

**Tracing Conflict Minerals in the Great Lakes Region of Africa:
Drivers, Barriers and Opportunities**

by

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Author's Declaration

I hereby declare that I am the sole author of this thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners.

I understand that my thesis may be made electronically available to the public.

Abstract

Traceability has played a significant role in numerous product sectors – including food, agricultural and fish/seafood products – in assurance of product safety and quality, material origin and sustainability attributes. Since 2010, traceability has been adopted and implemented in tin, tantalum and tungsten (3T) supply chains to assist in removing conflict-related minerals from global supply chains, and ensuring the conflict-free origin of minerals. However, while factors impacting traceability in other commodity chains are fairly well studied, those impacting traceability in minerals supply chains are unknown. This study aims at understanding the drivers that motivate 3T supply chain actors to participate in the industry supply chain system and the barriers that inhibit traceability in conflict minerals supply chains in the Great Lakes Region of Africa, specifically in the Democratic Republic of the Congo (DRC). To achieve these objectives, a grounded theory approach was employed. Primary data were collected using semi-structured interviews with ten key informants holding high ranking positions in various organizations within and outside the physical supply chain. Collected data were analyzed inductively via coding. The study identified three drivers that motivate participation in traceability of 3T minerals in the DRC, with market access being mentioned more often than legal requirement and social pressure. The study found that barriers to traceability of conflict minerals in the DRC are institutional, contextual and people-related. According to the informants, the most significant institutional barriers involve government and the industry traceability system, with the DRC government being the biggest barrier to traceability of 3T minerals due to its weak governance over minerals trade, which is epitomized in the deficient monitoring system of mine sites, trade routes, and trading points, weak legal system and corruption. In addition, among the ten barriers identified, four are unique to conflict minerals traceability, which constitutes the originality of this study. This research contributes to the literature on traceability on two fronts. First, it fills the knowledge gap in commodity traceability literature. Second, this research opens new grounds for research in traceability of minerals. Moreover, this study provides significant recommendations that can be used to improve traceability of 3T minerals in the DRC.

Key Words: traceability, conflict mineral, driver, barrier, opportunity, improvement, 3T minerals, chain of custody.

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Dedication

I dedicate this ground-breaking research to all those who strive for the protection of the environment, ecosystems and natural resources around the world.

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List of Acronyms

ASM: Artisanal small scale mining.

BGR: Bundesanstalt für Geowissenschaften und Rohstoffe (Federal Institute for Geosciences and Natural resources).

CEEC: Centre d'Expertise, d'Evaluation et de Certification des matières précieuses et semi-précieuses.

CFSI: Conflict Free Smelter Initiative.

CFSP: Conflict-free Smelter Programme.

DFA: Dodd-Frank Act.

DRC: Democratic Republic of the Congo.

EITI: Extractive Industries Transparency Initiative.

EU: European Union.

ICGLR: International Conference on the Great Lakes Region.

ITRI: International Tin Research Industry.

ITSCi: ITRI Tin Supply Chain Initiative.

OECD DDG: Organization for Economic Cooperation and Development Due Diligence Guidance.

OEM: Original equipment manufacturer.

RCM: Regional Certification Mechanism.

RINR: Regional Initiative against illegal exploitation of Natural resources.

SAESSCAM: Service d'Assistance et d'Encadrement de Small Scale and Artisanal Mining.

UN: United Nations.

USGS: United States Geological Survey.

3T: Tin, Tantalum & Tungsten.

3TG: Tin, Tantalum, Tungsten & Gold.

Chapter 1: Introduction

1.1 Background and context

Minerals and the metals they contain are ubiquitous in everyday life. They are essential to various industries such as electronics, construction, manufacturing, agriculture, and cosmetics. In order to be used in industries, minerals are extracted from mines, processed into metals and traded in complex global supply chains. This results in challenges to tracing minerals back to their origin. Further, it is acknowledged that the exploitation, processing, and trade of minerals may be associated with social, economic, environmental issues and armed conflict (Azpagic, 2004). Such is the case with conflict minerals supply chain, the focus of this study.

