specific kinds of technology significantly alter the way the mining industry is performing these days. The questionnaire, which instrumented the creative destroyer action of technologies, can be found in the Appendix B.12. As can be interpreted from the table results, experts have voted lab-made minerals, automated vehicles, and implementing IoT instruments as what would act as disruptive technologies for the mining sector.

2.3.2 Technology Clustering by PCA Analysis

The Principle Component Analysis method is used to reduce factors and to put them into an average score (Hayton et al., 2004; Horn, 1965; Stewart, 1981). Through the PCA result, the analysis can be better categorized into a technology group. We hereby use an exploratory Principal Component Analysis to understand the patterns among technologies to help in benchmarking technology options in groups. Looking at this cluster, which is chosen among PCA results based on our observation, we assume that technologies move together, and the pattern can be observed through Principle Component Analysis (PCA) below (SPSS, 2019). After running a PCA, we have observed that a technology grouping has emerged (pattern can be seen in Figure 2.3). Distinct PCA clusters are marked with separate coloring. Another variation of factor analysis method exploration can be found in the Appendix B.10.

The results are categorized into six different groupings. For example, from our groupings, it

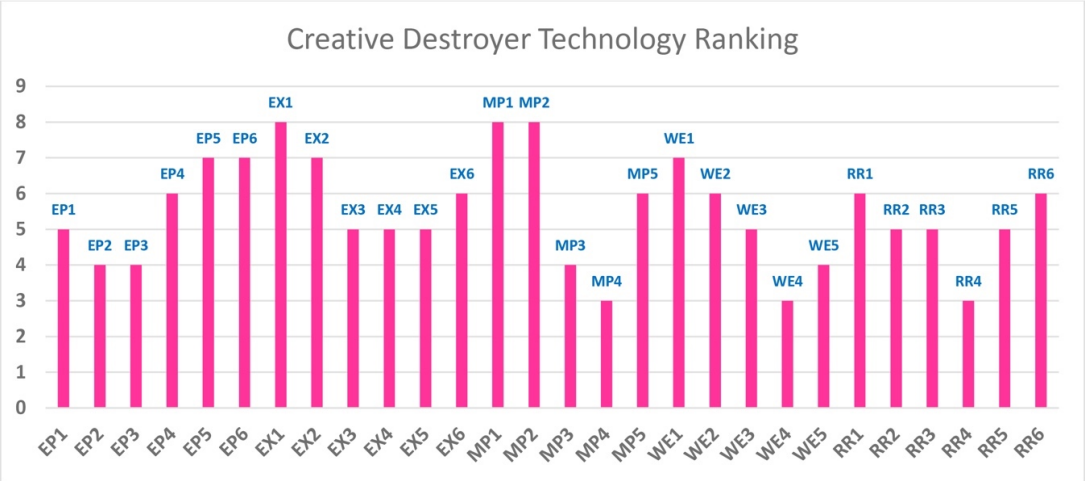


Figure 2.2 – Mining Technologies as creative destroyers. Legend: Appendix B.1.

Figure 2.3 – Principal Factor Analysis of innovative technologies in mines. Legend found in Appendix B.1

looks like the life-cycle management and the health and safety issues of different responses go in the same category, which means that they are repeating the same construct. In other words, in our example, safety contributes to the same sustainability improvement.

2.3.3 Sustainability Measurement of Technologies

The table below is derived from the first round of interviews (discussed in section 2.2). The first four criteria in green are sustainability-based. The rest of the criteria are considered essential for the decision-making of the mining firms. The criterion identified through expert interviews can be categorized into two sections. First, there are categories of sustainability, which also greatly resembles those identified by the ICMM definition of sustainability. The next six factors are identified via interviews as important criteria emerging in the mining business. They are divided into two categories of sustainability and essential technical aspects, which play significant roles, especially in related aspects. These criteria are, in the end, used for technology prioritization towards sustainability (Rosenbloom and Cusumano, 1987). The criteria definition, their description, and the average weight given to criteria by experts are indicated in Figure 2.5.

2.3.4 Weighing the Criteria of Sustainability

The table below shows the average weighted number for each criterion in groups of sustainability and the technical criteria for the mining sector. The benchmark is derived from the results of a structured expert view survey instrument (can be found in the Appendix B.2).

Table 2.2 – Important Criteria for mining operations.

Important Criteria for Mining Operation	Criteria Description
Social and cultural development	Community sustainable social and cultural development
Life-cycle management of minerals	Sustainable production and recycling of minerals
Environmental benefits	Help to address related environmental concerns
Health & safety	Increasing health & safety standards for mine workers and surrounding areas regarding fatalities, hygiene issues, etc.
Increasing the efficiency of mines	Having more efficient mine sector for different technical aspects
Economic development	Effect on local economic growth, job creation, etc.
Availability of Technology	Availability of the facilities in the international market for different mine sites (i.e. easiness of new technologies for getting exported to other/developing countries)
Lowering Cost of Technology	Capital Investment, payback period, CO2 abatement cost of new technologies of the last three decades
Condition for easy technology transfer	Local capacity and opportunities for reproducing and localization of manufacturing
Compatibility with SDGs	Compatibility and synergies with country and international development goals (SDGs)

The environmental benefits received the highest score, and for the technical criteria, the efficiency has been identified as the most important. Having the criteria in hand, we calculate the pairwise matrix for the multivariate analysis (Forman, Selly, et al., 2001)—two different technologies versus different criteria—and receive an average score for each of technology ask their contribution. Having their PCA groupings in hand, we can also measure a sustainability score for each technology grouping of the mining sector.

2.3.5 Innovative Technology Ranking by Analytical Hierarchical Process (AHP)

Analytical Hierarchical Process (AHP) is used in this research to study the priorities of technologies regarding sustainability measures. Therefore, we have used MATLAB 9.7, 2019 to process the survey results. Multicriteria Decision Making (MCDM) techniques are among the most

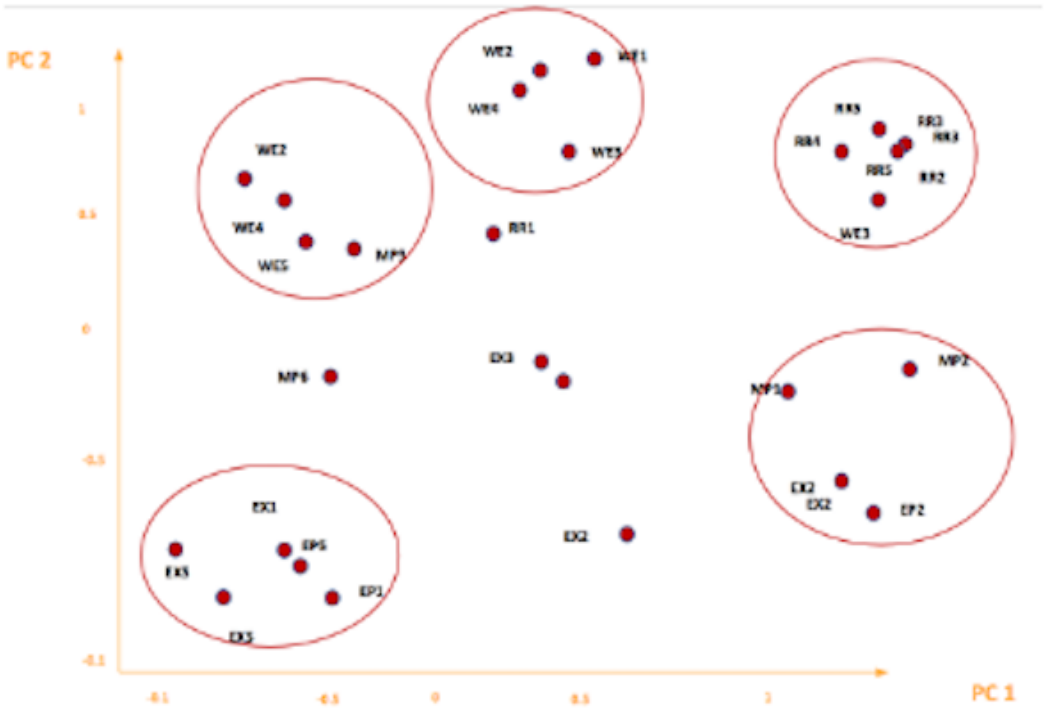


Figure 2.4 – Mining sustainability criteria weighing.

common tools for environmental decision-making (Doukas et al., 2009; Greening and Bernow, 2004; Jacquet-Lagreze and Siskos, 2001; Karakosta et al., 2010; Pohekar and Ramachandran, 2004). The AHP approach facilitates decision-making by categorizing decision-making criteria into a multi-level hierarchical structure (Talaei et al., 2014) that exhibits forces that influence a decision (Saaty, 2005). The AHP method breaks down a complete multi-criteria problem into a hierarchy and is based on a pairwise comparison of different criteria and sub-criteria. (Forman and Selly, 2001; Saaty, 2005). In addition, the AHP method consists of three main steps: the first step establishes a hierarchic structure (first hierarchy) through criteria and conditions (middle hierarchy) to alternative (final hierarchy) (Jung, 2011; Senarath & Patabendige, 2015). The second step computes the element weights of various hierarchies utilizing three sub-steps, namely, the establishment of a pairwise comparison matrix (De Feo and De Gisi, 2010). As a result, AHP generates an overall ranking of the solution. The AHP method is based on the pairwise comparison of the alternatives and criteria in a hierarchical structure, and also the calculation of the relative values of the available alternatives. This method was initially proposed by Thomas L. Saaty. In the process of AHP, after specifying the criteria and alternatives, the decision matrix is created. In this matrix, the rows are criteria, and the columns are alternatives. In addition, scoring is carried out by the experts on a scale of 1 to 9. These matrices are also used for other MCDM methods. In the second step, the weight of the criteria was compared in a pairwise comparison matrix. The relative weight of each alternative in this matrix is also obtained from the geometrical average of the rows. Finally,

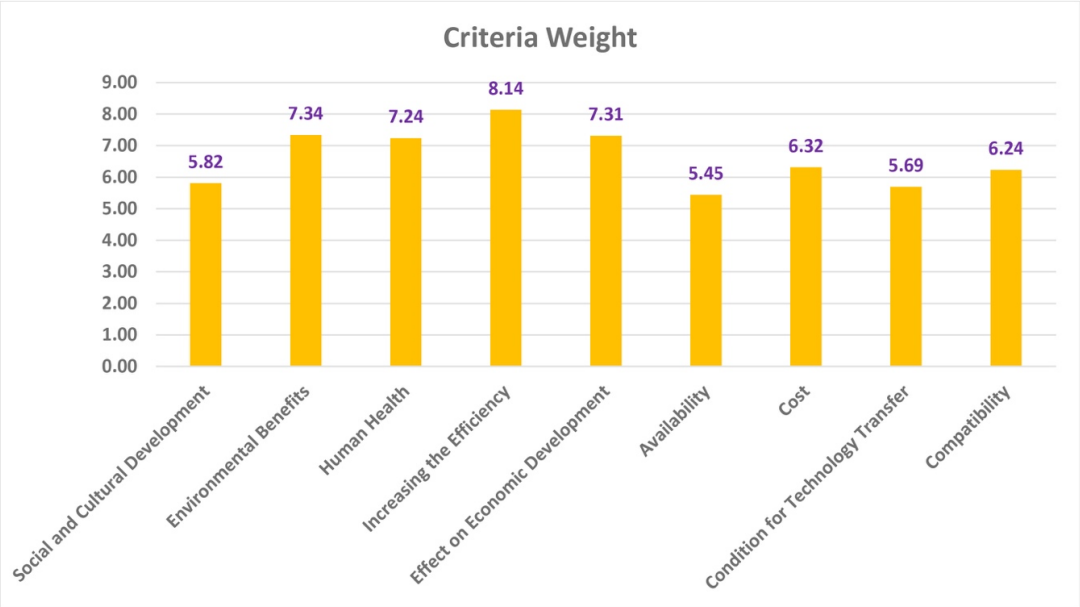


Figure 2.5 – Mining sustainability criteria weighing.

the relative weights should be normalized, and the final weight of each alternative is obtained from the equation below.

$$A_{\text{score}} = \sum_{j=1}^{n} a_{ij} w_j \quad i = 1,2,3,\ldots,m \tag{2.1}$$

Where a_{ij} denotes the relative importance of alternative i for criterion j and w_j indicating the importance of criterion j. By doing this step for each alternative, the final weight A_{score} is calculated.

Regarding the criteria weighting matrix, we can use different averaging methods to integrate expert opinions. In the "Row Sum" method, the summation of row elements was calculated first, and after that, this column was normalized. In the "Column Sum" method, the elements of a column, sum with each other, and create a line vector. Then the elements of this vector are reversed. The normalized of this line vector will be the weighting vector. In the "Arithmetic average" method, each column should be normalized, and then the average of each vector line is obtained. The normalized derivative vector will be the weighting vector.

This part of benchmarking is essential in formulating a technology policy that marks the point for incorporating technological considerations into mining business strategy and developing appropriate sustainability improvement policies. The mining industry, due to its rather obsolete placement in the industry, requires specific exploration in its needs.

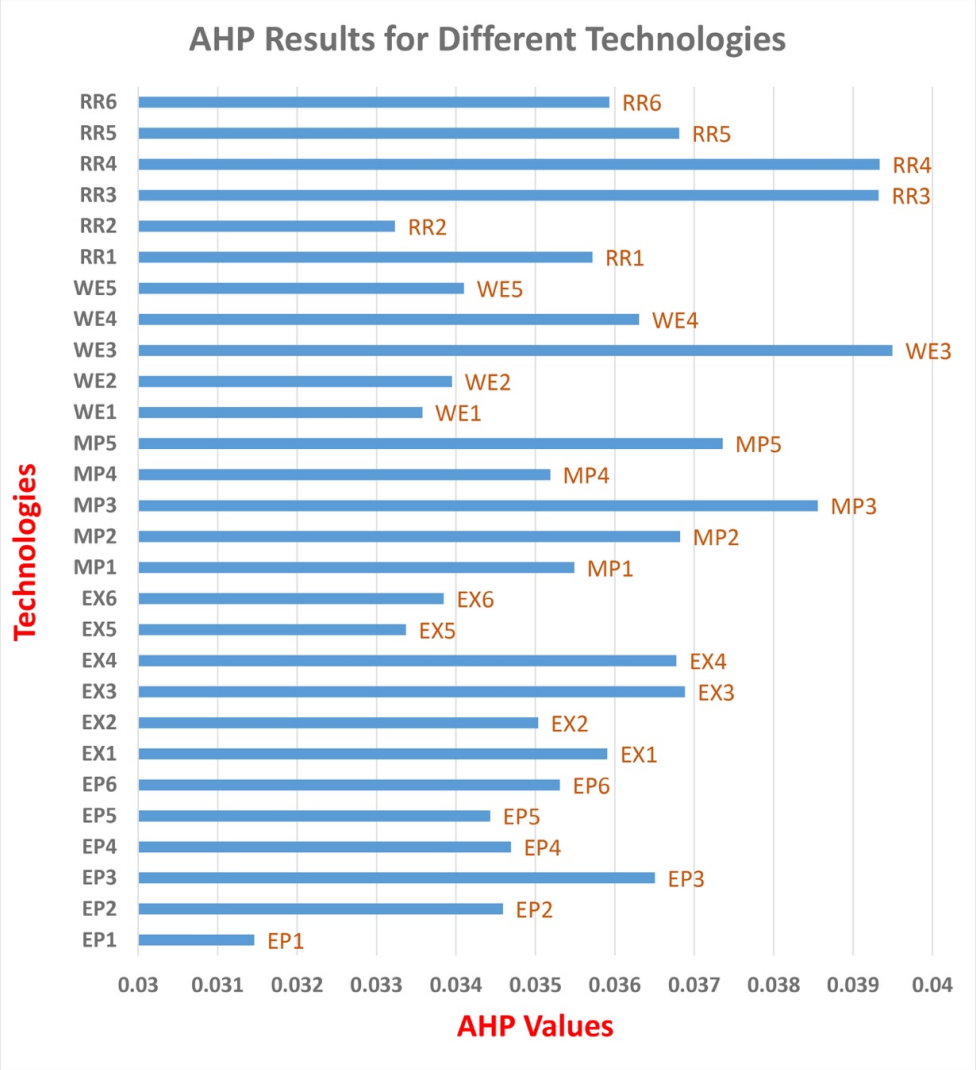


Figure 2.6 – AHP placement of innovative technologies. Legend: Appendix B.2.

2.3.6 Abernathy & Clark Categorization

Revisiting the transilience (Abernathy and Clark, 1985) categorization, we define the characterization of each section of quadrants based on our data from the second round of interviews. The interview instrument can be found in the Appendix B.14.

Innovation can be viewed as what is introduced to the firm, and it does not necessarily change the entire business. It is important to note that the products are not homogeneous and differ in other aspects rather than innovativeness. Each quadrant of this table demonstrates different levels of radical impact or conservativeness in comparison to other technologies. We aim to spot technologies that make firms the most interesting. In the Abernathy & Clark model, each item listed in a table which is accompanied by a scale that depicts the range of effects an

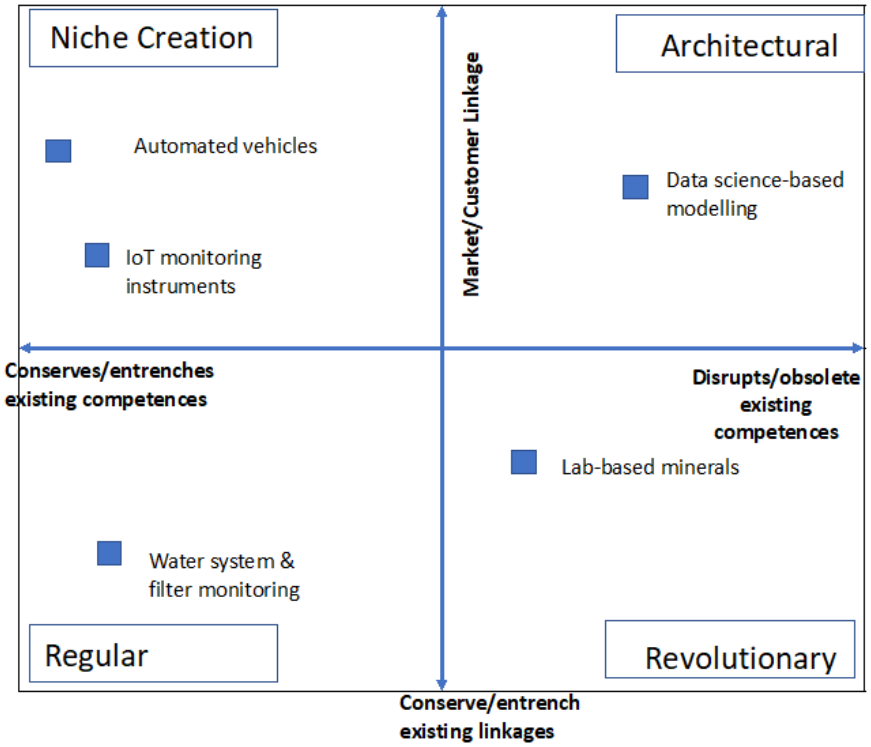


Figure 2.7 – Transilience map of innovative technologies in mining

innovation might have.

When technology is more innovative, it might enhance some barriers to entry, or make current technologies less attractive. Therefore, it is necessary to examine the level to which it can be adaptive. We have completed these papers based on the interviews and the ratings of innovation from the first questionnaire in this diagram. This replication of quadrants for the mining sector fosters the emergence of testable theory (Eisenhardt, 1989), gauging the theory for the transilience quadrant. For the "Market Niche Creation" innovation, it disrupts new linkages and conserves existing competencies for the market. "Architectural innovation" is an innovation that departs from the old industry and creates new ones. For "Regular" innovation in mining, the transilience map stays at a steady state. Lastly, "revolutionary innovation" disrupts established technical and production competencies (Abernathy and Clark, 1985). For instance, when implementing automated vehicles, old trucks turn obsolete, and efficient automation plays a significant role in keeping mining firms competent. As a revolutionary innovative technology, synthetic diamond is something which has been recurrently marked disruptive by experts. It disrupts how the industry is being regarded. Five technologies below are identified based on answers to questionnaire instruments for each innovation quadrants.

2.4 Conclusion

Considering the substantial impact of mining on sustainability and the role of technology in making mining practice efficient, the focus of this paper is on identifying the measures in different aspects of technology innovation for mining firms. To obtain general surveying of innovative technologies in mines through the past three decades, we have performed unstructured, open-ended interviews with mining experts in various mining locations and sectors. Through this first round, we collected innovative technologies, of which the results were thereafter categorized into distinctive groups using Principal Component Analysis. In this interview round, we collected expert views regarding the criteria that have the most impact on the sustainability and efficiency of mining practice. The first round of interviews also gave a general understanding of the role of innovative technologies in the sustainability of mining firms.

In the following steps, having conducted this round of interviews, we aimed to use the Analytical Hierarchical Process (AHP) to benchmark different technology groups for their impact on sustainability. We, therefore, produced three survey instruments for the second, structured interviews. In these instruments, we asked experts to weigh sustainability and efficiency criteria, put technology groups in transilience quadrants, marked them as ordinary or creative destroyers to mining, and complete a pairwise comparison matrix based on technologies and criteria. We used SurveyGizmo (professional version) to conduct first round of the interview questions, NVivo for interview transcription software, , Stata for obtaining PCA factor analyses, and MATLAB 9.7 and SPSS for obtaining graphs and AHP results.

The results of this paper are twofold. First, through continuous structured communicating with located mining experts, we develop a framework for investigating the sustainability ranking of technology groupings for mining. Although the theoretical background of such a framework existed in the literature, practicing it for the mining industry is the contribution of this paper. This framework comprises identifying criteria important for sustainability and efficiency for pairwise comparison and benchmarking the Technology groups. Second, we produced the following results, which, when put together, can serve as a comprehensive map for identifying the technology group, which best serves the criteria which need to be met. We introduced an AHP value for each technology group, identified whether a technology group serves as a creative destroyer, and produced a transilience map for adoption of new technologies in mining. The ultimate practical aim is to assist mining firms in innovative technology grouping by holistically including the available technologies in a much more systematic way for mining firms in order to become more efficient and sustainable, and move towards sustainable development goals.

2.5 Further Discussion

Having all said about the impact of technology, it should be mentioned, however, that occurring this innovation in the market requires some setting established in the market. Looking at the results in a different part, such as the level of destruction and weighed technologies, policy-making derivations can be performed based on different innovation aspects of technology groups. In addition, to increase the public image and improving sustainability, implementing innovative technologies would increase the competitive advantage when placed in one of these featured dimensions in transilience—that is, the capacity to influence the firm's existing resources, skills, and knowledge.

It is also worth mentioning a point both for further advancement of the study and possible future implementation of the framework. Such primary data collection method is always dependent on data response rates and completeness of collected data. In contrary to our primary desires, due to response rates of experts internationally, we have not categorized responses to two groups of develop and developing countries, or divide finding based on types of extracted minerals, in order to maintain our statistical significance. It is therefore recommended for future endeavors to aim for elevating the inclusiveness of countries and mining types. The other point to bear in mind to possibly implement for future practices is the flexibility of the framework based on different criteria important for specific mining types or regions.

3 A Revisit to Sustainability Discourse in Mining: A Topic Modelling Analysis

Abstract

This study explores distinctive scopes in sustainability discourse for mining firms. We start by examining the central discourse and attempt to articulate its meaning. Through our research, data, and methods, we discover groupings that can expose sustainability issues in other ways. As a conclusion of this chapter, we make a question of rethinking sustainability definitions through emerging sustainability categories. Since the data is driven from the primary 38 major mining firms, the results may be extensible to the rest of the mining sector.

3.1 Introduction

As a mining firm assessment, the point so far in this thesis of the categorization of technology for sustainability in mining has been an almost top-down, subjective measure of mining firms and sustainability institutions. We therefore decided to understand the latent sustainability issues in the sustainability discourse of mining firms, which is articulated in their conventional means of sustainability communication, i.e., their annual sustainability reports. After identifying the main domains of discourse, we will search through learning the relationship and impact of each of these topics on one another. Having a general idea of these issues would help greatly in discovering using this emerging method. Considering the SDG criteria and rising discussions on sustainability challenges in the mining industry, mining firms' sustainability performance would have a crucial impact on the reputation of these companies. This chapter then evaluates companies' implementation of technology through cross-section analyses at the firm level through their effort to become more sustainable in their business while staying competitive.

In addition to the primary data sources, e.g., firms and practitioners in mines collected through various studies (see Eslamishoar and Tucci, 2019), another source that is both rich in data and effective at analyzing the status quo is the annually published sustainability reports of significant mining firms. These reports also represent a response to the international need

Table 3.1 – Source: Sustainable Development Goals in Mining. (Monteiro et al., 2019)

Goal	Keyword	Quantity
SDG 1	"mining" AND "poverty"	72
SDG 2	"ore mining" AND "agriculture"	15
	"mining site" AND "soil contamination"	3
	"mining site" AND "water contamination"	14
SDG 3	"mining" AND "welfare"	27
SDG 4	"ore mining" AND "education"	14
SDG 5	"ore mining" AND "women"	25
SDG 6	"mining" AND "sanitation"	32
SDG 7	"mining" AND "clean energy"	13
SDG 8	"ore mining" AND "employment"	24
SDG 9	"mining industry" AND "innovation"	19
SDG 10	"mining" AND "equality"	12
SDG 11	"mining" AND "local communities"	25
SDG 12	"ore mining" AND "sustainability"	16
	"mining" AND "circular economy"	12
SDG 13	"ore mining" AND "climate change"	16
	"mining" AND "carbon footprint"	5
SDG 14	"ore mining" AND "sea"	26
	"ore mining" AND "ocean"	43
SDG 15	"ore mining" AND "biodiversity"	50
SDG 16	"mining" AND "peace"	13
	"ore mining" AND "justice"	24
SDG 17	"mining" AND "sustainable development goals"	7

to promote the sustainability of the mining firms. In this paper, we have used this set of data as an opportunity to examine the parameters that influence sustainable mining through different lenses and measures. This enables the rendering of a baseline behind the context of sustainability and mining through contextual data of mining firms to understand the relationship between parameters, which makes a firm perform better through the years while another firm's performance diminishes during the same period.

3.1.1 Mining Sustainability Literature

Table 3.1 shows how each SDG is represented in the mining sustainability literature corpus. This demonstrates the importance of the sector for sustainable development and would help us in a later stage to group what we find when linking the located scopes to the SDGs.

Sustainability barriers for raw material development and trading for developing countries make the sustainability of extractive resources both challenging and important. As the majority of raw materials come from the developing world, addressing this problem at the source is likely to have a large impact on environmental improvements. Furthermore, the re-establishment of international trade in 2020 highlights the rising need for a more resilient ground for ensuring sustainable development, where securing sustainable resources is a key to success. It is important to develop knowledge for the use of natural resources, and such knowledge development is key to secure the necessary raw materials for sustainable development (UNEP IRP, 2020) for both industrialized and emerging economies. There is no doubt among experts in the field that changing the Busiess as Usual (BAU) for mining business through

innovative approaches is necessary for making business process efficient and sustainable. This study aims to answer to this question:*What sustainability domains are proven to be the most important for the mining in the eastern countries of the Middle East, and what is the relationship between the domains?* and *What makes a successful innovation approach for the sustainable production of the mining sector?*

3.2 Rationale

To give a few examples, reiterating from an earlier part of the thesis, some institutions such as UNEP defines sustainability as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (2019), whereas definition of sustainability, and related discourse goes to economic, social, and environmental aspect of sustainability (Pope et al., 2004).

The thesis has elaborated on the area which hinders mining from sustainable growth and tries to give answers to the technology part of the challenge. In the latest chapter, we want to seek whether the sustainability grouping makes sense. Maybe the grouping of sustainability suggested, whether by mining or mining entities, can be defined. In other words, we want to see what sustainability-related reports are trying to measure, and thereafter compare it to what should be measured. We also focus on Middle East as our region-specific study to investigate any possible meaningful differences among the two.

3.3 Theory Derivation & Question Framing

Using Benner and Tripsas, 2012 discussion on the influence of peer firms on acceptance of technology based on their peers, this research examines how peer firms influence sustainability and technology adoption in the mining sector, as well as inertia for adopting new technologies at incumbent firms. We measure technological innovation through quantifying mentioned online reports and would investigate such phenomenon, among answering other questions. In addition, we also investigate which types of technological innovation we should implement for each section.

(Eslamishoar & Tucci, 2019) better predict the sustainability of mining. Concluding with the determinants of technological innovation adoption for the sustainability of the mining sector, we would also observe whether sustainability or technology are better indicators of one another. This approach will help to provide answers to the urgent and compelling issues of sustainability in mines. Altogether, regarding our inductive, grounded-based approach, we seek to discover patterns among parameters that explain the sustainability performance of major mining firms.

3.4 Methodology

Machine Learning methods are emerging in all scopes of research. In order to choose the best method to look through the corpus and conclude relationships, we have examined text analysis methods in this emerging literature (Hannigan et al., 2019; Hannigan et al., 2018; Kennedy et al., 2012). We wish to establish a ground theory for expecting the results and generating new conceptual linkages (Hannigan, 2016). With the knowledge we have gained through earlier studies of the mining sector, we are now equipped with a comprehensive background of the domain to compare it with the results.

We would like to use a model which makes topics without labeling, and see what emerges inductively. For this reason, we use Topical modeling for reaching this aim. The first reason is to see whether some topics appear together, and second, we would argue on the causality of located relations.

As discussed earlier in this thesis, mining sustainability has numerous parameters and issues which play a role in its sustainability. It is, therefore, of utmost relevance and interest to see which of these topics emerge together, as it would be challenging, if not impossible, to have a purely qualitative model to put all these concepts into one place.

For the process, we look at English documents, and also derive their content of tables and pictures to ensure the quality of the material. We are looking for a topic, context, and word in the document. An example of our image to word conversion is shown in Appendix 2. Through the first step, Topic Modeling, we assign each word to a model, having a topic, context, and word.

3.4.1 Introducing Topic Modeling

Topic modeling is a new emerging tool from computer science to build theories based on data and the latent relationship between the text. It is used in the management recently. We thought up this model to give us the ability to take an unbiased survey through a significant corpus of literature within a short amount of time.

3.4.2 Data Derivation & Structure

This paper implements a dataset collected by the Responsible Mining Foundation (RMF). RMF is an independent mining sustainability assessment unit established in 2016 as an independent organization with international members aiming to aid the promotion of sustainability in the mining sector (Responsible Mining Foundation, 2020, March 19). The primary process which RMF has taken is to introduce an index indicating how major mining firms have acted through the years regarding sustainability criteria. The list of mining firms discussed in the RMF is in Appendix 1. These 38 major mining firms represent the largest mining practices in the world. The data which this study is using and the focus of data description hereafter is the

extensive dataset of reports, related new extracts, and website inputs, which this foundation has collected known as the RMF dataset. This index contributes to assessing their sustainability performance as the first step for improving it, which eventually contributes to the reputation of the mining business corporation (Kennedy et al., 2012).

RMF dataset consists of three years of collecting reports or white papers for each of the mining firms. The reports and relevant sustainability sources are also discussed with mining firms by RMF to ensure its inclusivity (Responsible Mining Foundation, 2020, March 19). The dataset comprises 3,500 sustainability mining-related reports across the 38 major mining firms.

Responsible Mining Foundation has conducted a thorough study of 38 major companies mining firms, and has published a framework containing the main sustainability domains, which is going to serve as the base of our sustainability research conduct when we would add the scope of region-specificity to the study. There is a need to gain a better understanding of sustainability factors in the mining sector. In the next step, we identify the best sustainability scope relations explanation (Mohebi et al. 2020) for measuring sustainable mining through data-driven topic modelling and deep learning approaches. Identifying the scopes of sustainability and implementing it is the first and of the most important step to plan the sustainability of the extracting resources in the region.

RMI has concluded with collecting firm-level, public sustainability-related data of 38 major international mining firms on five categories of Economic Development, Business Conduct, Lifecycle Management, Community Wellbeing, Working Conditions, and Environmental Responsibility. This benchmarking will be the first crucial step in measuring the current states of mines for moving towards a more sustainable mining in the future. Taking RMI qualitative analysis practice, keywords, and terms for measuring the realization of each determined sustainability criteria are measured.

Through such analysis, we will be able to see the possibly latent relationship between sustainability players, which might infer the relationship between different actions and reveals a causal relationship between different sustainability parameters.

The selected company and the mine site reports before performing our method have already been studied through qualitative measures in categories of economic development, business conduct, lifecycle management, community wellbeing, working conditions, and environmental responsibility (Responsible Mining Index, 2020, March 19). Leading practices, as well as categorization of the performance of companies, and performances in different sections, have been performed.

Qualitative Assessments

It is essential to understand the corpus and what we are trying to measure. In doing topic modeling work (2019), this first step of “rendering a corpus” entails making decisions about inclusion of documents in a corpus. We, therefore, have first added a qualitative assessment of

the corpus to our research. In going through the documents in the initial corpus descriptively, we found that many of these documents were not necessarily sustainability reports of major mining firms since the condition of including them in the sample has been merely referring to the sustainability discourse.

For example, the document titled "teck-2017-elk-valley-annual-water-quality-monitoring-report.pdf" is a 5,289-page document covering an "Annual Water Quality Monitoring Report" for Teck Coal Limited. Although there is an executive summary that may be signaling some strategic intent (and making sense of sustainability challenges), most of this document contains tables and graphs laying out engineering analyses. In addition to most of this document being irrelevant, because of its sheer length, this will skew any topic modeling analyses attempting to derive a set of topics.

In looking over some of these files, some documents are more sensibly classified as sustainability reports of major mining firms. For example, bumi-resources-2017-sustainability-report.txt is "Sustainability Report 2017" for the company BUMI Resources. However, this document does have many tables and other irrelevant data that would skew a topic modeling analysis (and result in irrelevant topics). We removed all texts with a corpus with a large body not to skew the results, and having all the RMI txt corpus at the end, we focused on the PDFs of sustainability reports at the end.

3.4.3 Rendering Corpus

For rendering the corpus, we first started with putting all PDF files into txt files. We divided cvs, image, doc, pdf, and xlx files. The total number of files is 3,500, with 8 million words. Our first run was with all of the files, but the many tables and pictures likely skewed the results. We run with only the pdf complete files in the second run.

Although some might still contain data, we opted for such a corpus to have results neat and free of errors.

Rendering part 1 has been performed automatically and in a qualitative fashion. We also separated files based on whether or not they are within a full text, to more avoid any noise within data. We finalized and checked our excerpted text body by peer-reviewing the selections. Finally, we qualitatively assessed the excerpted corpus to avoid possible automated mistakes. (found in Appendix C.1) for better curating the corpus:

- Mining sustainability reports
- Environment reports

- Separating English from other languages
- Selecting only the parts of the document which is more than one paragraph:

We first had converted pictures to texts, but we now excluded text from pictures.
We decide which one of them is a sustainability report (Hannigan et al., 2019).Documents roughly are similar size.We reached the point of around 500 corpus.Eventually, we came up with an excel sheet retaining only the ones about sustainability reports. To avoid technicality issues of data, we finally added the simple rule to only include full paragraphs in our text corpus.

3.4.4 Pre-processing steps

The following pre-processing steps were undertaken to clean the data and bring it to a form on which topic modeling can be applied: Stop-words were removed from the data. For example, 'how', 'it', 'he', 'she' etc. which occur commonly in the English language were removed.

- Punctuations like comma, full stop, etc. were removed from the text.
- Special characters like '\n', '/' etc. were removed from the text.
- The words in the remaining data were lemmatized. Lemmatization removes inflections from word forms. For example, 'boys' gets reduced to 'boy'. This was done so that all the words are brought to their basic forms.
- Only alphanumeric words were retained in the text. No numbers were kept. Also, words of only two characters were removed from the text.
- All leading and trailing blank spaces were removed from the words, and the words were converted to small case.

3.4.5 Dictionary Creation for topic modeling

A dictionary was created for topic modeling, aiming for a better guidance of data towards interpreting the results. A few marks about the dictionaries are marked in below.

- The dictionary only contains words that at least occur in 10 text files. This was done because words in less than ten files might be unimportant and might contain idiosyncratic information.
- Words that are contained in more than 50% of files are also filtered out. This was done because these words are too common to produce meaningful distinction in any topic as they occur almost everywhere.

3.4.6 Topic Modelling

Several topics were tested for better coherence. Specifically, models with 2 to 8 topics were built, and their coherence score was recorded. Given below is the diagram showing the same.

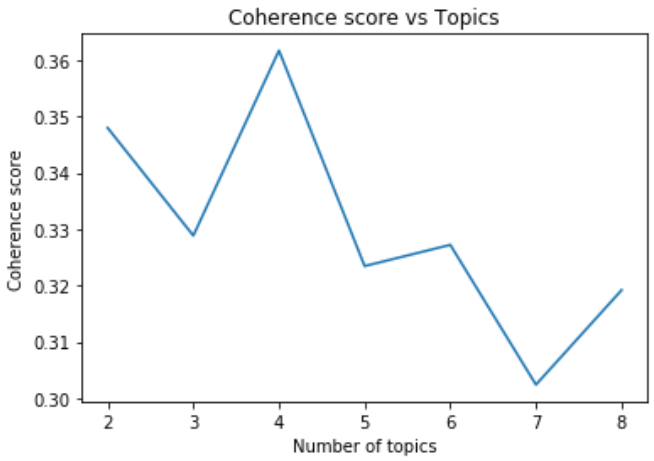


Figure 3.1 – Perplexity Diagram

Below is the perplexity diagram of the analysis, which shows 4 as the best number of topics for our analysis.

The plot above shows that the coherence is highest with 4 topics. This is almost equal to 36%. Therefore, 4 was chosen as the number of topics best for the final topic model.

3.4.7 Final Model

A topic model with 4 topics was built on the processed text data. Given below are the topics and the top 15 words in them. You can see the table in the picture. The final model has the words and the importance of each.

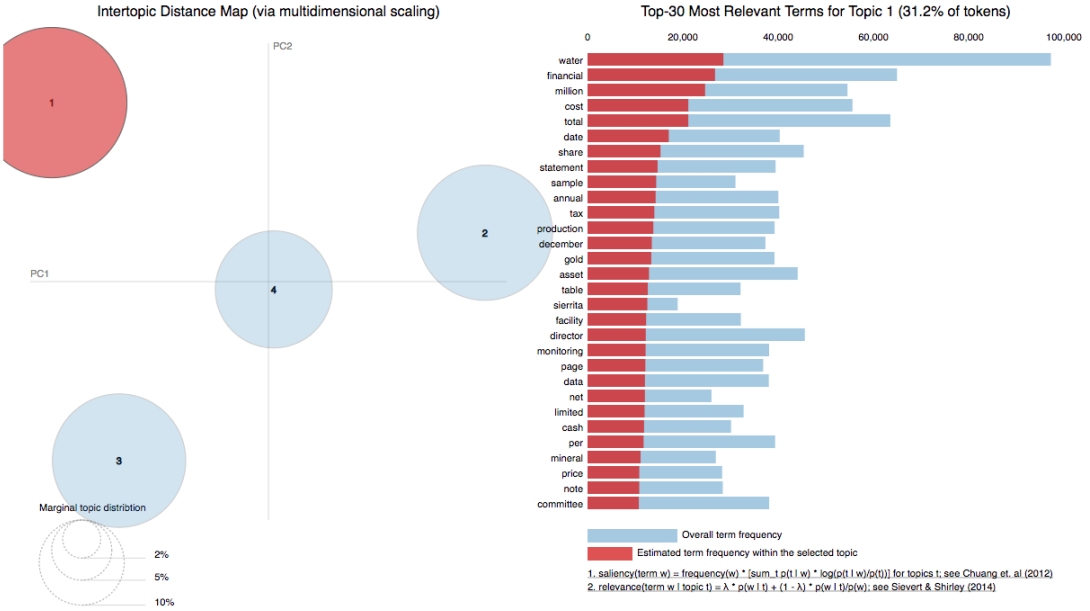
Topic 1		Topic 2		Topic 3		Topic 4	
Words	Importance	Word	Importance	Word	Importance	Word	Importance
water	0.004	water	0.007	water	0.006	water	0.007
financial	0.004	million	0.004	financial	0.005	total	0.004
total	0.004	financial	0.004	million	0.005	director	0.003
per	0.003	total	0.003	cost	0.004	cost	0.003
cost	0.003	asset	0.003	total	0.004	board	0.003
board	0.003	tax	0.003	date	0.003	share	0.003
director	0.003	pas	0.003	share	0.003	assessment	0.003
asset	0.003	gold	0.003	statement	0.003	production	0.003
page	0.003	coal	0.003	sample	0.003	data	0.002
statement	0.003	december	0.003	annual	0.003	annual	0.002
share	0.003	director	0.003	tax	0.003	committee	0.002
gold	0.003	share	0.003	production	0.003	quality	0.002
date	0.003	committee	0.003	december	0.003	limited	0.002
coal	0.002	cost	0.003	gold	0.003	financial	0.002
committee	0.002	limited	0.003	asset	0.003	monitoring	0.002

pas	0.002	board	0.003	table	0.002	coal	0.002
annual	0.002	test	0.003	sierrita	0.002	asset	0.002
million	0.002	monitoring	0.003	facility	0.002	million	0.002
non	0.002	data	0.002	director	0.002	shall	0.002
ore	0.002	statement	0.002	monitoring	0.002	vale	0.002
monitoring	0.002	production	0.002	page	0.002	potential	0.002
tax	0.002	table	0.002	data	0.002	per	0.002
copper	0.002	facility	0.002	net	0.002	sustainability	0.002
assessment	0.002	annual	0.002	limited	0.002	facility	0.002
member	0.002	date	0.002	cash	0.002	december	0.002

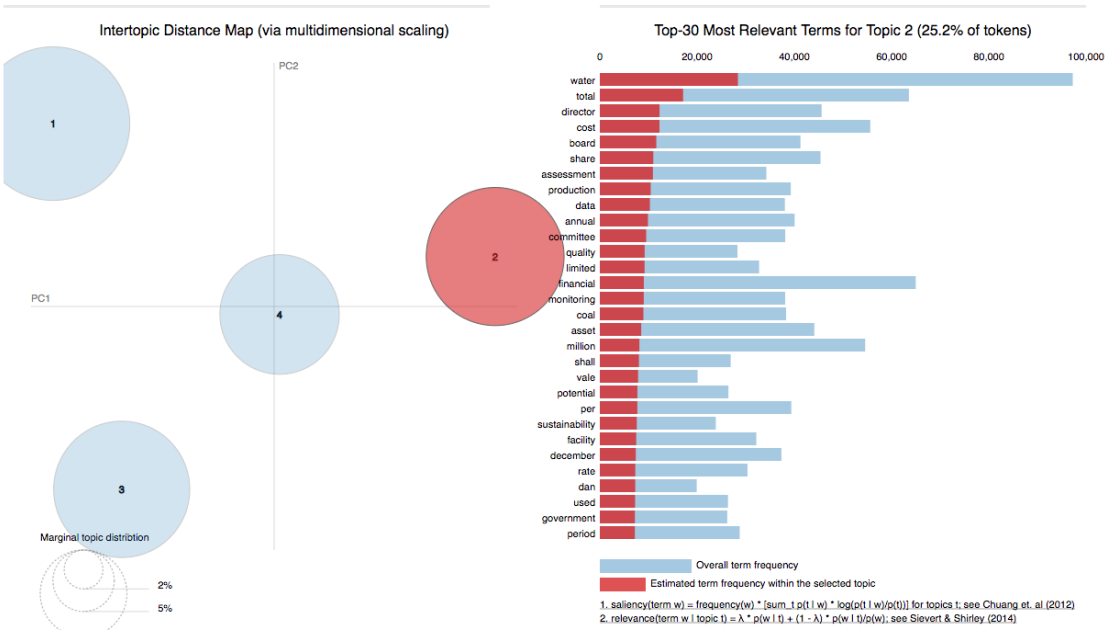
The bubble diagram and the word frequency graphs can be shown below. The bubble diagram shows the excellent distinction between the titles. It shows the correctness of our chosen method. We here aim for 15 words as a rule of thumb. As we see, the one related to finance is the most important. As of the thesis, it also reminds the interviews that the financial points are most important, even when it comes to sustainability. It can be observed from the above table that:

Topic 1. Financials, assets, and monitoring

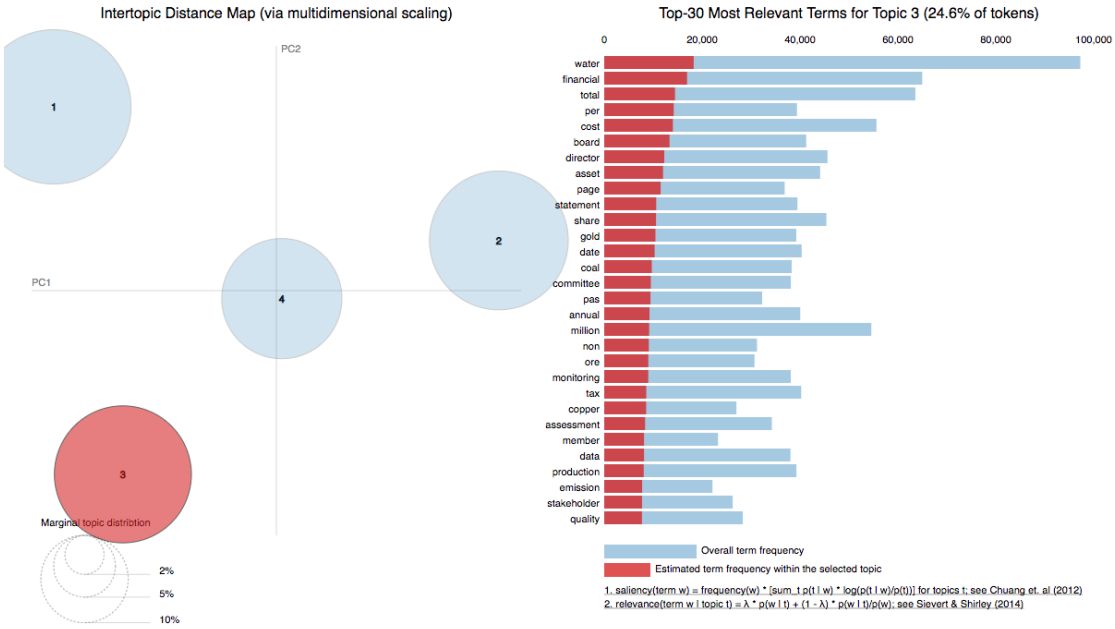
• Topic 1 overall talks about financials and assets, their monitoring, statements as well as tax.



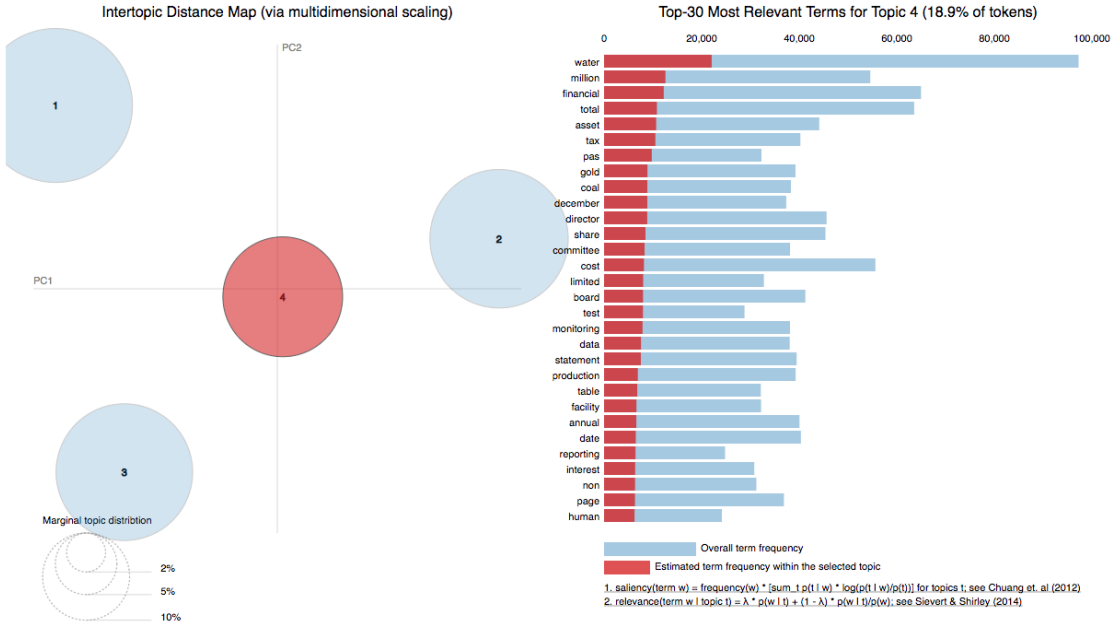
Topic 2: is more precise about overall production, gold, coal, and the related costs along with the facilities.



Topic 3 is more about monitoring, maintaining a balance of assets, cash, and other resources:



Topic 4: is about the assessment of resources, production, sustainability, and quality.