1.1.1 Conflict Minerals

Conflict minerals refer to four minerals and/or the metals that are extracted from them: cassiterite (tin), columbite-tantalite (tantalum), which is colloquially known as “coltan” in DRC, wolframite (tungsten) and gold, known to be illegally exploited and traded, and thus financing armed conflicts in the Democratic Republic of the Congo (DRC) (US Securities and Exchange Commission, 2012).

For over 20 years, conflict minerals have been illegally exploited and traded to fund and sustain armed conflict in the Great Lakes Region of Africa, specifically in the Eastern Democratic Republic of Congo (DRC) (Nzambo-ko-Atumba, 2004; Onana, 2009; Onana, 2012; UN Security Council, 2002). It has been established that armed conflicts in the region are waged by an elite network that is controlled by the Rwandan Patriotic Army (Nzambo-ko-Atumba, 2004). This elite network refers to various interest groups including armed groups, businessmen, criminal groups, local politicians, neighboring states and multinational firms engaged in illegal trade of minerals (UN Security Council, 2002).

There is strong evidence that illicit trade in minerals has sustained armed conflicts in the region from 1996 onward. In 1999, for example, the Rwandan Patriotic Army (RPA) Congo Desk that

controlled most of the armed groups involved in illegal minerals trade contributed \$320 million to the Rwandan military expenses (UN Security Council, 2002). In addition, in 2008, trade in conflict minerals was estimated to have contributed \$184.4 million to armed groups: \$115 million from cassiterite, \$12 million from coltan, \$7.4 million from wolframite and \$50 million in profit from gold (BSR, 2010). For instance, estimates for 2010 suggest that the Forces Armées de la République Démocratique du Congo (FARDC) that controlled Bisie mine in North Kivu, the largest cassiterite mine in the region, earned approximately \$2.4 million a month and \$28.8 million a year from 2006-2009 via the illicit exploitation and trade in minerals. These earnings were collected from on-site minerals trade at the mine, and from taxes on diggers and on porters (Global Witness, 2010).

Notably, conflict minerals are necessary to the functionality or production of electronics and many other high-tech products, such as computers and cellphones (Resolve, 2010; US SEC, 2012). An overview of conflict minerals description, production, industry uses and global production is displayed in Table 1.1.

Table 1.1. Overview of 3T minerals description.

Source: Based on data compiled from Prendergast & Lezhnev (2009); BSR (2010); Share (2012); UN Economic Commission for Africa (2013); USGS (2016).

Mineral	Description	Uses	Global Production of primary metal (2016)
Cassiterite (Tin)	Symbol: Sn	<ul style="list-style-type: none"> ▪ Solder on circuit boards for electronics (44%) ▪ Solder on industrial applications (8.8%) ▪ Tinplate (16.4%) ▪ Chemicals (13.9%) ▪ Float glass (2.1%) 	<ul style="list-style-type: none"> ▪ China (42%) Indonesia (20%) Peru (11%) Bolivia (8%) Brazil (4%) Australia (4%) Burma (3%) ▪ DRC (6-8%)
Columbite-tantalite (Coltan) (Tantalum)	<ul style="list-style-type: none"> ▪ Symbol: Ta ▪ Mixture of 2 minerals: Niobium & tantalite ▪ Ta is ductile, highly resistant to corrosion by acids, good conductor of heat & electricity; has a high melting point 	<ul style="list-style-type: none"> ▪ Electronic components: (e.g., capacitors in cellphones, pagers, heart pacemakers, computers, videogames, automotive electronics (65-80%)) ▪ Super alloys for jet engine and turbine components (10%) 	<ul style="list-style-type: none"> ▪ Australia (2%) Brazil (21%) Canada (2%) China (8%), Mozambique (10%) ▪ DRC (15-20%)
Wolframite (Tungsten)	<ul style="list-style-type: none"> ▪ Symbol: W ▪ Tungsten has the highest melting point & the highest tensile strength at temperatures over 1650°C 	<ul style="list-style-type: none"> ▪ Carbide tools ▪ Cellphone vibration application ▪ Filaments in light bulbs ▪ Turbines for jet engines 	<ul style="list-style-type: none"> ▪ China, Russia, Brazil, USA, India, Uzbekistan, Vietnam ▪ DRC (2-4%)
Gold	<ul style="list-style-type: none"> ▪ Symbol: Au 		<ul style="list-style-type: none"> ▪ China, Australia, Russia, US, Peru, Canada, South Africa, Mexico