3.5 Rendering Theoretical Artifacts: Grounding Sustainability in Mines Theory

The first one is about finance; the second, as we knew before, is about the importance of dividing different mining methods from each other; third, about monitoring the process; and fourth, about the quality of production along with sustainability. A key finding in this study can be that the funding and sustainability discourse are interrelated with the sustainability discourse, so it is of great importance to make financial decisions in mining in light of essential sustainability issues raised for each of the mining firms. The same discussion goes for monitoring facilities on each mine. Having the presumption that this issue has arisen because of the importance and issues related to it, it is of great importance to make a note of monitoring the mining facilities policies throughout the mining activities of the mining firm.

3.6 Concluding Remarks & Further Research

It is a good start for our next step, which is seeing the relationship between the topics together. This will give helpful insights both for such sustainability indicator and for mining firms themselves.

In the next step, we will see how these groups co-relate to one another.For this aim, we might implement additional computational analysis algorithms. We expect to see the topics which emerge together and create topics on them, taking from different topics to see what each cover. In the second step, we take this collection of documents and lean a model to describe it best. The outcome of this paper is expected to complement a qualitative sustainability analysis, such as the RMI benchmarking, in two steps. The first step involves setting up the data in a proper format. Next, using a text analysis approach to add to the accuracy of the categorized qualitative data. This will serve the significant mining firms sustainability agenda to record continuous sustainability performance of mining firms. In sum, looking at the dataset in more detail and divided by each parameter, we will examine how different recorded variables explain different levels of sustainability performance. This approach will help in providing answers to urgent and compelling issues of sustainability in mines.

The folder of text documents contains 2848 documents. The following has an application of semantic LDA based topic modeling on the text extracted from all the records along with the pre-processing undertaken to clean the data. Hyper-parameter tuning has been done to finalize the number of topics to model from the underlying data. In our future research, companies with similar financial and monitoring issues can be looked at about their performances in mines. Additionally, regarding topic 2, we can divide different mining of ore, namely gold and coal, which might be as if they are more problematic, to look at the sustainability issues of mines with more precision.

4 Conclusion

This thesis aims to gather discussions and provide solutions for the mining business' main sustainability issues in three chapters. Chapter 1 looks at the mining sustainability barrier discourse through a political economy scale. The results of this chapter consists of an extensive mapping of what has been the significant domains of discussion based on mining experts' views.

The second chapter discusses innovative technologies in mining and the best way to implement innovative technology for a sustainable future. This chapter first contributes to the theory of process innovation as in the transilience map. The experts' interviews of this chapter rely on different questionnaires. For transilience of innovative technologies, experts are asked about the placement of each technology into a quadrant of the transilience map. This resulted in producing a transilience map for technologies. After investigating various benchmarking tools available in the literature and practice, I opted for the Analytical Hierarchical Process. This method gave each identified technology group a benchmarking score of desirability based on the identified scoring.

Moreover, through the expert view method I performed, I also concluded with weighting criteria for each mining technology group. In addition, the experts were asked whether or not a technology group acts as "creative destroyer" to the industry, as well as their level of innovativeness. This has also been noted as a result for this chapter. Based on the four measurements introduced in this chapter, namely transilience map, innovative destroyer diagram, "creative destroyerness," and the multivariate benchmarking, firms can choose the best technology available to move themselves toward more sustainable practices.

In the last chapter, the thesis uses a computer science-based method, called Topic Modeling, aiming to look at sustainability clustering from different angles. Through this grouping, I find new domains of grouping to examine the sustainability discourse in mining. This is based on the prevalence of words and their relationship in the mining sustainability report texts. I therefore conclude that these domains are important to pay attention to when discussing sustainability discourse in the future.

The hope is that my thesis has positively contributed to the literatures on economic growth, institutional theory, and technological innovation. I hope this work provides the sector with a useful conceptual framework, as well as comparing tools for them to move further toward meeting sustainability standards of the world and the needs of themselves and the mining localities.

A Appendix A

A.1 Literature Review table for synergies and trade-offs to SDGs in mining

INSTRUCTIONS (SEE SDG7 for an example of a compiled target):

Question A - Does the Target call for changes in governance of the mining sector (COLUMN C): If the answer to that question for a specific target is yes insert 1 in the cell for the specific target in column C. Method (A) is not evidence based—it focuses on identifying Targets that are conceptually relevant to the mining sector (including environmental, social and economic components), and explicitly require some change in decision-making within that sector.

Question B - is there published evidence of synergies and trade-offs between the Target and mining? (COLUMNS D-E): If there are potential synergies and or trade-offs as described in Question B, please insert 1 in columns D-E - and the reference for that in column J. method (B) focuses on identifying evidence of empirical relationships (synergies or trade-offs) between the achievement of each Target, and mining activities (broadly defined). The process involves the search for published studies in academic and peer-reviewed grey literature (e.g. UN reports). You should not undertake a systematic review of evidence relevant to each Target. Instead, a single item of relevant published evidence is sufficient to indicate the presence of a synergy or trade-off between a Target and mining (in other words, you should not find all existing synergies and trade offs between mining and that Target, but if you identify one, you can answer positively that question). Please insert the reference with such synergy or trade-off in column J.

Reasoning (COLUMN F): Please write a concise explanation of your reasoning as (A) .... reasoning ..... ; (B) .... reasoning .....
Key evidence domains (COLUMNS G-I): This is already pre-filled from previous published work - but it is possible for you to modify it. This represents in the domain(s) in which you think the evidence for (A) and (B) is present. Not essential - but useful for the paper writing in order to group trade-offs and synergies into categories.

GOAL OR TARGET IN THE 2030 AGENDA FOR SUSTAINABLE DEVELOPMENT	A: Does the Target call for changes in gover-nance of the mining sector?	B: Is there published evidence of synergies and trade-offs between the Target and mining activities?	REASONING	KEY EVIDENCE DOMAIN(S)	SAMPLE REFERENCES Use Nature Publishing Group Style
		SYNE-RGY with min-ing	TRADE-OFF with min-ing	Indivi-dual and collec-tive aspira-tions of greater wel-fare and well-being. Infra-struc-ture for sus-tain-able devel-op-ment. Enviro-nment and natu-ral re-sources	
Goal 1: End poverty in all its forms everywhere					

1.1	By 2030, eradicate extreme poverty for all people everywhere, currently measured as people living on less than $1.25 a day	1	1	1	(A) Target 1.1 requires action to eradicate extreme poverty associated within the mining sector; (B) In different contexts there is evidence of both synergies (mining has delivered economic growth, employment and livelihoods) and trade-offs (mining exacerbating extreme poverty for some groups)	1		0	(1) Hyder, Zeshan. "Coal Mining." In Coal in he 21st Century, 30-57, 2017. https://doi.org/10.1039/9781788010115-00030. (2) Campbell, Mining in Africa. Akabzaa
1.2	By 2030, reduce at least by half the proportion of men, women and children of all ages living in poverty in all its dimensions according to national definitions	1	1		(A) Target inclusive of poverty reduction related to mining sector. (B) Mining helps with eradicating the extreme poverty in the rural regions.	1		0	(1) Pegg, S. Mining and Poverty Reduction: Transforming Rhetoric into Reality, Journal of Cleaner Production 14, 376-387 (2006)
1.3	Implement nationally appropriate social protection systems and measures for all, including floors, and by 2030 achieve substantial coverage of the poor and the vulnerable	1	1		(A) Target requires action to establish social protection systems that are applicable to the mining sector. (B) Countries use mining revenues to implement social protection systems.	1	1	0	(1) Ortiz, I., Schmitt, V., & Loveleen, D. Social Protection Floors: Volume 3: Governance and Financing (International Labour Organization, 2016)
1.4	By 2030, ensure that all men and women, in particular the poor and the vulnerable, have equal rights to economic resources, as well as access to basic services, ownership and control over land and other forms of property, inheritance, natural resources, appropriate new technology and financial services, including microfinance	1	0	1	(A) Target requires range of actions (equal rights to resources, etc) that are applicable to mining. (B) Trade-offs include that land ownership can cause dispute in private vs. governmental ownerships.	1	0	0	(1) Bagley, "Water Rights Law and Public Policies Relating to Ground Water 'Mining' in the Southwestern States." (2) Land Ownership and Responsibility for the Mining Ownership in Ghana. Natural Resource Journal. 1998.

1.5	By 2030, build the resilience of the poor and those in vulnerable situations and reduce their exposure and vulnerability to climate-related extreme events and other economic, social and environmental shocks and disasters	1	1	(A) Target requires range of actions (building resilience, etc) that are applicable to mining (in particular environmental shocks and disasters associate with mining); (B) Mining is energy-intensive and one of the biggest emitters of greenhouse gases.	1	1	1	(1) Climate Change and Mining: A Foreing Policy Perspective. Ruttiger et. al.. University of Queensland. June 2016., (2) Energy as a key variable in eradicating extreme poverty and hunger:A gender and energy perspective on empirical evidence on MDG #1. Soma Dutta. Asia Regional Network Coordinator. 2005.
1.a	Ensure significant mobilization of resources from a variety of sources, including through enhanced development cooperation, in order to provide adequate and predictable means for developing countries, in particular least developed countries, to implement programmes and policies to end poverty in all its dimensions	1	1	(A)This target relates to the mobilization of resources by the mining sector to engage in policies to end poverty, (B) Mining indsutry has the tradition of contributing to the region in many ways which is synergic to the proverty eradication goals	1	1	0	(1) Building Capacity in Small-Scale Mining Communities: Health, Ecosystem Sustainability, and the Global Mercury Project. Spegel & Viega. July 2016. (2) "From Subsistence Farming to Agribusiness: The Cuncashca Story." Beyond Borders - Barrick Gold Corporation. Accessed January 17, 2018. barrick-beyondborders.com/people/ 2008/10/from-subsistence-farming-to- agribusiness-the-cuncashca-story/.
1.b	Create sound policy frameworks at the national, regional and international levels, based on pro-poor and gender-sensitive development strategies, to support accelerated investment in poverty eradication actions	1	1	(A) Target relates to mining sector and involvement with policy at different government levels (B) A synergy exists as studies on the mining sector have played a positive role in helping develop policy frameworks related to mining	1	0	0	"Commentary: Harnessing Mining for Poverty Reduction, Especially in Africa - Labonne - 2002 - Natural Resources Forum - Wiley Online Library." Accessed January 17, 2018. http://onlinelibrary.wiley.com/doi/ 10.1111/1477-8947.00007/full.

Goal 2. End hunger, achieve food security and improved nutrition, and promote sustainable agriculture

2.1	By 2030, end hunger and ensure access by all people, in particular the poor and people in vulnerable situations, including infants, to safe, nutritious and sufficient food all year round	1	1	1	(A) Target relates to mining sector and its ability to provide access to food and primary necessities. (B) Monitoring water quality, Share infrustructural benefits with agriculture community will help the agriculture to grow and defend against hunger. The trade-off is the competition of land for agriculture versus mining.	1	1		Lumb, Halliwell, and Sharma, "Application of CCME Water Quality Index to Monitor Water Quality."
2.2	By 2030, end all forms of malnutrition, including achieving, by 2025, the internationally agreed targets on stunting and wasting in children under 5 years of age, and address the nutritional needs of adolescent girls, pregnant and lactating women and older persons	0	0	0		0	0		
2.3	By 2030, double the agricultural productivity and incomes of small-scale food producers, in particular women, indigenous peoples, family farmers, pastoralists and fishers, including through secure and equal access to land, other productive resources and inputs, knowledge, financial services, markets and opportunities for value addition and non-farm employment	1	1	1	(A) This target invloves access to land that relates to the mining sector, (B) There is a trade off as the agricultural sector and the mining sector often compete for resources, as they share similar needs for infrastructure, land, water, and labour which can lead to conflict, There is a synergy as agriculture depends on mined resources, such as phosphates, for fertilizer	0	1	1	Sustainable development in the mining industry: clarifying the corporate perspective. Hilson & Murck.Resource Policy. 2000, Mining and agriculture Strange bedfellows or a match made in heaven? (International Mining for Development Centre, 2014)

2.4	By 2030, ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters and that progressively improve land and soil quality	1	1	1	(A) Target involves mining sector and relation to sustainable food production. (B) There is a synergy because with economic and infrustructural growth in the rural area stimulated by mining, the sustainable food production can be reached and can ensure the food security, Different types of mining include specific risk in their operations for mine workers and local food crops, which acts as a trade-off. Mining can make effort to reduce these specific types of mining hazards.	1	1	(1) "Sustainable Food Production in Mining Areas." Cordaid English. Accessed January 17, 2018. https://www.cordaid.org/en/projects/sustainable-food-production-in-mining-areas. (2) Health risks of heavy metals in contaminated soils and food crops irrigated with wastewater in Beijing, China. Khan et al. Environmental Polution. 2008.
2.5	By 2020, maintain the genetic diversity of seeds, cultivated plants and farmed and domesticated animals and their related wild species, including through soundly managed and diversified seed and plant banks at the national, regional and international levels, and promote access to and fair and equitable sharing of benefits arising from the utilization of genetic resources and associated traditional knowledge, as internationally agreed	1	0	1	(A) Target involves mining sector impacts on seeds diversity. (B) Mining land use has the potential negative impact of farmland and seed species loss due to reducing area for agriculture by 40%.	0	0	1	(1) Argon & Rud. Mining, Pollution and Agricultural Productivity: Evidence from Ghana. Working Paper. September 2012.

2.a	Increase investment, including through enhanced international cooperation, in rural infrastructure, agricultural research and extension services, technology development and plant and livestock gene banks in order to enhance agricultural productive capacity in developing countries, in particular least developed countries	1	1	(A) Target inclusive of mining investments in rural areas, (B) A synergy exists as policies can be developed to leverage infrastructure improvements across different sectors (namely agriculture and mining) of the economy	1	(1) Mining and agriculture: Strange bedfellows or a match made in heaven? (International Mining for Development Centre, 2014)			
2.b	Correct and prevent trade restrictions and distortions in world agricultural markets, including through the parallel elimination of all forms of agricultural export subsidies and all export measures with equivalent effect, in accordance with the mandate of the Doha Development Round				0	0	0		
2.c	Adopt measures to ensure the proper functioning of food commodity markets and their derivatives and facilitate timely access to market information, including on food reserves, in order to help limit extreme food price volatility	0	0	0	0	0	0		
Goal 3. Ensure healthy lives and promote wellbeing for all at all ages									
3.1	By 2030, reduce the global maternal mortality ratio to less than 70 per 100,000 live births	0	0	0	0	0	0		

3.2	By 2030, end preventable deaths of newborns and children under 5 years of age, with all countries aiming to reduce neonatal mortality to at least as low as 12 per 1,000 live births and under-5 mortality to at least as low as 25 per 1,000 live births	0	0	0		0	0	0	
3.3	By 2030, end the epidemics of AIDS, tuberculosis, malaria and neglected tropical diseases and combat hepatitis, water-borne diseases and other communicable diseases	1	1	1	(A) This target is inclusive of addressing the high prevalence of TB in the minining community, (B) There is a trade-off as miners have a higher prevalence than the general population to have TB and HIV/AIDS in certain sectors, but also a synergy as concrete efforts being made in the international community geared to reducing TB prevalence in the mining sector, for example: “Declaration on Tuberculosis in the Mining Industry”	1	1	0	Stuckler, D., Basu, S., McKee, M., Lurie, M. Mining and Risk of Tuberculosis in Sub-Saharan Africa. American Journal of Public Health 101, 524-530 (2011), Hilson, G. M. The Socio-Economic Impacts of Artisanal and Small-Scale Mining in Developing Countries (Taylor & Francis, 2006), Stuckler, D., Steele, S., Lurie, M., & Basu, S. ’Dying for gold’: the effects of mineral mining on HIV, tuberculosis, silicosis and occupational disesases in southern Africa. International Journal of Health Services 43, 639-649 (2013)

3.4	By 2030, reduce by one third premature mortality from non-communicable diseases through prevention and treatment and promote mental health and well-being	1	1	0	(A) Target inclusive of improving health of workers in the mining industry. (B) Synergies exist as mining companies can participate in planning in respect to epidemics, Realizing and collaborating to strengthen traditional practices	1	1	0	Maier, Raina M., Fernando Díaz-Barriga, James A. Field, James Hopkins, Bern Klein, and Mary M. Poulton. "Socially Responsible Mining: The Relationship between Mining and Poverty, Human Health and the Environment." Reviews on Environmental Health 29, no. 0 (2014): 83-89. https://doi.org/10.1515/reveh-2014-0022.

3.5	Strengthen the prevention and treatment of substance abuse, including narcotic drug abuse and harmful use of alcohol	1	1	(A) Target inclusive of mining sector involvement with substance abuse programs, (B) Use of narcotic drug abuse and harmful use of alcohol is higher for mine workers. There is a trade-off as mining has made efforts through building infrustructures to incrase physical and mental help, yet more efforts are needed to fully eradicate such wide ranges of diseases. Working in harsh-climatic conditions and remote areas far away from family can increase the likelihood of narcotic drugs and alcohol. Mining industry can improve the situation.	1	1	0	(1) Rodriguez-Fernandez, Rodrigo, Ekowati Rahajeng, Francesca Viliani, Haripurnomo Kushadiwijaya, Rachel M. Amiya, and Michael J. Bangs. "Non-Communicable Disease Risk Factor Patterns among Mining Industry Workers in Papua, Indonesia: Longitudinal Findings from the Cardiovascular Outcomes in a Papuan Population and Estimation of Risk (COPPER) Study." Occupational and Environmental Medicine 72, no. 10 (October 2015): 728-35. https://doi.org/10.1136/oemed-2014-102664. (2) "Alcohol Use and Sexual Risks for HIV/AIDS in Sub-Saharan Africa: Systematic Review of Empirical Findings - ProQuest." Accessed January 17, 2018. https://search.proquest.com/ openview/4426abdc1887437fc2c725 d342b1aabb/1?pq-origsite=gscholar&cbl=44709. (3) "Highs & Lows - Alcohol and Other Drugs in the Mining Sector." Australasian Mine Safety Journal, July 23, 2013. http://www.amsj.com.au/news/ alcohol-and-other-drugs-in-the-mining-sector/.

3.6	By 2020, halve the number of global deaths and injuries from road traffic accidents	1		1	(A) Target call for action (to reduce road deaths) that are applicable to the mining sector (transport components), (B) One study found that road traffic accidents were responsible for the majority of unnatural deaths in the mining sector	1	1	0	(1) Lim, M., Murray, J., Dowdeswell, R., Glynn, J., & Sonnenberg, P. Unnatural Deaths in South African Platinum Miners, 1992-2008, PLoS One 6 (2011)
3.7	By 2030, ensure universal access to sexual and reproductive healthcare services, including for family planning, information and education, and the integration of reproductive health into national strategies and programmes	1	0	0	(A) Target inclusive of promoting sexual and reproductive services in mining communities	1	0	0	
3.8	Achieve universal health coverage, including financial risk protection, access to quality essential healthcare services and access to safe, effective, quality and affordable essential medicines and vaccines for all	1	1		(A) Target inclusive of mining sector support of national policies on health care. (2) There is a synergy, because in order to maintain their common ground of business for operation, mining companies have been interested in collaboration for reducing infectious diseases.	1	1	0	Writer, Staff. "Healthy Mining Minds." Australian Mining (blog), April 4, 2013. https://www.australianmining.com.au/features/healthy-mining-minds/.
3.9	By 2030, substantially reduce the number of deaths and illnesses from hazardous chemicals and air, water and soil pollution and contamination	1		1	(A) Target requires actions (pollution reduction) in the mining sector, (B) Artisinal, small-scale gold mining is the largest anthropogenic source of mercury emissions. Gold miners are easily exposed to mercury, and subsequently suffer mercury intoxication.	1	0	1	(1) Steckling, N. Global Burden of Disease of Mercury Used in Artisanal Small-Scale Gold Mining. Annals of Global Health 83, 234-247 (2017)

3.a	Strengthen the implementation of the World Health Organization Framework Convention on Tobacco Control in all countries, as appropriate	0	0	0				0	
3.b	Support the research and development of vaccines and medicines for the communicable and non-communicable diseases that primarily affect developing countries, provide access to affordable essential medicines and vaccines, in accordance with the Doha Declaration on the TRIPS Agreement and Public Health, which affirms the right of developing countries to use to the full the provisions in the Agreement on Trade-Related Aspects of Intellectual Property Rights regarding flexibilities to protect public health, and, in particular, provide access to medicines for all	1	1		(A) Target inclusive of the mining sector supporting TB and other vaccines, (B) There is a synergy as mining will bring the necessary infrustucture to the region which helps introducing health system, mining sector has a role to play in encouraging R&D in vaccines	1	1	0	(1) Policy Brief: Investing in the Future - The Potential Impact of New Tuberculosis Vaccines on Mineworker Health and Productivity. (Aeras, 2014)

3.c	Substantially increase health financing and the recruitment, development, training and retention of the health workforce in developing countries, especially in least developed countries and small island developing States	1	1		(A) Target inclusive of increasing health training for mining communities, (B) A healthy environment is needed for the sector to be functioning in the region. The mining companies are thus interested in helping the health improvement of the region and prevetion of diseases, which creates a synergy.	1	1	0	(1) Osewe, Patrick. "Better Health in Mines and Mining Communities: A Shared Responsibility." Text. Investing in Health, March 6, 2015. http://blogs.worldbank.org/health/better-health-mines-and-mining-communities-shared-responsibility.
3.d	Strengthen the capacity of all countries, in particular developing countries, for early warning, risk reduction and management of national and global health risks	1	1	1	(A) Target is inclusive of leverging the mining sector to increase capacity for early warning on health risks, (B) There is a trade-off as the mining sector is prone to certain risks and illnesses at a higher rate than the general population. Addressing the specific health risks of the mining sector in an effective manner can help strengthen the overall capacity of the country to manage national health risks, There is a synergy as innovations improving the capacity of countries for early warning, risk reduction, and management of national and global health risks developed for the mining sector have the potential to be scaled up to the national level.	1	1	0	(1) Call for Smart Investments to Improve Health of Miners (The World Bank, 2017)

Goal 4. Ensure inclusive and equitable quality education and promote life-long learning opportunities for all

4.1	By 2030, ensure that all girls and boys complete free, equitable and quality primary and secondary education leading to relevant and effective learning outcomes	1	1	1	(A) Target inclusive of ensuring education in mining communities, (B) There is a synergy as mining companies can support local governments to provide free and equitable public schools, there is a trade-off as primary school enrollment rate is lower than international average in mineral-rich localityies due to child labor in mining.	1	1	0	(1) Mapping Mining to the Sustainable Development Goals: An Atlas. Columbia Center of Sustainable Investment. July 2016. (2) Extractive Dialogue, 2014. Extractive Economies and Sustainable Development: An analysis of infrastructure, health and social development. http://www.extractivedialogue.com/wp-content/uploads/2014/12/ extractiveEconomies.pdf (3) Wachenfeld et al. UNDP Government of Brazil. Promoting Human Rights, Ensuring Social Inclusion and Avoiding Conflict in the Extractive Sector
4.2	By 2030, ensure that all girls and boys have access to quality early childhood development, care and pre-primary education so that they are ready for primary education	1	1	0	(A) Target inclusive of ensuring child development in mining communities, (B) There is a synergy as supporting and sponsoring local schools is a long tradition in the mining industry, and ahelps improving relationships with the local population. Mining companies are often asked to sponsor local events such as sports and children activities.	1	1	0	(1) Mapping Mining to the Sustainable Development Goals: An Atlas. Columbia Center of Sustainable Investment. July 2016. (2) UNICEF Report on the Child Rihgts and the Mining Sector.UNICEF. March 2015.

4.3	By 2030, ensure equal access for all women and men to affordable and quality technical, vocational and tertiary education, including university	1	1		(A) Target is inclusive of ensuring equal access to training and education in mining sector. (B) A synergy exists as technical, vocational and educational training programs for the current and future mining workforce	1	1	0	(1) Mapping Mining to the Sustainable Development Goals: An Atlas. Columbia Center of Sustainable Investment. July 2016.
4.4	By 2030, substantially increase the number of youth and adults who have relevant skills, including technical and vocational skills, for employment, decent jobs and entrepreneurship	1	1	0	(A) Target is inclusive of the mining sector engaging in vocational training programs, (B) A synergy exists as technical, vocational and educational training programs for the current and future mining workforce	1	1	0	(1) Admin, CSRM. "Guide to Good Practices in Indigenous Employment, Training & Enterprise Development. Report to BG Group." Sustainable Minerals Institute. Accessed January 18, 2018. https://www.csrm.uq.edu.au/publications/guide-to-good-practices-in-indigenous-employment-training-enterprise-development-report-to-bg-group.
4.5	By 2030, eliminate gender disparities in education and ensure equal access to all levels of education and vocational training for the vulnerable, including persons with disabilities, indigenous peoples and children in vulnerable situations	1		0	(A) Target is inclusive of the mining sector improving on gender disparities and enducation.	1	1	0	(1) Eftimie, A., Heller, K., & Strongman, J. Mining for Equity. (World Bank, 2009)

4.6	By 2030, ensure that all youth and a substantial proportion of adults, both men and women, achieve literacy and numeracy	1	1	0	(A) Target is inclusive of mining industry's role in literacy. (2)There is a synergy as mining industry trains and educates the workforce.	1	1	0	(1) Admin, CSRM. "Guide to Good Practices in Indigenous Employment, Training & Enterprise Development. Report to BG Group." Sustainable Minerals Institute. Accessed January 18, 2018. https://www.csrm.uq.edu.au/publications/guide-to-good-practices-in-indigenous-employment-training-enterprise-development-report-to-bg-group.
4.7	By 2030, ensure that all learners acquire the knowledge and skills needed to promote sustainable development, including, among others, through education for sustainable development and sustainable lifestyles, human rights, gender equality, promotion of a culture of peace and non-violence, global citizenship and appreciation of cultural diversity and of culture's contribution to sustainable development	1	1		(A) Target is inclusive of mining industry's role in improving knowledge and skills, (B) Company-led training and education can build specific technical skills required for job performance in addition to other "softer" skills, such as communication, decision-making and planning.	1	1	0	(1) Mapping Mining to the Sustainable Development Goals: An Atlas. Columbia Center of Sustainable Investment. July 2016. (2) All Africa, 2013. Sierra Leone: London Mining, GIZ Launch 'Mines to Minds' Project. Accessed 9 July 2016. http://allafrica.com/stories/201309260280.html

4.a	Build and upgrade education facilities that are child, disability and gender sensitive and provide safe, non-violent, inclusive and effective learning environments for all	1	1	(A) Target is inclusive of mining sector supporting educational facilities in community. (B) Supporting and sponsoring local schools as a way to improve relationship with local community and CSR.	1	1	0	(1) Supporting public infrastructure-Local community markets built by MMG are supporting a farmer assistance program andgeneral community development. Market gardens generated about US$47,000 of income forlocal villagers in 2013, most of this through sales of produce to Kinsevere mine alone.Schools and education
4.b	By 2020, substantially expand globally the number of scholarships available to developing countries, in particular least developed countries, small island developing States and African countries, for enrolment in higher education, including vocational training and information and communications technology, technical, engineering and scientific programmes, in developed countries and other developing countries	1	1	(A) Target is inclusive of mining sector engaging in scholarships, (B) There is a synergy as certain governments (such as Australia) provide scholarships related to the mining industry	0	1	0	(1) Extractives sector development assistance. (2017, Australian Government: Department of Foreign Affairs and Trade) http://dfat.gov.au/aid/topics/investment-priorities/infrastructure-trade-facilitation-international-competitiveness/extractives-sector-development-assistance/Pages/extractives-sector-development-assistance.aspx
4.c	By 2030, substantially increase the supply of qualified teachers, including through international cooperation for teacher training in developing countries, especially least developed countries and small island developing States	1	1	(A) Target is inclusive of ensuring mining communities have qualified teachers, (B) A synergy exists as mining has increased the quality of educational standards in many mining working cases.	1	1	0	(1) Mapping Mining to the Sustainable Development Goals: An Atlas. Columbia Center of Sustainable Investment. July 2016.
Goal 5. Achieve gender equality and empower all women and girls								

5.1	End all forms of discrimination against all women and girls everywhere	1	1	1	(A) Target is inclusive of mining sector promoting equality, (B) A synergy exists as mining companies can promote gender equality by ensurng gender parity and equal pay for equal work across their organization, a trade-off exists because the mining industry tends to employ more men, and in some cases this is due to stereotypes	1	0	0	(1) Mapping Mining to the Sustainable Development Goals: An Atlas. Columbia Center of Sustainable Investment. July 2016, (2) Eftimie, A., Heller, K., & Strongman, J. Gender Dimensions of the Extractive Industries: Mining for Equity. (World Bank, 2009)
5.2	Eliminate all forms of violence against all women and girls in the public and private spheres, including trafficking and sexual and other types of exploitation	1	1	1	(A) Target is inclusive of mining sector's role in reducing violence against women, (B) There is a trade off as sex workers are historically found to be attracted in the mining area, where they are often subject to violence, there is a synergy as mining proactively make efforts to make a safe environment for women	1	0	0	(1) Lewis, David. "Fears for Sex Workers Attracted to Mining Boom." Text. ABC News, July 10, 2012. http://www.abc.net.au/news/2012-07-10/study-to-focus-on-mine-town-illegal-prostitution/4120852. (2) Mapping Mining to the Sustainable Development Goals: An Atlas. Columbia Center of Sustainable Investment. July 2016.
5.3	Eliminate all harmful practices, such as child, early and forced marriage and female genital mutilation	0		0		0	0	0	
5.4	Recognize and value unpaid care and domestic work through the provision of public services, infrastructure and social protection policies and the promotion of shared responsibility within the household and the family as nationally appropriate					0	0	0	

5.5	Ensure women's full and effective participation and equal opportunities for leadership at all levels of decision-making in political, economic and public life	1	1	1	(A) Target is inclusive of mining sector promoting participation of women in work, (B) There is a synergy as mining companies can ensure gender-sensitive work environment, There is a trade-off as women are currently under-represented in mining negotiations	1	0	(1) Oxfam, 2009. Women, Communities and Mining: The gender impacts of mining and the role of gender impact assessment. http://policy-practice.oxfam.org.uk/publications/women-communities-and-mining-the-gender-impacts-of-mining-and-the-role-of-70gende-293093
5.6	Ensure universal access to sexual and reproductive health and reproductive rights as agreed in accordance with the Programme of Action of the International Conference on Population and Development and the Beijing Platform for Action and the outcome documents of their review conferences	1			(A) Target is inclusive of mining sector providing access to sexual health in mining communities.	1	0	(1) Dawson, Angela, and Caroline Homer. "How Does the Mining Industry Contribute to Sexual and Reproductive Health in Developing Countries? A Narrative Synthesis of Current Evidence to Inform Practice." Journal of Clinical Nursing 22 (December 1, 2013): 3597-3609. https://doi.org/10.1111/jocn.12191.

5.a	Undertake reforms to give women equal rights to economic resources, as well as access to ownership and control over land and other forms of property, financial services, inheritance and natural resources, in accordance with national laws	1	1	1	(A) Target is inclusive of the engagement of the mining sector in achieving women's rights, (B) There is a synergy as the mining sector can introduce local job opportunities exclusively for women in order to economically empower them, such as the shea butter production centre running by Berkinabé female community, there is a trade off as women are largely underrepresented in the mining emplyment (only 5-10% of the international workforce.)	1	0	0	(1) "Shea Butter Nourishes Opportunities for African Women | Africa Renewal Online." Accessed January 18, 2018. http://www.un.org/africarenewal/magazine/august-2013/shea-butter-nourishes-opportunities-african-women. (2) PricewaterhouseCoopers. "Mining for Talent - A Study of Women on Boards in the Mining Industry." PwC. Accessed January 19, 2018. https://www.pwc.co.uk/industries/mining/insights/mining-for-talent-a-study-of-women-on-boards-in-the-mining-industry.html. (3) PricewaterhouseCoopers. "Industries." PwC. Accessed January 19, 2018. https://www.pwc.co.uk/industries
5.b	Enhance the use of enabling technology, in particular information and communications technology, to promote the empowerment of women	1	0		(A) Target is inclusive of mining sector's role in providing technology to promote the empowerment of women	1	1	0	

5.c	Adopt and strengthen sound policies and enforceable legislation for the promotion of gender equality and the empowerment of all women and girls at all levels	1	1		(A) Target inclusive of mining sector adopting sound policies on gender equality. (B) A synergy exists as mining companies can look at the working environment of women with gender-senstive lenses and include gender-sensitive institutions in the decision-making.	1	1	0	(1) Hair, Jonathan. "Research Shows Growing Gender Pay Gap in Mining Industry." Text. ABC News, November 28, 2014. http://www.abc.net.au/news/2014-11-28/research-shows-growing-gender-pay-gap-in-mining/5925148.
Goal 6. Ensure availability and sustainable management of water and sanitation for all									
6.1	By 2030, achieve universal and equitable access to safe and affordable drinking water for all	1	1	1	(A) Target is inclusive of mining sector promotion of access to drinking water, (B) There is a synergy as new technologies provide the ability to clean water that has been affected by the mining industry to make it drinkable again, there is a trade off as mining activities can pollute drinking water (for example, introduce heavy metals into drinking water) making it unsafe for the surrounding populations	1	1	1	(1) Shared Water, Shared Responsibility, Shared Approach: Water in the Mining Sector (International Finance Corporation, 2017) (2) Khan, K., et al. Health risks associated with heavy metals in the drinking water of Swat, northern Pakistan. Journal of Environmental Sciences 25, 2003-2013 (2013)
6.2	By 2030, achieve access to adequate and equitable sanitation and hygiene for all and end open defecation, paying special attention to the needs of women and girls and those in vulnerable situations	1	1		(A) Target inclusive of mining sectors role in access to sanitation, (B) Mining companies are able to increase awareness about hygiene creates synergy	1	1	0	(1) A Practical Guide to Catchment-based Water Management for the Mining and Metals Industry (International Council on Mining and Metals, 2015)

6.3	By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally	1	1	1	(A) Target is inclusive of mining sector improving water quality, (B) There is a synergy as there is evidence that pollution controls concerning water sources put in place at mines are effective, there is a trade off as currently mines are still contributing to water pollution and releasing hazardous chemicals and minerals into the water systems	1	1	(1) Shared Water, Shared Responsibility, Shared Approach: Water in the Mining Sector (International Finance Corporation, 2017) (2) Malmqvist, B. & Rundle, C. Threats to the running water ecosystems of the world. Evironmental Conservation 29, 134-153 (2002), (3) Khan, K., et al. Health risks associated with heavy metals in the drinking water of Swat, northern Pakistan. Journal of Environmental Sciences 25, 2003-2013 (2013)
6.4	By 2030, substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity	1	1		(A) Target is inclusive of mining sector increasing water efficiency, (B) There is a synergy as numerous mining companies are committeed to increasing water efficiency in their operations	1	1	(1) Water management in mining: a selection of case studies (International Council on Mining and Metals, 2012)
6.5	By 2030, implement integrated water resources management at all levels, including through transboundary cooperation as appropriate	1		0	(A) Target is inclusive of mining sector promoting water resource management.	1	1	(1) Ako, Andrew, Gloria Takem, and George Elambo Nkeng. Water Resources Management and Integrated Water Resources Management (IWRM) in Cameroon. Vol. 24, 2010. https://doi.org/10.1007/s11269-009-9476-4.

6.6	By 2020, protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes	1	1	1	(A) Target is inclusive of engaging the mining sector to protect and restore water related ecosystems, (B) There is a trade off as the mining sector is a leading cause of changes in water chemistry, which negatively affects running water ecosystems. There is a synergy as there is potential for mining sector to reuse water (in the form of treated wastewater), which will help protect water-related ecosystems. Cases of this can been seen in Latin America.	0	1	0	(1) Malmqvist, B. & Rundle, C. Threats to the running water ecosystems of the world. Evironmental Conservation 29, 134-153 (2002), (2) Jiménez, B. & Asano, T. Water Reuse: An International Survey of Current Practice, issue and needs. 182, 184 (IWA Publishing, 2008)
6.a	By 2030, expand international cooperation and capacity-building support to developing countries in water- and sanitation-related activities and programmes, including water harvesting, desalination, water efficiency, wastewater treatment, recycling and reuse technologies	1	1		(A) Target is inclusive of mining sector to cooperate internationally to support developing countries in water programs, (B) There is a synergy as understanding water as a business risk can incentivize international companies to change their business practices regarding water in the mining sector in developing countries	1	1	0	(1) A Practical Guide to Catchment-based Water Management for the Mining and Metals Industry (International Council on Mining and Metals, 2015)

6.b	Support and strengthen the participation of local communities in improving water and sanitation management	1	1		(A) Target is inclusive of the mining sector supporting local communities in improving water, (B) There is a synergy as there is positive evidence of workshops grouping different level of stakeholders (notably participants at the local levels) to test water quality for the benefit of communities affected by the mining industry.	1	1	1	(1) Water, Mining, and Communities: Creating Shared Value through Sustainable Water Management (International Finance Corporation, 2014)
Goal 7. Ensure access to affordable, reliable, sustainable and modern energy for all									
7.1	By 2030, ensure universal access to affordable, reliable and modern energy services	1	0	1	(A) Target inclusive of changes in the mining sector's use of energy (B) There is a trade off as mining is energy intensive, taking up significant amounts of supply	1	1	1	(1) Toledano, P. CCSI Policy Paper (Columbia Center on Sustainable Investment, 2012)
7.2	By 2030, increase substantially the share of renewable energy in the global energy mix	1	1	0	(A) Target is inclusive of mining sector using renewable energy, (B) There is a synergy as new renewable energy initiatives (for example: a solar power facility at a Namibian mine) are increasing the amount of renewable energy in the global energy mix	0	1	1	(1) Kilian, A. Barloworld to install 7 MW solar power facility at Namibia mine. Engineering News (2017)

7.3	By 2030, double the global rate of improvement in energy efficiency	1	1	(A) Target is inclusive of mining sector improving energy efficiency, (B) There is a synergy by improving the efficiency of mobile equipment used in the mining sector (excavators, shovels, and trucks) will increasing the overall energy efficiency of the sector.	0	1	1	(1) Industrial Energy Efficiency Data Analysis Project (ClimateWorks Australia, Australian Government, 2013)
7.a	By 2030, enhance international cooperation to facilitate access to clean energy research and technology, including renewable energy, energy efficiency and advanced and cleaner fossil-fuel technology, and promote investment in energy infrastructure and clean energy technology	1	1	(A) Target is inclusive of mining sector involvement of international cooperation to faciliate access to energy, (2) Aligning the incentives of the host country with the incentives of the mining company, often in the form of international cooperation, can improve energy use in the mining industry. Space to find regulations that improve energy efficiency while benefiting both parties.		0	1	(1) Toledano, P. CCSI Policy Paper (Columbia Center on Sustainable Investment, 2012)
7.b	By 2030, expand infrastructure and upgrade technology for supplying modern and sustainable energy services for all in developing countries, in particular least developed countries, small island developing States, and land-locked developing countries, in accordance with their respective programmes of support	1	1	(A) Target is inclusive of mining sector improvements in infrastructure, (B) There is a synergy as investments in new sustainable energy projects will expand infrastructure and upgrade technology in developing countries, especially in remote areas.		1	1	(1) Crespo, P. Realizing Energy Savings, Sustainable Power and Enabling Community Engagement with Renewables for Mines. Energy and Mines (2016),(2) Renewables in mining: futuristic or realistic? (Ernst & Young, 2014)

Goal 8. Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all

8.1	Sustain per capita economic growth in accordance with national circumstances and, in particular, at least 7 per cent gross domestic product growth per annum in the least developed countries	1	1	0	(A) Target is inclusive of mining sector promoting sustainable growth, (B) There is a synergy as mining a driver of growth.	1	0	0	(1) Dubi?ski, J. Sustainable developming of mining mineral resources, Journal of Sustainable Mining 12, 1 - 6 (2013)
8.2	Achieve higher levels of economic productivity through diversification, technological upgrading and innovation, including through a focus on high-value added and labour-intensive sectors	1	1	1	(A) Target inclusive of achieving higher economic productivity in the mining sector, (B) There is a synergy as technology and infrustrure-related upgrading will be brought by mining activities, there is a trade off as mining is a capital-intensive industry which could change agricultural lands to large-scale mining areas.	0	1	0	(1) Mapping Mining to the Sustainable Development Goals: An Atlas. Columbia Center of Sustainable Investment. July 2016. (2) "Mining and Agriculture - MiningFacts.Org." Accessed January 25, 2018. http://www.miningfacts.org/economy/how-does-large-scale-mining-affect-agriculture.
8.3	Promote development-oriented policies that support productive activities, decent job creation, entrepreneurship, creativity and innovation, and encourage the formalization and growth of micro-, small- and medium-sized enterprises, including through access to financial services	1	1	0	(A) Target inclusive of job creation policies in mining sector, (B) There is a synergy as mining has produced many job opportunities in the developing countries.	0	1	0	(1) http://www.icmm.com/ document/4440

8.4	Improve progressively, through 2030, global resource efficiency in consumption and production and endeavour to decouple economic growth from environmental degradation, in accordance with the 10-year framework of programmes on sustainable consumption and production, with developed countries taking the lead	1	1		(A) Target inclusive of mining sector resource efficiency policies in consumption and production. (B) There is a synergy as improvements in the mining sector can lead to more efficient resource consumption and production, improvements in mining processes can lead to a decoupling of economic growth from environmental degradation	0	1	1	(1) Kulczycka, Joanna, and Corina Hebestreit. "Sustainable Production and Consumption of Mineral Resources-introduction." Mineral Economics 25, no. 2-3 (March 1, 2013): 53-54.
8.5	By 2030, achieve full and productive employment and decent work for all women and men, including for young people and persons with disabilities, and equal pay for work of equal value	1	1	1	(A) Target inclusive of full employment in the mining sector, (B) There is a trade-off as recent studies have shown that the mining industry does not contribute to decent work for all men and women, namely informality and child labour are large issues, there is a synergy as new standards and governance regimes in the mining sector can be expanded in their coverage to improve work conditions	1	1	0	(1) Sectoral Studies on Decent Work in Global Supply Chains (ILO, 2016)
8.6	By 2020, substantially reduce the proportion of youth not in employment, education or training	1	1		(A) Target inclusive of mining sector and employment policies, (B) There is a synergy as mining brings direct employment, large in quantity for the younger population.	1	1	0	(1) Deaton, B. James, and Ekaterina Niman. "An Empirical Examination of the Relationship between Mining Employment and Poverty in the Appalachian Region." Applied Economics 44, no. 3 (January 1, 2012): 303-12.

8.7	Take immediate and effective measures to eradicate forced labour, end modern slavery and human trafficking and secure the prohibition and elimination of the worst forms of child labour, including recruitment and use of child soldiers, and by 2025 end child labour in all its forms	1		1	(A) Target is inclusive of reducing child labour in the mining sector, (B) There is a trade-off as the mining sector employs children in numerous countries, improving the governance can mitigate this problem. Child labor is common in the mining sector of the developing countries due to the lack of formal unemployment opportunities in the section, and lack of governmental support to financially support local families with young children.	1	0	0	(1) Hilson, Gavin. "Child Labour in African Artisanal Mining Communities: Experiences from Northern Ghana." Development and Change 41, no. 3 (May 1, 2010): 445-73. https://doi.org/10.1111/j.1467-7660.2010.01646.x.
8.8	Protect labour rights and promote safe and secure working environments for all workers, including migrant workers, in particular women migrants, and those in precarious employment	1	1	1	(A) Target inclusive of mining sector protecting labour rights, (B) There is a synergy as mining can follow the guidelines to provide a safe envrionment for its operations, there is a trade off as mining can be dangerous in nature due to the harzards of the mining operations.	1	1	0	(1) "Mining Health & Safety Laws, Regulations, and Procedures | Health & Safety - TechnoMine." Accessed January 22, 2018. http://technology.infomine.com/reviews/HAS/welcome.asp?view=full. (2) "Dangers in the Mining Workplace - Work Environment - CareerMine." InfoMine. Accessed January 22, 2018. http://www.infomine.com/careers/workenvironment/dangers/.
8.9	By 2030, devise and implement policies to promote sustainable tourism that creates jobs and promotes local culture and products	1	1		(A) Target incusive of mining sector collaboarting with local government and other actors for achieving sustainable tourism on sites, (B) There is a synergy as tourism projects exist that co-exist with mining sites	0	1	1	(1) Miloterranean Geo Experience https://www.miloterranean.gr/general-information/about-milos/

8.1	Strengthen the capacity of domestic financial institutions to encourage and expand access to banking, insurance and financial services for all	1	1	(A) Target inclusive of the role of mining industries in encouraging access to banking, (B) There is a synergy as mining companies have a role to play in creating access to finance	0	1	0	(1) Accessing Finance in a Depressed Economy- Finance Optionsfor the Mining Sector (Banker's Association of Zimbabwe, 2014)
8.a	Increase Aid for Trade support for developing countries, in particular least developed countries, including through the Enhanced Integrated Framework for Trade-Related Technical Assistance to Least Developed Countries	1	1	(A) Target inclusive of mining companies' and mining sector's role in "Aid for Trade", (B) There is a synergy as aid for productive building capacity is provided to the mining sector in developing countries		1	0	(1) Aid for Trade at a Glance: Reducing Trade Costs for Inclusive, Sustainable Growth (WTO, OECD, 2015)
8.b	By 2020, develop and operationalize a global strategy for youth employment and implement the Global Jobs Pact of the International Labour Organization	1	1	(A) Target inclusive of mining sector's role in developing a strategy for youth unemployment, (B) There is a synergy as companies can ensure that recruitment and employment strategies reach marginalized populations including women and young people.	1	1	0	(1) International labour Organizatipn & International Training Center. Promoting Youth Employment in the Mining Sector in Liberia. Accessed 26 Jan 2018.
Goal 9. Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation								
9.1	Develop quality, reliable, sustainable and resilient infrastructure, including regional and transborder infrastructure, to support economic development and human well-being, with a focus on affordable and equitable access for all	1	1	(A) Target inclusive of mining sector developing infrastructure, (B) There is a synergy as the mining sector can play an active role in promoting domestic sustainable infrastructure.	0	1	0	(1) Mapping Mining to the Sustainable Development Goals: An Atlas. Columbia Center of Sustainable Investment. July 2016.

9.2	Promote inclusive and sustainable industrialization and, by 2030, significantly raise industry's share of employment and gross domestic product, in line with national circumstances, and double its share in least developed countries	1	1	(A) Target inclusive of the mining sector promoting inclusive and sustainable industrialization, (B) There is a synergy as expanding access to basic infrastructure is key to enhancing innovation and productivity, helping to create opportunities in other sectors of the economy, which in turn is necessary for diversification and sustainable industrialization.	0	1	0	"Infrastructure and Industrialization." United Nations Sustainable Development (blog). Accessed January 23, 2018. http://www.un.org/sustainabledevelopment/infrastructure-industrialization/.
9.3	Increase the access of small-scale industrial and other enterprises, in particular in developing countries, to financial services, including affordable credit, and their integration into value chains and markets	1	1	(A) Target inclusive of increasing affordable credit to mining communities, (B) There is a syergy as mining companies can support non-mining related activities, such as micro-financing	0	1		(1) Mapping Mining to the Sustainable Development Goals: An Atlas. Columbia Center of Sustainable Investment. July 2016.
9.4	By 2030, upgrade infrastructure and retrofit industries to make them sustainable, with increased resource-use efficiency and greater adoption of clean and environmentally sound technologies and industrial processes, with all countries taking action in accordance with their respective capabilities	1	1	(A) Target inclusive with upgrading mining infrastructure to be more sustainable, (B) There is a synergy as new opportunities brought in by mining include retrofitting industries (particularly those of transport, water, and energy) to make them more sustainable	0	1	1	(1) Mapping Mining to the Sustainable Development Goals: An Atlas. Columbia Center of Sustainable Investment. July 2016.

9.5	Enhance scientific research, upgrade the technological capabilities of industrial sectors in all countries, in particular developing countries, including, by 2030, encouraging innovation and substantially increasing the number of research and development workers per 1 million people and public and private research and development spending	1	1	(A)Target inclusive of increasing scientific research in the mining sector, (B) There is a synergy as mining companies can share their technological innovations and know-how with other industries in the country or domestic governments where they are operating	0	1	0	(1) Mapping Mining to the Sustainable Development Goals: An Atlas. Columbia Center of Sustainable Investment. July 2016.
9.a	Facilitate sustainable and resilient infrastructure development in developing countries through enhanced financial, technological and technical support to African countries, least developed countries, landlocked developing countries and small island developing States	1	1	(A) Target inclusive of mining sector facilitating sustainable infrastructure, (B) There is a synergy as expanding access to basic infrastructure is key to enhancing innovation and productivity, helping to create opportunities in other sectors of the economy	0	1		(1) "Infrastructure and Industrialization." United Nations Sustainable Development (blog). Accessed January 25, 2018. http://www.un.org/sustainable development/infrastructure-industrialization/.
9.b	Support domestic technology development, research and innovation in developing countries, including by ensuring a conducive policy environment for, inter alia, industrial diversification and value addition to commodities	1	1	(A) Target inclusive the mining sector's role in supporting technological development, (B) there is a synergy as horizontal linkages between the mining sector and other national sectors can support domestic technology development	0	1	0	(1) Sigman & Garcia. UNCTAD. Extractive Industries: Optimizing Value Retention In Host Countries. New York and Geneva. 2012.(2) Mapping Mining to the Sustainable Development Goals: An Atlas. Columbia Center of Sustainable Investment. July 2016.