Mineral ores illegally extracted in the Eastern DRC conflict-affected and high-risk areas are easily smuggled out to adjoining countries, such as Rwanda, Uganda, Burundi, Tanzania, and Kenya, where they are traded and exported, to East Asia – specifically to China – and then to the rest of

the world via legal channels (Bleichwitz et al. 2012); BSR, 2010; Global Witness, 2010; Prendergast & Lezhnev, 2009) (Figure 1.1).

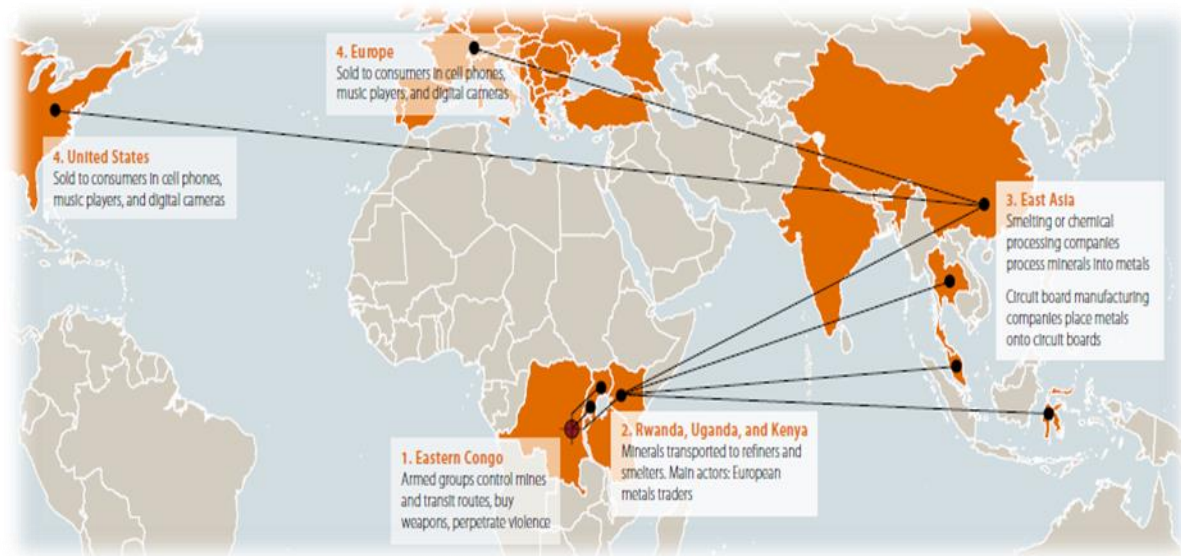


Figure 1.1. Illicit 3T minerals supply chains.

From Bukavu and Kivu, minerals are smuggled across the border mainly to Rwanda where they are exported throughout the world as material originating in Rwanda. Source: Prendergast & Lezhnev (2009).