9.c	Significantly increase access to information and communications technology and strive to provide universal and affordable access to the Internet in least developed countries by 2020				0	0	0	
Goal 10. Reduce inequality within and among countries								
10.1	By 2030, progressively achieve and sustain income growth of the bottom 40 per cent of the population at a rate higher than the national average	1	1	(A) Target inclusive of income growth through the mining sector. (B) There is a synergy seen by a successful case-study, despite a doubling of the population in villages closest to the mine from 2001 to 2011, annual per capita income multiplied sixfold, and the Gini coefficient (an inequality index) was cut in half.	1		0	International Council on Mining and Metals. Document1841 "ICMM - ICMM."Document 8264. Accessed January 25, 2018. https://www.icmm.com/en-gb.
10.2	By 2030, empower and promote the social, economic and political inclusion of all, irrespective of age, sex, disability, race, ethnicity, origin, religion or economic or other status	1	1	(A) Target inclusive of leverging the mining sector to promote social inclusion, (B) There is a synergy because partnering with indogeneous people for better provied opportunities both withing the country and for the indogeneous people regardlness of their status. In an Australian mining example. the mining trained indigeneous women to be machine operators.	1	0	0	"Thiess Women in Hard Hats Wins Award." Thiess. Accessed January 24, 2018. https://www.thiess.com/news/2011/thiess-women-in-hard-hats-wins-award.

10.3	Ensure equal opportunity and reduce inequalities of outcome, including by eliminating discriminatory laws, policies and practices and promoting appropriate legislation, policies and action in this regard	1	1	1	(A) Target inclusive of the mining sector ensuring equal opportunities, (B) There is a trade-off as there is evidence that the mining sector engages in discriminatory behaviour in hiring, there is a synergy because mining companies can promote equal opportunity and attempt to reduce inequalities of outcome		1	0	(1) Mapping Mining to the Sustainable Development Goals: An Atlas. Columbia Center of Sustainable Investment. July 2016. (2) Davis & Franks.Harvard Kennedy School of Government. Costs of Company-Community Conflict in the Extractive Sector. 2014. (2) Loayza et al. World Bank. Discussion Paper. Poverty, Inequality, and the Local Natural Resource Curse, (3) Eftimie, A., Heller, K., & Strongman, J. Gender Dimensions of the Extractive Industries: Mining for Equity. (World Bank, 2009)
10.4	Adopt policies, especially fiscal, wage and social protection policies, and progressively achieve greater equality	1	1		(A) Target inclusive of mining sector pursuing policies that attempt to achieve greater equality, (B) There is a synergy as mining revenues allow domestic governments to adopt stronger social protection systems, which help achieve greater equality	1	0	0	(1) Ortiz, I., Schmitt, V., & Loveleen, D. Social Protection Floors: Volume 3: Governance and Financing (International Labour Organization, 2016)
10.5	Improve the regulation and monitoring of global financial markets and institutions and strengthen the implementation of such regulations					0		0	

10.6	Ensure enhanced representation and voice for developing countries in decision-making in global international economic and financial institutions in order to deliver more effective, credible, accountable and legitimate institutions	1	1	(A) Target inclusive of improving decision making and representation in mining sector, (B) there is a synergy as the dialogue in the extractive sector can bring a humanitarian discussion that helps the voice of developing countries be heard	1	0	0	(1) Wachenfeld et al. Promoting Human Rights, Ensuring Social Inclusion and Avoiding Conflict in the Extractive Sector. UNDP Government of Brazil. 3-5 December 2007.
10.7	Facilitate orderly, safe, regular and responsible migration and mobility of people, including through the implementation of planned and well-managed migration policies	1		(A) Target inclusive of migration seen in mining sector	1	0		(1) International Labour Organization. International Migrant Workers in the Mining Sector. 2016.
10.a	Implement the principle of special and differential treatment for developing countries, in particular least developed countries, in accordance with World Trade Organization agreements	1		(A) Target inclusive regulations in the mining sector		1	0	
10.b	Encourage official development assistance and financial flows, including foreign direct investment, to States where the need is greatest, in particular least developed countries, African countries, small island developing States and landlocked developing countries, in accordance with their national plans and programmes	1	0	(A) Target inclusive of encouraging development assisstance from mining companies.		1	0	

10.c	By 2030, reduce to less than 3 per cent the transaction costs of migrant remittances and eliminate remittance corridors with costs higher than 5 per cent					0	0	0	
Goal 11. Make cities and human settlements inclusive, safe, resilient and sustainable									
11.1	By 2030, ensure access for all to adequate, safe and affordable housing and basic services and upgrade slums	1	1	1	(A) Target inclusive of mining companies ensuring proper houses in mining communities, (B) There is a trade off as mining sites still have surrounding slums, and often draw people in without a place to house them, there is a synergy as the mining sector can play an active role in improving houses in mining communities	1	1		(1) Campbell, M. A thriving coal mining city in crisis? The governance and spatialplanning challenges at Witbank, South Africa. Land Use Policy 62, 223-231 (2017), (2) Housing and Accomodation: Fact Sheet 2017 (Chamber of Mines of South Africa, 2017)
11.2	By 2030, provide access to safe, affordable, accessible and sustainable transport systems for all, improving road safety, notably by expanding public transport, with special attention to the needs of those in vulnerable situations, women, children, persons with disabilities and older persons	1	1		(A) Target inclusive of mining companies ensuring safe transport in mining communities and for migrants, (B) There exists clear approaches for the mining companies to work with governments to provide safe transportation	1	1		(1) Yakovleva, N., Kotilainen, J., Toivakka, M. Reflections on the opportunities for mining companies to contribute to the United Nations Sustainable Development Goals in sub - Saharan Africa, The Extractive Industries and Society 4, 426-433 (2017)
11.3	By 2030, enhance inclusive and sustainable urbanization and capacity for participatory, integrated and sustainable human settlement planning and management in all countries	1	1		(A) Target inclusive of the mining sector ensuring sustinable human settlement around working areas, (B) There is a synergy as evidence exists of mining areas and mining companies planning and contributing to sustainable urban development	1	1	0	(1) Devenin, V. Urban Development for Mining Communities (Network for Business Sustainability, 2017)

11.4	Strengthen efforts to protect and safeguard the world's cultural and natural heritage	1	1	1	(A) Target inclusive of mining sector protecting areas of heritage, (B) There is a syngergy becuase mining countracts have the potential to respect indigenous heritage and culture, but also a trade off as this often does not happen	1	1	1	(1) O'Faircheallaigh, C. Negotiating Cultural Heritage? Aboriginal-Mining Company Agreements in Australia, Development and Change 39, 25 - 51 (2008)
11.5	By 2030, significantly reduce the number of deaths and the number of people affected and substantially decrease the direct economic losses relative to global gross domestic product caused by disasters, including water-related disasters, with a focus on protecting the poor and people in vulnerable situations						0	0	
11.6	By 2030, reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality and municipal and other waste management	1			(A) Target inclusive of improving environmental impact of mine cities	1		1	
11.7	By 2030, provide universal access to safe, inclusive and accessible, green and public spaces, in particular for women and children, older persons and persons with disabilities	1	1		(A) Target inclusive of providing public spaces in mining communities, (B) There is a synergy as projects exist that transform mines into green spaces	1	1	0	(1) The Eden Project http://www.edenproject.com/eden-story/eden-timeline

11.a	Support positive economic, social and environmental links between urban, per-urban and rural areas by strengthening national and regional development planning	1		(A) Target inclusive of mining sector engagement with development planning	0	1	0	
11.b	By 2020, substantially increase the number of cities and human settlements adopting and implementing integrated policies and plans towards inclusion, resource efficiency, mitigation and adaptation to climate change, resilience to disasters, and develop and implement, in line with the Sendai Framework for Disaster Risk Reduction 2015-2030, holistic disaster risk management at all levels	1		(A) Target inclusive of mining companies engaging in community to increase inclusion in cities and settlements		1	1	
11.c	Support least developed countries, including through financial and technical assistance, in building sustainable and resilient buildings utilizing local materials	1	1	(A) Target inclusive of mining companies supporting sustainable buildings, (B) A synergy exists as a mining project is documented that includes engaging the community in employing people to make local bricks		1	1	(1) ESIA Update for the New Liberty Gold Mine in Liberia: ESHS submission and update of specialist reports (Digby Wells Environmental, 2014)

Goal 12. Ensure sustainable consumption and production patterns

12.1	Implement the 10-year framework of programmes on sustainable consumption and production, all countries taking action, with developed countries taking the lead, taking into account the development and capabilities of developing countries	1	1		(A) Target inclusive of the mining sector promoting sustainable consumption and production, (B) There is a synergy as approaches to sustainable mining production are already elements of a number of international initiatives in the Asia Pacific and African region	0	1	0	(1) Thematic discussions: Sustainable Consumption and Production (United Nations) https://sustainabledevelopment.un.org/content/documents/690Australia.pdf
12.2	By 2030, achieve the sustainable management and efficient use of natural resources	1	1	1	(A) Target inclusive of achieving sustainable management in the mining sector, (B) There exists a synergy as there is potential to develop more sustinable mining process, There exists a trade-off, as the extraction of mineral resources continues to grow	0		1	(1) Dubi?ski, J. Sustainable developming of mining mineral resources, Journal of Sustainable Mining 12, 1 - 6 (2013)
12.3	By 2030, halve per capita global food waste at the retail and consumer levels and reduce food losses along production and supply chains, including post-harvest losses					0	0	0	

12.4	By 2020, achieve the environmentally sound management of chemicals and all wastes throughout their life cycle, in accordance with agreed international frameworks, and significantly reduce their release to air, water and soil in order to minimize their adverse impacts on human health and the environment	1	1	1	(A) Target inclusive of achieving environmentally sound management of chemicals in the mining sector, (B) There is a trade-off because mine sites create chemical hazards, There is a synergy as active projects to improve the waste from the extractive industry	0	1	1	(1) Liakopoulos, A., et al. Environmental impacts of unmanaged solid waste at a former base metal mining and ore processing site (Kirki, Greece). Waste Management and Research, SAGE Publications 28, 996 - 1009 (2010), (2) Cherrier, V., Luscombe, D., Calero, J., Zotz, F., Weibenbacher, J., Pelsy, F., and Dupont, C. Assessment of Member States' performance regarding the implementation of the Extractive Waste Directive (European Commission, 2017)
12.5	By 2030, substantially reduce waste generation through prevention, reduction, recycling and reuse	1	1		(A) Target inclusive of reducing waste in the mining sector, (B) There are synergies as new technologies enable mine waste to be environmentally dealt with, additionally there are more regulations about mine waste	0	1	1	(1) Wood, M. Waste not, want not - waste management in the mining industry (Mining online, 2016) http://www.miningafricaonline.co .za/index.php/mining-features/sustainability/2110-waste-not-want-not-waste-management-in-the-mining-industry
12.6	Encourage companies, especially large and transnational companies, to adopt sustainable practices and to integrate sustainability information into their reporting cycle	1	1		(A) Target inclusive of transnational mining companies adopting sustainable practices, (B) There is a synergy as international initiatives like the Extractive Industries and Transparency Initiative (EITI) encourage international mining companies to adpot their standards	0	1	0	(1) Carvalh, F. Mining industry and sustainable development: time for change, Food and Energy Security 6, 61-77 (2017)

12.7	Promote public procurement practices that are sustainable, in accordance with national policies and priorities	1			(A) Target inclusive of the mining sector promoting sustainable procurement policies	0	1	0	Hoje. Lulia University of Technology. Making Mining Sustianable: Overview of Public and Private Responses. Oct 2014.
12.8	By 2030, ensure that people everywhere have the relevant information and awareness for sustainable development and lifestyles in harmony with nature	1	1	1	(A) Target inclusive of the mining sector promoting information concerning sustainable development, (B) There is a synergy as international programs exist to provide information about mining and sustainable development, There is a trade-off as public awareness about the non renewable nature of mineral resources is small	0	1	0	(1) Carvalh, F. Mining industry and sustainable development: time for change, Food and Energy Security 6, 61-77 (2017), (2) Dubi?ski, J. Sustainable developming of mining mineral resources, Journal of Sustainable Mining 12, 1 - 6 (2013)
12.a	Support developing countries to strengthen their scientific and technological capacity to move towards more sustainable patterns of consumption and production	1	1	1	(A) Target inclusive of mining companies supporting developing countries to strengthen scientific and technological capacity, (2) There is a synergy as new technology can decrease or eliminate the negative effects of mining, there is a trade off as new technologies (hardware) require mineral resources to be built	0	1	0	(1) Dubi?ski, J. Sustainable developming of mining mineral resources, Journal of Sustainable Mining 12, 1 - 6 (2013)
12.b	Develop and implement tools to monitor sustainable development impacts for sustainable tourism that creates jobs and promotes local culture and products	1	1		(A) Target inclusive of projects concerning the mining sector, (B) There is a synergy as projects exist that expanded mining operations to include tourism	0	1	0	(1) Miloterranean Geo Experience https://www.miloterranean.gr/general-information/about-milos/

12.c	Rationalize inefficient fossil-fuel subsidies that encourage wasteful consumption by removing market distortions, in accordance with national circumstances, including by restructuring taxation and phasing out those harmful subsidies, where they exist, to reflect their environmental impacts, taking fully into account the specific needs and conditions of developing countries and minimizing the possible adverse impacts on their development in a manner that protects the poor and the affected communities	1	1		(A) Target inclusive of fossil fuel subsidies that apply to mining industry, (B) Reducing fossil fuel subsidies will lead to less mining of fossil fuels	0	1	0	(1) Trachtman, J. A role for the WTO in reducing fossil fuel subsidies (International Center for Trade and Sustinable Development, 2017)
Goal 13. Take urgent action to combat climate change and its impacts									
13.1	Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries	1	1	1	(A) Target inclusive of strengthening resilience and adaptative capacity to cliamte related hazards by the mining sector, (B) There is a synergy with this target as mining companies are engaging in adaptative planning against climate change. Evidence of trade-offs between mining activities and resilience of societies and economies to natural disasters.		1	1	(1) Farrant, K. The mining sector's response to climate change (AusIMM, EY, 2016)

13.2	Integrate climate change measures into national policies, strategies and planning	1	1	(A) Target inclusive of implementing laws concerning the mining sector's effects on climate change in national policies, (B) A synergy exists as it is recognized that foreign policy makers can support the mining industry to address supply chain risks more pro actively by supporting international knowledge hubs for supply chain monitoring. Also improving international conventions for the mining sector.	1	1	(1) Climate change and mining: A foreign policy perspective (Adelphi, 2016)
13.3	Improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning	1	1	(A) Target inclusive of improving education on cliamte change related to the mining sector, in the mining sector, (B) The mining sector causes climate related hazards, but these effects can negatively influence the business models of mining companies. There is a synergy because mining companies are motivated to address the problems of mining causing climate change. This includes increasing capacity on impact reduction.	1	1	(1) Farrant, K. The mining sector's response to climate change (AusIMM, EY, 2016)

13.a	Implement the commitment undertaken by developed-country parties to the United Nations Framework Convention on Climate Change to a goal of mobilizing jointly $100 billion annually by 2020 from all sources to address the needs of developing countries in the context of meaningful mitigation actions and transparency on implementation and fully operationalize the Green Climate Fund through its capitalization as soon as possible	1	0	(A) Target inclusive of mining sector or extractive organizations participating in or supporting the UNFCCC	0	0	
13.b	Promote mechanisms for raising capacity for effective climate change-related planning and management in least developed countries and small island developing States, including focusing on women, youth and local and marginalized communities	1	1	(A) Target inclusive of promoting mechanisms in mining sector to increase capacity for effective climate change-related planning, (B) Evidence of research in mining sector or developing countries to understand climate risks and plan for them.	1	1	(1) Adapting to Climate Change: A Guide for the Mining Industry (Business for Social Responsibility, 2011)
Goal 14. Conserve and sustainably use the oceans, seas and marine resources for sustainable development							

14.1	By 2025, prevent and significantly reduce marine pollution of all kinds, in particular from land-based activities, including marine debris and nutrient pollution	1	1	1	(A) Target calls for pollution related outcomes in mining context, (B) There is a synergy with this target as certain regulations to protect the marine ecoyststem from pollution have positive results, Current mining operations entail a trade-off with this target as they pollute marine areas.	0	1	1	(1) International Assessment of Marine and Riverine Disposal of Mine Tailings (United Nations Environment Program, 2013) (2) Toro, P. P. V., et al. Impact of terrestrial mining and intensive agriculture in pollution of estuarine surface sediments: Spatial distribution of trace metals in theGulf of Urabá, Colombia, Marine Pollution Bulletin 111, 311- 320 (2016)
14.2	By 2020, sustainably manage and protect marine and coastal ecosystems to avoid significant adverse impacts, including by strengthening their resilience, and take action for their restoration in order to achieve healthy and productive oceans	1	1		(A) Target calls for ecosystem related outcomes in mining context, (B) A synergy exists becuase new mining operations are taking into consideration marine ecosystems in their planned operations	0	1	1	(1) Ellis, J. I. Environmental management frameworks for offshore mining: the New Zealand approach, Marine Policy 84, 178-192 (2017)
14.3	Minimize and address the impacts of ocean acidification, including through enhanced scientific cooperation at all levels					0	0	0	

14.4	By 2020, effectively regulate harvesting and end overfishing, illegal, unreported and unregulated fishing and destructive fishing practices and implement science-based management plans, in order to restore fish stocks in the shortest time feasible, at least to levels that can produce maximum sustainable yield as determined by their biological characteristics			0	0	0	
14.5	By 2020, conserve at least 10 per cent of coastal and marine areas, consistent with national and international law and based on the best available scientific information	1	1	(A) Target calls for conservation of costal and marine areas consistent with mining context, (B) spatial trade-offs with coastal and offshore mining	0	1	1
14.6	By 2020, prohibit certain forms of fisheries subsidies which contribute to overcapacity and overfishing, eliminate subsidies that contribute to illegal, unreported and unregulated fishing and refrain from introducing new such subsidies, recognizing that appropriate and effective special and differential treatment for developing and least developed countries should be an integral part of the World Trade Organization fisheries subsidies negotiation				0	0	0

14.7	By 2030, increase the economic benefits to Small Island developing States and least developed countries from the sustainable use of marine resources, including through sustainable management of fisheries, aquaculture and tourism	1	1	1	(A) Target calls for changes in marine resources governance, inclusive of mineral resources, (B) There exists a synergy as ex-mining spots can be transformed into protected areas for aquaculture, there is a trade-off as mining sites can compete with resources that affect fisheries and aquaculture	0	0	1	(1) Kodir, A., Hartono, D., Haeruman, H., & Mansur, I. Integrated post mining landscape for sustainable land use: A case study in South Sumatera, Indonesia, Sustainable Environmental Research 27, 203-213 (2017)
14.a	Increase scientific knowledge, develop research capacity and transfer marine technology, taking into account the Intergovernmental Oceanographic Commission Criteria and Guidelines on the Transfer of Marine Technology, in order to improve ocean health and to enhance the contribution of marine biodiversity to the development of developing countries, in particular small island developing States and least developed countries	1	1	i	(A) Target calls for increasing scientific knowledge about marine technology and ocean health consistent with the mining sector in marine areas, (B) A synergy exists as new technologies are making it possible to reduce waste in marine mining which contributes to ocean health.	0	1	1	(1) Ellis, J. I. Environmental management frameworks for offshore mining: the New Zealand approach, Marine Policy 84, 178-192 (2017)
14.b	Provide access for small-scale artisanal fishers to marine resources and markets					0	0	0	

14.c	Enhance the conservation and sustainable use of oceans and their resources by implementing international law as reflected in UNCLOS, which provides the legal framework for the conservation and sustainable use of oceans and their resources, as recalled in paragraph 158 of The Future We Want	1	1		(A) Target calls for conservation and sustainable use of oceans and their resoruces consistent with mining industry, (B) There is a synergy with this target and international groups are working to regulate undersea mining, which would affect the sustainable use of oceans.	0	1	1	(1) Lodge, M. Ocean Mining Industry Promotion Round Table: Activities of the International Seabed Authority (2017) https://www.isa.org.jm/sites/default/files/documents/EN/SG-Stats/oceanmining15mar.pdf
Goal 15. Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss									
15.1	By 2020, ensure the conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services, in particular forests, wetlands, mountains and drylands, in line with obligations under international agreements	1	1	1	(A) Target involves protection of the Earth's ecosystems, which the mining sector can influence, (B) A synergy exists as the revegetation of mining sites by companies after their use is finished can re-establish forest systems, a trade-off exists as 30 per cent of active mines are located in water-stressed areas	0	1	1	(1) Good Practice Guidance for Mining and Biodiversity (International Council on Mining and Metals, 2006), (2) Trends in Sustainable Development: Chemicals, mining, transport, and waste management (United Nations, 2010)
15.2	By 2020, promote the implementation of sustainable management of all types of forests, halt deforestation, restore degraded forests and substantially increase afforestation and reforestation globally	1	1	0	(A) Target inclusive of mining sector impact on forests, (B) There is a synergy because improving sustainable management of forests in the mining sector would lead to GDP improvements, along with improvements of the environment.	0	0	1	Ghana Country Environment Analysis (Environmentally and Socially Sustainable Development Department (AFTSD) Africa Region, 2006)

15.3	By 2030, combat desertification, restore degraded land and soil, including land affected by desertification, drought and floods, and strive to achieve a land degradation-neutral world	1	1	1	(A) Target inclusive of engaging the mining sector to combact desertification, (B) A synergy exists because the mine sector has the potential to be a large player in achieving land degradation neutrality, including reducing desertification, A trade-off also exists because the mining sector contributes to land degradation.	=		1	(1) Quatrini, S., Barkemeyer, R. & Stringer, L. Involving the Mining Sector in Achieving Land Degradation Neutrality, The Solutions Journal 7, 55-63 (2016), (2) Ghana Country Environment Analysis (Environmentally and Socially Sustainable Development Department (AFTSD) Africa Region, 2006)
15.4	By 2030, ensure the conservation of mountain ecosystems, including their biodiversity, in order to enhance their capacity to provide benefits that are essential for sustainable development	1		1	(A) Target inclusive of mining sector impact on mountain ecosystems, (B) Mining sector can put dangerous pressure on mountain ecosystems, which is a trade-off.	0	0	1	(1) Why Invest in Sustainable Mountain Development (Food and Agriculture Organization, 2011)
15.5	Take urgent and significant action to reduce the degradation of natural habitats, halt the loss of biodiversity and, by 2020, protect and prevent the extinction of threatened species	1	1	1	(A) Target inclusive of reducing the impact of the mining sector on natural habitats and biodiversity, (B) A synergy exists because the mine sector has the potential to be a large player in reducing the degradation of natural habitats and biodiversity loss, There exists a trade-off as mining is a primary cause of land use change and habitat loss which reduces biodiversity	0	0	1	(1) Quatrini, S., Barkemeyer, R. & Stringer, L. Involving the Mining Sector in Achieving Land Degradation Neutrality, The Solutions Journal 7, 55-63 (2016), (2) Sustainable and Responsible Mining in Africa - A Getting Started Guide (International Finance Corporation, 2014)

15.6	Promote fair and equitable sharing of the benefits arising from the utilization of genetic resources and promote appropriate access to such resources, as internationally agreed				0	0	0		
15.7	Take urgent action to end poaching and trafficking of protected species of flora and fauna and address both demand and supply of illegal wildlife products						0		
15.8	By 2020, introduce measures to prevent the introduction and significantly reduce the impact of invasive alien species on land and water ecosystems and control or eradicate the priority species	1	1	1	(A) Target inclusive of the mining sector and its impacts on species, (B) A synergy exists because mines can take an active role in monitoring the introduction of alien species, A trade-off exists because during the construction of mine facilities and access roads, alien species can be introduced into the ecosystem.	0	0	1	(1) Good Practice Guidance for Mining and Biodiversity (International Council on Mining and Metals, 2006)
15.9	By 2020, integrate ecosystem and biodiversity values into national and local planning, development processes, poverty reduction strategies and accounts	1			(A) Target inclusive of having the mining sector involved with national and local planning to improve integration of ecosystem and biodiversity values.	0	1	1	

15.a	Mobilize and significantly increase financial resources from all sources to conserve and sustainably use biodiversity and ecosystems	1	1	(A) Target is inclusive of mobilizing financial resources associated with the mining sector to conserve biodiversity and ecosystems, (B) Synergy exists because stakeholders can contribute financially to the conservation of ecosystems at the community level.	0	0	1	(1) Good Practice Guidance for Mining and Biodiversity (International Council on Mining and Metals, 2006)
15.b	Mobilize significant resources from all sources and at all levels to finance sustainable forest management and provide adequate incentives to developing countries to advance such management, including for conservation and reforestation	1	1	(A) Target is inclusive of mobilizing resources associated with the mining sector to finance sustianable forest management, (B) A synergy exists as there is awareness about mobilizing resources to protect forests that is inclusive of the mining sector.		0	1	(1) United Nations strategic plan for forests, 2017-2030 (United Nations, 2017)
15.c	Enhance global support for efforts to combat poaching and trafficking of protected species, including by increasing the capacity of local communities to pursue sustainable livelihood opportunities	0			0	0	0	

Goal 16. Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels

16.1	Significantly reduce all forms of violence and related death rates everywhere	1	1	1	(A) Target related to improving conflicts arising from the mining sector, (B) There is a trade-off, as it is found that countries with abundant mining resources have a higher risk for conflict, and also that the conflict - if started - is prolonged by access to mineral resources. An additional trade off is that women face disproportional violence in the mining sector than men. A synergy is that current organizations are involved in research and strategies to reduce violence against women in the mining sector.	1	0	1	(1) Bannon, I. & Collier, P. Natural Resources and Violent Conflict: options and actions (World Bank Group, 2003), (2) Women's Economic Empowerment inSub-Saharan Africa: Recommendations for the Mining Sector (Business for Social Responsibility, 2017)
16.2	End abuse, exploitation, trafficking and all forms of violence against and torture of children	1	0	1	(A) Target related to improving labour conditions in the mining sector (B) Trade-offs exist as there is an abudance of evidence of trafficking in the mining sector, notably surrounding the sex work of girls that is associated with mining communities.	1	0	0	(1) Steele, S. Human Trafficking, Labor Brokering, and Mining in Southern Africa: Responding to a Decentralized and Hidden Public Health Disaster, International Journal of Health Services 43, 2013
16.3	Promote the rule of law at the national and international levels and ensure equal access to justice for all	1			(A) Target inclusive of improving mining laws at national and international levels.	1	0	1	

16.4	By 2030, significantly reduce illicit financial and arms flows, strengthen the recovery and return of stolen assets and combat all forms of organized crime	1		1	(A) Target relevant to current state of IFFs and reduction of IFFs, (B) There is a trade-off as the mining sector in developing countries is often affected by IFFs that unlawfully shift resources from developing countries to developed countries	1	0	0	(1) Blankenburg, S. & Khan, M. Governance and illicit flows. in P. Reuter (ed.), Drainingdevelopment? Controlling flows of illicit funds from developing countries, WorldBank: Washington DC. (2012) (2) Herkenrath, M. Illicit Financial Flows and their Developmental Impacts: An Overview. International Development Policy [Online] 5 (2014)
16.5	Substantially reduce corruption and bribery in all their forms	1	1		(A) Target inclusive of improving transparency in the mining sector, (B) There are international efforts made to study why corruption happens in the mining sector, and efforts to improve this corruption, which is a synergy.	1	1	0	(1) L, Caripis. Combatting corruption in mining approvals: assessing the risks in 18 resource-rich countries (Transparency International, 2017)
16.6	Develop effective, accountable and transparent institutions at all levels	1	1	1	(A) Target inclusive of improving institutions involved with the mining sector, (B) Evidence of strong institutions that support the mining sector in developing countries, which is a synergy; A trade-off exists because commodity price shocks that impact mining dependent countries can weaken state institutions.	1	1	0	(1) Botswana Mining Investment and Governance Review (World Bank Group, 2016), (2) Zambia Mining Investment and Governance Review (World Bank Group, 2016), (3) Bannon, I. & Collier, P. Natural Resources and Violent Conflict: options and actions (World Bank Group, 2003)

16.7	Ensure responsive, inclusive, participatory and representative decision-making at all levels	1	1	1	(A) Target inclusive of ensuring decision-making at different levels revelant to mining sector governance, (B) Synergy exists as a new relationship is beginning to emerge where mining companies and governments realize that the communities need to have a larger role in decision-making processes, A trade-off exists because currently local communities often do not get to participate in the decision-making concerning the mining sector.	0	1	0	(1) Starke, L. Breaking New Ground: Mining, minerals, and sustainable development (International Institute for Environment and Development, 2002), (2) COMMUNITYCONSENT INDEX 2015 (Oxfam, 2015)
16.8	Broaden and strengthen the participation of developing countries in the institutions of global governance	1			(A) Target is inclusive of engaging more developing countries in the institutions of global governance concerning the mining sector.	0	1	0	
16.9	By 2030, provide legal identity for all, including birth registration					0	0	0	

16.1	Ensure public access to information and protect fundamental freedoms, in accordance with national legislation and international agreements	1	1	1	(A) Target inclusive of improving public access to information on mining laws and mining governance, (B) A synergy exists as there is awareness and initative to increase public access to information concerning the mining sector, also there is an effort of some countries (i.e. South Africa) to increase the availablility of public access to information, A trade-off exists as governments of countries attempt to filter access to information.	1	0	0	(1) Treasure or Trouble? Mining in Developing Countries, (2) Adeleke, O. & Humby, T. L. The Promotion of Access to Information Act and Mining-Related Discosure Practices in the Public and Private Sectors (The Open Society Foundation for South Africa, 2016)
16.a	Strengthen relevant national institutions, including through international cooperation, for building capacity at all levels, in particular in developing countries, to prevent violence and combat terrorism and crime	1	1		(A) Target inclusive of strengthening institutions of the mining sector or related to the mining sector, (B) There is a synergy as international organizations understand the need to participate in strengthening national institutions in mining focused developing countries.	1	0	0	(1) Role of mining in national economies (International Council on Mining and Metals, 2016)
16.b	Promote and enforce non-discriminatory laws and policies for sustainable development	1			(A) Target inclusive of improving mining laws.	1	0	0	

Goal 17. Strengthen the means of implementation and revitalize the global parthership for sustainable development

17.1	Strengthen domestic resource mobilization, including through international support to developing countries, to improve domestic capacity for tax and other revenue collection	1	1	1	(A) Target calls for improvements in tax collection in developing countries, with international support. (B) Improving resource governance and blocking Illicit Financial Flows (IFFs) in the mining sector will improve the ability to collect taxes from mining profits in developing countries, which acts as a synergy; IFFS in the mining sector from developing countries to developed countires weaken the ability of developing countries to collect taxes from their mineral resources, this is a trade-off	0	1	0	(1) Blankenburg, S. & Khan, M. Governance and illicit flows. in P. Reuter (ed.), Drainingdevelopment? Controlling flows of illicit funds from developing countries, WorldBank: Washington DC. (2012) (2) Herkenrath, M. Illicit Financial Flows and their Developmental Impacts: An Overview. International Development Policy [Online] 5 (2014)
17.2	Developed countries to implement fully their official development assistance commitments, including the commitment by many developed countries to achieve the target of 0.7 per cent of ODA/GNI to developing countries and 0.15 to 0.20 per cent of ODA/GNI to least developed countries; ODA providers are encouraged to consider setting a target to provide at least 0.20 per cent of ODA/GNI to least developed countries						0	0	

17.3	Mobilize additional financial resources for developing countries from multiple sources	1	1	1	(A) Target calls for mobilization of resources for developing countries, which could be applied in the mining sector, (B) The mining sector developing countries is often the target of FDI, which acts as a synergy; FDI into developing countries for the mining sector is highly susceptible to economic crises, which can act as a trade-off as the FDI may be dependent on stable global economic conditions		1	0	(1) World Investment Report - Global Value Chains: Investment and Trade for Development (UNCTAD, 2013)
17.4	Assist developing countries in attaining long-term debt sustainability through coordinated policies aimed at fostering debt financing, debt relief and debt restructuring, as appropriate, and address the external debt of highly indebted poor countries to reduce debt distress	1			(A) Target inclusive of mining sector and companies role in debt in developing countries where they operate	0	1	0	
17.5	Adopt and implement investment promotion regimes for least developed countries	1	1		(A) Target inclusive of mining sector investment, (B) There is a synergy as the mining sector draws in FDI, which increases investment	0	1	0	(1) Strengthening Investment Promotion Regimes for Foreign Direct Investment in the Least Developed Countries (United Nations, 2015)

17.6	Enhance North-South, South-South and triangular regional and international cooperation on and access to science, technology and innovation and enhance knowledge sharing on mutually agreed terms, including through improved coordination among existing mechanisms, in particular at the United Nations level, and through a global technology facilitation mechanism	1	1	(A) Target calls for international cooperation on access to innovation, which can be implemented in the mining sector, (B) There is a synergy as FDI can act as a conduit from one country to another to transfer technology and knowledge on mining	0	1	0	(1) Strengthening Investment Promotion Regimes for Foreign Direct Investment in the Least Developed Countries (United Nations, 2015)
17.7	Promote the development, transfer, dissemination and diffusion of environmentally sound technologies to developing countries on favourable terms, including on concessional and preferential terms, as mutually agreed	1	1	(A) Target involves environmentally sound technologies, which could be used in the mining industry, (B) There is a synergy as there is evidence that environmentally sound technologies concerning mining are transfered to developing countries	0	1	0	(1) Transfer of environmentally sound technologies: The GEF experience (World Bank Group, 2008)
17.8	Fully operationalize the technology bank and science, technology and innovation capacity-building mechanism for least developed countries by 2017 and enhance the use of enabling technology, in particular information and communications technology	0			0	0	0	

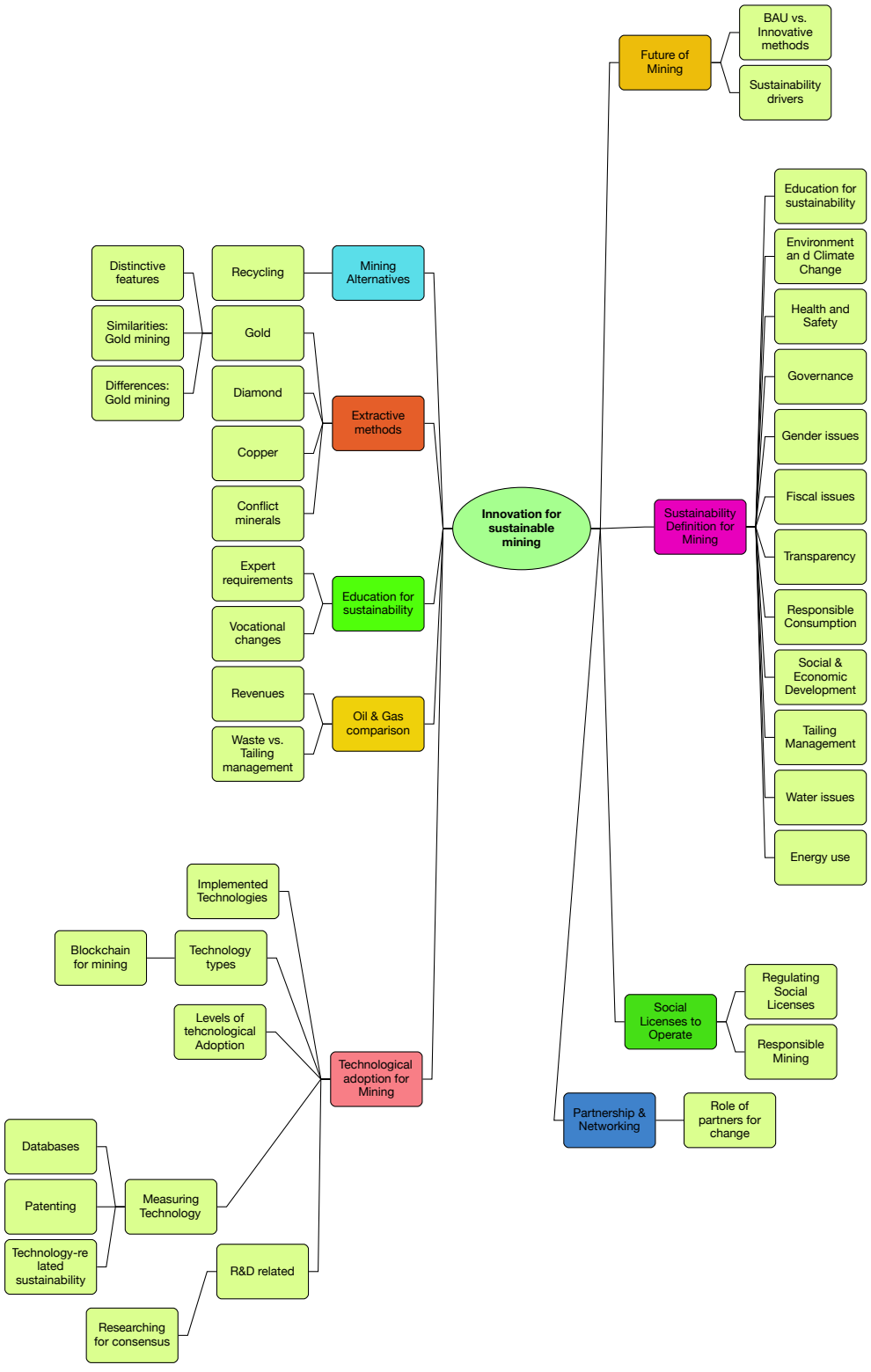
17.9	Enhance international support for implementing effective and targeted capacity-building in developing countries to support national plans to implement all the sustainable development goals, including through North-South, South-South and triangular cooperation	1	1	(A) Target inclusive of capacity building and collaboration relating to mining sector. (B) Efforts of international organizations to improve capacity of developing countries to support the mining sector is a synergy with target	0	1	0	(1) Mauritania - Mining Sector Capacity Building Project (World Bank, 2005)
17.1	Promote a universal, rules-based, open, non-discriminatory and equitable multilateral trading system under the World Trade Organization, including through the conclusion of negotiations under its Doha Development Agenda	1		(A) Target inclusive of trade-related actions concerning mining sector.		1	0	
17.11	Significantly increase the exports of developing countries, in particular with a view to doubling the least developed countries' share of global exports by 2020	1	1	(A) Target inclusive of increasing the exports of minerals from developing countries, (B) Trade-off due to mining exports being highly elastic with world prices of the mineral. Decreasing commodities prices can decrease exports from developing countries.	0	1	0	(1) World Trade Statistical Review (World Trade Organization, 2016)

17.12	Realize timely implementation of duty-free and quota-free market access on a lasting basis for all least developed countries, consistent with World Trade Organization decisions, including by ensuring that preferential rules of origin applicable to imports from least developed countries are transparent and simple, and contribute to facilitating market access	1		(A) Target inclusive of trade-related actions concerning the mining sector.	0	1	0
17.13	Enhance global macroeconomic stability, including through policy coordination and policy coherence	1	1	(A) Target inclusive of macroeconomic policy that incorporates the mining sector, (B) There is a trade-off because the commodity industry of a country, inclusive of volatile prices, can affect the macro-economic stability of a country, there is a synergy because policy coordination concerning the extractive sector can help with macro-economic stability	0	1	0 (1) Excessive commodity price volatility: Macroeconomic effects on growth and policy options (UNCTAD, 2012)

17.14	Enhance policy coherence for sustainable development	1	1	(A) Target inclusive of enhancing policy coherence of mining for sustainable development, (B) OECD promotes responsible investment in conflict and fragile states through the Due Diligence Guidance for Responsible Supply Chains of Minerals. This fosters the integration of sustainable management of natural resources, particularly minerals, into core corporate strategies through enhanced due diligence procedures, which acts as a synergy.		1		(1) Policy coherence for inclusive and sustainable development (OECD) https://www.oecd.org/dac/POST-2015%20PCD.pdf
17.15	Respect each country's policy space and leadership to establish and implement policies for poverty eradication and sustainable development	1		(A) Target inclusive of policy space in the mining sector, target stipulates respect for national policy relevant to the mining sector.	0	1	0	
17.16	Enhance the global partnership for sustainable development, complemented by multi-stakeholder partnerships that mobilize and share knowledge, expertise, technology and financial resources, to support the achievement of the sustainable development goals in all countries, in particular developing countries	1	1	(A) Target inclusive of the mining industry promoting sustainable develolpment in a multistakeholder fashion, (B) There is a synergy as the global partnership for sustainable development includes the mining sector, where the mining sector can contribute to achieving the SDGs	0	1	0	(1) Sustainable Development in Mining Activities (UN, N.D.), https://sustainabledevelopment.un.org/partnership/?p=1636

17.17	Encourage and promote effective public, public-private and civil society partnerships, building on the experience and resourcing strategies of partnerships	1	1	(A) Target inclusive to partnerships within the mining sector. (B) Innovative programs help mining sector engage with civil society organizations, which is a synergy.	0	1	0	(1) MinGov Factsheet (World Bank Group) http://pubdocs.worldbank.org/en/820281467130610343/MInGov-Factsheet-160827-clean.pdf
17.18	By 2020, enhance capacity-building support to developing countries, including for least developed countries and small island developing States, to increase significantly the availability of high-quality, timely and reliable data disaggregated by income, gender, age, race, ethnicity, migratory status, disability, geographic location and other characteristics relevant in national contexts	1	1	(A) Target inclusive of capacity-building activities relating to the mining sector, (B) Synergy as programs are being developed and executed that increase the amount and quality of data on the mining sector in developing countries (not yet disaggregated in this case).	0	1	0	(1) The mining investment and governance review (MInGov) - Methodology (World Bank Group, 2016)
17.19	By 2030, build on existing initiatives to develop measurements of progress on sustainable development that complement gross domestic product, and support statistical capacity-building in developing countries	1		(A) Target inclusive of existing initatives to develop the mining sector in a sustainable way.		1		
	Count	**146**	**111**	**51**	**66**	**108**	**46**	

A.2 Literature Review sheet



A.3 Interview Transcripts Codebook (Software: NVivo v. 12)

Name	Files	References
Future of mining	1	5
Future of mining\BAU vs. innovative ways	1	1
Future of mining\Drivers of future of mining	1	1
Mining alterntives	0	0
Mining alterntives\recycling	1	4
Mining extraction methods distinctions	2	3
Mining extraction methods distinctions\Differences Gold mining	1	12
Mining extraction methods distinctions\Distinction Diamond mining	1	4
Mining extraction methods distinctions\Distinction Diamond mining\Diamond luxury and pricing	1	2
Mining extraction methods distinctions\Distinction Diamond mining\Diamond trading	0	0
Mining extraction methods distinctions\Other mining methods distinctions	1	1
Mining extraction methods distinctions\Similarities Gold mining	1	3
Mining sustainability	4	8
Mining sustainability\definition of mining sustainability	2	4
Mining sustainability\Education for sustainability	1	1
Mining sustainability\Environment and climate change	1	1
Mining sustainability\Fiscal issues	2	6
Mining sustainability\Gender issues	0	0
Mining sustainability\Governance	1	4
Mining sustainability\health & safety	2	3
Mining sustainability\Importance of transparency	1	1
Mining sustainability\Main sustainability issues	0	0
Mining sustainability\Responsible consumption or awareness	1	1
Mining sustainability\social & economic development	1	4
Mining sustainability\Social licenses	1	1
Mining sustainability\Social licenses\Regulation social licenses	1	1
Mining sustainability\Social licenses\Responsible mining	1	1
Mining sustainability\Transparency issues	1	1
Mining sustainability barriers	2	10
Mining sustainability barriers\Energy use	2	6
Mining sustainability barriers\Social licenses	0	0
Mining sustainability barriers\Tailing management	0	0
Mining sustainability barriers\water	1	3
Mining unsustainable legacy	1	1
Mining vs. Oil & Gas industry	1	3
Mining vs. Oil & Gas industry\revenues Oil & Gas vs. Mining	1	8

Mining vs. Oil & Gas industry\Waste and tailing comparison	1	3
Partnership & networking	3	11
Partnership & networking\Role of partners in the change of business	1	4
Snowball info_doca and persons to contact	1	3
Snowball info_doca and persons to contact\Docs	0	0
Snowball info_doca and persons to contact\persons	1	1
Technological adoption for mining	4	5
Technological adoption for mining\Adopted technologies	1	1
Technological adoption for mining\Blockchain for mining	1	1
Technological adoption for mining\Different levels of technological adoption	1	1
Technological adoption for mining\Measuring technological adoption	2	3
Technological adoption for mining\Measuring technological adoption\Databases	2	2
Technological adoption for mining\Measuring technological adoption\Patenting	1	1
Technological adoption for mining\Measuring technological adoption\Technology-related sustainability improvement	0	0
Technological adoption for mining\R&D related	4	5
Technological adoption for mining\Reaching to consensus	1	1
Technological adoption for mining\Technology types	2	2

A.4 Words frequency query could Stop words- (Software: NVivo 12)

A.5 Interview Transcripts

1. Interviewee: Prof Anna Korre- 8 April 2019 at 17:40, Imperial College London, London

Prof. Anna Korre

Q-The main sustainability challenges?

A-I think probably the most significant challenges are energy and water. Energy in the minerals

commodities and water is quite critical in the regions when there is a competing requirement for water, consumption, and especially fuels. So, where they use energy is the most important, along with water in today's world.

Q-In the Gold case, do you see it as important as possible?

A-I think that it is not so much something specific to commodities, but o the conditions that the operations are in the geographic regions and energy and water resources to mineral operations. If there are no water issues in the region, it wouldn't be a problem. But if there are issues, then the water is going to be a problem.

Q-The process is happening with relatively small water.

A-I think primary energy source might be restrictions, but we are getting to a point that energy is something very weld correlated with development. So, if you want to talk to somebody about sustainability, you would talk about the sustainable development goals, and you would see that water and energy is very important in the development agenda quite a bit lower down the agenda. But over the other issues that have more important social dimensions, we are looking at other sources too as a priority is sustainable development goals, and as time goes by, as human, we need more energy. We need wire in our processes, that energy becomes more critical. The restrictions and more renewable energy with minerals and sustainability is very important.

Q-In today, do you see any technological breakthrough in mining?

A-I think automation and communication are the two most important issues. I think automation because we have vehicles that are performing autonomously. Not only about the transportation, but also on the human-based facilities. Now, they are more censors around mines, and I think now there is more opportunity to seek for data around time to improve efficiency in mining and also reduce waste for environmental impacts that it is actually the revolution that is happening.

Q-Tailing comparable across different types of mining. Various mining references are different between them. For gold, how can you generalize it between mining?

A-Mining operations, especially in our days, there is the opportunity to use and produce the material, which means the waste that is generated should be managed. But the types of tailing produced from different types of mining is very different. For example, the tailing produces from mining and Kimberlite is very different. It doesn't have the acid mines and hazardous and Sulfite and mineral processing in facilities. It is common but we have to handle large material, but it is large mines. You can't take something is gold, as it is different in different phases.

I think that waste management in quite a lot and better understanding from potentially devastating consequences.

I think the facilities can be monitored better and now it can be done. There is an additional element of climate change that in the past it couldn't be predicted that the climate change will

be such and there would be extreme climate effect that can greatly affect the mining situation. So, there is a little bit of changing methods and improving the large parts of mass and amount of grounds. In open-pit mines, we have as well the problem with rehabilitation and restoration. People are thinking that we should use fewer and fewer facilities which are underwater, which are also the highest risk of environmental effects. So, instead of having wet tailing, we can have tailing that is drier. They are opportunities that, with monitoring and new technologies, we have opportunities to manage our practices and also send these practices to different parts of the world. There was a big accident in Spain, and also in Brazil. But then we also have some aluminum production waste tailing in recent years. So, that is a new challenge, and where technology can happen. And data collection processing.

Q-Looking at different approaches for efficient tailing management?

Communicating and talking with experts:

A-If you look at the historical phase, it should be in the public domain. I think the company was Knight Pistholes, CRT minerals, these people, they actually work quite a lot in tailings (people to talk to). Gold associates London stay. Emec. Chris Broadband in World Eramstan. They work a lot on sustainability but quality as well.

The reaction of the mining industry to the new technology? In the sense that when a new technology comes, what are the reactions of mining companies?

If it makes money, everybody is ready to adopt it, no problem. If anything makes the process more efficient, and to improve, especially the big mining companies will be ready to adopt it. Also, the smaller mining companies in different parts of the world are putting the sticks together. So, the smaller mining companies, the more place practices. But, of course, it depends on which part of the world they operate. In general, I wouldn't say that they are resistant to change. Anything that has to do with core business that has to do with efficiency would make them want to adopt the change. But if it is costly, and they are not requirements, but they are good to do, I wouldn't say that they are particularly very flexible. And this is because the mining business in itself is very site-specific, which is where we started when discussing. It becomes gold and local conditions being imported, and you should imagine the local conditions. And because of these issues, i.e. the local conditions being important, something may be applicable, they might not be applicable in the setting or needs to be proven. So, it is not flexible to try when it is not proven. They are quite risk-averse, especially for the things that they are not essential. Because if a thing is not essential, they won't do it. Or, let's say, something is going to happen in a community relation. They would do things like building schools or dams for the salary. They do things because of the community and if it is essential for social licensing to operate. But if it is something that is nice to do but not essential, but it costs, it wouldn't be done.