The link between armed conflict and minerals trade is well established (UN Security Council, 2002). Concerns arising from the conflict minerals phenomenon and their implications are presented in Table 1.2. Armed groups are known to illegally control mine sites and trade routes, and collect taxes on mineral resources (BSR, 2010; EICC & GeSI, 2011). According to Nathan & Sakar (2010), before the implementation of traceability in 2010, twelve of the thirteen mine sites in Eastern DRC were controlled by armed groups. As shown in Table 1.2, conflict minerals exploitation and trade involves social issues such as serious human right abuses, which include slave and child labor, widespread sexual and gender-based violence, and loss of lives exceeding six million (Enough Project, 2014; Levin et al., 2013; Share, 2012).

Table 1.2. Links between minerals trade, armed conflict, and related concerns and impacts (Enough Project, 2014; Hayes & Burge, 2003; Prendergast & Lezhnev, 2009).

Major Concerns	Implications
(1) Link between armed conflict and minerals trade	<ul style="list-style-type: none"> ▪ Funding of armed groups ▪ Army’s control over mines & trade routes ▪ Conflict minerals traded in global supply chains
(2) Social concern	<ul style="list-style-type: none"> ▪ Serious human rights abuses ▪ Hazardous working conditions
(3) Economic concern	<ul style="list-style-type: none"> ▪ Tax evasion ▪ Poor price on minerals/Poor wages
(4) Environmental concern	<ul style="list-style-type: none"> ▪ Biodiversity loss ▪ Water pollution ▪ Devastation of fauna & flora

Although the Eastern Congo houses invaluable minerals, the region and its populations do not benefit economically from minerals trade. The DRC in general, and mining communities in particular, are not well off, because miners are price takers, and elite networks pay taxes to armed groups. Illegally collected taxes at mine sites and trade points are roughly estimated at \$500 million (Koning, 2011). Miners receive unreasonably small prices for their minerals, and are paid low wages amounting to \$1-5 a day (Hayes & Burge, 2003), which is below minimum wage. Moreover, according to Global Witness (2010) conflict minerals trade is characterized by tax evasion as minerals mined in the DRC are traded and exported from neighboring countries.

Mineral exploitation and trade also has an adverse impact on the rainforest, environment and its ecosystems (Bleischwitz et al., 2012). Previous studies indicated that Artisanal and Small Scale Mining (ASM), which is the principal mode of conflict mineral exploitation, does not observe basic environmental standards (Bleischwitz et al., 2012). Mining activities taking place in the Congo basin environment result in land disturbance and degradation, deforestation, biodiversity

loss, and watersheds pollution (Hart & Mwinyhali, 2001, UN Security Council, 2007). For example, Virunga and Kahuzi-Biega parks, both World Heritage sites, have been overrun to extract minerals that only profit armed groups, and business actors down the chain (Draulans & Krunkelsven, 2002).

1.1.2 International and Regional Responses to the Conflict Minerals Problem

In response to illicit exploitation and trade in conflict minerals, international and regional laws, regulations and initiatives have been developed and implemented to support transparent and “conflict-free supply chains”¹ (OECD, 2013; Taka, 2016). Initiatives will be presented in order of importance.

International Initiatives: Since 2007, a number of international initiatives have been developed in support of supply chain due diligence practices, including transparency on 3T minerals origin. These initiatives include regulatory frameworks, such as the UN Due “diligence guidelines”² by Group of Experts (GoE); Organization for Economic Cooperation and Development Due Diligence Guidance (OECD DDG); the Dodd-Frank Act 1502 (DFA); and industry-driven initiatives, including Conflict-Free Smelter Program (CFSP) and ITRI Tin Supply Chain Initiative (ITSCi). Except for Dodd-Frank Act, which can be enforced in law, all regulatory frameworks and initiatives are voluntary, relying solely on a sense of responsibility and moral obligation (Geenen, 2015). The following is an overview of some of the most significant regulations and initiatives.

¹ Conflict-free minerals supply chain refers to the mineral chain that is free from support for non-state armed groups or public or private security forces who: (a) “illegally control mine sites or otherwise control transportation routes, points where minerals are traded and upstream actors in the supply chain”; (b) “illegally tax or extort money or minerals at points of access to mine sites, along transportation routes or at points where minerals are traded”; and/or (c) “illegally tax or extort intermediaries, export companies or international traders” (OECD, 2013).