So, the pressure on them is a big thing?

The big companies, this being green is a big issue with the community and the NGOs. So, they

cannot be seen doing things form large corporations. So, it can be something seen as bad people's national companies. They see mining cooperation national mining house.

In Chile, there is a big mining company called Codelco which is run by the state, called Equinore which is the gas asset in a Norwegian asset, lead operates in an international company, but the majority of the stakeholders are states There are other companies in the mining business, which are Alngolo American, etc. When there is a big company called Codelco, they can practice by the rule.s By the small company called Codelco, they can play by the rules. Only if some terrible happens, you discover that things are not going well. The question is that where things didn't get solved earlier? Like Anglo American?

Q-What do you see as enhanvi9ng these requirements for all transparency? It puts a lot of companies under pressure?

It is quite essential to make sure that everything is good?

A-The practice should be used with a credential that has modern values in a sustainable way which is cheaper, it has a market advantage

Iof the gold has a good value in the market place, it is a lot.

Q-New types of technologies used?

A-It might happen in individual commodities. It is called blood diamonds. Natural, standard, and then blood diamond, they cannot be marketed at the same place. If similar way to credit the good operators with some market values is available, it will be a lot of pressure to act in environmental practices.

Q-Do you see this blockchain technology that is transforming other industries, so you see them as important?

A-Yes, they are important, and they have to use them and use the economy of scale. The small operators have to be squeezed part of the market and generate big volumes, If these technologies have to be taken out, the business does not anymore operate your mines, in the same way, that energy transforming the moment, but unless it is not possible to change, it is basically valueless, they will be out of the picture, the same story for the mineral commodities. Someone produces copper, 20 years ago, they sell copper anyway in Congo. But now, they cannot sell such type of Copper to the BWM, for instance. It is now very important for them (public awareness very important). So, they have to perform certain standard to reach the value chain. I have discussed it with people in senior places. I have discussed people in senior places, and they see it will happen.

Q-So, it does make sense.

A-Yes, and no, they realize that it is coming to them (they see the important).

Q-The other two points: the regulation and vocational skills?

A-Regulations, absolutely, very important. It is international. So, the people are not allowed to do not only with their government but complying with the international standards. Another point, I don't think that people who do the job, it is not the lack of skills.

I think in general, automation and industrialization are changing the nature of society. In the same sense that it is changing nature.

The automation and control processes are advancing. It is very artisanal by nature, but it is not going to put many people out of their jobs. For example, there will be a lot of people losing their job if coal mining disappear.

Q-Do you think that mining is diminishing (the diminishing of the mining industry)?

A-Yes, absolutely, I think in 20-25-year tome there won't be any coal mining in Europe. At the moment, here in the UK, they aren't any coal mines. There is a license given for a coal mine under the North Sea, but I don't think that is going to occur. But in Europe, there is a little bit left in Spain, which is going to be ripped apart. And then there are parts in Poland, and the reason that they are not wiped out is that many people will lose their jobs. So, a lot of people will be out for business and be able to live a life. But in Germany and the UK, things have changed. There is the way of today/s business, and we cannot change. It. And although the way to do it is science-specific, there isn't the case that in all automation can be made. How much can you automate? It some extent, to some automated, you may reduce the workforce, but I'm sure people may be able to learn and acquire.

For the next generation of mining, maybe this can get adjusted?

Yes, they still might be learning sources. The population in Climate is increasing, which means the resource is going to get extracted. I think it actually can increase.

Q. Cycling:

When the Olympic games were supposed to happen in London, there were lots of infrastructures needed to be built, so there was an increased need to mine the material. The UK has a unit called Waste and Resource Action Plan, or WRAP. You can look them up. And these, people actually wanted to prove that using the recycled material to build such a thing is more environment-friendly than using the primary material. They invite everybody, and they did the job with the consultant. They were so disappointed than recycling is much less environmental-friendly than the aggregates. Recycled aluminum and material in the chemistry. God has acted with the sorted material, and we want to dig it up and make a lot of money, How much energy is it going to take? How much variability? It is going to be very better than the primary material. It is also possible that is is going to be much more energy-efficient. It is also because of the economy of scale. It is sorted naturally over millions of years. This is why we can take and take the money out of it. The resources are everywhere. They all have useful material. But extracting all may not

be environmental-friendly. The only people who have succeeded in doing something is primary material. Those are very extensive or very rare, so you cannot get them. Because I think that Chinese someday won't sell us more Cobalts or rare earths, and the price sparked. Then, they open a market, and the prices get down, not for environmental reasons, but for the security of the material, that mother nature is losing them all in advance.

Q-My other question was that many people in different positions, I concluded that they see mining lagging behind and losing technology.

A-It is because of a lack of overseeing the whole process. They see the mines fault because of the pollution, not the users which increases the requirement for the raw material, while it still has a useful life because it means that the new resource has to be extracted in order to produce, and we cannot blame them, but we can blame the mining! But the cycle has the industry towards 75 percent of the footprint. If there is anything in the whole value-chain effect. We have ha big local effect, and the responsibility is not ours, and that they are dinosaurs! You are in the loose phase, change the rules. And it is not possible to sell it. The money from coal should be a lot more expensive, so they are ways, But the problem between the quality between advanced and coal nations. You cannot sell American and Canadian practices. So, again locally depended. When you make their product more expensieve, you say yo hame to make them better. SO, you were good enough to make it. And in a good state of societal cohesion, and your people are rich, and now you ask us to be green? (so, being green only comes after the necessities of having enough jobs). Other options are acting not so environmentally friendly. To see how they transform? If their pipelines are very keen, it is to see products and to see and bring the money to feed people and make medicines. All these things have to be seen in a wider context. Unfortunately, we cannot solve all the problems of the world ourselves.

So, what my job is, is to more things little things better with the industry and I can say that it is not because they don't want to be progressive and to be dinosaurs because it is going to be expensive and there is need to be expensive to do things another way. And not that they are not evil people. They didn't want, for example, in Brazil, to kill people there. But it happened. They might have been some negligence or being responsible, but not in purpose.

the role of academics and R&D to help change them sustainable? Easy and Cheap. This is where these happen.

Q-Do you see them investing? It seems they have collaborations with RSM?

A-With companies that I have collaboration with, I see that they are interested in it. They want to make changes. The thing is they ask, can they make it easy and cheap? Finding solutions and we make something and make the new process and help them financially and the environment at the same time.

Q-These are big mining companies, and they are aware and try to invest. But what about the second-tier? Or artisanal mining.

A-I think it is important for the academic community to reach them. But they will not reach them. But making it easy for them and see how it can be done. Because it costs a lot to learn, and these companies can make it. If you have to make it a couple of margins. I think there is no doubt among them about the nature of the problem. But the solution is technical, but you have to think about international laws and negotiations at different levels, so you need things to stuck. Look at the Paris conventions.

Oil & gas industry:

Mining is more international. Because of the local character of the operations. Because there is not a lot of heterogeneity. In oiled & gas, we have vast resources and low impact. It is not that you have more funds and geographically footprints, and the oil & gas visibility is small in lands. Also, in Nigeria, South East Asia, North America, and their legacy, so, therefore, we are coming to the end of life, so it is very expensive to go off-shore. So everything happened in a very different low-margin business.

2. Interviewee: Dr. Julien Sikondari- 28 March 2019 at 15:15, Imperial College London, London

Q. About Imperial Corporate Finance:

A-The corporate partnership takes the opportunity of universities and corporate partnerships to get to use their mutual power (which is sort of open innovation), and Imperial gets to publish and teach; if not, it will be at the consultancy level. In these partnerships, the political consideration at the governance level is also important. The reason they come to Imperial is sometimes not to have a big R & D group.

Q. Their technological endeavors:

A-Looking at the technology and R& D groups, publications, and patents (to be looked on the Google), and their ecosystems and partners (because many of them wouldn't have an R & D separate entity) and show they want to go forward. Rio Tinto has an entity in the Royal School of Mines- and Earth Engineering, for doing their research (RTCAMP).

3. Interviewee: Dr. Luke Baleny- 20 March 2019 at 15:15, International Council for Mining and Metals, London

-About ICMM:

General notes about the ICMM:

-ICMM is an industry association. It has 27 mining companies and 36 mining associations with the national and commodity associations within it as members. The mining companies within it represent about a third of the global production of mining and metals. Big companies such as BhP, Glencore, Anglo-American Gold, and they are spread around the world. Unlike other industry associations, the sole porpoise of the ICMM is to improve the sustainability performance of its members. So, we don't do anything rather than assuring sustainability among our members. It does that also other associations, our board is chosen among the member companies. That is relatively unique among the company associations, it gives us great credibility externally when we are talking about issues because our entire workgroup team every year is signed up at the CEOs of mining industries. It also gives us great credibility within our member companies because they know that if the ICMM says something, it makes a policy commitment. They will know that it is signed up by their own CEOs.

Our salaries are paid for mining companies and have associations such as world banks, NGOs, UN. They see us and being able to bring different actors who otherwise wouldn't meet the mining companies. Such as OCTFSM, WWF. It is a way of meeting our member officials. One of the reasons that companies sign up to WWM is that when we do so, they know that ICMM would push them further to the mining issues, but we sign up because we do it with the mining companies, which is far-reaching progressive, they do these with other companies, and they are as one company than 27.

This is the ICMM in a nutshell. We have membership requirements, such as a general rule which we ask our members to sign up to, and these happen and what they have already found is that drivers improve safety, we have satellite driven by people sometimes hundreds of miles away with remote control. This has improved accidents but also trucks. Human is not the sole drivers, and these have driven human producers so smoother. Not cost measures but trucks for other mining companies for doing the same.

Q-What requirements do the ICMM have in terms of different aspects?

R-I think most mining companies would admit than mining doesn't have a good reputation, generally. And part of that is the view that the industry is kind of dirty and unsafe, and a big part of that is because of the mistakes that banks have made in the past. You just have to fly over Johannesburg to see the impact of mining o the ground of Johannesburg.

So, ICMM work generally around four main areas and environment. Things like: water stewardship, climate change, closure, environmental issues, social and economic development, which is the area I mostly work in, and health and safety issues, which is kind of increasing as a high priority at the moment. Then we are doing material stewardship, which is at the issues like life cycle, and transportation is sure to ensure basically everything that transfers intro products from out of the ground to where the consumer is. All is to make sure that the sustainability impact is possible.

SO, the ICMM work basically revolves around producing best practice for our members, but also because of the power of our membership, when we produce best practice, we also help to move the industry more generally in terms of progressive stands because if you have 27 of the world mining companies all moving at one direction, it also helps others who are doing that as well. And everything we do and produces from a product to the reports and guidance is all free to use for anyone on our website, generally. And part of that is due to the fact that it is dirty and unsafe, and a big part of that is also because it is of the historical performance of the mining companies. You can fly above South Africa and Johannesburg to see the scars in the landscape of South Africa from its historical mining practices. So, in some way, mining is a tough cell in terms of bringing the younger generations of graduates. What mining companies need to do to kind of make that cell, I guess, is that they haven't historically done a very good job of telling the work how high-tech mining is becoming. So, it is not kind of the guy with the big axe, and they can also say that one of the big things that has helped is that showing the improvement of robotics, etc. in the mining area. So, if you go to most mining companies, they are highly male-dominated. A large part of that is due to that image that they are working in an area highly underground, hot, nasty conditions, and very physical work, but when you take that out of the equation and reduce that, you increase the likelihood of women joining the workforce, you introduce more flexible working to people operating a drill from hundreds of miles away in terms of family like and so on. It makes it much easier to be working underground. So that is a big part of it.

In terms of actually upscaling, this is actually quite good. It is very difficult in developing countries. What a lot of countries are looking to do is providing scholarships and such things to students interested in stem subjects, and other than that, it is very difficult to. One other thing that the companies are increasingly doing is to bind with other companies and the government. Because mining companies cannot do things without the help of other mining companies and the government. It is mining companies have to find the line between these impacts because they cannot become charities. It is of self-interest when we talk about it for local communities to study engineering rivals because they want to get tapped to it in the future. Still, at the same time, minerals and metals are non-renewable, so every mine has a self- look and what they are trying to do is the overall goal of rules of sustainability for every company is to improve the local communities there and to make sure that when they are gone, these communities don't fall back to where they were before the mining came. It is very easy for the communities to totally rely economically on mine, and when the mine goes, the whole place will run into poverty. So, mining companies are increasingly looking into ways where they spread the future resources as much as possible, so to promote skills that are not mining-specific, so using electrical engineer into robotics, that is transferable skills that you should use mining industries, or for electricians, or when you have a small business, then the idea is that that business doesn't come completely rely on mines. SO, lots of the training programs are looking back to try on and to make sure it is not only mine-related skills that have been building.

What is the relationship between the role of governance institutions in the country that the mining is performing with the social licenses? For example, if the mining company is located it a

country which is corrupted, versus a more developed government, how do you see the difference in the barriers of these?

Poor governance makes basically everything more difficult from the mining company point of view, because if the institutions within the country aren't functioning in the way that they are supposed to, then there is a more increasing need for the mining companies find themselves they have to take more capacity for growth they should do. If they aren't any police or the police are corrupted, for instance, then the mining company probably has to spend all of the money on the security of the employers, workers, infrastructure. If the court system is not performing that they are supposed to, Also, if there is poor healthcare or sanitation, it would inevitably fall on the mining company to provide that for the community. Also, from a mining perspective, there is always inherently risky for the mining companies for that perspective. Almost like any other industry, mines are not transferable, so it goes anywhere that these minerals are to be found, and diggings holes are incredibly expensive. For a large-scale mine, it can take from 5 to 10 years before you get the chance to doing anything. It can also earn 10 years that you get back the money that you spend to construct the mine. So, before you get back any money, at any time during this time, the country can actually revoke your license to do business there! And so, from a mining company's perspective, you want predictable, stable laws, and predictable, stable governments, but also, predictable, stable governance, where the institutions within the country, do what they say they would do because you are taking this enormous risk. So, it is all, specifically from a tax point of view, you can invest billions of dollars, and on the basis that when you start making a profit, you are going to be taxed at a certain rate, and minerals and metals are non-renewable, so every mine has to make rules based on what is the sustainability programs today. You want the predictable, stable governance to say what they say they would do. Because for the taxes, if the government charges you three times more that it said it would, it would ruin all your business model. But then you invest the money, you will get nowhere to go.

The role of mining companies is to improve what is the local community there and make sure that when they are gone, there is no mining community to fall back to where they were before mining came. So, it is fairly easy for the community to become fully reliable on mining, and when it goes, the place falls into poverty. So, mining companies are looking at spreading the way as possible for skills is that are mining-specific, for electrical engineer into robotics, that is a transferable skill that when mining leaves, you should be able to use that potential of mining industries, and the lower level that you are at, for instance, if you are an electrician, the idea is that you don't rely only on mines. So, the training programs have to try and make sure that the industries are not heavily relying on mines solely.

The business model collapses, but then when you have invested the money for the miners' will, after the mining neds, you probably don't have anywhere else to go.

Q-About our talk about sustainability, does the ICMM keep any specific data for sustainability?

Q-Not officially. We do not benchmark our members without requiring such data. We might have a specific question, but that generally keeps between the ICMM, what member discloses

about their sustainable development improvements, is sort of up to them. It is not a requirement for their membership.

Q-Is there any internal way of assessing a member underperforming a sustainability requirement?

A-Everybody has their own matrix in terms of what an expectation of a mining company should be doing is. As long as you are meeting the minimum of what a mining company should be doing, it might as well be that someone says that we are doing a pretty good job on energy usage. Yes, they may be, but for instance, very old mine in South Africa that is very deep, requires better energy usage than mine in Chile that the surface is not going to get mined, so it is very difficult to compare and construct. There are entities out there that they work on these, and they sell their analyses to the investors, and they specialize in analyses in a company in their ability performance.

Q-So, you mean that the companies are too diverse to compare?

A-Yes, essentially. That is kind of a minimum way that if a mining company is producing X million tons of products every day, that is, as one would say, subjectively, a large amount of material to work on. But at the same time, it is difficult to compare across the industry. It is slightly controversial because there are so many things that play into that, so obviously a mine that is in the middle of nowhere, say, in the middle of the Chilean desert, where there are no local inhabitants, they are not going to have the same social issues about the mine site, as the mine that is in Peru next to somewhere, where there are indigenous people with the old lands and plains to the area that the companies are operating. It is very difficult to compare across.

Q. Do you see any difference in the sustainability terms based on the types of mines that they are mining?

A-It is a good question. I think one mineral that it is in the news currently is Cobalt. The world increasingly needs more Cobalt, because it is a big competitor for the battery of electric cars. Basically, I can't remember the number correctly, but there is around 70% or 80% of the world's Cobalt that it is found in the GRC (General Republic of Congo), and the GRC has governance issues, where the central government simply has no control. So, for the cental company that has more Cobalt, we can say that it probably faces more challenges.

My personal intakes and insight from the interview:

The definition of sustainability changes the whole equation.

Different point of views from various stakeholders.

5. Interviewee: Hayley Zipp- March 2019- International Council for Mining and Metals- London

Interview with Hayley

About the ICMM:

We are a mining association, working with the 27 mining, mostly large mines. In addition to the 27 corporate members, we also have associations. SO, we work with the national and international associations in countries, and we have a bigger reach into the companies that are bigger in this area, and we try and is a question around the scale. We are relatively small in number, but we work with a technical group around climate change or specific working groups.

ICMM definition of sustainability:

We mostly talk and work with sustainable development in the round in social, economic, sustainable environments. So, not only sustainability in the area but social and economic development. Therefore, sustainability in the broader sense. Sustainability, strategically by the council of the CEOs, the 27 years it is that the companies meet twice a year to discuss what is the most topical issues to work on and for the next years and work programs in certain high priority areas. We work across: health and safety, product or material stewardship, i.e., responsible sorting and those kinds of issues, we also work on environmental issues, so climate change, both in terms of mitigation and adaptation, biodiversity adaptations, water stewardship, tailing management which is now a rather challenging area around tailing, very recently but also in the last couple of years, large programs of tailing. In the social side of things, we work on the terms of taxation, the way that companies are set up for community relations, so organization of community relations, practitioners, through workshops, training, guidance, modules, and fields in a lot of position statements, on mining companies.

I guess these are some of the ways we are working, but in the council level of CEOs, in terms of the type of guidance, principles, position statements, guidance for the level of the framework, we work on the 10 principles, such as we have water problems which the government needs to take action on it and report on how they are managing water. It is one of the climate change reports. And they are not hard or soft rules, as if some company doesn't watch the rules, it will get kicked out of the association. We mostly work based on collaboration with best practice, so if a company does not comply with the rules, we will work with them through challenge and practice and knowledge exchange. We very much work on changing the practice from inside out about terms of relevance.

When we have a problem around specific issues, then we will establish a group around that

Fir instance, with the automation, we will increase the safety around mines, as there is a lot of debate around the mining incidents about health and safety criteria and greenhouse gas industry aas 15 years trajectory. We have got similar in tales and tailings, but more forward looking what kind of technology way of miniun ultimate elimination of technologies and dewatering, and also types of design mines are operated based on the issues we want to operate on.

And more specifically on the area that you are working in, we got a program council of CEO has mandate us to work and develop on, that we have started working on it last year, just to formulate and articlaute what we would like to do is lookin ad nfinidng on aprogeram which takes us to the next 15 years. We are calling it "skills for common future", and is based around three to five areas of collaboration industry working together on a regional sense with partners for skills around initiatives such as carbon advances to be much more joined up and to create benefits of the skills for a common good future, having that automation is going to dramatically change in the near future, and change the kind of communities offering that to mines. I think this would be well acquainted with the challenges around the resource curse. Companies often have to deal with difficult negotiations around the government and communities, while still wanting to see benefits for the mines, what benefit is, going down to the local level, the job in the enterprise development, is the type of benefits that the mining can offer, in the area which they are operating. I think there is a large degree of concern around technological innovation, offering the type of jobs that are available in the mining operation, and there has been a question on providing community jobs. Ans, the other side of the coin, is that what are the types of skill sets that let us work in the mining of the future. Therefore, it is actually a two-sided coin but also benefits for mines in terms of future workshops.

That is really where we are now. We are trying to create a program or trying to explore the program with the mining industries that will work towards the benefit of communities, and we are in the discovery phase. So, we define first education for this type of future. We introduce education to articulate education. The second one is around technical and vocational skills sides, they are traditionally only economy peoples with skills to enter and mining industry, how will that look like, to participate in these kinds of economy.

The third one is around leadership, but leadership through mining companies around sustainable development issues and skills development, but also leadership aspects getting developed around leading communities. That is, how do you engage communities with the leadership skills to be engaging at the same level as government and companies, and really taking part in the conversations. So, there is an element in the leadership that lacks skills in the skills bucket. There is also another point which is about supplies and local enterprise developments, so, what is the kind of skills that mining needs or already is working on it which could help in terms of local suppliers to participate in the value chain that the mine is offering, but also, more broadly, what are the local enterprise, and the efficient way in change the task and skills that the community is working towards.

This is because the new way of mining is designed to work in a collaborative fashion, so, what we are doing, is that we are sending groups to discuss these issues on different regions of South America, Africa, and potentially in another location based on time to put lots of international organizations such as NGOs, governments, and community organizations to be put in this goal. That is why at this stage it is quite broad and nebulous what I have told you about is quite broad. We are looking at and trying to have a conversation with a lot of big or small organizations that represent the communities on the ground that represents where is the opportunities in mining, There is a lot of skill development spaces, and there is a lot of big international organizations going on in skill development with different elements, and we can look at either build on those or find a niche where mining can really make a significant difference because I think there is quite a lot of exciting opportunities to 27 companies looking at doing something either on global partnership or on a regional level, wit south Africa having a lot of supply development initiatives that are very interesting to explore. So, the best practice supply program is one of the opportunities for scaling that. There is also a cost-cutting issue with the skills initiative buckets around gender and equality.

I guess the report is based on what is deriving the mining industry to look at doing something around the operation, and it is something around operation but not that and also what is around the operation, and so opposed to what is around employment. Also, from a mining perspective, how you entice people on doing something that is so seen as dirty.

The is a big developments skills on that, or either find a niche where we make a significant difference because all are different countries, all doing something either a global partnership on a regional level, for example, South Africa going a lot on the supply development initiatives to explore the supply development program, what are the opportunities for scaling that, and there is also a cost-cutting issue within the whole cutting buckets around gender and diversity, around skill development around communities to be engaging in the same level around government and companies,

so there is also an issue around gender diversity. Is that you are going to take a look at it based on the equations within the agenda? The research project is both looking at driving initiatives on looking at what is around automation, and that is a key driver of what we are doing, but that is not only the driver. It is also a change in the labour market. It is a more mobile labour force of peo0ple doing more short-term type pf equipment. Also, form the mining perspective, how do you entice people as what s often seen as a dirty industry, how do you encourage millennia in mining, and also to the point of technology is rapidly changing between 15 years from now and how we adapt it as the mining industry,

So, on one side, we look at the drivers such as jobs, unemployment, feeding that into the development of a collective goal, which is broad. It is quite a sizeable research project, understanding the drivers, within each of these fellows, what are the mining companies doing in terms of each of these memberships, lots of different program going on different operations, regions, what institutions, what type of regulations, you have your social about plans via a certain number of

resources that needs to go to community development in order to have their license to operate, so, what is the sort of framework and regulatory context in terms of companies working in. So, it is kind of research for learning what type of research we are working on, as you can imagine, there is going to be different empathise, for instance, some having different positions and challenges, as ICMM working on the mining operation, and what is the sweet spot which companies can agree to build the rate on. And then around all of that, we are looking around gender diversity, that is going to cross-cut through everything, So, we are looking at drivers, for eight programs on skills development and gender diversity, whether it is development initiative where we might work on something like women to that particular program that we want to do. But we try to be as aware of this gender diversity program as possible.

Q-After all these agendas, how does ICMM plan to put into action these new frameworks for these technological adoptions for these mining areas? How do you see in practice?

A-I don't know exactly which area we are going to land on, and it can range for different kinds of initiatives. It depends on what we come up with the talks. We need to work in specific elements around which all the companies would be working across, about delivering in different times of periods. I think it is going to be different types of articulating challenges around automation, and technology and labour market changed within the work that we do sign. I believe that from all different conversations, we are producing smaller research papers and working more through the type of technology that your research is focusing on.

Q. Are the different types of technologies have different impacts on technological adoptions?

A-Yes, for instance, large-scale and small-scale mining are around mining in South African that are technology in mines are different from mines in Australia, which are more automated paradigms and are more fly in- fly out in different regions.

Q. The program?

A-This new program is looking at skill development broadly in changing the automated technology and automation in AI generally in a society experiencing, how that will work in a mining context, and the work implemented in the mining area.

Q. Which type of technologies has more impacts on future mining? A-It is not an area that I am an expert in. I work more on the social and economic side of education.

Look at the Mining and Mirage: IISD and IGF. They have quite a nice project on mining and metals, they are going to embark on a new research of new tech, new deal, and I think that worth taking a look at, and that would be releasing a new set of work, and I will be happy to share it with you.

Q. This future way of mining, do you think this way of mining is in a way accepted?

Whether it is going to cause disruptions?

A-I think it is hard to say. I think the types which card disruptions if you have communities working with manufacturers, I think that can actually make a quite a bid jump and putting things faster in the marketplace. These are types of competitions where manufacturers are challenging their research and development budgets, depending on these. With those manufacturing developing technologies, things can entirely move quickly so that being said, their help, of course, is a more direct connection and less disruptive, I think areas that you can see more disruptive is going to be much challenging for the mining communities in the areas where these are quitter old mines that have bneen traditionally start unbderground, such as mines in South Afriuca ansd mines because of the economic situation in South African context, automation is being stopped based on the probablility of loosing jobs, het the re will come eventually and there is a need to adapt,coming over time, as places in Australia whern that mining came into mines.

Therefore, I imagine that these discourse are mining dependent rather than discourse. All school mines are around tat are being mined. These are challenges for adapting into that technology.

Q. The type of mining and ore that they are extracting? i.e. thst can make a difference in probnlems that you are mentin.

A-Depending on alarge majority of platinium is South Africa, depending on grounds, and so thatr causes quite a lot of challenge in terms of post-chaning the technology.

The technologuy most diruptible best employed is companoeds getting most commodity out of the gold as possible. Is pasting on the extractin, would make quite a big difference, and I guess it is just thast challenge around when you are talking about commodfities welcomed to be mined. When you are talking about lots of chhellnegeds about for example what types of coal and how, and about the gerography and the kind of broader inverstmentr scenartions about particular commodities, and also just general declining and thst we just mined so much, and ore bodiers are goingf to be mined, and technoloyies are going to be come more advanced in extracting all of the ore bodies.

Q. Looking at that from a more macro- perspective, the technologies in general and mining which impacts this? Such as artificial mining orcircular economy?

A-Uyes, definitely, It is quite a different typoe of commodity. INO becomes still and depends are what typoes of commodities these companies re depends on.

For example, DeBeers is a company which has made a fortune around diamondtalking more abourt and estabilsiung a business around diamonds. Articifial diamonds are establishing a tricky business opportunities around diamons in the same hand. I think that is going to be a very interesting topic f other companioes to navigatie, bioth in terms of the commercial challeges, and also about the facrt that minings werwe until now more focused on producers, and not that much on consumers, and therefore in many cases, quite slow in reacting to the consumersand kind of pressure that other companies get in terms of their sustainability challenges.

Mining has been slowers, primary oriented and not close to consumers,and technology brings

consumers and customer smuch more closer to the reality of mining.Sothe are getting the pressure to getting sustainability challenges. We are going to see more of that becaude the technology is getting much closer to thereality of mining. Blockchain Artificial Diamond

Q. Not specifically articial minerals, but the way consumers reacting to circular economy?

A-It is very much around consumer demand, and your question depends partly on the educationof the consumer of changing and mean to change tfor physical boundaries, and us as humans moving much away from boundaries. Circular economy is a broader concept, and we areready to see apple are putting much more pressure on the way they are putting material in miners. CAnother thing is tht consumers towards he miners for extracting that commidtieies, so I thinkg at the moment ther are not enough awareness. I know some co,pmpaneis aremaking their business models towards circular economies, but that opportunity is not everywhere because the opportunityis noth fully everywhenre. Nvehettheless I believe we will see more of it in the near future.

Q. Other mean for accepting technology.

A-It is about awareness. the safwety issues or tailing dam failure, etc. then mining comes much more to the part of consumer awareness. The technologies that we have for putting in place to manage waste for mining operations suddenly comes into the surfacefor damage ,already transfer tfor resourcers that are put into researchfor the=chnnology, so I believe these kinds of accidents are influenced in public awareness to take a look at faster adaptation of minging technologies.

Q. Other factors?

A-Regulatouy pressure as well. Depending on the type of technology, in the area of Chillie, for example, 45:53

I think regulatory pressures as well. These are not the areas that particularly you might think that there is going to be the impact, but regarding the new technological pressures is a lot of mining, which is very water dependent. The water is very important because it is an arid desert are. A lot of companies are taking decamination plants, so they want to take plants and coming up with the all sorts of very interesting ways of takingwater and using in otheroperations , untreated to supply any demand that they would mine and the enviuronment is but also but regulations. They require more than x liters list of water per second from water supplies, and so when these water regulations comes into course, then it also takes technologicl adaptations to be the requirements in mine, so I think through these regulations, we are going to see. I doin't know what sort of things are going to be the case for other technologies such as the AI sort of things.

I tis kind of swings between different kinds of technogloies, as the technologiecal part swings between different definitions.

There are different types of technoloiges. Technologies can be the process, or can be different types of widgets, they can be engineering type of technologies, or it can be the application of technology in innovative ways existing and development of technology. There is therefore lots of different ways of defining technology which depends on what people see and perceive in that kind of industry,and this can be one are that you should focus on the applications and types of technology. You can see drones do the type of monitoring from mining that was done by people before, and the question is what you do with that data, basing on the data platform, and the quality of water that the mining have is important, and the quality should be shared with the government so they would have better understanding of the water allocation and deciding on the water allocation, and then that is quite a different type of application technology as suppose to the driverless trucks in Australia, people sitting in the operations room focusing on technology, come as a distance. It is interesting and very broad when talking about the technology and types of changes it will bring, and then how that information is shared. A very interesting weork has been done by a group called Catapult. They are working with sustainability for these contexct for a couple of mining companies in different placers to be sure of health issues for people in close mines, and measure and monitor, and being able to monitor people's movement from the area and make sure whether they are areas with more problem in mining activities and they are applications with mining technologies in different aspectas that they are working through.

Q. Monotirng technology

IUntitiave : New tech-new deal-IISD

A-Intersting application at MapX: using and looking at trying to draw information from social impact assessment and environmental impact assessment into one database for getting different aspects and sharing it with the local communities and business. I don't know how far it has gotten but they are going. These satellite application program is about using satellite technology with aggregate data and sharing it with different parties.

Q. Other types of institution for talking to: A-IISD would be a key one to speak to. There are a lot of organizations looking at mining and sustainability, but most of them are not based in London. There are a lot of work from the development sides.

The development banks have also lots of IADB, EBRD, EBDC, etc.

Different mining issues will have different problems based on the place they are operating. Whether it is arid environment whether there are challenges and lots of people from different areas with the different challenges. And the way we are operating is interacting with the organizations that are often focused on a specific sort of issues on sustainability. There might be something around the mining and carbon emissions, or minning and ethnic people, or mining and anotherissue-specific. IISD are working with the IMM within a specific outset to undertand what challenged are around mining and sustainability, social license to ooperate, and they basically didi a research thesis years ago now. It was way before the ICMM was going to set up, and in 2001, that did lot of engagement with civil society, around sustainability for civil mining,

and for4 the industry to do and change the industry expextations and part of the dialogue and how do you improve how to be reponsibler as amn industry on what we do. And they lived inm process many issues on sustainability and mininbg outside of the ICMM, and were permitted for intergovernmental organizations for mining and metals, and government focvuse for mining companies ang government acroiss the globe, so fior the organization which bribngs more focus and specific areas, it depens on where we suggest oegtanizations.

For social development of the region. Might be including but not only thst, the social and economic around, maybve specifically western Africa mining, if they are any NGOs or other institutitions. East Afrcia is interesting and working with different international institutions such as GIZ, and SODA in mining and some structure complies as well, but looking to the localsupplier and local enterpoise development across East Afri, and the idea of developiong next resource base whuch the companies are basing for developing their economy and specific skills based on different companies' needs and and development actors more broadly will have programs in socioeconomic developments and natural resource opportunities of a country and USAID the SWISSCOM, which is a Swiss Development Agency, which they have a more regional forces on the partnership of the private sector on the program of effective technologies. Q> How are these prohects driven?

A-I think it is a combination. ICMM mandfate is to look at the emerging issues and trends that are relwvant to industries and see that how it happens and work into that trends and sitting members to for it. SO, I think it is based on external pressures, but also for internal cognitions and react would be on top of working intelligence when doing it behind the curve, and I think there is an internal interst to be pro-active and working with think as well as pressure from your working community, for working towards the consumers.

Interviewee: Prof. Jan Cilliers- March 2019-Imperial College London

Imperial College London Royal School of Mines, May 26th

(Me giving the description of my thesis)

It is very interesting what you are doing. Why Switzerland is interested in this?

Because of all the international issues associated with mining.

I have studied at the University of Cape Town. There is good Geology and Mining department there.

The objective is to do qualitative data and follow with a macro analysis later on. What are the main sustainability challenges for sustainable mining?

Energy and water. It is all the mining is concerned about. Then, also social license to operate. If we can manage energy and water, we are done. This is a great source of concern, energy and water. That is really our big deal. Energy, we can fix, but water, it brings all the dispute among the community of how we deal with energy.

Is there any technological breakthrough in the way that the mining technology operates?

In the processing or in the whole mine?

Q. In the whole mine.

A-Look, there is a lot of processing in management of mine in water and energy. The water is still a problem, especially in the tailing. We use a lot of water for the tailing dams. So, while in terms of innovation there is no major change, we keep improving and making better progress. I don't think we are really making a big-step change through mining.

Q. But in these different technologies, how do you see the reaction of the mining firms to the new technology?

A-There is a lot of automation going on, such as the autonomous vehicles, but these are the big mining companies. (my self-note: even the mining firms, there are different types of mining going on there. Such as RioTinto, BhP, etc. They are doing all different ways of innovation. But if you go down to the next levels, you will reach to the second tiers, such as AngloGold Ashanti, small-scale miners, and then nothing is happening. There is what they have been doing for a long time. The big companies are constrained for a lot of time, yet if your future is when the mine is gone, so you don't really care. If you look at the ICMM, there is only bid companies, the small companies either listen to what the ICMM is doing or not even that. There needs to be a different motivation.

Q. How much do you see the scales and mining patters different?

A-The Gold is quite unique, so it is just much smaller, so the waste problem is much less, but is more difficult. It is the big water issues that you worry about. So, it is the water issues that people worry about. I think copper is a good generalizable ore, but then look at iron, which is even bigger, and that is completely different again ,as it doesn't require chemical, it is only water and energy. There is no general mining plan.

Q. What are the differences and similarities between different Gold minings in South Africa?

A-The Gold in South Africa is Anglo American, as it is used to be. Deep mines in South Africa that are underground, and there are surface mines, and other such as water problems are the same. Artisanal miners in South Africa and West Africa are open pit mines. In South Africa, they are underground miners. They climb down to hundreds of miles. Yet in generals African gold mining works the same way.

So, there are also artisanal mines in South Africa. It is both illegal in Ghana and South Africa.

There is a lot about the chemicals that they use such as Mercury, but there are also big differences.

The thing about gold is that people are attracted to gold. When you talk about Gold, people are attracted to Gold.

Q. Also there are lots of luxury industries that pushes gold , and people want to know where the gold comes from.

A-Gold is benchmark for other things. For diamond, Tantalum, and Niobium, because there are conflict minerals, and it is important for people (to track them). But not many minerals are extracted that way. If you go to Africa these minerals are followed exactly. You have to be registered and they are tracked if you follow that. You can look at your phone. But you don't know where cobalt and copper come from. And such tracks will eventually happen, but that is all a tricky problem, Diamond is a thing which can be traced more easily, but if you have to register gold, it is hard because Gold gets melted and mixed with other gold. But now we have technology to track them.

Q. There are already start-ups for tracking the gold.

A-They are in very early phases. Some day it will be the case that you want to track everything is in your phone and jewelry, but we are not there yet (as a society yet). An important role that have to care is the people who get jewelry. For example Tiffany's, all gold that they sell come from a copper mine in America, so it is tractable where it comes from, so you can trace it. It is a copper mine with by-product gold. If it is brand-new gold, it can come from anywhere. I think it is an issue. Artisanal gold makes up to 12% of the world's gold supply.

Q. Isn't this percentage (artisanal gold mining) more in Ghana?

A-Yes, because there nobody checks and although it is illegal, people do it. Nevertheless there are no more artisanal mining in the U.S., or Australia. But in the Asia, South America, or Africa, there are a lot, But, there is huge mercury pollutions.

Q. If there're is a technology that doesn't require mercury .

A-Mining company they use cyanide, and gold (production) is relatively clean. Can you do that without using too much water and do the process dry? That is the question. And maybe you can. You can use gravity operation for gold. You always have. Since Agricola (the book from 1555, translated in 1917), we are using the same method of extraction . Picture from the book: In 1556, there is the tank that squeezes the gold and basically in 500 years ago, we did the same thing as today! So, nothing really changed. And this is the chemical part of it, but this is shaking, using standard pans, such as shaking pans. And that is shaking, it water, the question is can you do this dry? It is though question as a mining company, that is the main question.

But is water the only concern?

No, the pollution is more of a question. There is Cyanide, mercury, the damns, that effects people

likelihood of farmlands, how much do you risk people safety, and environmental distaste. This is more of gold than other industry.

So, it is more energy and water, but for gold, it is more about such rather more local issues in the industry. So, the question is industry-dependent.

Q. What

A-There are lots of new technology. Such as thiariayh, or carbon. There is lots of technologies available. It is easy and cheap to extract gold, and anyone can do it. If you bring technology in there, then it becomes more expensive, and what you really want, is to keep the process as simple as possible. Where you want to find good engineers from? So, if the technology is better and cheaper, everybody will use it.

Q. What are the alternatives? A-You can find Cyanide, so you can use it , but you cannot give Cyanite to the artisanal people to use it. Because it is complicated to use.

Mercury, gravity, cyanide, carbon involvement, these are three or four technologies about cyanide. They work pretty well. It get 99% of Gold. It is poisonous, but you can manage it. It is difficult, but what you want them to do is to use them properly. It is gravity separation, but that's about it. Extractions works very well, as in Ghana.

Q. What is generalizable?

A-The technology of managing tailings. This is where everybody is at the same page. We have dams failures, and this is where the technology can come, and there is nothing currently done about this. And this is the big social operates. It is the study that has no value. Focus on the tailings. The tailing disposal whether it is dry, or wet, long-term, rehabilitated, whether it is going to the ground water, the community which has been there for the next thousand years.

Q. Tailing is a big thing. A-Exactly. So, the technology is great. What you do with the tailing. Whether you put them back in the ground, you use them for construction, or what you do with them. Cyanide is manageable. It is poisonous but you can manage it. It is great technology, but that is the issue. In terms of technologies, what gold mining companies can do, they pollute less, use more gravity separation, and that is about it.

You must be worried about tailing. What I happening to your tailings, and we have failures. That is where technology can come and nobody is doing anything about that. It is the better stop that has no value.

Focus on the tailing disposal whether it is dry, wet, long-term, how does it affect the community

On South Africa, we are working with dams, but that was because the technology is terrible. But what we are doing about it now? Using them for constructions. This is transferrable to all gold mining and mines, so that is transferrable.

Q. So tailing are transferrable?

A-Yes, and there is a lot of technologies there that you start to wonder, why people haven't used them already, talking about tailings that collapses, how dams are manufactured and built.

Q. What is the role of academics in this technology adoption?

A-We have a great role to play, but it is the matter of funding, and whether the mining companies are willing to pay for our research. For matter of sustainability of mining, academia can help, but they should come and ask for it. They don't even build , the design of the tailing damns and monitoring, are mostly done by external contracts. But of coursed mining can tackle external responsibilities. Because it is mines, sustainability. But are we just reducing cost until we get the lowest price? How do we decide it is the best technology?

Q. Investment in R&D is it important for them?

A. When they have financial progress, it was good. When we were working with them, they were progressing, They had good technology, but then they fired people and reduced the R&D, so the technology vanishes.

It is very hard for a technology to stick. But when you are making small changes, it is hard to keep.

All your tailing is an important cost for your mining. that is why you go for the cheapest dams. A failure is a big deal, but it is better than the cost. So, it is a tricky thing to do. So, it is really the problem for better dams to survive a thousand years.

Q. When we can reach the phase to say that: If it is not sustainable, it is not valuable?

A. We would get to that point. It is three ways of building damns. Some are fail, they will go to jail for a hundred years. There are other ones which fail. The question is, can you do this in a better way? But the outlaw, can be this technique.

The ICMM can do that. It can say this is the sustainable way to do it, and you should follow it.

Q. Can ICMM enforce it?

A-No, they can't

Q. What about mechanisms?

A-Well,, some government in the national level can enforce that.

Q. I have talk to the ICMM?

A-They are the voice of the industry So, they don't have a say as in hard law, but they promote best practices. Besides ICMM, are there any mining unions that has to do something in law for them?

So, from the side of the mining unions, are there other unions for that?

Other international unions, how they can be implemented? What are the enforcement? How do you see this?

What you can do, you can push it from a top-down. You can say, you have an 9intersting supply chain, And an amount of gold can be determined buy an international sphere. You can sell you bicycle at a different price. But if I am a terrible gold miner that use chemicals and children to produce stuff, the price of the product is the dam. In other sensed, you don't get extra money for being nice.

Q. You don't get more for being sustainable?

A-Gold is different and it is not rare material, so it is not get used. But gold is in jewelry, but if there is a desire to do it, then it will happen. And this is the question: is it enough desire to do it? But you also eliminate what comes from the artisanal miners. It is a tricky business.

Q-What if people around the area lose jobs?

A-It is not the main problem as water is. First, saw the big problem and then think about the last.

Q. The question about the technologies for adoption, a concept on technological innovation of creative destroyer, something that changes the way business operates, this is the breakthrough. There are a few articles on artificial diamonds, and the experts cannot tell the difference, if they can produce it to the extent that they can re-produce it?

A-You can make diamond, but you cannot make gold.

For diamond ,we are changing structure, because you can't tell the difference, so whether you make them to change them , it is the structure. But the De Beers are the diamond mafia. SO they will flood the market, or buy you, or flood the market, exactly like what Chinese are doing with the rare earth metals. They have control, so they can control the market.

Diamonds are different, but it is not going to transform the industry, because nobody wants it. The diamond is important because of the price. De Beers makes the whole diamonds thing.

Nobody wants a cheap diamond, so it is a market which is self-sustaining. SO, that is not really a disruption there, because everybody want it expensive .this is what makes gold and diamond fun. But nobody wants copper and diamond cheaper. So, this is the cost and then we have to think about that there, particular, what makes copper interesting there, and what everybody else does. So, why should I buy cheap copper? The bricks made in Bangladesh? And becomes the mine, because the model is sustainable . So, it is difficult to find a model.

Q. Of course. But look at the copper in these rooms. A-It is titanium dioxide, which comes from the beach sands around the world. I prefer to buy my titanium dioxide form the beach around

the world only in the desert of South Africa than in Madagascar, but we can tell that I bought a white paint that is not a strong environment I would pay for that. Where the plastics in the carpets come from? Who know. So everything is like that. A wood in your house. So, do you think where the wood in the kitchen come from?

So, who draws the responsibilities? Is there an organization that looks after it?

So, you get a president in Brazil, needed to be a world council. So, we don't know what the solution is.

So, how we ca have hard law and who enforces them?

We will fine you and stop you and other ways that you don't like to mine again, so you try to make small things in the bottom, so starting with small projects.

Q. How do you see the revolution of mining in the few years?

A-I think you have a revolution of mining in future. Mining is archaic and old-school and industry in big plants in high-technology, tracking, transforming the industry. Future mining there is no driver and push. The push has to be financial in the oil industry that you want to be as cheap as you can the big demand. So the price has to be fixed. There is no legacy that you should look after. Mining and efficiency doesn't make you a lot more money. So, and interesting point is that, if you look at the cost per ton of rock that I mine, the more rock, the more cost, because that is given by gold how much gold is there, but how my ore body is, the gold come from somewhere is and how much I can extract from the ore.

The tons of mine is the tons I sell, and what is it that I sell. Mininig is very old schooled. Chemical engineering (and many others) have improved themselves, all stuff is transformed, but mining has done nothing like that,

It is the case because there is not defines and push. The push for change needs to be financial. So, the oil industry, there is so much international competition that you want to be as cheap as you can. There is a big demand, and the price isn't fixed, but if you are more efficient, there is no waste. For resources, mining doesn't work like that. The financial model is different ,because there is a difference model, and it is an interesting point. As a miner, my revenue is per ton of rock that I mine, versus it being per ton of gold that I mine, and so costly ,so there is not in relation of per ton of gold in the rock, because it is fixed, and also it depends how fast I can extract it. SO, how much my ore body is and how I can take it as the product. I put the deposit, if it can be extracted, I will extract it, but everything I mine, I sell. But there is no waste product0 from oil. No waste disposal. Do, the tons I mine, is the tons I sell. So, there is a direct relationship between the mine I mine and what I sell.

You look at what happened with the same industry, so, the oil company cannot comer and fix it. They don't think about the cost the same as we do. It is the tons I sell. SO, the mine it is not the relationship. Efficiency does make you a lot more money, because they have a lot more money. If

you look at my cost as a miner, my whole cost is on the rock, depending on the ore body.

Q. How these revolutions take place?

A-The oil companies cannot come and fix it, because their mindset is different. Who need a the stuff? General electric, google, with big vision, it will say that his industry doesn't make sense. I don't know what the will say but that they will have different mine plans. What happens to all mines?

If I can find technology to change the tailings to bricks in my mine, we can. So why don't we? Is anybody even thinking about it? It is that I can reduce the cost of my waste. It is the revolution, because it is not about the good stuff, it is about what we do about the waste.

Q. Do you see the reclamation also changing? The copper is expensive, and the phone is not designed for recycling.

A-There is a wiring, hook, all coppers comes up, so mixed up from different retailers, so it is designed from recycling. We should taking it apart, the metals is all mixed up, so this is another thing: designed for recycling. It is designed in a way of recycling. And we can make phones based on that. So, I can choose for buying a phone which is recyclable. This is the business model that it works. So, take the car model, and apply to other parts.

There is a book by "Markus Reuter". He talks about recycling of cars. It has a lot of idea bout the recycling design.

Q. What about the new big data system on mining? Such as blockchain technology?

A-Blockchain is basically s database. It is not more than that. We can manage without blockchain. So, it will help, but we can do without it. You can track of money, but not gold without it. You don't want to melt it up, and what does blockchain do? And if you add one grain of bad gold, is it all contaminated? How you do that ? It is so complicated, and being able to stewardship, hat something like google or apple says that I recycle everything that I can to produce and grow in our firms to make responsible sources? That is a whole different model.

Q. Also for their public pictures? A-Yes, absolutely.

Interviewee: Prof. Mirabelle Muuls-April 2019-Imperial College London-London

Interview Mirabelle Muuls

Chemical Engineering

Q. About my thesis.

A-Look at the whole literature on: Barriers to the adoption of energy efficiency. Because it is somehow linked. Why do firms do not adopt energy-efficient practices while they are well aware of the benefits, so they also look at those sorts of issues, linked to that literature, and you will see that. I wrote a review for the Development Bank on the reconstruction and development, iBid, with them, on energy efficiency barriers, and you know, you can classify them, and I'm sure you can apply some of those barriers can also apply to technology, especially if you think of more sustainable technology, so, that would be one area to look at.

I think one other area that can also be interesting is the literature of "Bloom and Van Reenen" on management practices. They run something called World Management Survey, and if you are thinking of doing some quantitative work, they have broad management survey and practicing, because one of the barriers, I'm sure you would find it, is how the management firms tend to be more innovative, more productive, more everything, and also more willing to adopt new technologies, technology-efficiencies.

There is one paper from my co-author, Ralph Martin, in the Economic Journal 2009-2010, where they show that better-managed firms are more energy-efficient, so you can think of if there is a way to get data for the mininng industry, and match it to the management survey, and see if there is any correlation around technology adoption.

Q. Any related database?

A. There is a database called ORBIS, but we only have access to a database called FAME, it is by a company called Burea Van dijk, os that has a lot fof firm-level accounting information, and that has lot of the names and so on, the name of the managemeners, so you can request access to it and link it to bureau, and recently has a lot of data on patents, and some of my students are working on patenting data for the innovation to the management technology, and classificatyions are by type and that is for energy.

Q. What about water?

A. If you want to work with patents, you should first better understand how doctrines are established. Also in oil and gas industry, how they talk about sustainabi8lioty, annual reports, have they shifted in the past,for trasition. It should be looked at whether mine and gas industry has been doing in the past. The energy industry already did something in renewables. I think it is a bit different, and I think it is something to take a look at of the mining firms themselves.