² Due diligence refers to “the process through which enterprises can identify, prevent, mitigate and account for how they address their actual and potential adverse impacts as an integral part of business decision-making and risk management systems” (OECD, 2008).

The UN Due diligence guidelines for responsible supply chains. The UN was the first international body to call for due diligence in conflict minerals supply chains. In support of conflict-free and traceable minerals, the UN Security Council mandated the GoE on the DRC to draft recommendations for the exercise of due diligence by downstream supply chain industries regarding the sourcing, purchase, acquisition, and processing of minerals originating from the DRC. The GoE thus produced a five-step due diligence guideline (UN Security Council, 2009), which was later on carried and formalized in the OECD DDG.

Organization for Economic Cooperation and Development Due Diligence Guidance. Created in 1961, OECD is an international organization that promotes policies aimed at improving economic and social well-being around the world. In support of responsible supply chain of minerals from conflict-affected and high-risk areas, the OECD in 2010 formalized the due diligence guidelines initiated by UN GoE into Due Diligence Guidance (DDG) as a tool designed to assist sourcing firms to exercise due diligence in their supply chains. The OECD DDG framework consists of five components (OECD, 2013) as outlined in Table 1.3.

Although OECD DDG is primarily intended to assist companies in exercising supply chain due diligence, it is equally useful for voluntary initiatives and programs designed to address conflict minerals supply chain concerns, such as CFSP and iTSCi (OECD, 2013). These industry-led initiatives help downstream firms, especially smelters and refiners avoid material from conflict sources. A recent study by Achebe (2016) shows that there is a significant increase in 3T minerals, specifically tantalum, sourced from conflict-free sources via compliant smelters and refiners.

Table 1.3. OECD DDG five-step framework.

Key aspects	Tasks
(1) Internal management systems	Restructure firms' internal management systems to include policies that support supply chain due diligence, including traceability of origin.
(2) Risk assessment	Identify and assess supply chain risk that sustains the link between minerals trade and conflict.
(3) Risk mitigation	Address identified risks accordingly.
(4) Independent third-party audit	Audit firms due diligence effort.
(5) Disclosure/Reporting	Firms to disclose to the public the steps undertaken to avoid trading in conflict minerals.

The US legislation Dodd-Frank Act (DFA) section 1502. The DFA act was signed into law in 2010 by President Obama to enhance conflict minerals supply chain transparency and support conflict-free sourcing (US SEC, 2010). The DFA via the Security and Exchange Commission (SEC) determines a set of requirements to be satisfied by all US firms registered with the SEC, and involved in the manufacture of products where conflict minerals are necessary. These manufacturing industries include electronics and communications, aerospace, automotive, jewelry and industrial products (Table 1.1). Firms are required to:

- (a) Disclose annually whether conflict minerals necessary to the products they manufacture originate from the DRC or adjoining countries;
- (b) Report on due diligence measures undertaken to determine/identify the source and the chain of custody (CoC) of conflict minerals in their supply chains;
- (c) Name the auditors of their reports;
- (d) Describe all facilities used to process conflict minerals used in their products;
- (e) Determine the country of origin of conflict minerals;

- (f) Describe efforts to determine the mine of origin of conflict minerals with the greatest possible specificity.

Unidentified and undocumented minerals exploited and traded in the context of armed conflict make their way into global supply chains, where they end up in various industries. The increasingly growing focus on removing conflict-related minerals from the global supply chain, and the requirement to identify the conflict-free origin of minerals produced in the Great Lakes Region of Africa, resulted in the need to implement traceability in 3T minerals supply chain (Melcher et al. (2008)). The need for traceability in the conflict minerals supply chain led to the development and implementation of various programs. These include the Conflict-Free Smelter Program (CFSP), at the smelter level; ITRI Tin Supply Chain Initiative (ITSCi) the traceability scheme for 3T minerals operating in the region; and Regional Certification Mechanism (RCM).