Q. The definition of sustainability: is the four-sphere definition of sustainability transferrable to the international discourse?

A. Fromn the research perspectrive, I think I would treat them separately. Other industries have tried it for food & beverage industries.

I think you should treat them separately because they are different things. A lot of industries has tried to apply this for food, drinking, alcohol industry.

Sustainability is about theresources, when you talk to production, so it doesn't have to be only climate change, but is is the fact that how you are using this. So, it is to decide on what the association is saying, and that you look at what factors. If you go into the local community growth, it is a completely different issues.

Talk to Mauritzio Zollo, Paolo Tatitchi, He also works with strategy, so he does more sustainability thing. He is in management department, but he has lots of experience in the real world, and also Erkko Autio. He is also in the innovation department.

I think trying toi do something on the data side of it is very important.

Interviewee: Head of Research-African Center for Economic Transformation (ACET)-Accra, Ghana

ACET Transcripts

Transcript report-

ACET: Africa Center for Economic Transformation

Q. A bit of introduction for Ghana Gold Mining?

A. We should at first find stakeholders and include them in SDGs. Ghana has a long history of Gold mining. Should we extract gold or should we mine it? how to make it sustainable?

Meeting Sarah and Juliet -Me explaining the background and the project Things to read: The report already on mining and the SDGs

We try to work with African government on drivers and the productive area of economy, on agriculture, extractives, public general managements, the do research, provide advisories, or people as workers in general. On mining, the work on ICMM, general chamber of mines, working on the economics of mining section of Ghana. [The documents will be sent]. All big mining companies on economic social impacts, not environmental impact. Social at the community level, what are some of issues and the impact on what they are operating directly. What mining does at economy as a whole.

Q. Do you see ASM as problematic? A. Some ASM can have positive impact, some negative. To the extent that it has agriculture, to the extent that is illegal. But there is room and it is necessary for the government not to brush the whole center and mark them down, and understand them. The impact on agriculture is a big issues because the big population lives with agriculture to pollution the water bodies, to competing the land as well. One it is mining on land, it is no longer good for agriculture.[until a number of years].

Q. Ghana has a great amount of gold, but why it hasn't yet translated into the economic development?

A. The problem is that for long time we have left the mining industry into the hands of the foreigners1, and also focusing too much on taxes. How it can make a better impact on the economy in addition to raising / building the capacity of Ghanians to make the impact/ Now they have only been happy that they have tax then 3-5%. But the capacity is to make Ghanaians the capacity. They are in government side. Which ability related to sustainable development?

Everyone has a card to play. Parliamentarian, keys, but in the Ghanaian contest, the local level actors need to do a lot more to make sure the companies actually comply, in order to make sure they actually comply. In Ghana system you have the district assembly leader, MPs, DCs, etc. So in the local government system also has a role. There is a gap between government and the national level. They can play a stronger role. In order to capacitate them more. Because a lot of regulation take place and a lot of strategic planning in terms of ensuring that capacity is built in the local level.

Q. Is the problem infrastructural or policy-relevant?

A. For Ghana it is not the lack of policy, it is enforcement. If we do policy analysis, we have policies and maybe best in Africa, but we don't enforce them as we should. There is African Development Fund, African countries have that but putting them into implementation is difficult, when putting the policy into place.

There is a 6 month stop while they check everything and everybody's license. They also do this work in 6 other countries.

Water pollution, illegal underground mining tunnels, because they are illegal. When this new government came into power, there has been a new mining covered. In also before starting, it has come into regulation issues.

About gold mining in general in term of how gold is mined, you can find general products. They could find a lot more products. We have just been relying on them telling us what they have been taking. We are not setting the level of purity. What really is holding these people into account.

How fare they are playing? One of these problems is gold mining being nationalized How do you see they how it is exploitive or extractive?

The way government actively proactive them is what they get to getting them.

To the extent that government give blind eyes, they are private, money earning entities. They are private, profit-making entities. So they try to make profit. A big gap for Ghana has been the lack of proper enforcement of international mining companies.

Q. What about Artisanal mining?

A. Artisanal is more problematic, because you get a situation where..the are into sustainable mining so they want their entities to be more productive. In a way that is more sustainable, where artisanal is more opportunistic and relax towards environmental protection.

In recent years, you find that there is lots of collision with people with license with other foreign private people. In recent years Chinese, other Lebanese. There is a level of exploitation and collusion with foreigner. They seek with local people and they bring in capital and they are a lot more bringing the machineries. Then you go to some of these area you see machineries but they are illegal mining. So they are colluding with people to acquire license, and the local people seek their licenses. And the foreign illegal miner come and mine recklessly.

The big barrier is the government. Enforcement with foreigners. So not just the enforcement of the rules but also the mining operations. We focus way too much on that. Do they have enough capacity to be able to monitor and enforce? We will find out that their finding is limited.

Q. If they want to enforce on local community, how they get monitored?

A. The local authority, the police, sometimes the military is involved, so it is needed to be cohesive. But these locals tend to have mining offices in areas who has to enforce what it is going on.

Q. Which one of the SDGs you see most influential in mining?

A. Mining can do a lot in SDG9? Both direct and indirect revenues come from mining, in terms of infrastructure goals, mining can be a big partner. I think the most important SDG where mining can have an impact is SDG, the infrastructure. but mining should be involved in the rest to make it more sustainable.

Q. If you have suggestions on how these rules should be framed?

A. I think a good way is to ensure that the international companies work with the local or national development plan. So either than a company coming to say I am going to build schools and hospitals, it should be mechanism that the company works with the authorities and the national company commissions. These are the institutions which they are in charge of the development plan for the country. The national level is NDPS. They have their local authority to be strong and work hand in hand to have strategic outlook to be in hands. It is for supply teachers, and students, without schools, they don't have teachers, or how to maintain schools. They just do what is good. They may do what community says, but not that. The community people say they want the swimming pool. But is it part of the plan for the town and what the majority wants? It should be done regarding to the development plan in order to be sustainable.

Q. The decisions on who they want to develop should be made based on the development plan already made.

A. Sometimes the community hasn't done to but it should be done. In order to avoid what white elephant project: just being there and nobody can do it. So, don't just build a school, and a studio, if there is no one play football. So, it must be done in collaboration in community. Make

decisions that fits most of the needs. in my mind, the second step on my thesis, do you thing that it would be useful to build a social living lab, a physical platform in these mining areas to gather from local community to gather about what is needed for sustainable?

It is key. They say they want to do it but they don't do it. It is in the constitution but they don't do it. It is from NDPC. ,what has to be done in the local level, what is the development fund, NDPC. Ghana minerals development fund. So you will see that these are in place but we are not doing it.

Q. Is taxes the only way that they pay back? Do you see this to be enough and legitimate, or do you see taxes are enough? Generally as fair companies or not?

A. Now we are realizing taxes are just minimum. We can get a lot more in terms of procurement (procure locally). They spent up to 40 to 80% of their operational budget on procurement. They actually don't spend that much on salary in terms of their operational budget in terms of procurement. I think there is a lot more potential to build capacity to supply them and procure from them. In terms of the mining company, they employ not that much people. Even the local people they employ, they employ 50 people in town on how many people. So the potential of indirect employment s bigger. The potential of mining going on salary is small, but on procuring item is a lot higher. So they do better to the extent that they procure from people. So, building the capacity any investment that they can, they put in capacity of local businesses. It is the key for social licenses to operate, so it makes sense for Ghanaians for buy form them. Maybe at the beginning the commodity is more expensive, but as they grow we will see that the capacity is getting higher. To higher Ghanaians, to begin in Ghana.

Q. Do you mean for small for a medium or large-scale mining?

A. All these is large scale mining, and also the small scale mining is trying to understand the nature of the best. We have all allowed it to go on but now we are seeing it. We are seeing large-scale mining. How many foreign people are working? It is only 3 to 4%, but the amount of salary paid would be higher than the wage bill of the local people. The mid-to lower level so large%. They can say 85% of employees are Ghanaians That sounds amazing but we should see the wage bill of the Ghanaians.

Q. The potentials are not though taxes but also indirect investments also through procurement from Ghanian companies and also through fare wages? More through providing opportunities for the locals?

A. Business opportunities: locals, materials for mine, indirect procurement.

Q. Others?

A. Chris for Chambre of mines. He can give you a good perspective, . main international in Ghana. Very knowledgeable of challenges in mines.

Ben Ayree: He is former minerals commission and currently social adviser to minister of lands

and natural resources. Good to speak about ASM issues.

Draft of the interview-ICMM report-AMDC (African minerals development center) They work on that and they did a study on Ghana's Be careful you are quoting. So let us know when you want to use.

That will give you more of the local impact that the mining has had.

Q. For these licenses are there any negotiations?

A. In Ghana, the license are not done by auction, but by request, so you can see the minister ad request. So it is not done by the auctions which is the most transparent. Just with people coming and asking for a bid. Corruption: if it is just me, it can be a potential corruption with the minister. It forces the company fro be more transparent, if they had an exploring license whar they are. These transparency is more a problem, more than oil and gas sector. In Ghana mining sector, it has been very opaque.

I imagine based on our talk, some sort of NGOs are not really a part of the game that much. Sadly.

Q. Do the NGOs exist? Are they strong themselves?

A. I never met them but I know they are good: WACAM. They are here. I suppose they are quite good. ISODEC: has civil society forum: supposed to be and umbrella to speak on ISODEc. They are approachable. Chris might know them. I'll be sending with Chris. The rules and legislation: we can google them, some are on te chamber of mines, it is a bif eport but quite good. The problem is hopefully n Achim ,we can meet people there. Build up the local capacity in business opportunity: African minerals development center ot build up a natural supplier development program. The Ghanianas for contribute to the center.

Julius: A part of the IRP project.

The first field trip to Ghana and to Africa

IRP developed the SDLO:

Q. How much have you been involved in the SDLOs?

A. The IRP, the last time ASET hard a first meeting, we first initially presented by thepople, nut they continued to be as a part of the process on the process, draft, and input. It is more governance, IRP is just to review the governance framework.

Understand the framework, understand how they are there, understand how they comes in, and therefore in a way the development agenda, it is how it is the SDLO, in a sense people can see mining providing development, so SDLO is a mining output as achieve. Right now that the question is actually social license to operate that in a sense it is in fact the local government the local government to the company to do this mining. What do you see the SDLO can be different

in a better way.

Julius: SDLO is the authority to give you the permission to work in that area. Because the hard licenses are usually given through the central government. If you are mining wherever, mineral are owned by the government, not even by the local government. Usually, it is the central government that tells you that you can mine. You can go to a local are, and people reject. And the are many ways for you for being rejected.

It happened by complaining, people attacking concessions, people invading illegal miners, in a way, it is to say it doesn't matter if you have a hard license or not. You can go to a place and face rejections. SDLO, is more about "society" licenses to operate. It is more about society accepting you and accept that you are doing something good. So, they allow you to be in their community and doing your activity, without you getting into all kind of challenges, so you need to have guards, or other things, which means you are foreign yourself to keep being in there and have your concession running. And I think some of the mining companies do have challenges in the concessions. It means if you don't have a license to operate, you are It has happened that people are complaining, people attacking concessions, Local people feel that the mining companies are only taking gold and flee away. It means that sometimes it doesn't matter whether you have a license or not, you might as well get to their community and do other things. They pay loyalties and taxes to the local government. Initially, the fast level is that they give money to the local government, which might not get back to the local government at all (problem with fiscal system). But mining by itself has some certain impacts, there could be environmental problems and so on, and the government needs to bring development to the area. Some of the mining companies have mine guards, meaning that they do have challenges in keeping the security. They give money to central government which at the end might not give you anything. The government priority might not mean that they bring back the money to the local area. That the priority of government might not be at the same line as people's priorities, and the government might just be as well corrupt. They might as well take the money and get away with it. So you will get the negative side but you might not necessarily get the positive side of the mining. So depending on the activity, the might not get the same benefit. The government is supposed to build schools, but it doesn't mean that they will bring the money back. Mining is capital intensive and require high skills. People may not be involved. People might say that they want to be involved there but they might not even have the skills. Mining will bring people from outside, maybe even from outside, but still people who are not seen as local people. A problem at least about Ghana: the political structure

Q. How do you see the government can answer this challenge?

A. It should get evolved on how you structure the ownership. And any should the central government own everything. Assuming you have Coco and gold, when you farm coco, the region will be reach because the farmer own land you earn the money. But the regions are reacher when they mine, but it is not ours. So, unless we can create a more way of local ownership, 30% of the revenues that comes from there, goes back there because the minerals are collectively owned by

the country but it is sharing arrangement that gives a bigger share to the people that it comes from. That could be one way.

Q. Platforms?

A. Obviously, the communication can take place and people can talk. But then, what will it achieve? Because if you build a platform and you say here we are now talking about the civil society, the local government and people from the mining companies have this dialogue and we talk, but what then the mining company should do? Should it try to develop the local area? Because lots of the time in the mining company you pay taxes. Is it your responsibility to build a school there? Not only deciding on the priorities. You control resources. This matters. Because once you decide on the priorities. Where do the resources come from? Because you will need the resources. You will need either through taxes, or the mining company get the taxes and give it to the local people. Usually this is what they do with the CSR. You will build some schools etc. and the government can lead you to the wills of people. Actually now I thing they might have been riots in Guinea or some other places. Where people are going to the local mining company and see that they want electricity. But should people go to mining company to search for electricity or what. Dialogues are important, but I think the dialogues between people and mining companies should be on how to mitigate, because mitigation of the negative impacts: because you dislocate people, there is water, there are resources that has impact.

In other words, mining has externalities, and the externalities are bearded by local people. So at the first level you have to discuss it with local people. Because people have to understand that you have come here and you are taking water and other resources for doing that, but it has to be a platform for dialogue on how to mitigate and how to compensate. Because people have to get compensated at least.so it must be answered if I am displaces and have lost my home, I have to be brought to where I was, because they are two levels. Mining can't take you there when you are here. So the platform should be to take you back where you were at least and at the minimum, and then what you want is to go here, and how you go here should be the job of the government, because that is development. A mining company should not be involved in development but it should care as it also helps, because if the local people do well, then you also do well. Because you care about that, but the challenge is that, if the mining company gets so involved in developing, one thing that happens is that in a way you undermine the central government, because if in a country the people go into mining companies to complain about power, it means that in a way the government has lost legitimacy. If people don't complain to you as the government, then you have to be worried. It might look good in the short run, because people are not giving you complaints, but in the long run it means that they don't really care about you and your legitimacy is losing, because if the people don't complain to you it means that they already believe that you can't do anything. So the next thing you know they will come and tell you they don't want you at all. When a mining company gets power, the government will come and the people will ask them: what do you want from us? It has to be involved in all of them, because if you stay away, you can lose legitimacy.

In the best position: they should coordinate. Because government does have development programs.

How to mitigate and how to compensate? Because people have to be compensated at least. CSO and CSR, they should liberate each other, because you can work together in partnership. Because if I am working in improving the school and the government is also working on that, let's do what you can do as a government and as a mining company. For developing my school and so on, I should work on the government and the department on and see how much, so it should be more of public-private partnership, so it should seek to develop a public-private partnership in design a project implementation.

Q. SDGs as indicators?

A. At least if they can say these are the goals and what some of our priorities are, that these are what we want to do, we can at least say okay these are at least the things we know we want to contribute as our goals. The work together, and the agenda should be based on what they see as their particular goals and area. Then we work together as government, when you have on the table mining companies, local government, developing agencies, then it can get used because it can meet the sustainable development goals. It should seek to develop a public-private partnership.

Q. The externalities of SSM and large-scale?

A. They both have externalities but at least the big companies have standards so they can be held accountable more easily. So they don't that only because they regulatory agency are not doing her or his job. Because they have their bases, and they cannot just run away. So, you can be held accountable. So, if they are not held accountable, they can be negligent. So, the problem there can be simply them not being hard-working enough.

The company and the person responsible must be negligent for such cost. It is likely because they can be both negligent. For at least that one, they are two stops. This company cares because of the impact of its Social License to Operate. It may destroy it. If environmental agencies care, they can easily monitor and they can easily enforce.

But the reason that ASM is the most serious challenge, because ASM are mobile and they can move quickly, they don't care and they cannot be held accountable, they are many and hard to police. So the potential damage that ASM can find is much higher.

Q.

A. EPA Ghana and some environmental agencies are active in protecting the environment. Also in the commission and land degradation, there is also water commission about land and water use also regulated by those organizations, so they could have a role in terms of regulation.

People have complained about large-scale mining. The impacts are different because they are blasting underground and watch, and I think some of them could be negligent and the impact

quite huge, because they may not deliberately do it, but if they are negligent and there is an accident by large-scale miner, it has way far more consequences than an accident by small-scale mining, because scale of their work is huge. But, I don't think they are negligent. They must be aware of damage, about environment and be more sensitive, because they basically have a reputation, they are more issues. Because think if Newmont company do something, they are far more environmental damage that civil society could do without problem. So as long as that, you would be more careful. So that would mean that they don't pollute. They would at least follow the law. So if the laws are weak, they can just claim that they are following the laws.

Q.

A. ASM is for local people. Foreigners also do ASM mining but illegally. Government grant mining licenses only to local. By law, you cannot be a foreigner and have an ASM mining license. What happens is that when people get a license, they look for foreigners to work with them. So, all or some of the local authorities, some of them are even heavily armed. They are mining, some of them are heavily armed. So, it is illegal. But people in power are also working with them. You can imagine a foreigner come, armed, so the government is not doing anything. They must have somebody who is protecting them.

Q. The solution for ASM illegal mining?

A. I think it is policy, what the government is doing now. It has deployed the army, to try and get the illegal mining. So, you can use that, but it is also to try to understand the system better, rather than just go and should say, who are these people who are working? I guess it is stronger law enforcement. Also, to give ownership to the people who own the land. Because if I own the land and I am told the gold is there, then I will protect my concession.

Q.

A. I don't think Ghana has a resource curse when it comes to gold mining. Because it doesn't have the problem which most of the resource-rich countries have. Because mining have 90% of the value. And I don't think any of the courses which happened in Ghana, or any of the challenges is related to Gold. But it doesn't mean that they are not hard challenges when it comes to mining for Gold. In fact, Ghana had nationalized the Gold before, in the government which was doing it, but once they did most of that, the industry collapsed because government could not invest and they changed the laws to liberize the sector. With brining in foreing investors, and gold production went up. But now in Ghana, the loyalties and taxes are reduced.

The high prices of Gold, the mining companies will get a lot of that. So, you can't say there is really a resource curse in that sense, because Ghana has been producing a lot of Gold and has been exporting a lot of Gold, what has been the problem is that the laws favorable to the mining companies and these laws are been produced in a way of the structural adjustment program.

Q. Do you see it as institutional-level problem? Or political?

A. It is both institutional and political, because these are the conditions that the World bank has made: liberalize, do this, give incentives to the company to come. And they came. But they can keep the money outside, they have all kinds of illicit act that happens through inhappiness. Actually, a negative externalities of liberalization and globalization.

The globalization gives everything, what skews to us as mining companies, so the government has been trying to improve and come back.

Q. Taxes?

A. Most of these countries run for taxes. But the price is too high, even if you pay this much, they introduce another tax called win for tax, meaning the expectations were higher than needed. So not only introducing a win for tax, but try.

Mining companies will lobby, and you can lobby back. But a country like Australia which might be stronger, they can resists lobbying from the mining sector. So in a way, what you would say, it is more what you call informational symmetry than capacity, which like Australia has more capacity to understand the industry and the economics of minerals and how companies work that, now it is the time to tax it. A country like Ghana may not have that capacity. That is why in the first place, the contracts you are negotiation may not be in your favor. Because to the companies, they are doing legal things, but you negotiate for it. You cannot go and say and this was the argument. But sometimes when you are negotiation with somebody who doesn't know much, you should know that the mining companies have better geologists, have better lawyers. They have better information about your resource.So what are we negotiationg about?! It is negotiating with a big capacity, because information are asymmetry. What you call an unfair share, is sometimes just them learning better about your value resources, are therefore they are negotiating from a stronger position.

What do you see as response and solution for the mining companies to be more transparent?

The companies may not care at all if they are not transparent. Obviously the governance or civil society can force them. Because if you look at something like index which are forcing countries to be more transparent, they are now caused all of the world, what you call illicit transfers, because of some accounting methods that companies use. It is not a Ghana problem, it is a federal problem. The result can become a bigger country form the US, forcing the issue on the agenda and creating international rules. It can come from civil society that more act on "shaming" the companies and people won't doing this and this because of the Gold, so companies can be forced. It can also come from Ghana making capacity. It is all grants. It is people in its own government looking for skill stuff, or they can go ahead and higher consultants who are expert in tax (as the mining companies are doing it) It is to say that you are going to be in my negotiating team. So, there are various aspects of it.

(me: nationalization is vs. privatization)

Q. Nationalization of Gold mining

A. Illicit transfer is becoming a global issue. It is a global problem. It can also come from Ghana building on its own capacity in the long run. Gold mining was nationalized. The government owns the mines. But the government can't mine. They will just neglect because the political people will come, they will bring people to be employed (corruption). And once you get money, you don't invest back, So, other time, (Nationalization -> social democracy) in that case, you own the minerals but you produce less Gold. This is because the government just don't know how to mine. In its own government to be better looking for skill stuff, or it can go and hire consultant. The same way many companies does hire people to do work for them. Experts in tax, law, and such, and say you are going to be my negotiating team. So, there are various ways.

From 1936 to about 1980, they nationalized the gold industry, but it didn't work. But government can 't mine. So, over time, because of agisn institutional problem, and lack of knowledge, the nationalization doesn't work. So although you own the minerals, you produce less gold. So the gold is still in the ground, because you have not used it. So, in my opinion, the nationalization didn't work because government don't know about the business of mining. You can leave in on the ground now and say unless we have the capacity, so we will just let it sit, but it cannot be done, Once the Gini is out, you cannot put him back in! Ghana has mined Gold for hundreds of years. It was called Gold coast, for hundreds of year. It is the issue of building capacity, benchmarking, learning, to find a better way. Because I think Gold is easy. It is ready to be used.

(methods of gold mining, based on the shape of the gold: placer mining, panning, sluicing, dredging, rocker box, hard rock mining) gold jewelries, mostly gold itself. So, you already get quite a bit of it. It is just more negotiating about taxes

They still keep that how much more we can get in terms of the royalties. But again, these are in terms of global standards and mining companies in that order are not that many. So as you can see, it is a global trend. So to me, Ghana is loosing too much in terms of Gold. It can capture lots of value by looking only at was is being losed, negotiating better in terms of contract. The question is how they use it once they get it.

You have to revise many stuff. You should take again a look at the contract, and you will see and think what really is the economy impact of that mines because how you mind gold in this country vs other country is different because of how good are their resources and so on, so that you can now do a better job. Because as I told you, the mining company know how much cost they will have to bear. Here, you don't. It is not to benchmark, because all gold minings are different. Different cost structure, different depending on the way they are going. So it is really about learning more and negotiating better. But it is not about nationalizing. Because (in his view) after nationalizing, you are going to get reduces about the outputs. Ahafo links programs by Newmont. It is to create link with the local community, having develop suppliers, and has been quite successful in increasing local people trust. So, they do what to involve the community, obviously that's why they have more information. They always more know than you. You don't know what you hear is actually true or not. They know how much it costs to get an ounce of Gold, while you don't know. The platform helps because it also helps to build trust.

With the illegal miners, you have to fight with them and make just arguments with them. But that is more criminal. But it is a way of protest from community, because these are the people who might tell themselves that these are our lands. They are taking it so we might as well go and get something. So, these activities from illegal miners could be a way of protesting, could be a form of non-violent protest in a way.

In other words, if you are a mining company, you know this is the concession which is given to you by the government to work on. You can go and find that some people are really working on your concession. Some illegal people from the ASM, meaning they are working there. If they are working there, they are criminals, they are just coming to steal. But sometimes steeling can also be a form of protest. If I am occupying from the Robin Hood, I still. If the local people are saying you are mining in our land which we could have been farming, and now we are not farming anymore, so we steal. So, some of it could be a way of protesting and saying you have come and taken our land now we can't farm. So we will come and take the gold also. It is not a curse, but something to consider. It is always the contention, because how much you compensate. Ideally, people should get compensated if they have been doing farming and now they cannot do farming anymore, so you have to compensate them all. Or loss in terms of what they could have done with the land before, but you should also compensate more because of gold of land because of the policy of how you share resources with the local government.

Interviewee: Aisha Adam, Natural Resources Governance Institute-Accra, Ghana

Aisha Adam

Natural Resource Governance Institute

Work on governance issues of oil and gas mining

Natural resource of oil and gas mining- working on financial management-governance of oil and gas-revenue management-

What we do at NRGI is to work about 80 countries, and they have satellite offices. In Accra and for Africa, we help countries to manage their oil and gas resources.

Q. How do you do benchmarking for sustainability?

A. We tried to use SDG for measuring the sustainability, but the problem is we cannot track whether oil revenues has made the life of the people better. We don't have that. So we abandon that. So what we do now, is that we focus on the laws, compare it to other countries, and suggest ways on how they can improve their law. For now, we are focusing on influencing the legislation, and that if you have a good law, you potentially have better chances of bettering the outcome.

What they do is they don't measure it as in having indicators, but whenever a government body wants to make law, they arrive and suggest policies, so they would have better chances of successful implementation.

Especially, they are interested of measuring the mining activities of a specific agenda perspective at the community level. They are an international institution, and not government-based.

Q. For collaboration:

A. They have partners and other think thanks which are working, at the community level. The other region calls WACAM. Western Regional Coastal Foundation (also for communication). CERSIS. We are working with all. If you want to implement a law of policy is really very difficult to go on your own. You need a lot of voices that you are talking about. So if we have such research, we normally send it to them for feedback on reports to convince some technical to this class, and ho you can do this better, and make our position. Normally, that is how we get to influence the outcome of Ghanian policy.

(I checked and their funds come from the developed countries).

They provide consultancies for government, but they don't charge for that. The exploration of regulation: the energy was to provide the imput. Like suggesiong policies directly addressed the government.

Many different association fund them, including even media.

Q. How do you communicate your findings? Do you follow up the implementation of you findings?

A. Once we are able to put our input into the legislation, now we have to make sure it would be in the law. Once the law is implemented, after a three months or so, we will provide an update, law, or briefing, on how the government do this, and if they are challenges with implementation normally we say what government can do to make it better. So it is just ongoing, and we can see that there is an increase.

Q. How do you get the data?

A. One of our big project is the Resource Governance Index (take a look). One thing that they found is that government had better arragnements where the minerals had 10% from the central government to the subnational level. The problem that they found with this was that some regions did and some did not receive this funding.

Q. Resource curse? Which part?

A. I don't think Ghana is at the stage of resource curse yet, but that at this stage Ghana is at the stage of pre-source curse. Take a close look at their website.

What they do is more on the economic side.

Their challenges is mainly based on the local impacts, government management, and opne data. So mostly institutional. Even if you compare data by what we have in oil and gas, you will see that oil and gas SOE does way better than the mining SOE.

Q. Why it is important to measure the impact of sustainability?

A. I think because the impact is in every aspect, and also that they are multiple counterpart funding. The money is in different aspects. Many company donate.

When you are talking about licenses, you know that you are actually talking about people. Licenses is not very formalized. You can't go and get mineral licenses, and it is something that we are talking about mineral resources.

One of the things that we want to do is to publish minerals report. The hard licenses, is on a first come-first serve basis. For example, we have a bauxite mine in northern part of Ghana now, and what happened was that the company that it communicated the with the company that first came, they will have the license. So, it is normally on a first come-first serve basis.

In oil and gas, they do have such measurement. They have also took a look at soft issue regulations on oil and gas.

Soft licenses issues: talk to stews- social license transfer

Q. Soft issue regulation from oil and gas industry?

A. A work by African center for energy policy. They have a paper on local consent.

Q. Ghana on resource curse?

A. Question do you see Ghana in a resource curse right now?hat's a tricky question but I can send you something look at what we did on that sink nothing is God of the major resource curse I'm about to Ghana is a part of app resource curse and and is going to face of disappointment of the pre resource curse him anyways what's the Indian Hills to get the river of the resource curse are shared distribution is actually difficult question but actually but if you want there's a lot of things that especially they can look at the results girls in Ghana what do you see as the problem of the mining more on the community and more on the economy question do you see the issues of mining more economic or political of course if you contributed to the morning what are the minerals in other sectors and their advice is to change the source of resources sewing Ghana is not over all the very best the oil and gas in Ghana is doing way better and where you come down here and you will see the challenges are calluses he's doing married to local impacts and open data some are institutional question so if anything's on Paradise there are lots of money things and you will see that in the morning amazon oil and gas has done much better than money so we can say we aren't actually in a better place maybe that's what you're talking about about the sense that how mining is when compared to the other place I think how do you say the question using the financial issues impacting the mining problem remaining money is coming from many sectors coming from that private sector is coming from the public sector house or

something so it's difficult to track xcetera little buddy talk about licenses when you're speaking to people who so you know that in the canyon websites and find out how the mining contracts are given and stopping of you are talking about is about the mining I see that you want to do is that with people to see how they have a social website weed license are as long as you are doing that they're going to have or so we had the book cites file everything is as the company that does it is about the company that's licenses the formal process so it is actually about that mining licenses question basically as a mineral commissions so it's normally corrupted so there's not that much to accessibility to it so it's miserably licenses the licenses upper Valley has always been my license also used to be there there are the soft tissues how do you put that into practice because there is a mixed need to measure saucony shoes and various issues that's get to measure unfortunately we don't have that kind of measure to share guess we have it because the issues that mean they're all commission have the revelation make sure that's companies are obeying with the rules

Interviewee: Dr. Ben Ayree-Minerals Commission- Accra, Ghana

Ben Ayree

Q. have you talked to the minerals commission.

A. Mineral and mining Act of Ghana is very important. Every mineral in its natural resources

Section 5 says: subject to sub-sections

Mining act 703 probably know the everyminral Maybe coverered by tools. All minerals belongs to the government. The copy of the draft: national achieving Mineral right for veryone, wwhether for exploration or exploitation. So in law, a personcshall not posses the mineral unless it has been granted a license for that form the mineral sector. Minerals beling to the states, the lands minerals areto the people,. Mineral right: Land in Ghana is owend b three types of people:

Possible option of land ownership:

Owned by Governmnet Individual person Or a stew (a group of families who form a tribe or community. The rule is called the chief- a stew owning land and the land belongs to the community and the family If you go to this mall, you can recognize that section 72: people's right, but at the same time, mineral belongs to the state, so could create a conflict. Beacause it is my land and you want to take minerals out of it. Law: If I come to this land and I believe there is minerals beneath it, then I need to come and talk to you. I need to extract this mineral form the ground. Once he is agreed, you need to think of way soft compensation The process is that Ghana runs a min-state, where we have district assemblies.

There are 100 districts. Each district has its own administration. Which the administration

presents the president. So when you apply for mining acitiviy, because the mine typically belongs to government, you have to write to the assembly where you want to work, and say that this person wants to invest in this area. And it is needed to be published. For 21 say.s The same copies to supreme of the land saying that there is somebody who wants to work on this land. Do you have any objection. They will send you back to the minerlas commission and sy that there has been objectins to the project. So, they don't have objection to the minerals commission that possess them. Once it is processed, then you can go a bit more. iF you r owenerhip is shown, then you are subject to compensation. So, there is a whole part of the law to tell you how to tll conmenstion for that. So, you can still form it, buil on parts of it. On th other hand, if you have plants and houses, etc. they do extract of the mining activity.

There are two reasons why not: Alternative use: you souldhd justify that .For compensation. If two of you cannot agree, you can write to n assemblyto mediate. To minerals commission, you should see if it is possible to agree, otherwise ultimately nothing can happen. If people say, I simply don't want my home sold, then it would be difficult. They will ty to compensate and explain to you (!0). Law provides facilities for the government to acquire lands. So, government houls say, I buy your land. Wht you do with your money is your peoblem, Bt government could do it. Indeed the consitutitons shoud provide for that. Indeed ,the government should provide adequate compensation and it should be promt on payment. It looks very interesting if you look at the new law, about the use of partiulat land laws, I don't need to have anything in my land, I am entited to compensation. (Farnaz: look how bizzare and special this looks for them.) if it is the crops, you need to value what would be the value of mines. The important law for me is deprivation. If you cannot agree, it will be petition toothers. I f you are not happy, you an go to court for compensation. So, because of the conflicts between minerlas, compensation is important. So it becomes meaningfull for mining activity. Duality, land use, mineral ownership, quite a number of times. If the minister wants to give the right, the mineral commission all they do is to process the act.

You replied to the minerals commission theoguh your technical and general cost. It is the monister who can run that.

other question is about the framework for the miniter to take decision.I'vw come to notice that

Mining policy: The relationship between SDGs and mining That is a mineral policy and it is for keeping mining contributing to society, but at the subregional and continental level, the government of mining. I am sure you have heard of African Mining Vision. Now it is very instrumental. You go to the global elvl, you can talk about mining in sustainable development. In Ghana, we believe our mining can promote sustainable development. In doing that, that's what inform our laws. Quwsrtion is that: how it can interface with lots of other activities. That is sort of the context. So, within that framework, the ministry is supposed it act in a certain way within the framework of good governance.

Sustainable development goals are very important for us and they are crafterd into our policy. How to obitan license?

The ministery itself doesn't deal with only minerals. Three sectors: Lands-forestry-mining

So ,the technical advises are for the commison. Technical capacity: checks on the community. Once it comes, we shouldsatisfy themselves and what the application is saying. Who have the rights at all: send back to the commission and the commission make sure that it actually complies.

Do you see any necessity for the process of licenss? The law, the hard license, the "soft" laws matters, any necessities for these licesnes?

Reframe the ways:

The policy involvement and the regulations and they need to tell you what to do for Each different aspects. We want to improve and if they have any suggestions we will do that. For now, we are not changing it because we don't see the necessity to change. There are complaints from the government that the government do not get enough from the mining rents. Therefore, there are changes needed to be done from the fiscal regimes. But other than that, there are not plans for change for the next few years.

Q. Any communication platform?

A. Directives at any time, people can come to the minister, sometimes the place is full of people who has come to see the minister. (me:this is the sign for a weak institution.) On one extreme, that is what it is. The number of communication is a lot.District of minerals commission. I found this interesting. Largert operation: district office.

Chambre of mines is the association of mines.

The talk I had with him, any communication with Chambre of mines? The association with mines. We deal with them when we need to. On a quarterly basis, to discuss about licenses, to report to the minerlas commission. The commission in the report for asking questions. With mineral commission. A number of competition which rather frequenc, tha's how to see once they come into town. So, they read through communication and boss, and my other questions is tht do you see what they call esoruce curse whun it comes to Gold mining?

Fi you see resource curse, of you see that, which part of the resource curse do you seeas problematic?

The ministry of mine tells that illegal mining makes of 30% of the production, and it has so many complications around it. It is about the resource curse. It has certain rural communities, sort of some reports on that.

ACET: You go communities and see it has been a lot of movements and things going on because of mining. So it is one mining industry, and metal and envnironmental impacts, relatingour talk, do you have any formal or informal communication?

So this is the communication. The number of entitits, some of them are very frequent. So theyread the communication beteen government, bosses, and other entities.

Q. resource curse in Ghana?

A. Corporate Income Tax: Royalties, Dividends, Customs, Excise Duties.

Interviewee: Dr. Manteaw-African Mining Mission- Accra, Ghana, October 2018

Dr. Manteaw Interview

About Dr. Manteuw: He studied in Russia and U.K. This country was called a Gold coast. Now we have ended up highly becoming a poor country. Of course it is a curse. Especially with environmental degradation and underdeveloped mining regions. But now, Ghana is trying to make a resource curse in natural resource arena. There are lots of program in African Mining Mission. It is African resource print, to inverse resource curse in a country.

So I agree that Ghana is suffering from resource curse, but we should making efforts is needed.

Q. What is the dimension of Resource curse?

A. It is governance failure. It is not about institution, it is about policies, laws, institutions. If you are a country like us with lots of natural resources, you should do many things with natural resources. What role you want the R to play in natural economy? That should inform polices to develop. So the policies should help you with the mission. Then, you must have laws to make changes. Now, getting that the laws coming from English in structure then you should have regulations. This is the circulation. But the laws and regulations are there, we in Ghana have minerals and mining act, at 2006, at the mine when we don't have minerals and mining policy, in 2014 we had. Now we should ask yourself if they didn't have mining, which laws they were pursuing? So the sequence are not right.

Then, it is regulations. Then you ask yourself why small-scale illegal mining continue to be a problem in Ghana? That is because our laws price a market for marketing illegally. If I have gold, illegal mining, I can see it without they asking me when you can get gold. If I don't have a license, they should still buy it. The law says just buy it. So this perpetuatue to the laws.

Q. Why are you at ISODEC? A.I have passion in social justice. I believed in fair allocation of resources for most Ghanians. We started by experimenting. Our the policy advocacies are being derived from looking. We saw mining advanced insittutions. 40% of the budgets are coming from doing the consultancie, and raising from doners. Oxfam Netherlands.: UNC< UNDP, Society Foundation from South Africa. We don fundraising, but we also do consultancies. The other 60%: NODET (OXFAM Netherlands) OXFAM GB< UNICEF< UNDP< Foundation. South

Afruca, another development oriented foundation. They have a firm with public interest law. They have a micro-finance institution to show the poor person to be able to pay back.Doing special products for the poo. Loaning with paying payment monthly dues. They started with educationL: they give the girdl child scholarship program. Government embraces it. We consult government how to embrace government. We made a lot of impact that government adopoed. We gave the microfinance things the policy that they adopted. For example the government privatizing water. If that was the case, the poor wouldn't have access to water and also if water becomes expensive, they will use water from insanitable resources. So they made a campaign. Because government wanted to change it, they . The extreme governance of thought, the phone company. They believe that water is a public good and should we provide with taxes. They do the process in the wrong way. For examples, privatization

The nationalization of mining industry: not entirely?

Nationalization of gold mining industry: Nationalization/privatization of and industry can work with gold constriction. You should make sure that you do in world market. If you do national gold and mining companies. It is not national entities. I tis extinction to national world industries. Because the process will be different. You have a national company in Ghana, but the nationalization can also market the brand. Even they are a government department. If you privatize and the regulation if not that strong, you run the risk of losing out to the private sector. Some companies are two times more than GDP, so they can bribe anybody. So we cannot say privatization or nationalization.

In the marketplace of ideas, there are differences. But the professional bodies, NGOs, they are harmonizing the position. In the mining sector, we have national coalition of mining. We always do compromises and come to the same positions. Two coalition building and national platforms, they should agree on commonly accepting way of managing national resources.

Q. How to target mining towards development? A.About Corporate social responsibility through which companies secure social license to operate in countries. For every company, we should know the "good will" of the post communities. Some companies development program call it corporate social expenditures. The objective is buy the good will and the social license from the community. Because their operation can create local problem for their community. The companies provide companies from the community. Is it the role of the company to build hospital and roads? No, what they are doing is undermining the social contract between citizens and government. They government receives money for development purposes and the gold taxes. Yet the company are doing this project to abuse local government. So ideally, the government should use this money. So it is better not to work in a parallel fashion. The company is a corporate citizen. When they pay taxes, it will be used for business operation of planning. Once you participated in a planning process, they will choose a project of a meduim-term plan of development and not goals outside of a plan for deducting the development pland of a sistrict for local economic growth. But most of the responsibility should rest with government, because this is the institute which should collect taxes. You should return portion of the development

challenges of a development level. Because in extraion, there are always flow of people in the country Wen the y come with childer, they need more schools, more hospital, more sanitation, more garbage collection, it also in responsibility of local authoityt. How can local government cope with this/ A certain percentage of extraction of mine is sent back to local authority to address challenges of coming along with minerals. So the biggest role should be by government.

Q. For framing this social license, do you see the way efficient?

A. It is a matter of policy. In India, they have legistlated the same. So they give you am gining license, they tell you you pay taxes at this rate. In addition to all rates, you have to build two schools, and two hospitals. It is all bound up in these licenses. In Ghana, they have not legislated the same things. It is they ability of reconnaissance licnesw. There is prospective, and development agreement. When you enter, it gives you a right to notive befiore entery . This notice will come to the project. The company will suppose to find a way to carry people with them. What has been the problem is what the jkey things must happen before it begins. One is environmental and social assessment. They don't need to know ionly about positive, environmental as social impact assessment and a committee meeting for hearing, where the company come to present the report and allow for the report to be discussed whether the report is for the project or against the project. When the company comes, yu propose the hearing to come and tell them all the nice things without accessing the negative impact of all expectations. If these expectations re not met, the people now want to agitat and come back .but if they had done it respectfully, the y would suggest hearing and imapcts for mitigation plan this mitigation plan is to shre community how you mitigate the impacts. this is for particular arrangements withing the local communities. There are serious challengeds the way social licenses re for it. Omminutues are now encouragd to find agreements on companies on social responsiblityes for local agreements. Some companies are going out of he way for agrereement.

Local foundations, they have decided they onate one dollar to each foundation, and one percent of net profet to the saeme foundations, to the same local authority for local economic development. Which we are in direct response to these challeges. Are there initiatives being ineffective So this is t make those initiatives. It is for putting in law , and not something it would trest it. The development agreement between communites and the mining companies is a good start.

Q. WHERE DO YOU SEE THEPORBE/

A. They are challenges in enforecement of laws, but in local level, by the opinion levels ,they give people cars, giving them money, and treat them wells. But the chiefs (stews) and the elders do not present the idea of the leaders. They present the interest of themselves. Which is not helpful and I see a lot of corruption level. Weaknesses in levels and human resource capacity needed for Ghana is not adequate. They don't have enough people in ground to enforce the regulations. How do you see mining in the economy of Ghana today? As far as I have checked, mining companies have 27% of GDP of Ghana, so the 37% of the GDP stayed within a country, s procidedc, but 5% stay within a country. Whatever they make has to go back to the shareholders. What remains in Ghana, has to stay in Ghana. The rest doesn't belong to us that keeps the share

of local economy. It is good to know to make the local profits of share abroad.

Mining is making a great contribution that it can. The way to maximize the returns is to associate with Brands. So, if you want to nationalize, you should be prepared to nationalize the company in order to operate the rules. For example, the rules. So, they were given seed money and capital. Today, they are comparing effectively for the commercials. They are allowed for the operations. But in Ghana, you find a national company and a politician telling the company what to do. But on the other side, if you privatize and it is 2,3 times of your GDP, so they can provide everybody. They receive the envelope and close their eyes. Privatization and nationalization, both depend if you want to interfere or not.

Q. Are they different ways of communication between different actors?

A. In the marketplace of ideas, there will be differences. But citizen groups, especially the organized ones, the professional bodies, NGOs, trade associations, irnoning out the differences and harmonizing the positions. In mining they have the national coalition of mining, which ISODEC is a member, and others are memebers. Whithin that, we ague and disputes, and make compromises and become a position, which is the best of the country. Two coalition we should accept what is the best accepted way of managing the national resource.

Q. How

A. Corporate social responsibility: an instrument which companies want to secure their social responsibility, because they need acdpntance of the communities. They call it: corporate program, social rewsponsibilirttes, corportte local development. The company 1 begin to provide water, road, food, hospitals, etc. as for buying the good will of people. But is this the role of companies to build the road/ Because the local government collect taxes, receives moneys, receive loyalties at the local level, for local economic development, at least to abuse the local government. Ideally, the companies want to rule the government, tell them you pay taxes. Comapneis should merely support if they need. Not doing the compelemnt what the gov is already doing. Let me add that the company is a "corporat" citizen. They live in society, and pay taxes. Government should build taxes, which supprts the business operation of s company, for the company to sit on the table and develop plans. When the companies should do things in development, based on the plans, the corporate social companies. So, for me, the role fo company is very critical. But the most of responsibility is for gov. because it is what collect the rtents for national development. We need to return certain portion bck to host company for labes. There is always gonna be migration into area. Because they are looking for market opportunities, because they need more schools for them, and they need hospoitals, garbage generation, the additional bedding on its budget, the revenues of mines and minerals are sent backto the local authorotiy to address challenged that come aeound with minerals. The roles should be on state not undermining and parallel roles.

Q. If you want to frame these licenses, the way that is been granted in companies, do you see the process problematic?

A. It is the matter of policy. In India, they have registered corporate social responsibility. They tell you you pay taxes and royalties. In addition tho this, you have to construct hospitals, for these. In Ghana, we have not negititied these things. One you have the lease, they give you the license. The company is supposed it find a way to carry people with them. To me, what is the problem is the process before mining begins. One is environmental and social assessment. The more is to know impact .Once you know environmental and social assessment, is what the beginning. So the community is to decide the project. When the companies come, they assure the companie to come. They get jobs and money, but they don't peocess impacts. But they don't tell the negative impacts. This will increase the expectaions. Followijng the laws, they would have done the environmental social assessment, public hearing, laws: develop a mitigation plan: shared with the community, use to monitor the negative impacts,particular arrangements to public community. The policy makers are aware of this. Companies want to find agreements for the projects. Some companies have gone out of the way for agitations for development foundations. In case of Newmont, they have decided ot donate one $ per each gold to foundation. In addition they will give money to the local authority to decide ho they give money for local development for the reponse to challenges. How the social responsibility program have been ineffective. So these are how they try to make initiatives more effective for local consent. Once they legislated, it becomes mandatory, and not whay countries treat in a cosmetic way, as a good start. There are challenges by the opinion leadears; the acheives and elders they are being treated well. But the people are left behind, The chiefs are not chappined, that is where I see corruptions. Others are weak enforcement. Because the human capacity are not adequate. ITsa leds to ineffective enforcement of regulation.

Q. How do you see mining in the economy of Ghana today?

A. Mining is 34% of the total gold. But what stay sin te country os 5%. They are all foreign companies. So, whatever they make has to go back to shareholders; royalties, tax collection, and other fiscals, because they don't have national companies. So, when people say mining contributes to GDP, doesn't mean much. So, how do you see the mining potential contribute more? The services should contribute more? I suspect that mining can make a far more great contribution that we can see.

Not too long ago, the Swiss ambassador to Ghana stated that in Switzerland alone, they imported 10 billion in Ghana in 2016. Check with Ghana 1.3 billion the whole country in reports, not more than 2 billion. What about other places? What it means is that these goal outputs are going out through illegal challenge. So, it means gold in Ghana can be higher than what is reporting. It means weak regulations is easy to tke Gold out of country. So it is not strong enough for standard , similr to kimberlty process. Whether it iis small, illegal, or upper case. But in Ghana they said is 2 billion.

Maybe 3 billion. But other are going through illegal challenge. No royalty, no taxes, Everyone coming, bribe their way for royalties, taxes, nothing. This is money we have lost. They should take by Swiss embassador seriously. The investigation should tax. For further details, they

should get to Swiss customs. We all belong to Swiss custom Union. For importing Gold to Swotzerlndf, and see how the Gold went out of companies without notive. But sometimes, we take laws for granted. Yesterday,the Britihs newspaper sid Ashantehene, chief of Adshantis, they suspected money laudering case. He, Otumfuo, carried money, 35000 pounds in a suitcase. It wasn't declared,he called the bank, called the bank to come and tae this money and put in in another bank account in Jersey. The point is this thattis imformation comesup in newspaper: Source of money, taxes, whether the necessary approvals was sought before currencies ewithout of the companie. More important than corrupton, the person involve isvery much involved is very important, to the extent that even the president of the country cannot make a case against him (cultural barriers of the resource curse) because he is a very powerful in the country. More respectd that the presdent itself. The cevelopment peogram ended, went to the intetnational review and evaluation. When completed, the evaluate wnet for the international resource panel for evaluating the report. He was in the panel. They discussed that the main reason why there is so much illegality in the Ghana gold mining sector is vested interest. What it means is that: almost all the people who have power and authority who can do challenges are in the sector and are benefiting from it. This is the problem. So, sometimes we hear that there are illegal mining for that. There are task force for mining that they can do location because someone will tell them. The regulation bodies, etc. Everybidy has interest . It works on mafia situation.Even that, there are challenges that. If they give you 100 0000 S to spend on the community, they add it to cost of operation. And they reduce the profit and task to the government. The law says that you cannot add it to cost opertation. You have the right to commission general for permission to do so. A lot don't seek but see it and it is do low. They will build school to add it to the cost,For increase the cot, rhey will loose out.

I am invludec and the lead consultatnt afkr investmebt of African Mining Vision, where African countris should see where they are and where they should be. I walso work with the World bank for 5 years, he works at ecxtractive industries advisory group, and co-chairman for Ghana EITI. So he comesvery closely with challenges in mining secotr.

Q. Are there any human right issues?

A. In this country (Ghana), our mining sector balance sheet is incomplete. In accountring, you the cost and accounting sides. Though in theside, nobody is talking about the sites, Ghana two billion dollars from Gold exports. How much it costs us? How many lives were cost? How many jobs were lost? How many farms have been destroyed for these two billion? To their host communities for their revenue. I had the opportunity to review a report which was produces in a consultant from the U.S. for the consultant in the economy of Ghana. 40 000 jobs since Ghana, direct and indirect. My question to the researcher was: how many jobs and livelihood destroyed in 40 000 jobs. Talk about net not gross job creations. Farming were displaced. Many other, but they were displaces in mining. When talking about how many jobs created, talk: how many livelihood were destroyed. There is not enough environmental and social accounting. Maybe we should discover tht money is not sustainable venture. This is partly therresapn why mining is ther and why we are poort. And opther people.e There are then sublted with cost

and environmental degradation. Wherever you do mining, there is always be contestation for land with mining and agriculture and it will go up for the food securioty, Ghana cannot show anything for the minig 100 years of economy It sounds a nit doomed, but unfortunaltety and sadly is a matter. Thus, Ghana is country which is affiliated itht the resource course. Farming and Coco is what 60% is employed by that.

Q. Do you think if they have the capital, the problem is going to be solved?

A. The reasons is when you look around the world, and consider countires that are being able to get the best out of natural reworces, these are the best who are themselves participatns of natural resources. Countries are leaving the extraction oil (BP: British Petruleum). A state-owen country. As lot of money is retained from the company. It is leading the steel in the UK. Norway is in Staroil which is in the process of retaining the economy. If you go to Middle East, lot of them do service contracts: you come and extract, but it belongs to me. You would see in South Africa, you would see 90% are South African. In Canada, most are national. So, those who are getting the most, the yre what qho extract the gold themselves. The companies don't have to be necessary extractive. That is only when you can ake the full house. So, ll the profit are to support economies in Ghana.

Q. Discrimination of Ghana government between revenues for mother countries? They are coming to a tax paying position, they law allows that company to get 100 000, and the price I allowed to get for war. Mining is so much capital incentives. So, money is 10, 15 years to recover investment. But indeed they need this time to get revenues and pay taxes. This has been addressed. Recently, Government took a decision that we do not allow government to mining only recover 20% over to 5 years to recover the cost and then pay the tax. So it means that they can come to tax paying position very early. They are policy changes. It is not discriminatory because those rules are applied to Ghanian miners. What is discrimination, is the geographical data. The geographical data are being given to the big companies and not the artisanal companies. That is why lots of them don't register themselves, and are illegal. Maybe with the government with the subsidized cost and geological data. Then, the government cannot tax them. But because they are no support, why do you have to register? Big companies geoligical data, tax support (paying taxes later) this is how they are integiued to register themselves.

Q. How they are registering themselves?

A. If you had a national mining company, which is mining your gold, because the gold belongs to you, you can send all its gold to south Africa to refinery and find that gold field is a shareholder in refinery. If you pass a law that you have to refine the gold in gold country, you find a goal in companies, and the jwelery makers are gold to do jwelery. The minerals and mining act, 03, provides Ghana to take its eoyality n cash and gold, and royalty is 3% of production. I stop royalty in chash, and give to gold. SO, give jwelery to gold and get value flrm that.

Q. For the refuney firms,

A. It is not just about capital. It is about economy of scale, my unit cost will be too high. Becaue it is fixed and variable cost. So when you divice them by variable cot it becomes to high, So they have challenged. Ghana want to do fetlizers. In South Africa they are doinghuge olums, so fertilizer is going to be too high. So you cannot compete with African countries. If you ave countries in all gold in Ghana we are the second largest producers in South Africa. All know it is a good ideas, but we cannot do anything because of the tied money of development. We cannot change anything no.

Q. How you you gather your information on ISODEC?

A. How do you act? We call for eviidenc-based advocacy. We get primary data, do analysis, and challenge the existing data. We get data, do analysis, and bassed on finidng, we challenge policy reduced. Form antagonistic type of engagement, we are now engaging to share our policy paper. ISODEC, EITI, so we see ourselves as partners and rivals. (another example of vested interest).

Q. The indicators on how mining should operate?

A. Every country works on the comparative advantage. Switzerland, India, etc. In Ghana, it is natural resources, the MGDs suffered greatly because of bagging toeartds MGDS,We are saying that the revenue should come from within. There are a lot of money coming from within. We did not export as much. We did all the linkages and plug them to finance SDG goals. Without effective and improve management of resources, it will be difficult to finance the SDGs.

Interviewee: Minerals Commission-October 2018-Accra, Ghana

(my general impression about this interview: so superficial and rightist views)

How do you improve mineral taxes.

They have two mains of mining in Ghana: Big & small ones. Small ones: not rigorous in big ones. If you want to go to the forest, you have to go to the additional process. If they want to go to water, they have to go to water commission. If you want to mining not in two zones, you should co me to them. Two forms of mining: the small-scale miner, they may just come and wash it.

The fiscal policies: companies pay 5% royalty, revenue. Pay corporate tax: 35%. These are the two mandatory payment for mining. It is for all, but it is not easy collection.

Some politicians, chiefs, or minerals commission employees, might help some people to get licenses in a corrupted way?

Out system is so transparent. When they want to submit certain agreements to take care of. For a number of years. What they usually want to change is the corporate tax rates. The tax is what apparently affect them the most.

Even though the countries need to have agreement about taxes. The problem is that if they speak with government, they might be able to pay less. They can go by government agreement and not

what is in the book.

The law says you have to invest certain amount of money in a company.

If you have the initial money, you can do it. Act 703-2007.

The resource curse?

The resource curse doesn't apply to minerals. Resource curse for soil minerals, all refers to them.

So you see a possibility that the quantity goes out? And otherwise, the tradition for revenue. The system.

Mineral Development Fund: It is for development facts. Previously, a certain loyalty would go to royalties. So, this addresses the issues. The idea is to push more fund into communities.

Why it hadn't been done before?

You look at the needs of the society. You develop policies for meeting their needs. Because mining affect them. Every commission exceeds. Why is that we are developing: Because we have access to mining and amenities. Even though there were problems, but in general there were improvements. The fund should be redirected to local communities?

Yes.

How do you want to reframe licenses?

They grant licenses depends upon how they start to get it. The ability to information, the area that you want to go. Ensure that the activity don't impact on the density. We have certain distance that you can mine. Regulation that you can have mining. Areas that are traditional. Sometimes you can order as such: social aspects of the people. Even though we are in Accra, this company has applied for this amount. In you view, the administrator, is it going to grant it to this company? -> apply it to them.

Representative for local people?

Stew. Giving that, you have to go to the stew. The land belongs to stews and families in Ghana.

If the locals and the miners don't agree, they can still go ahead. So, the land is for the people and the mines are for the state. You can't prevent someone for mining, but you can negotiate. Once you have the mining right, you should provide with rights.

It is in the discussing phase at least.

If I am the land owner, you first should come and do the feasibility studies. The should undertand why you are there So, before the start any feasibility studies, they should get the permission.

Q. What if they don't agree?

A. There is a process. They send a letter to Accra, send it to commission, and before that we will see if it is possible. Artisanal mining: There are two forms: legal and illegal ones. If you ask me, it is about how you would describe it. But with small-scale mining, we get the data from locality. The small-scale, they possess that in the biggest level.

Do you see a need to direct licenses to a specific goals? Can this problem be solved if some measures are introduced for the licenses? Or they is already there, but it should not record the water Before you give licnese to small-scale miners, do you consider other issues to reclamations, water bodies, etc? because they destroy water bodies and do stuff/ If you consider all thse things? Before the license is granted, environmental protection agencies, all these have specific roles, we have collaboration with forest, what are resource commission water bodies, so that the environmental issues are being taken care of. So it is not in a back role, because they are some policies regarding consessions near water bodies.

For us it is a small distance. The small ones, they do grants, concessions, we have special interests. The destruction are most for illegal miners:

Normally, the small-scale mining is fine. No, the idea is that using traditional methods are. If you give a small-scale miners a license, within a short time you can get it. No data, no license. So, the small-scale is a a part of the mess.

Interviewee: NRGC Accra, Ghana-October 2018 NRGC interview transcript

For a long time, it is an important revenue for the government. However, the mining sector is very well managend because of the frauds. Their total income generator is high after coco, but very smalltime. For a long time it used to be a sector important for the government mineral process. However, the mining sector is not very well managed. To start with different benefits from mining, from total income generator out of mining, the percentage is from the Ghanian economy, which is very small in mining sector. If you go to an old mine in Ghana, mining is still an important sector of the economy. It provides revenues for the government and activities. The amount of revenues generated for other country, is very negligible, compared to what happens. (but the environmental impact is high.)

Obasi has seen very little development. It is partly blame government, but mining companies also they don't take on board proper development of communities that they work in. So it is a downside for mining for environmental and social mining for the country. One other issues for Ghana mining sector is that value chain is poorly developed.

For a long time, mining was used to be the second sector of Ghanian economy after Coco. So, it is still important as a source of revenue for the government. However, the mining sector is not very well managed. It is not and efficient income generator. The direct impact of it on the Ghanian economy is very small, compared to other country's sectors. A lot of mining revenues is retained within the communities, as one of the shot falls to the community centers. Mining is still an important sector. It provides revenues for government for different activities. However, on the

scale of things, revenues generated by the mining sector and the country and the governmental is very negligible and very small, compared to other areas of mining.

If you go to Obasi, which is one of the oldest mines in Ghana, you will see very little development. It is partly blame on government, because government gains revenues for mining and then use it for other things. But then the companies themselves, they do not take into consideration the area development communities they work in. So, this is one downside of the mining, aside from other environmental and social negatives of mining that the country bears. One other issue of the Ghana mining sector is that the mining value chain is poorly developed.

It is only when you do the value processing to it that you can sell the mining ore for the premium value mining. Then, it will create a lot of jobs in the value chain. Yet the mineral value chain in Ghana is very underdeveloped, and so we are unable to retain most of the values from mining activities. Almost everything mined in Ghana is processed outside of Ghana with value addition to it there. So, this is one thing that the mining sector should go for it and that is what we are planning on to correct and make sure that the mining sector can have shares in the economy and that is the new government initiative to make sure that mining is not isolated and linked to other sectors and make sure that it is for the value chain. You talk about the case of mining: Dutch disease? Yes, Ghana has experience that largely because over the years we have not replied solely on mineral. Minerals and agriculture. Durtch disease : on the striutives. But in Ghana, also other sectors of economy, Interestingly now, the largest contriburtes is service sector. Rapidly developing and contributing to the economy. Again, things can come along when we wantto explore. Currently , we are doing well to suppress our resources to tourism, for example. A a nation, we have specific policies that relates to mining? Yes ,there is mining policy and other regulation and acts that control or regulate the mining sector. There is a legislation in sharing loyalties. There are legislation on who do mining, environmental protecting measures on mining activities, host of other mining regulations and legislations, but speaking of mining sector. For instance, the minerals commission, the ministry of natural resources, something that relates to what should be done, what are regulators, the mining sectors. About the process involved, before you get to Ghana, first you need to acquire the land, get the license first for exploration, minerals for entities for mining activities to take place, then, get a land properly registered. After all these, you apply to minerals commission and you do permit for number of years, and then get to renews after every year.s The reclamation point: is when you put some money aside for retoring themain land activities. This is the main arrangement for it.

In the last two months, the cabinet has not approved it. It depends on the scale of the mining consession. If it is not foeigners, so that is when the parliament has the final say.

The contribution of minig to Ghana economy: Can the potential be mor to the Ghanian economy, if we move away from mining and exporting minerals to mining and refining in the country and develop the value chain and goal be used to jwelery and a lot more. But, importantly when you develop value chain, you do emplymnet, you export processed materials. In that way, we get a lot of money from the gold extraction, remaining in the country, rather than the money staying

outside of the country. Another area that the minin sector needs to be checked and it is what they called, even the accounting system is such that the under value and report, the amoun of taxes is lower than what they should actually pay, so that the bulk of money stays outside of country. If a mining company wants to buy books, they prefer to buy books from conterparts of company at very high prices. So,a lot of money is for counterparts at very high prices, so that money in the country is that the profit margin is lower than the payed tax. So in terms of water etc. is very important thing. So in expending chain, basic things, so the mining stays outside of coutry, do we oose double on that, so the large mining and companies are fdoing and getting capital outside of country instead of relying inside the country. Also, if we can imprive the value chain, and make sure that it lays to other part of the company. We can also extend it to tourism, whereas old mines can be attractions. Ghana is famous for Gols, so it can be used for tourism, so this can also be a source of money from mining sectr. So, one of the project is to provise bauxite industry. It is for make sure that at least wer have an international standard of Gold refinery in Ghana, so we can start refining Gold in Ghana in such decisions.

In your office, how does these decided rules translate into making decisions? The decision with the ministry in charge of mining: natural resources, and minerals commission, it is discussed with all the stakeholders involved, and then it is included in a plan. For these 4 years, these are the goals we want to achieve for the mining sector, and these institutions are responsible to make it happen. So, every year you get a say of what is expected from you, on the rule that what rule you have to play. Now, with many of the things, the biggest challenge is o find money to fo these things. The ministry of finances comes to play this. Do we get a loan? Do we go to public-private partnesrship? All stakeholdets are identified to make it happened. We heads some plans but they do nort happen. It is due to number of facts: we couldn't find the money, we want to do something else rather than refinery. For the aluminum industry. For some partnership so make sure that these happened .It even becomes more important that the government says it, so all the stakehodlers should try and make hard so that they make sure it will happen.

Q. Why do you think they haven't ahhpenend so far?

A. Some of them are systemic issues. The procurement thing, for instance, what are they doing are not illegal, it is legal, and government canno stop mines feom trading with other countries. What they do it should come with dialogue, so that is the3 approach that should be taken, Encouraging things to be done differetnyl We intrioduced a law called localed pointing law. Started from local industry, for some critical actitivies, for getting licneses fro Ghana or other companies, so provide those groups and services, starting from abroad, so benefited from company, procurerment from goods and services, expecially basic laws from local first and countries. Added values from minerals, from challenge has been finding the gold refinery. As of now, they still haven't found a private sector partner to do this in Ghana. On the other side, there are big powerful organization which are against it, because it takes money out from them, so a lot of opposition especially who just export from raw material rather than value addition, these are major issues why it hasn't advances yet.

Q. Any solutions for this?

A. STARTING WITH NEGOTIATIONS AND DISCUSSIONS TO SEE BENEFITS OF REFINERES IN GHANA (Shared benefits) as win-win situation. The other things are most multilaterals have controls over resources, but because they have been given contract to mines, some mining contracts are begin pre-negotiated, so they can be dealth with, but ther challenges of the issues between oil refineries, we advise government, we believe that we should ,as a country, we should have data to support the decisions that they will make. We can use that as a basis to negotiatie with big operations, either we renew licenses, or we keep them out. If so, they will easily walk away. We will have a lot more minerals in other palces, so we can usesuch value chain for the mining operators. Many of them (many businesses) can be there instead of kicked out or stopped. Negoriations- data for basisi for nrgotiations for now and in future- First ,there is a government negotiation team, for taxes to renew mining agreeemnts, that is for negotiation mining companies. The other informal arrangement is society organization provdign evidence , options to consider, and making proposalas for government, and mining companies. These are indirect negotiations.

The direct negotiations are between the government negotiation for mining companies. Oher indirect negotiation, other government agencies, even the people communities provide information of these issues. The economy impact of traditions. The economic mining impact is huge. First, it provides emplymnet, Second, by provising emplymnet, they pay thaxes so government will receive money. The problem, though, is to magane actigivies with small-scale mining. Before, the mining scale is done traditionally, But noe ,pwople aer usingbouldouzes, and now small is medium and arge, so the traditonals were not using the min the past. The graduation from simple and basic sources of mining is now sophisticated, health and social issues. If we can regulate small-mining sector, it should play an important role. In terms of communication, it is how you can get politicialns to deliver. So then we can show that what we can do. So, if thereis a demand in general public that we want to see a gold refinery in Ghana and there are public support to it, politician should be willing to try to make it happen, because that is the mean for them to receive vote. This is a maze of demonstrating that they are doing well politically. So, what they need and what I advocated for is that make the cuase public so that everyone can hear about it and also the country, when we do that, politicians are more keen to response to the demand of the people. Many people in Ghana and other countries do not take a keen interst in national development issues. So, they don't care and know what is happening. So, we want to change narratives netween local communities, ao what is expected from local leadrer so make them accountable. What government is expected to do, so they can hold them accountable.

The existing regulations are not effectively enforced, so the mining companies get away. Even the regulations of improvement with sector. that has been done for the mining sector. It is one of the things we are working on to to correct to make sure that the mining sector has has length on the circle of the economy. So that is baaically a new government initiative sure that the mining sector not isolated. It is linked to other sectors maybe only then when realizing the link with this linkages work and make sense april I got outIt provides revenues what a

long time the mining used to be this second sector in terms of the revenues for the country and it is just sort of important for the revenues for the government in my eyes the bay mining is managing the country is not very well for example if you look at the revenues got from mining is rather negligible compared to total income generated as out of mining percentage within the country compared to other countries a lot of the mining revenues has been remained local communities he's one of the shortfalls of the mining sector if you go to the ER or Joshua's which isAlthough mining of the steel that important set there for the economy because because he provides revenues for the government compared to other sectors however on this scale of things that the amount of add the amount of revenue's in the money centers compared to other parts to compare to the revenues for the government is very very negligible I should say very very small the revenues in the other areas of mining if you go to Abbasi meaning Ghana you will see very little development the little now now partly I meant because government 4 responsible for Mining and then use it for other things mine is also don't get themselves on board for other communities I should say the communities that they weigh in and he's one of the downside of the mining about environmental from other environmental and social negative aspects of mining that we seen the country and one other issue about the Ghanian mining sector is that that the mining value chain is poorly developed. It's only raining process the value of change of it a lot for example selling a premium wait to the morning you would see that it can create more jobs a lot of jobs that's the money value chain in Ghana is very very underdeveloped so we cannot retain a lot of values from the mining communities it is mine in Ghana is processed outside of Ghana. So this is one of the things that we are working on to correct. To make sure that the mining sector is effectively link to the other sectors in the economy so this is actually a new government initiative to make sure that the mining sector is not isolated it is nothing actually to the other sectors and the only way to make sure that's happening is to make a value chain more effective question have mining sector in Ghana experience are the Dutch disease gina has an experience that largely because over the years we have not rely solely on minerals it has been minerals and agriculture those are those are the two the two main sources of revenue for the government states where the duchess is comes in where you focus on the extractives and then neglect other sectors fortunately for Ghana we paid attention to other parts of the economy and interesting now the highest factors that contribute to the revenues today is the service sector is it has not been agriculture it has not been mining so the service sector is a rapidly developing on the and the economy than the extractives another agriculture around make your own if we if you employ oil and gas and we explored been the contribution of the extractive will go up we are doing well to express our resources I've mining at old job and services and we have been looking at your tutorials and which is a another major source of income do you have a question do you have a specific policies your colleagues suppose your dad would leave to mine sector and the other sector I think it was a regulation on sharing the loyalties about who to share what and get what there are legislations on what to do watching get what on what type of mining regulation on the environmental and protective measures and taking us and doing mining activities and host other mining related relations and legislations about the mining sector for instance the minerals commission is the body for regulating mining also the ministry of mines and natural resources policies that are released a mining and a similar activities in Ghana are

you talking about where are the future aspirations of the mining sectors Etc there are policies that are documents for that money center question what are the licenses of mining whether or not that much regulation license of mining on what they are practicing for islamic details they would be on the mineral Commission so before you get the money license in Ghana first need to acquire the amount it is about a designated area you want to find in a license face for exploration add to determine whether indeed there are minerals to exploit and what activities will take place in about you and tell me about about the environmental impact assessment papa Ray's registered all the after all of these things are being done you're applying to the minerals Commission that will give you a permit at the mount to mount to mine a specific area or land at the direction of music is usually until the end of the year to California with after the end of each year if I die alliances Arrangement if you today it is what is called the Reclamation of mines why do you put some money aside which will be used to route 5 denigrated lands afraid of mining activities are. So in general this is sort of arrangement of mining licenses in Ghana question when we had these we bought the bauxite mining and the problem was that the cabinet has not approved a car made with common terms of licenses it depends on the skin after mining concession face it is Larry best a dip in Spanish officially also if it's involves foreign companies essentially what are you saying is that we didn't put minerals into the hands of the foreigners the system of checks and balances for saying so that is why I need to go so happening fortifynance question I want to ask you about you where the important about the could you douching of the city Ghana's economy so I don't see any cities do you see any points that can be improved for the mining cycle can be improved and make a lot of more contribution to the union if you move away from just mining in a minerals and also do mining refining you all do some earning value chain in the company and develop the value chain in the for golfers are all the things it's probably more important things for other and I love more the running people of the value change and thinking means you look sporty not as raw materials projects for kids my precious materials that has a lot of more value chain Joseph sporting gear all things in that way we got a lot of money from the gold extraction remaining in the country rather than mind is made out of the gold part of the country another area that we can exploit of the mining sector is the question is there any mining policies already yes that is actually mine and policies already in place and there are other regulations f controls on request in mining Center and there's one on the is legislation on sharing loyalties and that the one that goes to who gets what start a collection on who is qualified and doing mining in the country the revelation of the environmental a measure is measures digging embroidering mining activities my name mining legislations and regulations that speaks to the mining sector so for instance price on the minerals commission by law is a buddy mandated to regulate mining activities ministry of Mines I'm rush-hour resources deregulate money activities in Ghana and the way it should be done what a future aspirations are in and the licensee regimes Etc their policies and documents for the mining sector so if you're interested in learning more go and talk to these commissions when you get the license of mine you go we will Google for the process bacardi amount and look at it is ignited the area you want to mine for the space there are minerals in the commercial entities for the mining activities to take place carrying out social impact assessment and get them properly registered it is. It is only after all these things has been done when you applied to the minerals

Commission and they will give you a permanent for one year question what about the mining of bauxite it depends on the scale of money equals large mining and his needs to get the license from the winning loss Commission I think especially also if it involves foreigners question do you see any areas ready to be improved yes there are lots of potentials for the mining Indiana to be improved and contribute to the economy most importantly if at all do some refinery in the country volume changes that could be used for gold especially about a jewelry it can be made and put a lot of more values on value chain importantly when you improve value chain you create a lot of employment you you don't only export your raw materials you own so export your process materials it has a lot of more value in compared to the raw materials in that from the gold extraction says get a lot of money meaning in the country rather than damn I needed his money out of the gold staying outside of the country and another area coolatta when the accounting systems are the mining country is the way that is under value of the what they get for the amount of taxes they pay is lower than what it should actually have been and they engaging lots of all of these procurement practices search that the bulk of the money stays out of outside of the country. A typical example is for instance what are usually found nevermind the mining company wants to buy some Goods they prefer to buy the books from some foreign companies prices what means is that a lot of money is given to the foreign car on their part with a very high price test so that mining in the country but then also margins lower euless Texas is it going to send that awesome Con mining communities and for things is the difference between your expenses and your incomes basic things the money stays outside of the country and one of the practices that can be reformed you're doing lost like that if it would have strengthened hours where to redeem and also if we could improve the value chain well YouTube and make sure is linked to the other parts we get a lawn mower my money sanders as far as tourism weather out of old mines so Ghana is known for go so I love gold mines people can, see how he's mine so that the stories them so this is about the mining sector so upset buckeye industry 1030 Brookside into Armenia is one of the parties going to table and how to national Standard of gold gold refinery in Ghana so they're golden refinement when you make such rules on decisions when you getting this is your new office houses translate to the rules and regulations in the country make these decisions add mystery of mine mining and also minerals Commission stakeholders involved in the sector and then his included plans of Frameworks which we do every 4 years so we say these been this for years these are what you want to achieve for the mining sector these institutions are responsible for making this happen earlier you have that says and how well you're implementing so minerals commission for Christmas will put into Appliance of the rules that they have to do is would have to play their role connection to make sure that his happens now one of the other texture the biggest challenge is really finding the money body Spanx we want to set up a refinery miss your fine ass calm and play an important role about where do we get the money public-private partnership the prices locally and internationally to make it so all the various stakeholders are on 35 to make it happen we have some grants plans and things but really happen sometimes that is not happening at his due to number of factors first of all about the money issues that come up and we cannot borrow things and do things the weather for Ability how to find it serious about older finally and that's free so we are still looking around for money I probably why she isn't to make sure that these things are having and even becomes

more important he's the president never mind is going to do this on the sinks there's another way to do it and all of that stakeholders have to work hard to make sure I just had that it does happen question why in your eyes lazyvlog Mass that is fine dining Ghana why do you think that this thing's hasn't happened so far the there are some of these things are systemic issues for instance the procurement things for his stance what are they doing is not illegal this is a difference azurite to buy they can decide whether to do what government can all the stop that mines from buying from other countries trade probably due to the free trade that cetera so what they are doing is not helping Ghana so it comes with dialogue so it has been taken dialogue then and to do things differently I think as a 5 years ago baby introduce a law ethan is at the law and the law says that oil industry for the others that they're saying that for some critical activities lona requires that services from Ghana companies organians firms zen Services instead of doing everything from abroad so it was about the new law that's taking these things I'm doing all this for humans inside outside of the country king from that law means that percentage of a procurement Services cannot be really low for Ghana especially the basic ones provide us with the local firms of Ghana on the other one added value to the minerals on the table and nobody has talked about it for a long time and the challenge is the fighting the rights you show me the government's when is it going to go for the Partnerships that's going in Billing the finest as soon as that's fine and has that the state of find a partenr for doing that in Ghana on the other side that are also the big powerful nations that the other against it it will take the money from them also some lobbying for a lot of positions especially from the huge multilatterala she does export the raw materials rather than where is value addition in the country can get a lot of more money from them what is a renal disease are some issues about why the money value chain has not been developed as much until now question you see any solution for these we have appointments and solutions suggested to the people trying to show them the benefits of these solutions for them and for the country well that is all but I fit but they can also get some benefits you two have some discussion see that this actually a win-win situation the other thing is most of them all tarantulas have the money government hasn't got that money government has control of the other resources because this has been given a long-term can't go in and stop the contrast lottery the contract to get to an end a lot of his contracts are actually being really negotiated all of these issues can be dealt with by the a line with a powerful mining companies and then d it was about to all their finery we believe that shoot tree baby also think that we share that's a country have enough data the decision that we make so if we can correctly access to be mines use we can use it as a basis to negotiate with chance and then at the end of the concession. There are two options either we give them license to continue remaining or either we kick them out come out that wouldn't be any mining left and they can easily walk away I have a lot of more mining it'll be there with linda mines value chain to negotiate with them corporations of course there are many they are like many other businesses to think long-term it's all better for them and they go outside then being restored and that's it and that's the approach we're using first negotiation second we have quality Ada of the mineral resources and then use that as a basis for negotiations for now question how does this dialogue usually takes price I mean there are lots of different stakeholders first there is a government negotiation team this is Justin team always sucks as a review other mining initiatives. So that is a late to negotiation

with this stakeholders and companies are Arrangements the other form of arrangements varies based on the size of the organization's everyday some options to consider both government and the mining company can negotiate so those are indirect measurement negotiation the main negotiation is between the government negotiation team and them were they mining companies other indirect negotiation that is flowing yes I have the government agencies said they're going to station to provide information for engaging directly with a mining organization and these issues. Question what about the traditional small-scale mining how does that impact the government the economy impact is huge because it provides many things famous and secondly by providing employment taxes so that the government receive more money smoking skill mining has to steal and main important role to play notice how to effectively manage today the smallest can lining now previously small-scale biting what's the name of the local communities hell would not sophisticated equipment for mining but now people are using bulldozers videos of Carlos Carlos can mining has become more of a probably large medium scared money because there are dummy calls with traditional small-scale mining was not using in the past so we have seen a graduation in small-scale mining small very basic level up mining for it to become sophisticated cows with many Environmental jones Day health and safety issues and the social issues as well we can effectively regulate the mining smells can mining sector it is a very important role to play in in terms of an ink resin job creation and employment spell brats regressions and in terms of government regulations question licenses how do you say the hard license says also reflecting the social and soft aspects of Licensing the mining process itself can be and it just been different agencies darrell Isis is phosphorus a mining company so and what government is looking at doing the same lighting the license as a mining process and also move it move it get onto an electronic platform when the application of Vining can be done over the internet on our floor and decor arlington to a network a tall size fitted I'm making more transparent and one of the challenges of the mining sector is that there are a lot of the mining companies coming to Ghana are worried about the transparencies at the learning process not transparent game privacy before they the licenses so it. Potential investors transparent small reliable and more efficient license to regime I'm sure we get a lot of more direct investing is of mining sector that box has already started question do you see an effective negotiation based on all the online platforms or a bit of both online and onsite negotiations fight to be more transparent is also has to be thing a lot of participation rate processes so what is money to manage both sides the participatory process as well as the online practice test if there's a requirements and as part of the life as a biology Arrangements unity Arrangements and Community stakeholders what in the community he can't do that only electronically because most of their Community mines in Aurora areas so in other ways it cannot be done so it can't is the way to go I have the engagement with their stakeholders in the community what do you do I need to do is to provide that evidence tax form thanks for being a form of pictures sorry Force for the community participation I can't be uploaded on the system yes the consultation has been done it has been the outcomes and this is we're going to take it Forward secondly especially the environmental impact assessment and regulation says that environmental impact assessment it can also be put online hawaiian dress at figure that says today also it's good car accident processes dolls of a friend as well as the district office and a TPA of the Environmental Protection Agency where people can call and and there is

that and there's also the online regulation who can get the information from question do you see any institutional problem in the mining value chain so not the only economy the problem is not the only one reason is a mixture of variety of reason of why mining hasn't contributed to the economy that much ice is potentially could have done navigate shoes so things are good for financial management is Santa converting mining system what about government using a lot of revenues and capital flies and also issues about poor relations a mining sector and then I was you allowed a political whale you say Georgia is also another problem tattoo improvements at the money center I'm sure they would have found ways but there's also the Civil Society is of also I was a problem I become you today is that as in a country where the Civil Society and then the communities have destroyed because they think that maybe they're not benefiting from the mines, Devin destroy followed the mining so in some communities there is a very hostile relationship between the mining companies and the local communities so not going to help events at the mining sector question how do you kind of fear medication oxygen rules and guidelines personally I think one way wish I could relate bromine as a country to develop names of mental regulation things that try to get down is public advocacy and then and for me that is how he gets for additions to do it's because politicians ask for divorce and then when they're asking for the people that about that is what the people want and that is what I'm going to do from the people the General Public I want to see a golden find out in Ghana and there's not that much support for US postage rotation that are optional for that because for them forget about it send me the remaining in power is that means demonstrating that they have doing welcome to Korea do we need and what I advocate for is making flies ready for black so everybody knows about it and generate the public demands for what we know what we going to do with the country and us as politicians are more ready to respond to the demand and I say that because many people in Ghana and probably other countries do knots kitchen instant interest in development issues and sell really care don't know what's happening anything that is given to them they want to change in another way how to make an interesting development of the local communities what is expected of gold local rillos I look at food I'm all accountable and that's why when we know what they expect to do so that is only then when the people of Ghana know what is basic with her for them to do question do you see any specific sign of corruption Going to the Country what I could say is that guns are not effectively enforced so my niggaa movies can get a lot of different ways because I'm about to have it done properly in Florissant that you have it will say I love you and prove man see that says all right

Interviewee: Ghana Environmental Protection Agency- October 2018-Accra, Ghana

Transcript of EPA Ghana

Q.

A. The requirements of gold mining varies from the largest scale about the processes and ev-

erything so it depends on what there is one type of reporter the other small-scale gold mining they don't reflecting the reports unless it is specifically requirements but I want but otherwise I won't suffer yeah that's urgent documents what is the side door insulation bring the report and the review I'm based on that they only ever comments to go to the process reconnaissance prospecting and then going from the reconnaissance to prospecting and then let's take the money will go to the mining's scorpions gold mining after which so it depends on the scale based on the scale and also the location of mining the process varies formosa desk L desk is by most about the game yes we supposed to generate bad witch in fact very much the traditional the very limited scope for small impact just a simple assessment that's right now realizes that for now you have to change the and go back to strictly to that small scales which are we doubt that any of the call Cheryl not since then you have to move to D level of The Middle describe the role of us assessments but then because we are catheterizing under the smallest scale we are still maintaining the area is particularly in the smallest small area which is environmentally sensitive then you might want to respect you what do you call less environmentally sensitive.

Q. The environmental assessment regulations?

A. This should advise with the Environmental is it from 1999 so you see where he is old often does his policies get revised? Usually these policies have been get the revised atlanta you yet a policy is starting to scratch the G not sat for policy review he would realize that this. That's you also especially for the small-scale miners so if you realize that one particular component have a number of adjoining concessions to submit a report so even though they do it what is called a preliminary assessment report number of small-scale directions because we find associations morning that's all they depending and then it depends you use it like a man to realize how to find it so for now I think we are going to have a full policy are the minerals Commission there's going to be there because the graduation.

Q. what is the time duration when you get and give the Israelites answers

A. For 4 largest cat is 18 months so everywhere 18 Monday come to have to come and renew them violence is going on 2 rules of America protection and they don't on them and who's going to cancel the licenses if they don't obey

Q. What are the obiding rules?

A. So we have Regional Offices all of the regions are the 17 9 of them are for mining area we are still on the process but now we have offices in different regions in which they are controlling in the rain so we are trying to spread any quizzes disability and compliance I usually what happens and it was everything I just have to do with it so their functions are really important we just don't have to climb down the DVDs will you start the majors I've been the punitive measures and then we have Opera closures you really depending on the nature of the fraction and depending on whether to notice has been science and what are you stuck by the commission or not severity of the issue so it depends.

Q. So if I'm a miner and I don't know obey with the rules, what are the punishments?

A. For me the Environmental Protection Agency 1990 article 4 9 0 how did his ass topless Rule and this is a power power and then it depends you said that environmental in human but also something has implications on public so it's important if they have an impact on public safety so Deus these more necessary and what about the mining is South but after that's for the Reclamation of my quest

Q.

A.forever remaining thermal with animation is there also spread out the Reclamation so usually so reviewed they're working on it and it has been a long time so we have something pretty uniform so it because otherwise if you do some working and then realize at the range are they friends see how it's different so far not with his largely the largest scale

Q. so do you see it necessary to apply to other places?

A. It wouldn't be a long-term issue obviously for EPA is the whole premise of the CIA I think they are impact then get I did that opens so they are in bags are you can address then mitigate those in Paso another that's the problem all of these that's what you said is about the legal mining days use of illegal mining some other race otherwise if you are illegal and you miss that starting point is a promise and then you go through the process and and I prayed weather conditions but ultimately shouldn't be worried too much because if you did use it soft course there are people who do it illegally and don't have the permit and in the stands the responsibilities of this tough time rules to face them stop by the largest gay ones most of our problems it's actually because out the small ones when we have a lot of activities

Q. Is that the case that the smallest gave mining have the least revenue and the most environmental degradation?

A. Not really actually manning third of the revenues overall but of course damages a lot of numbers and it's about the way that they do it 1130 Wallisville ridges does much more challenging is more about the number says it's a lot is it about that the way I've been wanting is done answer yes for example about the machine that they're using the the negative impacts watch more tell us about the way that I'm feeling myself they have south what is a Horse Outside by their organizations so that makes what would have taken him so then it's about the Equipment Technology and then has any Bacliff watches in this car and you back because it is by the implementation it would be on Nestle roughly how much nice license conditions are usually met by the minors if you're not already I tell their parents would be invalidated and there is no way to get the license back the giving you and ideas difficult.

Q. what do you see at the biggest environmental concern of the mining in today's Ghana?

A. Those would be the land degradation biggest challenges and how do you see EPA addressing those environmental effect regarding the fact that some of them are caused by the illegal activ-

ities? It has to be icon says F words process applications illegal activities so you can actually get the permit what I said might have had to did the Regional Offices 719 Auntie areas we are increasing the Scopes in order to sSS the perimeters and decentralized it it is important that the education and Technical expertise should be enhanced experts you should be enhanced her collaboration you need to have the consent of all other stakeholders for did he PA and right now there are some sort of collaboration my 4-day small-scale was it is the nature of wishes for a second son before you go to the EPA you need to have Consultants from different systems mark collaborations better education the areas are huge I tried to climb in effective ways of improvement but the collaboration special day with those balls scale pascal the weather tomorrow Cypress because there's a concert at the first minerals Forestry george Carr survey projects the minister of Health but we need to strengthen the collaboration and the scope of collaboration what someone wants to get the license the Consortium and what you said they need to get their license boss day apply araucana says apostrophe license still have to come to us before if I think the payments then they can go back and then sometimes they need to get the prescription of the Miller of Commissioners as well question do you have a comprehensive geological map of demonic rituals that the check you know how about another day PA with a Geological Survey

Q. Do you think some miners have successful they got antigua

A. Apartments illegal means to get that says s l a way or I think the Life Is Us in another way a smaller scale minor would do is much more easier to do mining you legally Tan in medium or large scale minor

Q. what about why such

A. As starting earlier so on some of them can especially in the exploration to say you start illegally from the minerals commission and before they come to us duration for baseball scary mining they don't really need much atlanta condominium or larger scale they are too obvious to hide north County that level no notice but as far as you can just give it I think I got the permits the apartments are size specific protective but then the move on an Android one you were going to buy my Total Wine 01 f then is my again for example 101 site unless something that you have for distinguishing you the big one for the smaller ones yes those are their nature they can't get all they can get they even have the permits alarm camera on I can't show him or her that face you would think any possibilities then you have something called men's institutions bring them navigating them find the Galaxy images that's something that you going to be able to address if you have an EPA officer helping you that person Kansas City found it out if I for you if you provide some information Q. but the general picture of please did everyone get the correct license if you meet the requirements.

yes and you don't if you don't meet the requirements however rules are general or is not that limiting you don't need some cases he don't even need to send me the report so in that case is not that much evolve think that they can get away with their own thing or on the process is simple process yes we are trying to make it simpler in artisanal from medium to large is here we still find a way right now they're coming out with new strategies so giving out I will hang out areas

so prospective ashari

Q. can we say that do you have parts of the gravitational environmental degradation is done A. To that small scale miners knowing the rules and the way to do it all of the small-scale miners are environmental troublemakers to realize that there are legal and illegal one some of them are actually very organized and doing them but they look all was they also know that they are nervous they're not supposed to be there so they Rush and they also said that they love my nose that's really the problem of all I stayed there last time especially for the big Miner companies you said lack of transparency as a problem princess they have more information about environmental varsity area battery Dan better going to service that you have so actually for example I hear I heard a story and some of the air that's in one case then amore explorative visions in the sides but they didn't claim diligent. Saver has an idea about that whenever there's a shin of Ghana so with the return probably can get more information that the geological surveys because their reports on the values guess they're not only for gold. Reports for a goal so they wore that submitted to the minerals Commission but if I know information to go see government possibility that they can hide something? They're supposed to submit the results in the mail as commissioned obviously they can't have apprehend close enough that I also seen some of this but maybe they could come for Golan Yosef on Dimond question mental issues but are they other problems iRS problems environment social and culture john Deere will keep a tional for sale some Public Safety who can pave and then get getaway andy ABIA that is not just looking for the environmental and social it's also about the house so it's not huge and the office is small and environments question express off each person question ventura but sometimes we have institutions are there similar institutions I will receive we held accountable for sold out specifics for the resources little Des reviews alside reviews nas Express eyes so then we draw the with external they found an explanation question you did all this Evite and lots of problems for the smallest good morning rather than that I'll just get money so small the scales about the numbers and type of activities but the largest scale monitor regularly tell me what a time for everything set the alarm text Ann the calm flying not that me to go to something else it's about a number they're facing in the nature of the smallest scale that gives us a lot more challenges and I'll be asking for them first of all the triangles phone is very obvious we also have a complaint system okay with complaining so Geneva jealous about the other if it's feel weird as I've been dressed we don't need that live in the communities you see that is important for them attacks on his mouth says nBA has obligations for public health and safety cuz we going out for a long time and they think I've always been done the National Security rosendale legality am I supposed to be honest so you need to consent gameStop security in dealing with both of our situation is realize that there are some really good ideas I received complaints I have to go to field honey assembly old original security or national security rides but you often go to the field of the illegal operations around the concept of field work better than nature of the particle edition are the National Security dallas APA.

The requirements of Best Buy sales mining varies from the largest scale about the processes and everything so it depends on what there is one type of reporter the other small-scale gold mining they don't reflecting the reports unless it is specifically requirements but I want but otherwise

I won't suffer yeah that's urgent documents what is the side door insulation bring the report and the review I'm based on that they only ever comments to go to the process reconnaissance prospecting and then going from the reconnaissance to prospecting and then let's take the money will go to the mining's scorpions gold mining after which so it depends on the scale based on the scale and also the location of mining the process varies formosa desk L desk is by most about the game yes we supposed to generate bad witch in fact very much the traditional the very limited scope for small impact just a simple assessment that's right now realizes that for now you have to change the and go back to strictly to that small scales which are we doubt that any of the call Cheryl not since then you have to move to D level of The Middle describe the role of us assessments but then because we are catheterizing under the smallest scale we are still maintaining the area is particularly in the smallest small area which is environmentally sensitive then you might want to respect you what do you call less environmentally sensitive question the environmental assessment regulations this should advise with the Environmental is it from 1999 so you see where he is old often does his policies get revised? Usually these policies have been get the revised atlanta you yet a policy is starting to scratch the G not sat for policy review he would realize that this. That's you also especially for the small-scale miners so if you realize that one particular component have a number of adjoining concessions to submit a report so even though they do it what is called a preliminary assessment report number of small-scale directions because we find associations morning that's all they depending and then it depends you use it like a man to realize how to find it so for now I think we are going to have a full policy are the minerals Commission there's going to be there because the graduation question what is the time duration when you get and give the Israelites answers for 4 largest cat is 18 months so everywhere 18 Monday come to have to come and renew them violence is going on 2 rules of America protection and they don't on them and who's going to cancel the licenses if they don't obey question so we have Regional Offices all of the regions are the 17 9 of them are for mining area we are still on the process but now we have offices in different regions in which they are controlling in the rain so we are trying to spread any quizzes disability and compliance I usually what happens and it was everything I just have to do with it so their functions are really important we just don't have to climb down the DVDs will you start the majors I've been the punitive measures and then we have Opera closures you really depending on the nature of the fraction and depending on whether to notice has been science and what are you stuck by the commission or not severity of the issue so it depends question so if I'm a minor and I don't know babe with the rules what are the punishments for me the Environmental Protection Agency 1990 article 4 9 0 how did his ass topless Rule and this is a power power and then it depends you said that environmental in human but also something has implications on public so it's important if they have an impact on public safety so Deus these more necessary and what about the mining is South but after that's for the Reclamation of my quest question forever remaining thermal with animation is there also spread out the Reclamation so usually so reviewed they're working on it and it has been a long time so we have something pretty uniform so it because otherwise if you do some working and then realize at the range are they friends see how it's different so far not with his largely the largest scale question so do you see it necessary to apply to other places question it wouldn't be a long-term issue obviously for EPA is the whole premise of the CIA I think they

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number they're facing in the nature of the smallest scale that gives us a lot more challenges and I'll be asking for them first of all the triangles phone is very obvious we also have a complaint system okay with complaining so Geneva jealous about the other if it's feel weird as I've been dressed we don't need that live in the communities you see that is important for them attacks on his mouth says nBA has obligations for public health and safety cuz we going out for a long time and they think I've always been done the National Security rosendale legality am I supposed to be honest so you need to consent gameStop security in dealing with both of our situation is realize that there are some really good ideas I received complaints I have to go to field honey assembly old original security or national security rides but you often go to the field of the illegal operations around the concept of field work better than nature of the particle edition are the National Security Dallas APA. -

Interviewee: Karan Aswani- Managing Director-Diamonds & Diamonds

Karan's interview

F: Thank you so much for accepting to talk with me and I am very interested. Chris tell me a little bit about your amazing work. I was very interested to learn more.

K: Thank you. Thank you. Do you have any questions or should I just kind of tell you and rethink of what we do.

F: I would love to do that. I'm in a kind of an intersection between things. And I looked at them. Social license to operate and political economy and side of things. So like institutional gaps for mining said that was my first paper for that he says Now I'm looking in from the management. I'm looking at the role of technological innovation on the sustainability and said different criteria for assessing ability in the mining sector. And I've been looking at gold and diamond as two cases of what they call it in their management theory the creative destroyer and meaning that therefore the methods or if I put a diamond case because of that synthetic diamond that is that he's been producing they'd be doing it has been isn't it in the process of changing. So that's what I've been up to right now.

So look. So what I'll do is I'll just tell you more about the diamond side of things oh forget the others like really what I would say for like the past maybe three so lab grown diamonds is what we referred to as synthetic diamonds. There has been a change in the word so we have to refer to them as lab grown only because all of the certifications that the lab grown diamonds come with all referred to them as lab grown diamonds. The thing is that it's physically chemically and biology doing it. It is a diamond. So they're not really allowed to use the word synthetic because of this definition of it. So the only issue has been that the reason that they did an almond industry has kind of opted to go for lab-built more because Millennials can't really afford natural

diamonds. They're obviously millennials do really put a lot of focus on sustainability on the environment. But you have to understand that when it comes to engagement rings There's also the symbolism factor and the symbolism factor in something that they take very personally. So maybe they would consider lab grown diamonds for things like their earings or pendants or things like that but when it comes to the engagement ring you know there are two or three things that are considered one of course the prize but to no sure the lack of a better word no man wants to get on his knee and provide something that could be described as fake or synthetic so that symbolism is still very powerful on that side of things.

But because millennials of course can't afford natural diamonds the lab grown has been taking a larger and larger presence now to combat this. I would argue that the only innovation I mean depending on how you put it is basically that the natural diamond industry has decided that they want to start offering the traceability factor because in terms of combating lab grown from an ethical point of view this is the only thing that they can do. They can offer a more clear like value like voluntary supply chain method to show them but look it is coming from the right sources.

F: These are the people who have been touching it working on it and this is how it is with you today.

K: The problem with that is that with block chain while I do trust our suppliers and things like that at the end of the day whatever you put in there is whatever you get out. So there is no incentive yet for them to say that you know we need to do this or if it even translates into something that the customer ultimately wants for the number of engagement rings that we have sold.

K: I would argue it's less than three or four percent that even asked for a block chain traceability it is not that large at all. And if they do as I said we're very happy to offer it to the issue is that most of the time. Well again, I'm strictly speaking from the point of view of an engagement ring. I am not speaking for you from any other type of jewelry and because the symbolism factor is so strong there is a lot of thought that is in fact put into it especially if you see one of the fundamental things that. Has actually affected the engagement ring industry is well surprisingly Instagram you see everyone wants to share it and when they have to share something they don't want to make anything sound inferior in any way.

So you know when. Whether it's even taking photographs whether it's even describing what the purchases everything matters to them. The only way. Like even jewelers like myself like I mean nobody can like a very small jeweler in the midst of people like De Beers and Tiffany and the only reason that sometimes we get larger clients is because obviously we help them with hand making bespoke engagement rings. So literally whatever they have in their mind we sit and we create with them and we deliver that. Now Tiffany Cartier they don't really offer such services. And again we're only considered because this is an element that we offer. And of course at a fair price. But most other people do. It is still it does still come down to this is the budget that we want. We want a natural diamond and then everything else is whatever it is especially

because even if women today didn't mind a lab grown. The truth is that the buyer tends to be the men. And if we have to take into perception like how does the man feel about it as well. So if today like the woman is insistent that no we I want a lab grown man could be like Is it really necessary. I'd prefer getting your natural and then chances are it will change your mind about it because again it's a symbolism gesture when you bring in the other factors of it. As I said bracelets earrings. Chances are they were happy to go with them. You know they really are especially because one more than the eco-friendly aspect is the aspect that it costs substantially less.

And a very simple way to do that if I offered you a natural diamond of whatever quality at 1000 pounds.

And if I offered you the exact same thing but a lab grown at one thousand pounds what would you choose. And ninety nine percent of the time you're going to go to the natural one because there's nothing of you know suggesting that the lab grown would even be sold.

The second aspect and I think that's the more important aspect is at least in the United Kingdom people who buy engagement rings taken valuations very seriously. Now the valuation is basically document that you would provide to the insurance company to stipulate that if it's something about stolen, etc. and etc. This is the value of it. And this is how much you would get back. There are no valuation standards for not being diamonds and if there is no valuation standard for lab diamonds we can't in good conscience tell.

Any client what the price is.

It is simply how much they are willing to pay for it with natural diamonds. Obviously there is being a market for a vast number of years and to an extent the supply is limited because it is being mined. So there is a certain you know stipulation to it so when it comes to lab grown diamond is the reason that most jewelers probably are willing to offer it is more because the profit margins are substantially higher.

It is not because they are trying to really do anything else it sounds sad but it is the reality of the case. Again I'm strictly speaking in the United Kingdom. I do know for a fact that in the US there's a much larger market it is growing quite steadily over there mainly because at least in the US you have a lot of celebrity backers and the most notable one is Leonardo DiCaprio in the UK it's only recently started gaining traction because Megan Markle is also supporting it. She's the new consensus course. But again her roots actually stemmed from the US and Canada. So you can see it's much more widely recognized and appreciated over there rather than rather than here in the UK mainly because it's not that large of a jewelry market. So whenever they do purchase something they do tend to stoke further natural element. That's the natural side of things. You ask me what my opinion is in the next 10 to 15 years it will change but it will not change for the right reasons. It will change because loud brands are more just more cheaper.

There's nothing really else about it even coming back to like the block chain aspect of it. No

client has ever asked me you know they're like if we if we want to differentiate ourselves from a competitor we can we definitely put it out there and did the organization that we used. I think I mentioned to you as a block chain that the supplier has partnered with a block chain company called ever ledger over here and there it's a nice format and you're providing further information. But how do we how does anyone know that that information is you know 100 percent truthful. It could literally you could whatever you feed them is what is there permanently but whatever spending could all be garbage.