Conflict-Free Smelter Program (CFSP). The CFSP is one of the Conflict-Free Smelter Initiative (CFSI) tools used to address the conflict minerals issue. Launched in 2010, the CFSP operates as a tool for evaluating and providing third-party assurance on the plausibility of the conflict-free status of origin of materials sourced by compliant smelters/refiners (Young et al., 2014). The CFSP is the largest industry-led program to address conflict minerals, as its scope includes tin, tungsten, tantalum and gold smelters worldwide. The CFSP uses independent third-party audit to identify and validate smelters/refiners sourcing exclusively conflict-free products via audit protocols and procedures (CFSI, 2013). CFSI was established in 2008 under the leadership of the Electronic Industry Citizenship Coalition (EICC) and the Global e-Sustainability Initiative (GeSI). CFSI is an industry-led multi-sector nexus, which includes the Automotive Industry Action Group (AIAG), the Japanese Electronics and Information Technology Industries Association (JEITA), and the Retail Industry Leaders Association (RILA). CFSP focuses on the upstream supply chain from mine to smelter, with a specific interest in smelters/refiners. Another initiative focusing on the upstream supply chain is iTSCi, with a particular interest in helping upstream actors to trade

in 3T minerals that are traceable to a conflict-free origin. This initiative including the status of the current traceability will be explored in subsection 1.1.3.

Regional Initiative. The Regional Initiative against illegal exploitation of Natural Resources (RINR) is a legal framework developed by the International Conference of the Great Lakes Region (ICGLR) member states to address the issue of illegal exploitation of resources, including conflict minerals (PAC, 2015). Each member state has the responsibility to adopt and enforce this legal framework. Created in 2006 by the ICGLR member states, and launched in 2010, the RINR initiative aims at disentangling the link between minerals trade and armed conflict (Stream House, 2014).

The Regional Certification Mechanism. The RCM is one of the six tools of the RINR (Stream House, 2014), developed to obliterate the primary source of funding for conflict in the region. The six tools include:

- 1) RCM for natural resources;
- 2) Harmonization of national legislation in ICGLR member states;
- 3) Regional database on mineral flows;
- 4) Formalization of the artisanal mining sector;
- 5) Promotion of the Extractive Industry Transparency Initiative (EITI) peer learning mechanism;
- 6) Whistle-blowing mechanism.

Consistent with the OECD DDG for responsible supply chains of minerals from conflict-affected and high-risk areas, the RCM is aimed at supporting conflict-free and sustainable supply chains by ensuring that mine sites, trade routes and export channels are free from the predatory control of armed groups (ICGLR, n.d). The ICGLR's RCM is composed of four key components (Table 1.4). The objective of the RCM is to ensure transparency on minerals origin, verification of CoC compliance, and monitoring of regional supply chains (ICGLR, n.d.).

Table 1.4. Regional Certification Mechanism key components and tasks.

RCM key components	Task
(1) Minerals tracking from mine to export	<ul style="list-style-type: none"> • Mine site inspection and classification as green, yellow or red. • Implement traceability & Due diligence. • Certify minerals for export.
(2) Data management & Exchange via ICGLR database	<ul style="list-style-type: none"> • iTSCi to share information with member states . • Member states to share information with ICGLR, which tracks mineral flows in-country and across the region.
(3) Independent third-party audits	<ul style="list-style-type: none"> • Audit supply chain actors.
(4) ICGLR independent mineral chain auditor	<ul style="list-style-type: none"> • Act as regional inspector general. • Conduct ongoing monitoring and investigation as needs arise. • Make public reporting.

DRC government initiative. In 2012, the DRC government enacted legislation requiring mining and mineral trade firms operating in the country to implement supply chain due diligence in line with OECD DDG (Global Witness, 2012).

To date, CFSP and iTSCi, which are industry-driven, are the most prominent initiatives currently implicated in the process of assisting upstream and downstream firms to exercise due diligence in their supply chains. CFSP operates at the pinch point – that is, at smelters’ level – whereas iTSCi operates at origin, the Great Lakes Region of Africa.

1.1.3 Status of Traceability Implementation in 3T Minerals Supply Chain

Traceability of 3T minerals as currently implemented in the DRC involves two different institutions: the DRC government and iTSCi. The traceability scheme is owned by ITRI, but operated in collaboration with the DRC government, with the technical assistance of Pact. Pact is

the International Tin Research Institute (ITRI) partner for traceability implementation on the ground (Pact, 2015). iTSCi was created in 2009 by ITRI, and launched in 2010 in South Kivu, before the DFA, to assist the tin industry to satisfy supply chain due diligence requirements, and to document the conflict-free origin of minerals they purchase (Pact, 2015; Roesen & Levin, 2011). iTSCi is, by design, an industry-based traceability system operating in the Great Lakes Region of Africa, whose aim is to help deter conflict minerals from the supply chain and help business actors across 3T minerals supply chain, especially smelters, demonstrate that the materials they are sourcing from the region originate from traceable conflict-free mine sites (Stream House, n.d).

Presently, 231 firms participate in the iTSCi traceability system. Participating members include cooperatives, international traders, and smelters. As of a 2015 estimate, 39,622 miners participate and sell tagged materials in the DRC (Pact, 2013). The iTSCi system operates in the Eastern DRC, which includes the provinces of Katanga, Maniema, North Kivu, South Kivu, and the Oriental Province. Out of 366 active “mine sites”³ that were identified and characterized, 338 mines, that is 92.1%, have been qualified conflict-free; 16 of the 366 identified mine sites (4.8%) are yellow flagged, and not validated conflict-free; 11 of the 366 identified mines (3.1%) are red flagged, as result they are not qualified conflict-free (Ministères des Mines & Coopération Allemande, 2016; Pact, 2015). Processes and structure of the current 3T minerals traceability supply chain is portrayed in Figure 1.2.

³ A mine site is either a concession or a designated area/sector, which includes numerous pits. Each mine site has a tagging point where mineral ores are washed, weighed and tagged. For the purpose of this study, the mine of origin refers to the site where minerals are mined, washed, first weighed and tagged.