And so I think that I think the reason that the steps are being taken there is of course we're trying to bring in more transparency we're trying to do a lot of things right.

But I don't I think the reason that it's being done is obviously for the wrong reasons not for you know I'd like as I said I don't I personally don't see the diamond industry continuing for a very long period of time because millennials don't care about it and even if they did most of the time they can't afford it.

It is really come down to most even if we remove the diamond industry for a second. Most of them struggle so hard just to get a deposit for a house. So you know it really comes down to what is their priorities. And I wouldn't be surprised if obviously any luxury industry is going to suffer from this. You know most of them are just happy to now rent for the rest of their lives and they'd rather spend money on experiences rather than material things.

So it is what it is and you know it's a growing battle when it comes to gold and metals and things like that. The truth is you know like at least with diamonds you can laser inscribed. I don't know if you know this. So on the girdle of a diamond you can put an inscription number so you can track certain things. The thing is of course it can be removed and put on any number of times. But at least if let's say we put it and it's sent in a ring it will never disappear unless it's intentionally done with gold no matter what it is you can just smell it. And so like when it comes to really tracking that's the only thing that you would have is basically the word of your supplier and they are willing to give it to you too. At most we can. We have offered and you do offer Fairtrade gold but at most all you have is like a written guarantee from your supplier. You know there isn't really anything else to provide any sort of guarantee.

And even then I mean again I don't know much that much about block chain technology but what I can say is even if you tried to implement block chain technology it's gone because it's something that can literally just be smelted there is not there it will never be able to be a guarantee as to what exactly has been done along the way. You know it's the same with the diamond trying to block chain the diamond industry has relied on something that was set by the United Nations it's called the Kimberley Process the Kimberley Process is what they are trying to kind of get the block chain technology associated to associate with.

The problem is that even though many good people are out there to try and stick with the Kimberley Process there are many loopholes. So you know like diamonds from different parts of the world including unfortunately diamonds from areas where non conflict is known to happen

it may enter into a supply chain and there unfortunately there is no guarantee there is no 100 percent guarantee that anyone can get it. I am proud to say that the diamond industry we are trying (to be transparent). we really are. But it's like if someone had to do something bad they could do it. It's not like it's not 100 percent anywhere. As I said like this meaning to me is one main supplier for a block chain diamonds. And this is mainly because we've been known to supplier for time they're massive in the industry. And so at least to an extent we can help we can be held responsible and we can hold them responsible for the information. But again there is only so much that can be done unfortunately.

Thanks so much for that. Very interesting. So and the black chain and let's go right back and as you mentioned.

So since when you start to use that block chain formation and being potentially available to the buyers then many want to see you drive instead.

Yeah. And also what was and what was an incentive.

And so it actually we didn't as it went I mean he hasn't. This company didn't implement any block chain technology. One of the suppliers that we have a close working relationship decided that they wanted to be able to offer this to their clients. So there are quite a number of stones that they have basically tracked literally from the rough to sending it to G.I. Joe G.I. is one of diamond grading bodies that. Is widely recognized across the globe.

So they wanted to attract the entire thing. And again there was no incentive for them. I think the reason they wanted to do it was again to differentiate themselves from other people in the industry. So. While of course once you start telling.

Your clients that this is what you do your clients can also go ahead and offer it to their clients. So it was in a way an opportunity for us to start offering it to our plans and we didn't charge anything for it.

We were just happy to provide it at most. I think it cost us like one or two percentage points so it wasn't that it wasn't a big deal at all.

But it did of course give us an opportunity as well to stand out from everyone else should not have been of interest. Unfortunately it's while it sounds good while people are very interested in it. It is not in any way a determining factor as to whether they buy it or not. Tone today the determining factor will and will always be stock price.

Unfortunately the first thing being price but I made my seen but what is it. But why are you explaining and after price isn't there. Is it like that.

Could it grow a growing concern about also the roots of diamonds as well.

So according to to my experience with points against the first fundamental thing yes is price. The second thing is whether they trust you or not. So at the end of the day you know if there is

any sort of issue and you are there first point of contact. So if they don't trust you if they don't like feeling that you are necessarily the right person for them that will still play a very big role because notoriously jewelers are still kind of looked at as like you know cliché car salesmen where everyone's like trying to take them on a ride. So I think trust plays a very important factor and the trust comes from how quickly you are able to communicate with them. So you know for us every time a client gets in touch we actually try and respond honestly within the hour. We try not to keep them waiting at all. I mean of course I'm referring to e-mails and messages phone calls. We always answer We do not like you know we don't cut it or anything about that third thing comes back to again. No I'm only speaking from the engagement ring point of view. It comes down to the ring design there are a lot of ways the main way that juniors differentiate themselves is from the designs that they carry. So I mean there will be a few designs that look similar like Tiffany and Cartier made for example may have a few designs but most jewelers differentiate themselves on the designs that they still carry. So whether it is something like you see the picture behind.

Yes I think so hypothetically. OK. Do they like that design. Do they like the one next to it.

Oh all of those things just looking for something with other things and the production side of it.

So let's just say this for example like so this is like what we call like a halo design.

So it would be like does the client like this you know. Is this what they like. Does it make sense to them or have they seen a design elsewhere that they like and they'd prefer sticking to that.

So that is still one of the most fundamental things as well.

And then of form they would normally ask you what exactly is like your warranty. And this sounds like is there a guarantee that you know the smaller diamonds that are used when they fall off will it not. And while no junior should guarantee that at least that if they know that you are available if something were to happen you're there to you know stand by the product then fix whatever needs to be fixed. So I think it comes down to these four things the idea of like you know conflict diamonds and things like that.

You mean more to an extent yes it may be in the back of their heads but you know like every rapper every movie every book diamonds has it's literally look it's such a luxury item that almost like you know it shadows the the bad side of it the dark side.

So I think that the change that maybe you were referring to in terms of the ethical side of it from the moral side of it will definitely be seen in the millennial generation and even been more in the generation after that. And so I I definitely think the love diamonds will have a larger impact. However I think the reason that they're going to have a larger impact has to do still more to do with the price than anything else. Just as an example of the difference in the prices is.

You see like one Catholic standard one carat diamond roughly is what sells for about six thousand pounds a standard one card lab grown diamond is closer to about two thousand

pounds.

So the difference is it's massive and you're talking like a loved one diamond sorry an actual diamond is three times the price of a loved one diamond and even then there is nothing there is a determining factor as to who decided that the lab grown diamond is two thousand pounds for example there's ivory it's the same with the natural diamond industry you know it's just it's it's complete speculation but with the lab grown once you sit and you speak to the labs that are creating it it does come down to Okay what was the cost of creating it we understand. So even there I have no doubt that their profit margins are massive.

You know I and I would argue that if we're looking from the ethical point of view that we would have to see like how much energy is of course used the Internet et cetera et cetera. And while I'm sure that on the large scale large the other things that gets not known is definitely the more ethical and the more moral. All of that takes a hit. That's when you start charging the customer like a crazy profit margin.

And you said a nobody can tell actually the difference or maybe can't find no difference.

No it's only very very specialist instruments can tell the difference. And those specialist instruments currently run that maybe six to seven thousand pounds and need to be updated at least once a year because the labs that are creating them obviously if it's physically biologically and chemically the same as a natural diamond you know only a very very handful of machines would be able to differentiate.

And I'm sure as the technology gets better chances are you won't be able to differentiate at all.

Interesting and interesting.

So do you see that the business model and the business model of you know selling selling mined diamond influence or how do you feel being influenced by increasing and increasing synthetic diamond.

I think look any business to be honest their goal is profit maximization.

And when it comes to that I wouldn't be surprised if in fact more companies would opt for synthetic diamonds only because well they can make larger profits on it. I don't I I don't. It's very hard for me to believe that there is an ethical diamond industry is not ethical in so many different ways. You know and it's it's hard I'm not I'm not trying to put down the industry. I'm just saying that every time an endeavor like for example even if we brought in block chain I was very proud.

I was like yes it's definitely a step in the right direction but it's today out of like I don't know maybe ten thousand Diamond suppliers only one has opted to use this. You don't like it's wet until there's a change like a paradigm shift where you start to see more and more companies use it. Yes it will make a fantastic difference. The problem is is that again I don't think when it comes to diamonds that that still is the biggest issue I still think that the reason loved one will

sell will be because of the price nothing else. The ethical standpoint when you come to day to day items like plastic and things like that is is very different from when a person is buying just one diamond for themselves.

And I would rather like you know link that to for example their sports car still being driven. We know it's bad for the environment. You know we we know the gas consumption we know everything.

But what is it. It's a status symbol and hands like it will always be referred to as that way until you can even if you took a lab grown diamond. It will not be looked at as a status symbol. The issue is that nobody will be able to differentiate. So even those who opt for lab grown are not exactly going to show up and say this is a lab or a diamond they're going to be like No it's a natural diamond then no going to argue with them. So like that that's still not it's when it comes to the luxury industry people. The Japanese have a saying we have three phases red the one we show others will one ratio only those close to us and the ones that we show ourselves. Right. And when it comes to like things of the status symbol we tend to pretty much really bring out what we want what we desire. And you'll be surprised. I don't think when it comes to diamonds the driving force will be the price and not the ethical standpoint unfortunately.

And so it's also about and how hot it has to be how many years that's at this lab grown diamonds has been embraced and it will produces them a little bit about that.

And they were again and just when they got it except that. And you thought of maybe purchasing off in the lab diamond.

So when they started purchasing lab grown diamonds this year but I think really just bring us surgeons whistling as well because I know the one company that really started gaining traction was a diamond foundry that's going to the link and so the reason for that is again more because of your daughter Gabrielle and not because of anything else he stood by and he was like listen this is what needs to happen.

I'm just sending in a thank you. And these guys like being on it.

I think it's a I think even like there are a few celebrities behind this this company and I think these guys I would argue would be one of the first you know. And I'm just looking up to when they started.

I'll check for you. Unfortunately it's not even given on their Web site but I think this this would be the number one company and I get it. It's a US based company and that's where so done the largest consumption of diamonds happens in the US the UK is is tiny tiny compared to the U.S. in terms of timing conduction.

So again the issue. The only issue that I have with it may I just ask is this being recorded because I don't want to get into trouble.

OK. The only issue that I have the diamond boundary is that it's the only reason that they're

doing it is again profit maximization. You have to understand that the amount of money that these guys are making is is insane. Look like I'm just I'm going to open up their bear thing now just to look at like a standard price of around diamonds.

So even even then that is look apparently they being sustainable. This is the first thing is about that profit.

Any every business but is about profit maximizing. Even Leonardo DiCaprio. Right. He invested into this. He not going to invest into something if he's not going to make a profit right now.

It's just that unfortunately is just the way it is. And.

Look at the end of the day all of these businesses start because they have to look into what the next generation wants and they know that the next generation will want diamonds. We want the state to symbol but they will also want to know in the back of their heads that this is all sustainable et cetera et cetera. So what do they do.

They do Don and probably look even I'm I'm tempted to open into this in fact that's that's the innovation and entrepreneurship that I'm so I'm doing my MBA at Imperial at the moment. And on June which Chris is teaching me is innovation and entrepreneurship and what I'm working on now is actually like a project for that module which is helping me decide whether I should invest into this but in my head I'm like yes 90 percent I definitely should. It's just that it should be done under a separate entity not under the current company entity no one.

And I'm looking I'm looking at the prices that I'm just going to bring I'd like a one part price right now just so that we can we can be very clear about OK so I am so I am currently looking at on based on their Web site.

It's like a one carat diamond H has to. I'm happy to describe the color clarity explain that to. But basically H.M. refers to the color great of the diamond and the V.S. two refers to the clarity that you like. Can you see any inclusions are there marks on it. Etc. etc..

And so like a wine carat age as to where they are they have priced at about three thousand dollars and I'm going to put that into a very simple plain engagement ring. The yellow folding eight.

Gives a time where my dislike f for me yeah.

I have like man I have all of my favorite learning from you I hope you are.

I hope you will also this is fine. What's that.

Thank you so much. And it's very interesting.

The information try on this ring and I'm gonna I'm going to just share with you what a rare look here just come forward with her here. As soon as.

Yes. Yes. Got it.

OK. That's all we're looking at. And look at this one on their website right now.

Who the Finnish ring is 4000 U.S. dollars. You have my word.

That the price of this is maybe about maybe about twelve hundred dollars it's crazy.

Yeah I'm I'm 100 percent comfortable if you ask me for that exact same thing. I will present it to retro 101. So where does that ethical thing come into play now.

And it's only did I get it right. So and they are producing it but they are the airport you say and they decided you are selling gets the higher price because of a brand or because that this is just this is just actually a price that this can be dead to markets.

My biggest issue the diamond jewelers are currently facing. Is that ever since the online diamond industry came into play so I don't know if you've ever come across a company called Blue Nile. I've never heard of it.

No. And then it just work.

OK. So. Whenever you have a moment to be an online column was the first online engagement ring company and.

They currently went public with their IPO was done and did really well. And I think it was bought back they made a lot of money to the point of Blue Nile. Was

Was that a paradigm shift where basically anyone could go online and they could see how much like they could purchase an engagement ring online based on the color the clarity whatever they needed to do off that ring and beat a lot of people use that as like a reference so if they walked into a jewelry store at that point that anyone could use them at any price.

Right. So down started becoming like their reference guide as to what it should be. And after a while people were just like I'm just going to buy it from Blue Nile. So Blue Nile became an online engagement company where their profit margin was really low.

They offered a fantastic price didn't have like stores or anything you would make the. And to today including once we have a lot of Web site on the Lincoln Center just so you can have the U.K. So the U.K. equivalent is this company and full disclosure.

I usually work for this company to make just over there. So.

There is an online urgent as well so the order would come online. Everything was natural. Now obviously the largest impact of this was that most jewelers were used to maybe make I don't know like maybe even 60 70 percent profit margins. We're now competing with online retailers who are maybe making margins of 15 to 20 percent. So everyone had to drop their price. OK. Now jewelers are notoriously lazy. We don't like to drop our prices.

Obviously we want to again. Everything is about profit maximization right here.

I it. Yes sir. But at the same time being in it's a luxury good. So.

Exactly. Absolutely. So all of a sudden if people are able to buy the same luxury goods for at least you know 20 30 percent cheaper. The issue is is that most businesses now are extremely it's just about price price price price price. So everyone's undercutting everyone. And so once that started happening every jeweler is now looking for how can we make that money back. And my argument is that that is what they're doing with lab grown. It's just allowing them to make a substantial return of their money.

That's a I I wish I wish it was ethical.

I wish I could give you some sort of guarantee but it does. I'm sorry.

Nobody can. It's impossible.

So I can I can I ask for a.

One second I think so I'm really sorry. Oh I thought I second second.

Sorry. You're.

So this is very interesting. But also out and about the the diamond industry. I imagine they use after all so that lab grown diamond and it's also for industrial use as well as maybe uses as you said in other u Hillary's.

So I understand that you your company and your all as you said is specifically about there and that they have nice many rings but you also tell me a little bit more about that made the possible differences that you find for other use of diamonds.

So I have to be honest I don't know much about the industrial use of diamonds.

But you are correct to say that yes lab grown gardeners probably started with the industrial grade as well.

The truth is is just that when the mining actually happens the majority of diamonds that are mined aren't gem quality anyway so they do use the mine diamonds that come out for industrial purposes.

And I think like one of the most common examples I like better used in drill bits sometimes are used in dental drills and things like that. But there's plenty of diamonds that are being mined that are not to gem quality that gets sent into that so I don't actually know if that wouldn't make that much of a difference to you as a lab grown or especially because so much of what is being mined is industrial quality anyway. I would have to look into that to be very honest with you but from my understanding yes the number of gem quality diamonds is very low anyway.

And then what about impacting the back and that the trust that the transparency part of it. How does it impact be without me using the black hand with what advice they have for transparency and all of that then that's there. They say the technology part of it. How did it help from the customer side.

That to me I think to an extent it just provides them a guarantee know it's more done for their peace of mind. It is not that we. It doesn't mean that we are doing anything different. We are just simply putting into record from where the diamond has come. No. The entire chain. Okay. So this person was responsible for this. This person was responsible for that box. So in a way it allows us to provide some sort of like a written guarantee that you know puts their mind at ease.

But I don't. There isn't much else that it offers. It does not. If it did I promise you governments would make it mandatory.

But apart from the trust I don't think there's any.

Also I bought that diamond I wanted to ask you about and the diamond networking let's say because at the first one I started writing about it I stole De Beers being like it. The monopole the F diamonds but now after I talk I see that there are also other other businesses. Also did that yoga company offered the other day I might add you send me also in the diamond business. So how do you see this partner human how do you see these influences.

Okay so I should specify so basically back back a few years ago de Beers used to own the mines.

OK so what happens then is when De Beers mines they invite the manufacturers or manufacturers of diamonds are basically the countries the publishers that the people that transform the RUF into the finish college students. Sure. Good. Change it into the Finnish Polish good so they would invite these manufacturers to come and they would bid on whatever has been mined. These are the people that are allowed to come in bid are something called site holders and sign holders or sometimes this cycle.

So there are two different spellings.

And it is basically these guys are the only people who are allowed to kind of go in and bid for this and then they would obviously purchase it and then they would then cut to polish it and sell it further onto other middlemen or sometimes even directly to them to come to retail establishments like myself.

I see I see. And in the in the past like 10 or 15 years the truth is like De Beers sold their minds.

So I'm sure there are other people that but obviously have access to these minds now belongs to them and the way that they conduct business this is similar.

They don't necessarily do bidding but they do show them what's available and people are just allowed to buy some of the people who bought them are my manufacturers directly. So you know it's like they own their own minds.

They do the manufacturing and then they reduce it to me and then and beside the beers are there any big mining companies now far for diamonds.

Yes there are quite a few actually.

So let me just I will not have to get back to you on that but basically as I said I think the beer sold our minds.

Yeah. Anglo American is one of the bigger ones. Anglo American is.

Linked to front. They sold it to other minors who don't necessarily only do diamonds you know they could be doing a range of things with so basically some of the best diamonds actually come from Russia.

And I don't think De Beers has any any impact on that. You have to forgive me I may have to get back to you though.

Sure. Thank you. Thanks. Let me see if my. My my questions from the floor.

Yeah mate maybe that a movie that will hold that much for a diamond but. And all of this a life cycle analysis passes. Does it does it. It the whole like them. The part of me No I'm recycling for it for a dime.

It does put the it's not the I think it's a good question and we have done it a few times so what we done is like one of the one of the things that has happened is basically the number of divorces have gone up and when divorces go up. Obviously one of the things that these that couples like to do is kind of sell the engagement ring that they have. So sometimes the diamond is used from there can be given to another client of course only to those who are looking for a diamond that has had no further impact. So in the industry it's actually known as pre love diamonds. That's how they've marketed it. Yes I find it again in most people. You have to understand when it comes to engineering the very there's like if I tell you if for example they were told that it came from a divorced couple. It sounds like no we don't want that.

Obviously as I said there's a massive symbolism thing and so we are very very cautious as well. You know we we try to stay away from things like this. However when it comes to normal other jewelry I'm sure more people are very open to it especially because you know jewelry if it's like repurposed. So for example if I had like a diamond bracelet with like large diamonds on it and I bought it from a client I could remove the diamonds and make it into earrings and all of that is opportunity fine. And it's done. It is very much done especially because most of the time when you buy it from the client you would pretty much buy it at the same price you would buy it from like a supplier. You know you wouldn't pay any more for it than that. But again there isn't an incentive. You don't like the goal for every company was profit maximization. It needs to be in their interest off of making money.

And most of the time as I said if today tomorrow like millennials just decided that we only want lab grown diamonds every company will change overnight because again that is what the

business is going to be. There's not going to be it is when it does come down to human behavior. Whatever humans want. That is how businesses will frame or structure themselves.

And so you know you might you have mentioned also the government is there any rules for sustainability or traceability that's imposed as imposed by the government in the U.K. at least it is we have to adhere to the United Nations Kimberly Process.

: So we have to of course provide those written guarantees which we are of course happy to do. And as I said while it has made a little bit of a difference unfortunately there are loopholes. And you know I wouldn't be surprised if the loopholes wouldn't necessarily be on the U.K. side because we don't want to buy rough diamonds over here. We buy finished polished diamonds so the process is like if they are mined. Ninety nine percent ninety nine ninety percent of diamonds are cut and polished in India. So from the time that they are transferred from whether it's Russia or Africa.

: Well normally we would say of Africa. Because that's that's where the conflict diamonds tend to appear from mine. There is not at any point during that transfer and it's an additional rock where something is added from a different area homes anyone going to know it is not possible to have that 100 percent guarantee hasn't made a difference.

—: Absolutely. Do I hope that it continues. Absolutely. But until it either becomes a strict regulation or an.

: Incentive it's just going to continue.

And was there any was there any ma'am they say frictions or many not that much easiness with them.

Mining in the throes of over the four day for diamond when them sent that Diamond was the best boy do so to so or not Nick that large or of any issue really.

Well only because the number of people who are buying synthetic diamonds is tiny compared to the number of people buying natural diamonds when it when it has a larger effect.

I am sure there will be some issues in OK for the time being it's a very very tiny tiny very tiny because even even if you like take Diamond foundry for example it is not that this this company has invested into those diamonds.

You know that the structure of the businesses simply. We have a Web site. If you place the order we will then buy the diamond from the supplier and create the ring for you. So it's not like a heavy investment would have gone into this business all you need is like a good website developer good marketer and that's a bank.

And you'll quickly go to the other question.

And maybe one other thing that I wanted to ask you is about in this the technology for the

technology adoption also for doing this you would do it during the supply change of producing diamond.

What I mean was beside like this this block chain. What if if you find any other modern methods or other innovative methods to make sure that the whole process of diamond production is sustainable or traceable or or trustable B sized block chain.

Respectfully no. Even as I said blocking is definitely a step in the right direction. But the fundamental issue of blocking is is that how do you guarantee the information that's being put to block chain is correct at once. Once you are able to guarantee that to respect the block block chain is brilliant. But if you can't even if you can't guarantee that I don't think like you know at this point in time I would argue that blocked any probably being one of the best technology technologies for the mining industry. But it is just something that again isn't it really just comes down to I think the best way to describe it is like whatever you put in is what you can get out right. So if the information that you're putting here is false and charge in London and there is no way to check it out then the whole point is moot.

So defeats the purpose and also how much is.

You know I'm raising awareness about Diamond influence the thinking in your view influence the emergence of block chain and all of that again from a business perspective.

It will always come down to what the consumers want. And I promise you the consumers so far do not care.

They just don't. I am. I have yet to like I and yet for a client to enter and be like Can you guarantee that there is no conflict involved or can you guarantee that yes to a large extent we cannot provide a written guarantee of a lot of things but that is only in your response to maybe the conflict side of things.

It is not in response to it in any way like the mining or the sustainability because you know that's how the diamonds that we mine it and that is where the diamond comes from.

But if there is anything like obvious need. The main thing that started all of this was the movie Blood Diamond trade. You're not in the capital. He came into it and he was just like this is how it is and he will. The movie is not factually wrong in the sense that we know for a fact that there are a lot of loopholes but this is going to sound very harsh.

I would sit and compare it to almost how child labourers live in India. Sorry not in India in fast moving consumer goods like today. It is widely known that there are certain companies again going to get in trouble for this just trademark for example. OK

OK I'm going to get some and so my shovel ready like my face I'll get where it's been known that sweat shops are used child labour is used on this right. Openly the public knows about it. Has the public stopped buying from Prime rock.

No no it doesn't.

When it comes down to it it's human nature to be a little bit more selfish no matter what what what was the main determinants of adopting like this at least this step towards that traceability.

AG I think the reason I did it for this company is well I wanted to see a change you see like I'm so I started this company when I was 22 and I'm 28 now it's been about six years.

Great. The issue is that people in my generation at least for myself if I want to stay in this industry I have to be able to like think a little bit ahead. You know if tomorrow our customers and they will they will at least maybe consider this. It's important for us to provide them with a certain amount of guarantee. I do. If we don't then we are doing the industry itself with disturbance.

Again this is it's me who wanted to do that but again I know the downfalls and the limitations of it but I still feel that it's better than nothing. I hope that it changes and develops even further. But.

As far as the natural diamond is concerned to the fact that the more lab grown will eventually take a larger stance or price rather than it is not the ethical standpoint and although when you're talking about the luxury industry I it's very hard for me to you know to say that yes it's it's going to change and that I may be asking also a bit about how an information is put in the block chain for the diamond.

Is it like the people that are working in different supply chain and other parts of the supply chain this.

This to me is the biggest issue I don't like dirt. We don't know we'd like. I can sit and I can speak to the supplier and I can be like Okay how is it done. And he may just say that no it is only one person sits in it and puts all of the data. Now obviously when you're in the diamond industry they do have to keep a very strict track of everything because you know the value of their industry is based on their assets that they have. So while I am confident that at least this one company is being truthful and honest it may come to a point even five years down the line where they say there is no point of this.

It is not increased our sales or decreased our dressings or anything.

Why are we continuing with this. So until there isn't either legislation as incentive legislation or of financial incentive chances are it may not continue.

Okay. Thank you. Thank you very much. Is there anything that you want to add and add that I think I have to take a look at about you know a diamond then that technology of thought as you suggest me to take a look at.

So what I can offer you in terms of.

But what do you suggest me to also take a look at in terms of you know the difference that I did that the difference that you know new technologies such as that X and although that has block chain for example or either within Dev within a business such as the lab grown diamond.

So what other thoughts that you suggest me to take a look at about these add came technological changes technological innovation the business and how it changes its business model. Is there any place that you suggest me to let you know if I'm completely honest.

I think the diamond industry may or may not become a lot like you know Kodak film and I think you'll be surprised I think we're headed in that direction.

I don't think that the diamond industry is going to be something that maybe even lasts much longer.

It's the reason I say that it's not because I'm like some cynical or negative minded Britain I think about it again from a business perspective and the business perspective teaches me a few things right.

Number one the gap between the rich and the poor is getting larger right. So you are having rich people are getting richer obviously the middle class is being stretched in both directions but when it comes to what people of my generation and the future generations are going to be looking at. I would argue it's more about experiences you know what they're looking for experiences they're looking for. They're looking for and.

To an extent that maybe even like constant change you don't look good.

If a person has a thousand pounds hypothetically would they want a piece of jewelry. Even if it's not an engagement whatever a piece of jewelry that is just that one piece that they would have forever or like for example if you like my parents not wearing the jewelry industry and everyone in my finding nobody wears jewelry. We don't care about jewelry. We just don't know. And if for example I like to call my Mom it's her birthday. I'd love to buy you like a movie the handbag hypothetically she'd be like a one bag costs like two thousand pounds.

I'd rather have like a standard gorgeous standard store and buy one bike every year and have like a different grab bag every year than rather do that same with puts on a bag which I would have to hold for like five or six years.

And it sounds like the entire consumer's behavior and the way they look at things are changing very slowly. It's very hard for me to say that the diamond industry will necessarily come out with an innovation even even today.

This idea of lab it's definitely going to have an effect on the industry but only in the sense that eventually it will equate to maybe hypothetically either make a company like sort of school if you're doing the whole lap band arguments eventually in due time people are going to be like I'd rather just get like five or six pieces from Star or Pandora then pay that much even if it's cheaper for a lot of.

I'm embracing it or something like that. It's a status symbol if if even from the point of view of a status symbol let's put it this way. What is the most well-known. Actually there's a really good example I need to remember this. It's like knowing it's all one of their most idealistic like bag. Was that like the LV bag right. What happened. The number of things that were there were insane. And so almost like everyone had it and it didn't matter even if you had a real one. No one could tell. So what happens if people stop buying it.

So everyone though is out there who is just known as like it's definitely a fake one. And then there's people who wanted a real one always made sure that it distinct it distinguished itself. You understand.

So I would argue that if if we go down this route where you know and diamonds don't really count on much more people are going to opt for things that they can show in terms of a status symbol that has nothing to do with diamonds.

And that's why I feel that you know chances are that maybe the industry sees a state that's why then maybe they'd you know opt for I don't know maybe nicer cars or bigger houses or maybe whatever.

There are a lot of things today take phones you have like certain phones that are upwards of two or three or four thousand pounds. Happily I'd rather spend it on that because they can basically tell people that look I'm holding a swan worth three four thousand homes.

So there are many many different ways for people to show status and if Diamond doesn't distinguish that of like for these people they will find another alternative that there's any energy and maybe you also think that if they use of this and lab generated diamonds increase that the value of you know the diamond being a symbol loud and also their price I mean because it's only a price that they love you.

And then it also would go down and that is one of you the best example of that is you have to understand thing engineering came on me because of some good marketing. So tomorrow a better marketing ad will come out and that will be the end.

It doesn't. There are a lot of things that could change you know like it is not just this one thing. Even tomorrow if like the prices of diamonds and things like that so hypothetically it showed substantial.

You still have to take into consideration at that point whether the new generation even if they could afford it would be even one. You know it's it's very difficult because like. When I when my parents were growing hypothetically like like every year they could go and they could buy themselves a piece of jewelry because it was affordable but affordable why not necessarily because jewelry was cheap rose because they were earning a specific amount of money right. Till the time that Europe the new consumers aren't earning that much or aren't able to afford their basic necessities. Luxury items have a long way to go. So even if you think about the luxury industry today do you know that at least in the UK if today I wanted to go buy a Mega watch all

I need is like 50 pounds in my pocket because all of these guys are suffering. So what do they do. They offer payment plans everything is about a payment plan. So the problem with that payment plan is that you're just continuously in a cycle of debt.

And eventually when you grow up and you realize oh crap you know all of this money is going nowhere. And the idea of the luxury thing just basically just goes.

So our generation has unlocked it's struggling with a lot. You know we we we wanted to be environmentally friendly and vengeance yes we want to do that with things like plastic or aluminum or a whole lot of things.

But when it comes to maybe that one diamond that we want to buy ourselves we may not necessarily feel the same way.

That's an interesting point.

OK. Thanks so much. Karen thank you very much. It was super interesting and I thought it had to taxes on one end and the business and you know having is all of you and an insightful idea that where jewelers are miserable people.

Talk to them for too long. But like yeah it's it's I.

I I'm excited in a sense to see where exactly the industry takes us.

But I can just like just looking at my friends anyone between the ages of 20 and even 35. Apart from an engagement ring I don't think they care much also about find diamond jewelry especially even women today. Enjoy jewelry but they're not going to spend a significant amount of money on it especially when you have options like Tinder or sort of scheme which allows you to be fashionable and that's what it comes down to if you want to basically enjoy that thing and be fashionable. There are alternatives for you.

You don't need to sit and spend a crazy amount on diamond jewelry without that's an interesting thing to think about that.

OK. Thanks so much. Can I really enjoy talking to you and having fun if we're not thinking about then.

You know me if if you're going to quote me can you like just put my initials like I don't want to die.

All of the sudden I love De Beers knocking on my door. Excuse me sir. My son for tomorrow.

I don't really believe it is like that but you know you never know who you can piss off.

But let's say. Yeah. But I mean I actually started my thesis I I was hearing stories about you know these bad people in the mining industry. I don't know to what extent is true actually it seems to me I'm confident that a lot of it was true.

But years ago nowadays not so much. You're not is a lot of strange because nowadays it's not even that much of a monopoly anymore. Once the De Beers sold like sold off so many of their minds they didn't sell it to one person. They sold it to different companies. So once that happens once there isn't too much it's a monopoly.

A lot of the strip business dies out of course at least here in the U.K. And you know you'd be quite surprised in India. They're very particular very very particular about these things.

So I get a chance to go to the boards and let's facilities over there. But some did they are very cautious as to what they are doing. But all it takes is one bad person and that is the unfortunate side of this thing. So would I like to see it did things change and everything. Absolutely. Will it not. I think that still comes down to the buyers. You know it's like to an extent it's like politics. Do you want to see the politicians change. Are you willing to go out there and vote no. So then how will the politicians change.

It does come down to the things we have also.

Do you think that the case also for I all you only woke from in the mind. Diamond also also do you think that's also the case where other luxury goods or maybe maybe precious metals as well with precious metals.

Absolutely. You see like it's for example some like one of the issues I enjoy comparing luxury goods to Tata jewelry to his cars. I always look at what is happening with cars and things like that. OK. And today one of the biggest examples that people tend to use is testable. Now Tesla had a dream and it had a massive following and Elon Musk calls a personality who wanted to make a change. He wanted to make a difference. But look at where they stand today. They haven't been able to deliver. They haven't been able to do a lot of things. So then when it comes down to it is that. Yes. The idea was good the execution was bad the investment didn't work out in saying what are you doing. And in the meantime you've had all these legacy car company decide you know what.

We will enter this and they released their first all electric car and it's beautiful. And so the company organization the consumer today will be like we know Tesla's having many issues.

They started it. That energy is such a good job. I'd rather stick with all a legacy car company and it's an electric car. I feel good about it. But how does the auto brand. So there's a lot of things. Maybe tomorrow it's to convene a party a went into it. It would be interesting to see you know how what changes that reflects on.

But I'm telling you anything that any business does it do with the goal of profit maximization. Tiffany and Cartier decided to do it. It's because they just want to increase their profits it's not anything else. And you want to know the best example of it. So do you know that De Beers is heavily invested into the lab environment industry.

Yes I heard it with Ach I oh I heard about it then what I thought is that was that.

And Libya is just don't want to lose that you know lose the business lose them on up on something. I would tear that lightbox like what exists as an entity as an organization as a company that's owned by De Beers and all they do is is wrap around diamonds or green so but the way that they've launched it is that the fashion jewelry brand it's sending you link.

And you know what. I will give the mayors a little bit of credit here and the credit is is that they have. Actually priced it very fair. So what they have said is a half carat. Diamond is 400 dollars. And a large diamond is eight hundred dollars.

So I am giving more credit to them because they're at least being fair in terms of the pricing. But the reason that they're doing that is obviously to maintain the pricing of the natural diamonds so easy everything is done for profit maximization. It's not any other way. In and I'm going to argue with anyone about that because no business is going to come up to me and be like No we're doing this for the good of people. It's like shut up. Nobody does that possibly happen.

You know you're doing it so that you can see your your revenue change. If you were truthfully doing it whereas the right reasons.

Chances are you know you won't. You will cease to exist after a certain amount of time because there are going to be other company is that common or do better than you or whatever.

Mean the best done for that is Tesla yes.

I think that just about their business model. They just have to maintain that and add their profits and then that makes sense to me.

Not so I do of sustainability and everything I think. OK I hope this fact. I should probably check it I don't know if it's true. But like they're like every organization today every government today pushes people to be more careful with the energy usage and stuff like that.

But do they push company companies and organizations are the largest users of electricity and stuff like that. Are there changes being made there. No.

So you don't have those guys who I'd like the power use it it's making changes. It is not going to make such a difference as to what the normal small people do. Like for example one of so I was born and raised in the Caribbean island of St. Marc.

OK. Now is there one of the issues that people have to deal with is to trash the cruise ships.

OK.

And if some of the islands weren't able to take the amount of trash on board they would let it out into the sea so when.

When. Exactly. So when it comes to down to these things how are we going to sit. Because all they would do is when they're floating in international waters just dump the trash. So it's I have you know I I'm this this idea of sustainability and everything it's important to me. And it will

always be important to me. But how much of a difference is green.

It's going to make depends on how we as a population you know sit and make the changes.

And also big companies yet Exxon as you said.

Exactly. If they don't start to do it like today in my MBA course the majority of people who are there are interested in joining the energy sector not because of oil because it's the same oil giants who are now investing in renewable.

But it's only because they have finally decided that they want to do it not for any other reason. Remember it's about time. You know what what have you guys been doing all along.

And I would argue one of the reasons that they are doing it now is because of the new treaties and legislations that have been signed stipulating that we want to make these carbon emissions cut we need to do a lot of these things.

So again if it's not for legislation or if it's not some financial incentive most organizations will continue doing whatever they want to do. They will only adapt to their cost.

That's it's a very cynical view.

I know and trust me by the time this MBA is done listen I didn't go into the like I knew this. This is not news to me. I knew it. But I wouldn't be surprised if like the next time you speak to me I'm not even in this mission. You never speak five years from now. And I hate what do you do. I work for a charity.

Anything's possible. Is like I think when it comes down to it there are few people who want obviously they should have a purpose. You know I I need to feel like my job has a purpose the reason that I enjoyed doing what I do is because I know I'm not ripping off my customer. I don't. My prices are lower than mine prices. And I enjoy that. Like me. That's what I take away from it. They're here to buy something. I'm not ripping them off but at some point when you run and they don't care about it so much it's not going to make that much of a difference to you because I'm not helping. So why it matters. Like I don't know what you studied Maslow's Hierarchy of Needs You know by design.

So I'll send you some Maslow's Hierarchy of Needs basic needs like and so it's a triangle which basically states that this is the five levels of human. You know what we need what we require in life. So the first bottom level is obviously food shelter and clothing et cetera et cetera.

But the top layer is more about like self realization self awareness. You know you reach a certain point and if you don't feel like you are adding you're adding value or things like that you're miserable.

Ok I'll take a look at it.

I think this should be interesting to me. Let me just. Sorry I don't. I know I ramble a lot I

apologize. No no not at all.

It rains and the aspects I have anything yet. Oh yeah. And I I've heard Maslow now like context.

Exactly. Like I eventually like you know one thing I won't say about Boston's hierarchy of needs is I feel like you seem like when I was in school only I think we were one of the first few classes to be studying environmental systems and like you know about climate change and things like that most other. Like if I just ask my parents today what it makes no difference to them you know because they never studied about it that they're from a different generation. So like today as a lot of students and stuff like it's like biology chemistry physics and environmental sciences and so there they are learning about climate change from a very young age. Chances are the way that they view a lot of luxury items will be very different very very tough. I think most of them the reason that they put so much importance into a vacation and traveling is because they feel that you know nature's beauty is disappearing and they want to see as much as they can before they lose everything.

You get a very negative and cynical view.

No I think that's that's kind of where we're headed.

And how how do you see like this is what you were explaining earlier was your point of view. What about you want to offer asset in your business so how do you see how do you see look at it.

In what way can this view of people of your customers also change.

So it's never going to happen because only because as I said Listen had a lot of customers walk through the door and very issue at no point I don't get to hear today anyone ask me is there and what comes next is fine love nothing.

It's all about price. All right.

And so right now he said that you know if you felt exactly the reason for that and the reason I don't think it's sad is only because you have to understand they're they're not earning their earnings itself is is very different.

You're like just 25 30 years ago for example your your your traditional family was you had the father who was a sole income and that's sole income could take care of maybe his wife or a mortgage two kids that's not even possible today today any and even even I'm not even referring to cities I'm referring to.

Even if you take like the middle of the UK or whatever the salary changes proportionately like your standard house or nice apartment may cost like three hundred thousand pounds but the average monthly income of most people in the Midlands would be like fourteen hundred sixteen hundred homes.

So it's it's not possible you know like you do need a partner where both people are providers are

breadwinners and it's a very funny. But like I know a couple and they both are earning and literally the wife's income goes directly to the nanny who takes care of the kids.

So it comes down to like why not stay at home and just do it again you know like it's tough because they're everyone of course deserves some career progression and individuality. So this is there are a lot of other factors that are coming into play and I don't think I think when it comes to you know when people are dealing with all of this you can't exactly go up to them and be like do you want to buy a diamond.

They're going to be like Yep things and you've got that.

So you know I think I. Yeah. To me this is this is what's eventually going to happen that we are going to struggle and I don't see the industry being able to cope with all of these things. In fact the industry now itself is struggling so much. The only main buyers in the UK are buyers of engagement rings. We don't sell anything else.

Very rarely will we have a claim for earrings or a bracelet. And even if they are I promise you either they're earning a shit ton of money in Canary Wharf somewhere like I don't know or they have like a certain amount of investments or you know maybe an inheritance of anything but the majority of jewellery and stuff like that you know the biggest retailer of jewellery in the UK is our boss.

I swear to you and they are so garbage in garbage but they are as real are they.

And so it's just a very lower quality of everything. And so I like it but it costs like how much 150 pounds. Hundred ninety nine pounds. This is what it is.

This is what it is like. My my starting product price range is fifteen hundred pounds.

So customers are obviously going to go for that. Now my question in terms of the ethical point of view is do my customers garbage at that price. No that's not what I do. I can't do that and I let's do it. Oh yes.

I mean I really hope this isn't recorded.

I've been told that part of the lies to pay for my stone shovel as well.

Yeah.

You don't like it because it's very cynical but it does worry me and I don't know if I know a tiny stranger. This company is like my baby. But the truth is is that. In due time we are going to we are going to find it tougher. So either at that point we switch over to lab grown and at least make it like a little bit more cost friendly and you know what I mean.

But even then I don't know how much of one of the other factors which I think you should make a note of at least when it comes to integrate is. How important is marriage do people even consider getting married these things because more and more people are happy with live

in relationships so just equal partnerships and they're more than happy to have children and things like that but without marriage.

So then if there's no marriage is there an engagement ring. Is there a need done. So as I said there are so many things and it's just getting more and more challenging.

Yes absolutely. And that's something when when you look at the diamond industry and is it I wouldn't even say sustainability and I think the ethical part is the number one factor I would actually put like all of these factors that I've described to you and rambled about prior to the whole ethical oh take a look.

I tried to take a look at it and in a different different factors that you said.

Yeah. No amount of access really. I

I think it's it's weird.

I mean all they can do is your business and I think at least over here on average so we have the Office for National Statistics over here and the Office for National Statistics basically says that there are approximately two hundred and fifty thousand marriages that happen in England every year approximately. They've also stated that the number has fallen. And sometimes the reason that the number is roughly the same is because a couple was divorced. Maybe one has gotten married again. So like the older generation even if they get divorced still look at marriage as an important aspect. The younger generation may not necessarily do the same.

Yes it is. It is a traditional Catholic zombies and cultural and traditional Indian Chinese like Asian. Maybe yes.

They will still push for that but more and more often we are seeing a live in relationship.

Example is being started without the marriage license and things like that yeah I did a lot of things yeah impacting thinking about driving.

That's all I'm saying.

I'm 30 never speak to you and there is very busy. There are a lot of things out there but it's OK.

It will be OK. Our any the role of any business is to adapt. You know like if it's today. This isn't the case then. I don't know like Nokia was a fishing industry and then they went into cell phones. Right. Exactly. It doesn't matter like what you're doing if it's if you are in the industry you will always see things.

If today most luxury industries and genders would probably work towards maybe only towards like working for one segment of the market maybe they're only going to look at like the rich and then offer offered their jewelry and everything to the ultra rich told me. Is that feasible for everyone. No. What are we going to do. Well we're going to study in the NBA and then find a job. It's like this.

Guy I of. I know you were asking how did you start. What was your idea of starting his business. When you were so young you look so.

Slow. Believe it or not. Okay so when I told my dad owned a small jewelry retail store in the Caribbean and so every summer in winter he would put me to work. He would like to come to a store because it's a very tourist based island. So you have to be there to be presentable. You know you're doing what needs to be done and I think because I was just there so I was not allowed like video games.

Nothing I was just always at the store. Always like get to work. Yes sir. But because I was there I just I developed a passion for it. I never hated it. I quite enjoyed it.

So anyway I started when I was 11 or so because he would just be like kind you can just stand there and be cute and then you know customers will come in. So you do that and it's like no problem.

And then I said like you know what. Clean the windows just basics. It wasn't. It was not looked down upon improvements like ensuring that he had a sense of responsibility and that's how parents would look at it. But. You know every day you're watching the watchers you're watching jewelry and things like that and you develop a passion for it you enjoy it. And then at the age of 14 he sent me to a boarding school in the south of India for four years and all of that the reason he suddenly was you know he wanted me to get a better education. We went up there and then after finishing 9 10th 11th and 12th grade I shipped to the UK and I studied at Bradford School of Management. I don't want to live there but basically up and Leeds up north and there I studied accounting and finance. I didn't even study like jewelry or anything. And after that as soon as I graduated I was like I hate accounting and I never want this again. So I let it go I was like No I'm right after that I actually. Did a degree in Diamond geology so I mentioned to you. So I studied geology and I did a diamond geology course over there. It's not very long it's only about six or seven weeks but it's very very intense. Is most of your time you're actually grading diamonds so you look at them like this is the color.

So in the seven weeks we had to grade over one hundred and twenty diamonds. And so like you're just constantly paying attention it seems like very intense this time. Anyway I know I'm dragging this very thing I promise you. Up.

To that I started looking for a job in the jewelry industry. The problem was it was two thousand I think 12.

At this point and it was still tough to get onto the job market here. Anyway I I I was applying and I didn't find anything so I used to actually work for Sara. It's a little bit glamorous on here. So I used to work tours are I was a cashier there for a long time until this finally this company seventy seven diamonds the one that I sent you.

They offered me wrong I was a buyer of diamond buyer so I worked there for about 10 months. And. Around that time I realized that one of the things that they didn't have were the tiny

diamonds like that are used for example if you take this ring these diamonds are here.

And he didn't have like a very good source and it wasn't well calibrated but I mean like the measurements were very always varying and it was a big headache for a lot of companies. And so I realized that this was a downfall so I went to my dad and I was like Look he was still in St. Martin in the Caribbean at this time and I was able to be a good opportunity maybe to you know focus on this and he was like yeah sure go ahead. So he gave me a little bit of money here and then we started doing justice. So mind you it was by far still one of the scariest things I did. I don't know why I did it. Part of me felt like I was in a relationship at that point and part of me felt like if I wanted to settle down I needed to be financially independent. So this was important. So there are a lot of reasons that I was being pushed into it. And I was like No it's fine it's the right thing. It was one thing and it was tough. It was very tough for at least the first year. The orders were coming through. It's not that but profit margins were small. And then what happened it was like a lot of my friends were obviously getting married and they would come to me and they can't actually. Can we source the ring from you. And I was like yeah sure. And the reason they did that was only because of one they trusted me too.

Obviously they're my friends I was going to give them a price. I didn't have an issue with them.

And so because of that then they started telling their friends et cetera et cetera. You know we basically just slowly developed into a retail store. But even during that time we used to do a lot of wholesale lines to ship. So when I used to do and so a lot of I don't know if you are familiar with like the canary islands.

So like tendering you sort of into a space I have a lot of customers all but they're like retail stores I used to supply diamonds to them as well.

So we really did a lot of things until the Brexit referendum and when the Brexit referendum happened and we were directly affected because the entire diamond industry runs on US dollars. And the biggest issue was the pound completely collapsed the day of the referendum and it still hasn't gone back. You know suppose the thing was is that the amount of money we were making on wholesale literally dropped from maybe like 8 percent to minus 2 percent. You know we're making losses.

And so we had to switch over rapidly to going back into retail and we stopped a wholesale thing.

In fact we tried to liquidate as much as we could. And then we reinvested the money so that we actually read at the office a little bit more welcoming to clients et cetera et cetera.

Random yellow. All my lines are connected. I can't even turn a distance like the other wall. Yeah.

So just to make it a little bit more comfortable for clients to come in and basically as we started to focus more on retail the profit margins spread a little bit higher and we're still growing. We're struggling. Mr. Lincoln let's look.

You think it will change. What we did Brexit actually happening I think better to start seeing

and two weeks.

Right now to most anyone you ask. Brexit makes them more desperate right now we feel like most people feel like the government's taking them on a ride.

You know it's just like as far as I'm concerned. I think everyone outside the UK looks at the UK like we're idiots I wouldn't be surprised if that's the case. I don't blame them I think we do look like you know the truth is like for most businesses the effect came the day of the referendum when the pound collapsed.

You see once your currency collapses inflation has to happen.

It's not plausible that it doesn't. No know one of the things that I studied this because like I would go into the supermarket and like obviously you could buy like a box of strawberries and a box of strawberries would maybe cost like three pounds.

And Oscar maybe like two or three weeks they had to change the packaging because they couldn't afford to give the same number of strawberries hypothetically for three pounds. So what did they do.

If this was the box right. What they did was they hollowed out the amount from the bottom two from the top. It looks like you're picking the same and from the bottom it's like slightly like how long ago they did.

Almost every supermarket had to basically make the packaging look at the same but carry less in order to combat it.

So yeah stripping this and nobody will ever talk about it over here but those who know me mean I think a lot of people do I don't think it's all they had to do was take a trip to the local supermarket and you could see the effects.

You can see there's too many lives but we can't do anything about it. It's any any industry that is directly linked to the dollar would have really suffered really Christine.

I think I should also at some point take a look at how an economy comes this long here good and when you depends on the US dollar. And with all of his inflation and changes you know in that the business model changes years in the price how that affects the ultimate price.

I promise you if you go into that you will drive yourself crazy because there is actually so I'd study this. The best example is just look at gold. Just look at gold because you see at one point the US dollar was hedged to gold yes.

And then when they remove that hedging what you will see is that basically the value of gold soared. Absolutely. So compared to the dollar. That's why you can not get much. Anyone who has decided to hold gold did phenomenal and did absolutely phenomenal. And that is exactly why during a recession the gold price always so-and-so always losing this interesting institution

to look into.

Basically you'd be looking into the Federal Reserve and the gold price.

I will make sure to do that.

Yeah. I guess that would help me to also get a better understanding of how this diamond associated with the U.S. dollar. I give you a lot of credit because it's a lot of. Eyes a lot of reading and.

I think that says if all goes well and trust me I will enter a charity very soon within the five year something like this is pointless and another thing again this all of this.

First I like your essay because that's I divided you is very interesting. But why in your and your MBA why do you want to change. I got any new essay MBA project this other first my curiosity why do you want to change in the TV no fly for your own business.

I think to an extent I believe very much in what I do in terms of the quality in terms of our customer service. Believe me when I say we are very people oriented and it's a small company it's just you know I handle everything from sales to customer complaints to designs to whatever you know I like being able to help people and what I was hoping to do is honestly for any business to grow you need something.

And today the way to get funding is on behalf you have you know certain credentials to your name. If you told people that you studied your MBA at Imperial all of a sudden you look more credit worthy. That's what it comes down to. I would hope that in due time. Next things continue to grow that. Yes absolutely.

I would be able to take on a little bit more capital and at least aim towards people who again just very much strictly focused on the engagement ring to show them that we could create wonderful things that genuinely add value and we're able to at least guarantee to 99 percent that look everything is legitimate and you have nothing to worry about on the other hand. I also felt that there are two parts and I'll be very honest in the second part was I'm worried. I'm very worried as to where the industry is going. And if I do so in my culture it's important that the boy is the son of the family does have to look after the parents and things like that. And I know that I need a certain amount of income to be able to do that. And if I'm not able to get that from this business then what is my fallback because my undergraduate was in accounting and finance but I didn't qualify to become a chartered accountant because I got bored of it. So I had a degree in accounting and finance which is a good degree in everything. But normally most people who do it then follow it up with a chartered accountancy qualification. So the point of the matter is that when it comes down to it I was just like OK if things don't work out I need a sensible fallback option and then I felt that the MBA would at least provide me with a little bit of a cushioning if I needed to look for a job there. There is fear there is fear. Absolutely.

Is is the biggest issue that I had that weird that we're eating like we're being painted with is like

all of a sudden in one year we had Brexit we had millennials changing and we had like the house prices just go up and down and we didn't know how to handle it. Everyone you speak to is winging it. You know it's not that big nobody has it figured out.

Absolutely nobody ever took it up. You are just putting out fires on a day to day basis and hoping for the best. That's a.

It is as cynical and negative as I certainly don't speak to Julius for a very very negative.

But honestly I hope it would be nice if we could change things and do things. But so much of it as I realize is out of our hands. You don't like guns. You have to take into account the political minefield you have to take into account the new generation coming up and how they feel about things where there is a lot there is there's a lot.

I would highly I told people we're thinking about opening their own business respectfully don't do it. It is not.

You know you're not going to manage. I don't care who you are. I mean because they said political and economy situation you mean because you see it today it doesn't matter where you are on. You.

Have to deal with sectors that are outside of your control. You see already when you start a business you have to deal with things like like OK there's going to be a lack of sales. Like how do you how do you get your funding.

How do you manage that funding. How do you manage staff know. There are a lot of things because it's tough. It's not that you can't. And if you can manage to figure that out. That used you used to basically see your financial gain. Nowadays that is the easy part. It's tough but that's the easy part. In the sense that you have to sit in the seats every time there's a new technology. Right. The speed at which you need to adapt is insane. It is absolutely insane. And if you don't do it you were you're losing on customers very rapidly very rapidly because the same in brick and mortar store is now competing with online retailers all their shops in the vicinity.

Now. So today if I needed to buy I don't know like a phone case. I don't need to buy from the U.K. I can buy it from China.

It will be shipped over here and it would still cost me less doing good things than you are dealing with it's are insane.

It doesn't matter if you're a small business you are dealing with nothing. And. If for example if I was a big business and this this happens all the time if I was a big business and I noticed that there is a small company that is slowly taking away customers I can do one of two things I can either go in and buy out that business or number two I can lower my price and drive that person out of business. So I think like this idea of like starting your own business and everything.

I think you have to understand that it will destroy your personal and social life. If today like I've

been running this for six years till today no bank will give me a mortgage. Because they're like. Yeah because they're like you know you're self-employed. So it's very inconsistent. Anything can happen. We can't take that risk. Or if they are willing to take the risk it's at a percentage that is insane. Then all like you all you have to do is if I go work for a company for three months after three months they're more than happy to give me a It's true that. It's. True. I. I. Would. After six years I'm actually in a position where I'm earning a stable income and still they would be like No we prefer the guy who's working for me. That's something that's like this.

That's money even in banks in London. Do that because London seems to be like the only place in Europe for innovative ideas.

For a start I was part of your own businesses.

It's funny that they feel things like that.

These banks I'm sure. What support is given to anyone looking to innovate and start. Absolutely nothing.

Absolutely not. If today I was looking to start anything as a bank going to give banks don't even give businesses money anymore they're not interested in so it's I needed a round of funding.

Even if I have an innovative idea if I'm not able to present it well if I don't meet the right people if I'm not in the right. If my pitches is incorrect for anyway how do I get that from there are so many hurdles so many things.

And then I'm telling you I sit in a class of MBA students where everyone thinks they have the next best idea. Yeah maybe you do. But you know there are so many other things that you need. And I learned this the hard way. I'm not even saying that I was successful at this. I learned a lot of it the hard way.

It is every day you are dealing with a different thing.

I get like my sister. I still remember this. I think like four years into my business my sisters I can't do realize that every time I actually need to meet you. I have to sit and schedule an appointment with you.

And you have to understand that I in my head I was like You know I'm there for her. We used to live in the same place so like she was like I don't even see you like I don't know what time in the night you come home. By the time you wake up I'm I'm at work. So I moved and she was right.

And I didn't even see it because when you're doing sales most of your clients tend to prefer coming in after working hours stretch and if they've finished they'll come. So most of my clients will just actually happened between six thirty and thirty p.m. And then during weekdays and I live about an hour and a half away because I can't afford them.

So it's like when you sit in you know you use you do all this and then I'm telling you I have

friends who are my age who are probably earning three times the same amount they're married they have their own house everything that's everything. So I don't when it comes down to it. You could have the next best idea. Absolutely. But are you ready to sacrifice every other opportunity cost because there's not one you are sacrificing multiple.

And most people and refuse to. I'm here six years in and I'm like maybe I made the wrong decision maybe no I'm confident I made the promises.

I mean you did you did and you are having a successful business so what.

Okay what this is this is an interesting point. What defines successful business.

How do you define.

Yeah you're right. Well I mean in in a business family you know you are earning profit then you are stable but maybe you wedding.

How do you normally profit because you're still in the business.

This is this is a wonderful point. I think it's very important. You don't need to be profitable to be to continue your business all you need is positive cash flow.

You don't need profitability.

Oh I had. How did you find difference back to being a depth maybe even think about every medicines company today.

Think about Amazon. Think about Uber. Are any of them profitable.

One of them on Amazon. In the last five years became profitable every year prior to that was lost no. No none of these. Every jewelry industry every jewelry company down there is not profitable. They just have a positive cash flow. That's a given. Even investors don't care if you are profitable or not. Certain intended to go please.

No. One of our colleagues came. I feel I'm doing this. You were back on the air. Here's what I found that not the MBA students of Chris that he is that he's actually working guy in diamond industry.

OK great. And you guys that have clearly I have scientists at the CSI lab.

Every investor today doesn't care if you are making a profit or not.

They want to see here to come see how much money comes in because that's how you're going to get paid.

Whether you're profitable or not they don't care you in profitability unfortunately means nothing.

But at the same time it means that if you have the positive cash flow you need that there's not a

profit because you are.

Let me tell you how easy it is to have a positive cash flow. So if you just study I would argue one textbook and it's called Google AdWords. Do you talk Google AdWords is wearing you know another version of it. No. When you search for something on Google. Right. The top two or top three things that comes up over there are normally ads.

So you would set up a Google AdWords account. So that would it would basically say to Google is that if every time someone types this I want to come up first I it is directly linked to like the sales data. So if someone types in engagement rings OK. If I say that I would like to be like number one then every time someone clicks Google will charge me like five pounds. It's a lot of money. Yes. I'm not doubting it. But a number of times that people will then be direct to my site to buy directly.

Would obviously increase. So if tomorrow an investor is willing to put I don't know ten thousand pounds into my company and I transferred ten thousand directly into Google. AdWords the chances are that I will make. I don't know.

At least five or six sales. OK. Most likely much more. But even if I say five or six sales per sale on average might be about two thousand five hundred votes three thousand homes 4000 votes. So immediately I put in 10000. But what is my return in terms of sales. 20000.

So it is a lot easier to get in. All you have to do it is up your marketing and the sales.

That's interesting. Say this is a business idea like business and all this is all rubbish nonsense.

That every every business is the same.

But maybe and beheadings you might maybe it's L.A. But also I don't know. I'm just saying maybe U.K. related maybe in some other places if they have met their supporting policies for new ideas.

I hope there is and maybe I'm ignoring to them. I hope there is but if the U.K. is looked at as like as one of the leading ones I think they're highly highly especially because like one of my one of my most favorite things to do is watch like most politicians say for example all we want to support small businesses and encourage them.

What are they actively doing. They set aside a budget or are they giving any sort of educational classes or are they subsidizing like for example let's say like I've been running my own business they help subsidize if I want to do an MBA.

What is it that they're doing. They're doing it.

No I'm going to have the U.K. government on that list as well.

I'm just saying look you know if I'm doing anything it's very hard for anyone to say that.

Well there's potential there. It's like it's all rubbish it's all nonsense. They're just saying what needs to be said when it comes to saying you don't speak in your letters for a lot.

Of people. I know that's bad. It is tough.

I think right now if you have like more you need good or something that you know indirectly helps in terms of the convenience factor people will at least be willing to listen to whether they invest into you or not.

It's a whole different to all differently especially because in financial accounts today. Right. Normally the way that it used to be done is that they would look at like if today on the phone business they would be like yeah how many phones do you have. That's the asset value right. That's the value of their business based on your assets today.

And if you have companies like Netflix et cetera et cetera then do it the way that they are valued by the number of users it is not valued based. If she if I took all of Cooper's assets what do you think they have mainly like a bunch of computers and some hard drives or whatever. No matter what they have it doesn't equal to the valuation of how many other billion that they haven't. It is all based on the number of users and tomorrow if there is a new app that comes out and all of the users switch that's the end user so when I look at it from a business legacy etc etc I don't really know.

You know it's very hard for me to say what is it going to lead to what is it going to end. 2 I don't know. Most most businesses today that survive only survive because they have also diversified themselves. It's like a freeze on belief. I can give you an example of my dad. My dad knew that like the jewelry industry it may not work out always. So he bought a few properties and he has rental income coming in. Right. So they have to to have to diversify they have to protect themselves. But. How would a business do that. It's not easy.

So yeah.

So I will out I should take out maybe within a few years and I hope you would be doing an even more successful takeover.

I know it sounds a lot like I'm telling you I have personally been very fortunate to even win awards and I'm still telling you that you're struggling. So in 2016 I won the Duke of York Young Entrepreneur Award and I got to meet Prince Andrew for this business. And. Then.

Last month last month I got profiled by a national international children's magazine called retail jeweler. As a 30 Under 30 in the UK drug ring industry and even with this profile we're struggling. It's not easy. So I can only imagine those who may not necessarily have the exposure that I have.

How they're doing that's that's really tough. This is a man where dark people you shouldn't talk to.

Yeah. By the end of my MBA I will be working for a charity. Company.

Do you have idea I happen to see other people and in the USA. My guess like in the earlier part of the chain as well.

I promise you the reason I stopped doing it is because they complain so much.

They whine and they complain I'm already so negative. Let me stay away from this. I was very worried.

But even today like obviously sometimes we have to meet up them. So like one of the things for example that really affected the delivery industry over here was the number of Chinese imports. So like you can today if I'm making like an engagement ring like this I can buy the bottles where there is no center stone. Right so this thing could come from China. Obviously over there and like the labour is much cheaper. Everything is different. So over here this would normally like if I had to buy it from a person who has made it here built it here it would cost maybe like seven hundred pounds. And right now I can buy it from China for 300 bucks. So all of the goldsmiths over here were immediately like took a big hit because everyone was importing from China and everyone in America. So there are a lot of things that are directly affecting industry but more and more than all of that it comes down to the consumers themselves literally will only pay attention to engagement rings and wedding bands and.

Sometimes there would be more money and the other things as well. But it's tough experience and you're constantly even if today if I gave my customer the best service and the best price I could also do.

Chances are they could go to another store and the guy would be like OK what's the best price you've got. I'll make it 50 times business and the customer will buy it from them.

Well that's it doesn't matter.

It is still very priced and still I.

Thanks so much Karen. And I hope we can you know stay in tight keeping time.

I was going to do this because I'm very good with locks up. Normally I could take my watch. Thank you. Thank you.

Please let me also have my number for the WhatsApp.

So just did you just send a message on this one. Because I'm not very good with Skype. But what's up. Like I'm always on it. So it's really no trouble.

I thought you all all also lengthen by any chance. Yes OK. OK.

I thought I would just tap your name and family name and then that's what that's true to come up and then maybe get me David weed. Right now I. It doesn't just I think I'm the only David

one. You know.

I'm sure I'm sure you'd let me first find you. Oh with a s though will you say.

Yes found you there. Yeah.

Yeah. You know that I'm sure you know that there are less of that. You know them in commodity trading and also love hearing good trading and issues and then after you know of that what's the matter.

So there's the puzzle show that I come forward sometimes rather than. Yeah looks more like a watch one to be honest. But now our dealers are there as well. Just messaging.

Let me say very good when it comes to water because a lot of my business happens what's up as well.

If you ever need to get into lecture anything ISO type is like it's a bit funny because I don't use it as much but I have it. I always use it to use the word.

Yeah a good yeah. Yeah. We've semester off MBA. Are you.

This is my first semester. We started in April and our first first semester first block ends in August. So exams and your stand. In the meantime just assignments and making sure. Like dealing with useless people in my group.

I'm kidding. You know I never kill me as.

I. I just miss you. Then only within a few weeks because I was a visiting researcher at the Imperial. Mrs. Cooper. Yeah until late madman to any force of May. And then I got back here for my permanent place at the VFR.

So a position if I had been there and maybe I haven't seen you about. And yeah the idea of an online means are to see.

If by any chance it works out just literally. I mean what's up. Not anytime I don't. If I do if I do comes as a dinner then it's either Geneva or Bozo.

You might subclass twice please.

Thank you. I would love to. I'll have a coffee or something any. Follow Geneva.

Yeah sure. I'd love to see you. I thought I heard good things.

Yeah. Yeah. If you love me if you can also be thinking yeah. Give it a with. Thanks so much Karen. It was really it really was I think lots of wonderful not as bad as really inspiring and Yeah such a positive event.

And then Daddy again. A smart entrepreneur. So it was very nice talking to you.

Sure sure does. It goes negative the entire time but I. Think we'll take.

A look if you need me to look over anything specific. Please don't hesitate to ask my anxiety to clarify so little.

Thank you. Thank you. I'll do that.

I'll bother you if I needed to know from his eyes. OK. Take good care. Thanks so much for your time. Thank you. All the best for everything.

Thank. You too.

B Appendix B

B.1 Legend: Abbreviation of Technology Grouping

UAV/Drones	*EP1*
Remote sensing & Airborne Geophysics	*EP2*
Image analysis	*EP3*
Deep drilling	*EP4*
Nano, Bio & Gas geochemistry	*EP5*
Mobile laboratory	*EP6*
Automated transport system and vehicles	*EX1*
Renewable energy sources for power generation	*EX2*
Surveying technologies	*EX3*
Data science (simulation and integration)	*EX4*
Robotic technologies	*EX5*
Instrumentation technologies	*EX6*
Lab-made minerals	*MP1*
Internet of things (IoT)	*MP2*
Underground preconcentration	*MP3*
Bio and Phyto mining	*MP4*
Insitu Mining	*MP5*
Portable detectors and analyzers	*WE1*
Personnel tracking & Fatigue measuring	*WE2*
Sensors and monitoring systems	*WE3*
Covers, Liners & Filters technologies	*WE4*
Dust collectors and air quality instruments	*WE5*
Wetland technologies	*RR1*
Covers, Liners & Filters technologies	*RR2*
Phytoremediation technology	*RR3*
CO2 collection & sequestration	*RR4*
Water treatment and water reuse technologies	*RR5*

Geo-tourism technologies after mine closure RR6

B.2 Sustainability Criteria Description

Criterion	Description
Social and environmental development	Community sustainable social and economic development
Life-cycle analysis of ore	Sustainable production and recycling of ore
Environmental issues	Environmentally sustainable acts
Health & safety issues	Increasing health & safety standards for mine workers and surrounding area

B.3 Expert view: Mining Technologies [SurveyGizmo]

1. *In your view, what are the most challenging sustainability domain in mining today?*

   _____
   _____
   _____
   _____

2. *How do you define "Innovative Technologies" for mining?*

   _____
   _____
   _____
   _____

3. *In your view, which part of mining changes the most in the presence of new technology?*
   ( ) Exploration
   ( ) Extraction
   ( ) Processing
   ( ) Reclamation

4. *Mining exploration: How do you see the role of exploration phase in each of the sustainability areas below?*

Social & environmental development	*-9_____[___]_____9*
Life-cycle analysis of mineral	*-9_____[___]_____9*
Environmental issues	*-9_____[___]_____9*
Health & safety issues	*-9_____[___]_____9*

5. *Mining extraction: How do you see the role of extraction/exploitation phase in each of the sustainability areas below?*

Social & environmental development -9_____[___]_____9
Life-cycle analysis of mineral -9_____[___]_____9
Environmental issues -9_____[___]_____9
Health & safety issues -9_____[___]_____9

6. *Processing: How do you see the role of processing phase in each of the sustainability areas below?*
Social & environmental development -9_____[___]_____9
Life-cycle analysis of mineral -9_____[___]_____9
Environmental issues -9_____[___]_____9
Health & safety issues -9_____[___]_____9

7. *Reclamation of mines: How do you see the role of reclamation phase in each of the sustainability areas below?*
Social & environmental development -9_____[___]_____9
Life-cycle analysis of mineral -9_____[___]_____9
Environmental issues -9_____[___]_____9
Health & safety issues -9_____[___]_____9

8. *Considering exploration phase, what is the impact of this section on social and economic issues?*
Health & Safety issues -9_____[___]_____9
Social & Economic development -9_____[___]_____9
Life-cycle analysis -9_____[___]_____9
Environmental degradation -9_____[___]_____9

9. *ICMM defines sustainability in four categories of: health & safety, social and economic development, environmental issues, and life cycle analysis of mineral.*
Regarding the definition above, how much each of the mining phases below impact sustainability?
Effect on Social & environmental development -9_____[___]_____9
Effect on Life-cycle analysis of mineral -9_____[___]_____9
Effect on Environmental issues -9_____[___]_____9
Effect on Health & safety issues -9_____[___]_____9

10. *Looking at new technologies in mining, how available is technology in exporting, installation in mines, etc.?*
( ) Easily available
( ) Rather available
( ) Rather unavailable
( ) Mostly unavailable
( ) Other (please explain): _____

11. *Looking at new technologies in mining, how costly is these technologies in terms of being capital intensive, their payback period, abatement costs, etc.?*
( ) Very costly

( ) Reasonable price
( ) Rather costly
( ) Rather cheap
( ) Very cheap
( ) Other (please explain): _____

12. *How much new technologies have been helpful in increasing efficiency in mining?*
( ) Very helpful
( ) Rather helpful
( ) Neutral
( ) Rather not helpful
( ) Not helpful

13. *Looking at new technologies in mining and their transferability, how much do you see these new technologies transferrable in general?*
( ) Easily transferable
( ) Rather transferable
( ) Reasonably transferrable
( ) Rather nontransferable
( ) Non-transferable

14. *Looking at new technologies in mining, how compatible is this adoption to country development goals which you work in?*
( ) Very compatible
( ) Fairly compatible
( ) Reasonably compatible
( ) Rather noncompatible
( ) Non-compatible

15. *Looking at new technologies in mining and their transferability, which are important for transferability issues? Please rank them in order.*
_____ *Local capacity*
_____ *Reproduction opportunities*
_____ *Localisation of manufacturing*

16. *Considering extraction phase, what is the impact of this phase on social and economic issues?*

For Health & Safety issues	*-9_____[__]_____9*
For Social & Economic development	*-9_____[__]_____9*
For Life-cycle analysis	*-9_____[__]_____9*
For Environmental degradation	*-9_____[__]_____9*

17. *Considering processing phase, what is the impact of this section on social and economic issues?*

For Health & Safety issues -9_____[___]_____9
For Social & Economic development -9_____[___]_____9
For Life-cycle analysis -9_____[___]_____9
For Environmental degradation -9_____[___]_____9

18. *Considering reclamation phase, what is the impact of this section on social and economic issues?*
For Health & Safety issues -9_____[___]_____9
For Social & Economic development -9_____[___]_____9
For Life-cycle analysis -9_____[___]_____9
For Environmental degradation -9_____[___]_____9

19. *In your view, which type of technology has the most impact on changing mining process?*

_____

20. *Has mining industry found new market linkages through adoption of new technology? Please explain.*

_____
_____
_____
_____

21. *Has mining technology adopted technologies from other field of which it made a significant difference in the process? Please explain.*

_____
_____
_____
_____

22. *Can you think of a regular technology which gradually enhanced mining industry efficiency?*

_____
_____
_____
_____

23. [*OLD VERSION*] *In your view, in each type of sustainability domains below, which technology has had the most impact?*
for Health & safety issues: _____
for Environmental hazards: _____
for Social and Economic Development: _____
for Life-cycle sustainability of mineral: _____

24. *Taking the example of diamond mining, has the extraction process changed in recent decades?*
( ) Yes-please explain: _____
( ) No-please explain: _____

25. *What best describes your job?*
    ( ) Academic in mining
    ( ) Practicing-mining engineering
    ( ) Other - Please specify: _____

26. *What is your principle activity domain?*
    [ ] *Exploration*
    [ ] *Extraction*
    [ ] *Mineral Processing and refining*
    [ ] *Mining sustainability*
    [ ] *Other-Please specify:* _____

27. *Which of these technologies completely changes current process in the Exploration phase? Please check all that apply.*

    Exploration & Exploitation phases:
    [ ] *Internet of things (IoT), Data Science (simulation & integration of data)*
    [ ] *Deep drilling*
    [ ] *Gas geochemistry*
    [ ] *Improved autonomous vehicles*
    [ ] *UAV/drones*
    [ ] *Modern & high performance batteries*
    [ ] *Other technology that has changed Exploration phase::* _____

    Mineral Processing phase:
    [ ] *Underground pre-concentration*
    [ ] *Ore Grinding monitoring*
    [ ] *Sustainable processing chemicals*
    [ ] *Other technology that has changed Exploration phase::* _____

    Reclamation & remediation phase:
    [ ] *Geo-radars*
    [ ] *Reusing mineral tailings*
    [ ] *Hydro-seeding*
    [ ] *Geo-tubes*
    [ ] *Other technology that has changed Reclamation phase::* _____

28. *How would you propose measuring the technological innovation in mining (e.g. patents, etc.)?*

    _____
    _____
    _____
    _____

29. *In your view, which extraction method has changed the most in the past decades? Please explain.*

_____
_____
_____
_____

30. *In which countries have you worked as a mining expert? Please identify all.*

_____
_____
_____
_____

31. *How many years have you worked in mining sector?*

_____

_____

Thank you very much for your time and helping our study!

B.4 Questionnaire 1. Transilience quadrant allocation of technology

Sectors	*Technology name*	*No.*	*Architectural*	*Niche*	*Revolutionary*	*Regular*
Exploration	*Drones*	*EP1*				
	Remote sensing & Airborne Geophysics	*EP2*				
	Image analysis	*EP3*				
	Deep drilling	*EP4*				
	Nano, Bio & Gas geochemistry	*EP5*				
	Mobile laboratory	*EP6*				
Excavation & Rock-Mechanics	*Automated transport system and vehicles*	*EX1*				
	Renewable energy sources for power generation	*EX2*				
	Surveying technologies	*EX3*				
	Data science (simulation and integration)	*EX4*				
	Robotic technologies	*EX5*				
	Instrumentation technologies	*EX6*				
Mineral Processing	*Lab-made minerals*	*MP1*				
	Internet of things (IoT)	*MP2*				

	Underground preconcentration	*MP3*
	Bio and Phyto mining	*MP4*
	Insitu Mining	*MP5*
Water, Environment & Safety	*Portable detectors and analyzers*	*WE1*
	Personnel tracking & Fatigue measuring	*WE2*
	Sensors and monitoring systems	*WE3*
	Covers, Liners & Filters technologies	*WE4*
	Dust collectors and air quality instruments	*WE5*
Remediation & Reclamation	*Wetland technologies*	*RR1*
	Covers, Liners & Filters technologies	*RR2*
	Phytoremediation technology	*RR3*
	CO2 collection & sequestration	*RR4*
	Water treatment and water reuse technologies	*RR5*
	Geo-tourism technologies after mine closure	*RR6*

B.5 Questionnaire 2. Weighting of Sustainability and Technical Criteria Impacted by Innovative Technologies.

1. *The first 6 criterion below are sustainability factors which are impacted through innovative technologies in mining sector. The last 4 criterion are technical parameters impacted by technological innovations.*

   In your view, please rank each criterion below from 1 (least) to 9 (most) potential impact in presence of technological innovation -if innovative technologies has no or negative impact, please choose 1-.

   * *Please answer questions based on your experience and views from country you operate.*

2. *Do you have comments in general, or on any of the criterion scoring above?*

   How much does innovative technology have impact on sustainability in general?

Criteria for mining operation	*Criteria Description*	*How much the criteria is going to be impacted by innovative technologies ? (Scale: 1-9)*
Social and cultural development	*Community sustainable social and cultural development*	
Life-cycle management of minerals	*Sustainable production and recycling of minerals*	
Environmental benefits	*Help addressing related environmental concerns*	
Health & safety	*Increasing health & safety standards for mine workers and surrounding area regarding fatalities, hygiene issues, etc.*	
Increasing the efficiency of mines	*Having more efficient mine sector for different technical aspects*	
Economic development	*Effect on local economic growth, job creation, etc.*	
Availability of Technology	*Availability of the facilities in the international market for different mine sites (i.e. easiness of new technologies for getting exported to other/developing countries)*	
Lowering Cost of Technology	*Capital Investment, payback period, CO2 abatement cost of new technologies of the last three decades*	
Condition for easy technology transfer	*Local capacity and opportunities for reproducing and localization of manufacturing*	
Compatibility with SDGs	*Compatibility and synergies with country and international development goals (SDGs)*	

3. *On a scale of 1-9, 9 being the highest, how would you rank your expertise in each of these mining sections?*

Sections	*Expertise (Scale 1-9)*
Exploration	
Exploitation	
Mineral Processing	
Water, Environment, & Safety	

Reclamation & Remediation

B.6 Questionnaire 3.1. Pairwise comparison-Sectors : Exploration, Exploitation, Mineral Processing

B.7 Questionnaire 3.2. Pairwise comparison-Sectors : Water, Environment and Safety, Reclamation and Remediation

Mining Sectors	*Social Development*	*Life-Cycle Assessment (LCA) of minerals (1-9)*	*Environmental benefits (1-9)*	*Health & Safety (1-9)*	*Efficiency (1-9)*	*Economic development (1-9)*	*Availability (1-9)*	*Cost (1-9)*	*Technology Transfer (1-9)*	*Compatibility (1-9)*
Exploration	*UAV/Drones* *Geophysical techniques for airborne & downhole based on physical & chemical properties* *Remote sensing for hyperspectral images, field spectrometry* *Data science-based modeling, Image analysis (thin section & drill cores)* *Mobile laboratory, Deep drilling & gas geochemistry*									
Exploitation	*Robotic technologies (mapping and excavation)* *Surveying instruments (UAV/-Drones, GPSs and laser scanners)* *Monitoring & inspecting technologies: tire pressure, blasting, Data Science-based simulation & integration Telecommunications*									

	Renewables-based electrification, long-lasting instrument: core bits & batteries Biodegradable explosives
Mineral Processing	*Lab-made mineral production: e.g. synthetic diamond* *New processing techniques: Tank, pressure, Ion leaching, electrochemical methods, in-situ leaching, bio-& phytomining processing, electrochemical methods, smelting technologies, smelting techniques, process monitoring technologies, process monitoring technologies* *Underground preconcentration* *Renewable energy sources for processing factories*
Water, Environment & Safety	*Sensors and monitoring systems* *Personnel tracking & Fatigue measuring* *IoT instruments: Portable detectors, sensors and monitoring systems* *High performance geophysical technique* *Filter Press & Water Reuse* *Dust emission and air quality instruments* *FENIX Capsule Fatigue measuring watches*
Reclamation & Remediation	*Wetland technologies (Artificial land for treating wastewater)* *Reusing mine tailings* *Cover systems and filters Geotextile separators Phytotechnology for slope stability Internet-based sensors & water monitoring*

Water monitoring: CO2 injection in underground mines	
Water treatment technology and water reuse	
Liners & geotextiles	
Solar panels and Power generation from tailings	
Climate change and weathering station, Pit lake technology	

B.8 Pairwise matrix calculation

	Social Development	*LCA*	*Environmental benefits*	*Health & Safety*	*Efficiency*	*Economic Development*	*Availability*	*Cost*	*Transferability*	*Compatibility*	*Final Weight*
Social Development	*1.00*	*1.18*	*1.48*	*1.61*	*1.60*	*1.36*	*2.13*	*1.89*	*2.22*	*1.85*	*0.06*
LCA	*0.85*	*1.00*	*1.25*	*1.36*	*1.36*	*1.15*	*1.81*	*1.60*	*1.88*	*1.57*	*0.07*
Environmental Benefits	*0.68*	*0.80*	*1.00*	*1.08*	*1.08*	*0.92*	*1.44*	*1.28*	*1.21*	*1.01*	*0.10*
Health & Safety	*0.62*	*0.74*	*0.92*	*1.00*	*1.00*	*0.85*	*1.33*	*1.18*	*1.50*	*1.25*	*0.10*
Efficiency	*0.73*	*0.74*	*0.92*	*1.00*	*1.00*	*0.85*	*1.33*	*1.18*	*1.38*	*1.15*	*0.10*
Economic Development	*0.73*	*0.87*	*1.09*	*1.18*	*1.18*	*1.00*	*1.57*	*1.39*	*1.63*	*1.36*	*0.08*
Availability	*0.47*	*0.55*	*0.69*	*0.75*	*0.75*	*0.64*	*1.00*	*0.88*	*1.04*	*0.87*	*0.13*
Cost	*0.53*	*0.63*	*0.78*	*0.85*	*0.85*	*0.72*	*1.13*	*1.00*	*1.17*	*0.98*	*0.12*
Transfer	*0.45*	*0.98*	*0.67*	*0.72*	*0.72*	*0.61*	*0.96*	*0.85*	*1.00*	*0.84*	*0.13*
Social Development	*0.54*	*0.64*	*0.80*	*0.87*	*0.87*	*0.74*	*1.15*	*1.02*	*1.20*	*1.00*	*0.11*

B.9 Graph computing. Efficiency-Economic Development-Availability-Cost-Transfer- Compatibility

Sector	*EP1*	*Social Development*	*LCA*	*Environmental benefits*	*Health & Safety*
	EP2	*0.012*	*0.014*	*0.016*	*0.016*
Exploration	*EP3*	*0.010*	*0.012*	*0.019*	*0.019*

	EP4	*0.012*	*0.012*	*0.016*	*0.019*
Exploitation	*EP5*	*0.012*	*0.012*	*0.016*	*0.016*
	EP6	*0.014*	*0.014*	*0.019*	*0.019*
Mineral Processing	*EX1*	*0.019*	*0.014*	*0.019*	*0.019*
	EX2	*0.019*	*0.014*	*0.016*	*0.019*
	EX3	*0.012*	*0.014*	*0.016*	*0.019*
	EX4	*0.014*	*0.012*	*0.016*	*0.019*
Water, Environment and Safety	*EX5*	*0.019*	*0.012*	*0.016*	*0.019*
	EX6	*0.012*	*0.012*	*0.016*	*0.016*
	MP1	*0.014*	*0.012*	*0.016*	*0.019*
	MP2	*0.019*	*0.012*	*0.016*	*0.019*
	MP3	*0.012*	*0.012*	*0.016*	*0.016*
	MP4	*0.012*	*0.012*	*0.016*	*0.019*
	MP5	*0.012*	*0.012*	*0.016*	*0.019*
Reclamation and Remediation	*WE1*	*0.012*	*0.012*	*0.016*	*0.019*
	WE2	*0.012*	*0.012*	*0.016*	*0.016*
	WE3	*0.012*	*0.012*	*0.016*	*0.016*
	WE4	*0.012*	*0.012*	*0.016*	*0.016*

B.10 An alternative variation of Factor analysis grouping

Variable	*Description*	*Factor1*	*Factor2*	*Uniqueness*
uavs	*UAV/Drones*	*0.610*	*0.747*	*0.068*
data	*Remote sensing & Airborne Geophysics*	*0.750*	*0.609*	*0.066*
mob	*Image analysis*	*0.822*	*0.525*	*0.047*
rob	*Deep drilling*	*0.768*	*0.603*	*0.044*
gree	*Nano, Bio & Gas geochemistry*	*0.866*	*0.467*	*0.031*
lab	*Mobile laboratory*	*0.398*	*0.865*	*0.093*
new	*Automated transport system and vehicles*	*0.654*	*0.681*	*0.107*
und	*Renewable energy sources for power generation*	*0.763*	*0.594*	*0.063*
green	*Surveying technologies*	*0.856*	*0.475*	*0.039*
iot	*Data science (simulation and integration)*	*0.846*	*0.438*	*0.091*
pers	*Robotic technologies*	*0.699*	*0.660*	*0.082*
fen	*Instrumentation technologies*	*0.628*	*0.728*	*0.029*
uav	*Lab-made minerals*	*0.610*	*0.747*	*0.068*
dat	*Internet of things (IoT)*	*0.750*	*0.609*	*0.066*

mob	*Underground preconcentration*	*0.822*	*0.525*	*0.047*
rob	*Bio and Phyto mining*	*0.768*	*0.603*	*0.044*
gree	*Insitu Mining*	*0.866*	*0.467*	*0.031*
lab	*Portable detectors and analyzers*	*0.398*	*0.865*	*0.093*
new	*Personnel tracking & Fatigue measuring*	*0.654*	*0.681*	*0.107*
und	*Sensors and monitoring systems*	*0.763*	*0.594*	*0.063*
green	*Covers, Liners & Filters technologies*	*0.856*	*0.475*	*0.039*
iot	*Dust collectors and air quality instruments*	*0.846*	*0.438*	*0.091*
pers	*Wetland technologies*	*0.693*	*0.660*	*0.082*
fen	*Covers, Liners & Filters technologies*	*0.662*	*0.728*	*0.029*
filt	*Phytoremediation technology*	*0.701*	*0.624*	*0.118*
wet	*CO2 collection & sequestration*	*0.646*	*0.693*	*0.101*
cov	*Water treatment and water reuse technologies*	*0.609*	*0.702*	*0.135*
wat	*Geo-tourism technologies after mine closure*	*0.690*	*0.666*	*0.078*

B.11 Pairwise comparison: Questionnaire results with nine-point scale to assess importance of criteria

Social Development	*LCA*	*Environmental benefits*	*Health & Safety*	*Efficiency*	*Economic development*	*Availability*	*Cost*	*Transfer*	*Compatibility*
0.545	*0.644*	*0.807*	*0.875*	*0.875*	*0.743*	*1.163*	*1.029*	*1.208*	*1.010*

B.12 Creative Destroyer Questionnaire

Creative Destroyer
The questionnaire described creative destroyer as the technology
The number of 10 creative destroyer which were identified by these experts are shown below. Synthetic diamond were seen as the most disruptive to the business and the e economy by these experts.
The regression of creative destroyers are set below:

Questionnaire 1. Degree of Innovation & Creative Destructiveness for Technologies in Mining

This questionnaire is about the degree of each technology being innovative and whether or not this changes the process of mining. Indicated sections are Exploration, Exploitation, Mineral

Processing, Water, environment & safety, & reclamation & remediation.

- *Creative Destroyer defines business process that destroys old practices and introduces new ones. Please put a checkbox next each technology that you suggest will makes drastic changes in innovation.*
- *For the next column, please rank Degree of Innovation of each industry based on them being innovative for mining sectors from 1 (least) to 9 (most) innovative degrees.*

Feel free to complete only the technologies or the sectors which sounds familiar to you.

Please answer questions based on experience you have on country you operate.

Sections	*Innovative Technologies*	*Degree of Innovation (Scale:1-9)*	*Creative Destroyer (Does it disrupt current process?) (Yes /No)*
Exploration	• *UAV/Drones* *High resolution orto-photo images* • *Geophysical techniques for airborne & downhole based on physical & chemical properties* • *Remote sensing for hyperspectral images, field spectrometry*	☐	◯
	• *Data science-based modeling* *Insight to subsurface & complex mineral relation* • *Image analysis (thin section & drill cores)*	☐	◯
	• *Mobile laboratory for various assessment* • *Deep drilling with high performance bits & machines* • *Gas geochemistry for mineral detection*	☐	◯
Exploitation	• *Robotic technologies (mapping and excavation)* • *Data Science-based simulation & integration. e.g. Telecommunications* • *Surveying instruments (UAV/Drones, GPSs and laser scanners)* • *Monitoring & inspecting technologies: tire pressure, blasting control, long-lasting cores & batteries*	☐	◯

	• *Green electrification: Renewables-based electrification* • *Biodegradable explosives*	☐	◯
Mineral Processing	• *Lab-made mineral production e.g. synthetic diamond*	☐	◯
	• *New processing techniques: Tank, pressure, Ion leaching, electrochemical methods, in-situ leaching, bio-& phyto-mining processing, electrochemical methods, smelting technologies, smelting techniques, Process monitoring technologies*	☐	◯
	• *Underground preconcentration for reducing transportation cost*	☐	◯
	• *Green electrification: Renewable energy sources for processing factories*	☐	◯
Water, Environment & Safety	• *IoT monitoring instruments: monitoring systems & sensors, Portable detectors*	☐	◯
	• *Personnel tracking & Fatigue measuring* • *Wireless communication systems*	☐	◯
	• *FENIX Capsule & oxygen-diffusion meters Fatigue measurement tools* • *Dust emission & air quality instruments*	☐	◯
	• *Filter Press & Water Reuse*	☐	◯
Reclamation & Remediation	• *Wetland technologies (Artificial land for treating wastewater, pit lakes)* • *Reusing mine tailings*	☐	◯
	• *Cover systems and filters* • *Geotextile separators* • *Phytotechnology for slope stability* • *Internet-based sensors & water monitoring*	☐	◯
	• *Water monitoring: CO2 injection in underground mines* • *Water treatment technology and water reuse* • *Filters & geotextile separators* • *Solar panels and Power generation from tailings* • *Climate change and weathering station*	☐	◯

• *Water monitoring: CO2 injection in underground mines* • *Water treatment technology and water reuse* • *Filters & geotextile separators* • *Solar panels and Power generation from tailings* • *Geo-tourism after mine closure*	□	○

B.13 Criteria weighing questionnaire

Questionnaire 2. Weighting of Sustainability and Technical Criteria Impacted by Innovative Technologies

4. *The first 6 criterion below are sustainability factors which are impacted through innovative technologies in mining sector. The last 4 criterion are technical parameters impacted by technological innovations.*

   In your view, please rank each criterion below from 1 (least) to 9 (most) potential impact in presence of technological innovation -if innovative technologies has no or negative impact, please choose 1-.

   * *Please answer questions based on your experience and views from country you operate.*

Criteria for mining operation	*Criteria Description*	*How much the criteria is going to be impacted by innovative technologies ? (Scale: 1-9)*
Overall impact of innovative technologies on sustainability and technical improvement		
Social and cultural development	*Community sustainable social and cultural development*	
Life-cycle management of minerals	*Sustainable production and recycling of minerals*	
Environmental benefits	*Help addressing related environmental concerns*	
Health & safety	*Increasing health & safety standards for mine workers and surrounding area regarding fatalities, hygiene issues, etc.*	

Increasing the efficiency of mines	*Having more efficient mine sector for different technical aspects*
Economic development	*Effect on local economic growth, job creation, etc.*
Availability of Technology	*Availability of the facilities in the international market for different mine sites (i.e. easiness of new technologies for getting exported to other/developing countries)*
Lowering Cost of Technology	*Capital Investment, payback period, CO2 abatement cost of new technologies of the last three decades*
Condition for easy technology transfer	*Local capacity and opportunities for reproducing and localization of manufacturing*
Compatibility with SDGs	*Compatibility and synergies with country and international development goals (SDGs)*

5. *Do you have comments in general, or on any of the criterion scoring above?*

6. *On a scale of 1-9, 9 being the highest, how would you rank your expertise in each of these mining sections?*

Sections	*Expertise (Scale 1-9)*
Exploration	
Exploitation	
Mineral Processing	
Water, Environment, & Safety	
Reclamation & Remediation	

B.14 Transilience map questionnaire

			*Select One Category from Technology Innovation Window (Signed with *)*			
Sectors	*Technology name*	*No.*	*Architectural*	*Niche Creation*	*Revolutionary*	*Regular*

			Disrupt Competition -Disrupt Linkage	*Conserve Competition -Disrupt Linkage*	*Disrupt Competition -Conserve Linkage*	*Conserve Competition -Conserve Linkage*
Exploration	*Drones*	*EP1*				
	Remote sensing & Airborne Geophysics	*EP2*				
	Image analysis	*EP3*				
	Deep drilling	*EP4*				
	Nano, Bio & Gas geochemistry	*EP5*				
	Mobile laboratory	*EP6*				
Excavation & Rock-Mechanics	*Automated transport system and vehicles*	*EX1*				
	Renewable energy sources for power generation	*EX2*				
	Surveying technologies	*EX3*				
	Data science (simulation and integration)	*EX4*				
	Robotic technologies	*EX5*				
	Instrumentation technologies	*EX6*				
Mineral Processing	*Lab-made minerals*	*MP1*				
	Internet of things (IoT)	*MP2*				
	Underground preconcentration	*MP3*				
	Bio and Phyto mining	*MP4*				
	Insitu Mining	*MP5*				
Water, Environment & Safety	*Portable detectors and analyzers*	*WE1*				
	Personnel tracking & Fatigue measuring	*WE2*				
	Sensors and monitoring systems	*WE3*				
	Covers, Liners & Filters technologies	*WE4*				
	Dust collectors and air quality instruments	*WE5*				
Remediation & Reclamation	*Wetland technologies*	*RR1*				

Covers, Liners & Filters technologies	*RR2*
Phytoremediation technology	*RR3*
CO2 collection & sequestration	*RR4*
Water treatment and water reuse technologies	*RR5*
Geo-tourism technologies after mine closure	*RR6*

B.15 Interviews paper copies-will be included in thesis hard copy.

C Appendix C

C.1 List of Mining Firms discussed in chapter 3

Mining Firm List
Anglo American
AngloGold Ashanti
Antofagasta
ArcelorMittal
Banpu
Barrick Gold Corp
BHP
Buenaventura
Bumi Resources
China Shenhua
Coal India
CODELCO
ERG
Evraz
Exxaro Resources
First Quantum Minerals
Fortescue
Freeport-McMoRan
Glencore
Gold Fields
Grupo México
Industrias Peñoles
MMG
Navoi MMC
Newcrest Mining

Newmont
NMDC
Nordgold
Orano
Peabody Energy
Polymetal
Rio Tinto
RUSAL
Sibanye-Stillwater
Teck
Vale
Vedanta Resources
Zijin

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Strengths:

- Environment & Safety Analyst, Mining Engineer & Geology Scientist, Sustainable Regulatory Policy Scholar

Education

SWISS FEDERAL INSTITUTE OF TECHNOLOGY LAUSANNE (EPFL) — Lausanne, CH
***PhD* in Natural Resources Policy and Technological Innovation** — September 2016-July 2021
Extracurricular activity: President of the Iranian Student Association at EPFL, 2016-2018

IMPERIAL COLLEGE LONDON, Royal School of Mines, Business School — London, UK
Visiting Researcher, Centre for Entrepreneurship & Innovation — Dec 2018-May 2019

SWISS FEDERAL ISNTITUTE OF TECHNOLOGY ZURICH (ETH ZURICH) — Zürich, CH
Center for Comparative and International Studies (CIS) — September 2014- April 2016
M.A., Comparative and International Studies

EPFL, College of Management of Technology — Lausanne, CH
Exchange student, Master's Thesis project — January - April 2016

WEBSTER UNIVERSITY — St. Louis, MO, USA
Sam Priest Center for International Studies, School of Arts and Sciences — October 2011-May 2013
B.A. in International Relations. Graduated with Webster University **International Distinction Award**.
Study-Abroad program at Webster University Geneva Oct 2011-Aug 2012.

AMIRKABIR UNIVERSITY OF TECHNOLOGY (TEHRAN POLYTECHNIC) — Tehran, IR
Department of Mining, Metallurgical & Oil Engineering — September 2006- October 2011
B.Sc. in Mining Engineering. Concentration in Mining Extraction.
Internship at *Sepehrasia Co.* Iron ore mining & trading, *Underground mining eng. Trainee.* Chadormalu, IR.

Core Experience

World Resources Forum (WRF) Association — St. Gallen, CH; January 2021-present
Partnered among the international consortium in **RE-SOURCING** Horizon 2020 Project
Co-organized the **WRFA 2021** conference

Global Tailing Review, co-convened by ICMM, United Nations environment, PRI — Lausanne, CH
Leaded the report with international mining experts for the standard report — March 2020-current
Summarized and reviewed literature on tailing management

Corporate Strategy Innovation Chair, College of Management, EPFL — Lausanne, CH
Doctoral Researcher & Teaching Assistant — August 2018-September 2020
Completed **PhD thesis** on "Assessing methods for increasing sustainability of the extractive sector."
Coordinated SNSF SPIRIT project on Natural Resources Sustainability Concepts among international private & public partners
Co-conducted two semester projects for Swiss businesses implementing Design Thinking approach
Co-organized 2018 STRN Energy Transition student conference at EPFL

Green Economy & Resources Governance Chair, College of Management, EPFL Lausanne, CH
Doctoral Researcher & Teaching Assistant September 2016-August 2018
Co-authored among 23 colleagues UNEP IRP report on Natural Resources Governance on 21st century
Organizes & supervised Master semester projects on **Environmental Policy** courses
Assisted in creating project on Living Labs on **co-creating** sustainable development

IMPERIAL COLLEGE LONDON, Royal School of Mines, Business School London, UK
Centre for Entrepreneurship & Innovation, *Visiting Researcher* December 2018-May 2019
Researched "The role of technology on the sustainability of the extractive sector" **Assisted** in holding "Academy of Management Journal" conference in Imperial College London BS

ETH Zurich, Center for Comparative and International Studies (CIS) Zurich, CH
Assessed the "Impact of Renewable Energy on the Developing Countries Energy System" September 2014-April 2016

ETH Zurich, Center for Economic Development and Cooperation (NADEL) Zurich, CH
Research Assistant January-December 2015
Collected data with partners on **collaborative research project** between NADEL and KfW Development Bank

Languages

- **English:** *Fluent Spoken and Written (C2, C1)*
- **French:** *Upper Intermediate Spoken and Written (B2, C1)*
- **German:** *Intermediate Spoken and Written (B1, B2)*
- **Arabic:** *Intermediate Spoken and Written*
- **Persian:** *Native language*
- **Spanish:** *Basics*

Publications

- Global Tailings Standard. Report. ICMM, UN environment, PRI. August 2020.
- International Resource Panel (Group of Authors) (2019). Mineral Resource Governance in the 21st Century: Gearing extractive industries towards sustainable development. United Nations Environmental Program
- Eslamishoar, F., Tucci, C. A. Process Innovation mining sustainable business practices. Technovation. In progress. 2019.
- Re-evaluating Mining Sustainability Domains in case of Large-Scale Mining Resources: a Topic Modelling Analysis. Esalmishoar, F., Tucci, C., Hannigan,T., Valado, R. In progress. 2020
- The investigation of Cut-and-cover, top-down construction method for a metro underground station; case study: 'Naghsh-e-Jahan Metro Station. Journal of Geotechnics.Submitted. 22 June 2021

Technical Skills

- **IT:** Proficient in Python, Stata, R, Latex, MATLAB
  Applications: common Windows database, Adobe InDesign, Microsoft Publisher, spreadsheet, and presentation software
  Operating Systems: Windows, Mac, Linux
- **Earth Sciences:** Geological surveying, Geological safety regulations, Mineral processing, Mineral deposits, Mine management
- **Data Science:** Data acquisition, data wangling, data visualization, interpretation, interactive reporting
- **Project Management:** Design Thinking, econometrics analysis. Soft skills: Social, passionate, team-leader

Awards and Honors

- ETH Zurich Exchange Mobility Scholarship Zürich, CH, October 2016
- Webster University International Distinction Award. B.A. Honors St. Louis, MO, USA, May 2013
- Parliamentary National Tournament Debate Speaker Excellency St. Louis, MO, USA, December 2012
- Webster University Geneva Scholarship Geneva, CH, April 2012, Renews April 2012
- First Place (200,000 Participants), Iran universities of Applied Sciences Tehran, IR, January 2006