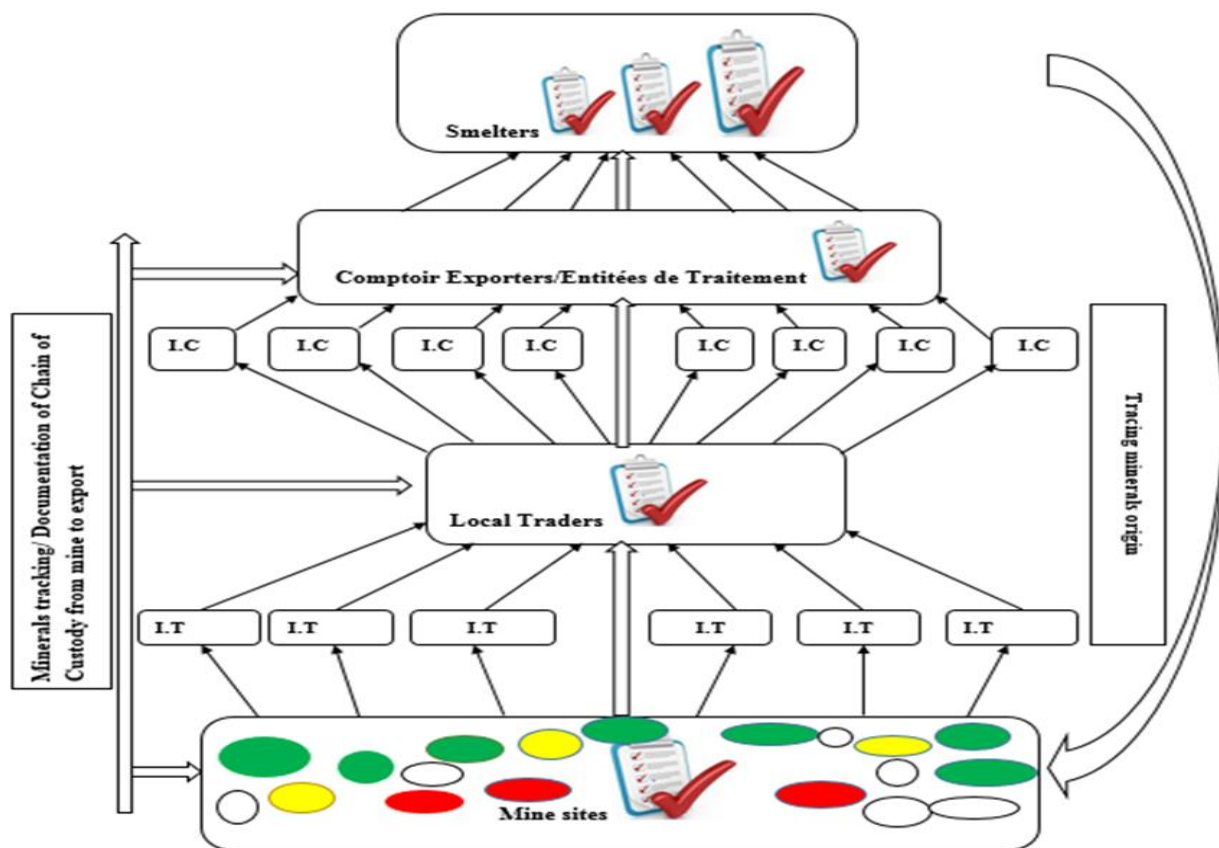


Figure 1.2. Status of 3T minerals traceability supply chain.

This diagram delineates the current supply chain structure, and traceability implementation in 3T minerals. The system uses direct (i.e., miners/cooperatives, local traders, exporters and smelters), and indirect supply chain actors (i.e., intermediary traders (I.T.) and intermediary comptoirs (I.C.)). Minerals are tracked from qualified mine sites to export through local traders; and can be traced from smelter to the mine of origin using CoC documentation.

Before traceability implementation takes place, the mine site must be qualified as conflict-free. This operation is carried out by the “Joint Mine Site Validation Missions”⁴ led by the DRC government (Ministères des Mines & Coopération Allemande, 2016). Identified mines are

⁴ Members of the Joint Mine Site Validation Missions include: Provincial Mining Ministry, Provincial Mining Division, SAESSCAM, CAMI, Mining Police, Bundesanstalt für Geowissenschaften und Rohstoffe (BGR), PACT/iTSCi, Mission de l’Organisation des Nations Unies au Congo (MONUSCO), Federation des Entreprises du Congo (FEC), Civil Society.

characterized as green, yellow or red. The green flagged pointers indicate mines that are qualified for traceability. The yellow flagged pointers show non-qualified mine sites, but with the possibility to produce materials for certified export. The red flagged pointers indicate non-qualified mine sites that are banned from producing materials. Mine sites that are characterized green are qualified conflict-free through a ministerial order issued by the Ministry of Mines. Once the process of characterization and qualification is completed, the DRC Ministry of Mines shares the status of mine sites with iTSCi (Ministères des Mines & Coopération Allemande, 2016).

As shown in the actual supply chain structure depicted in Figure 1.2., there are three main stages in the upstream supply chain of 3T minerals: mine site, trading house/negociant, and comptoir exporter. At mine site, miners are expected to have a miner's card issued by the DRC government. At the negociant level, official traders are to be registered with the DRC government and hold a trader's license issued by the DRC government. At the export level, exporters must be approved by the ministry of mines as processing entity. Thus, without this approval, exporters cannot legally purchase minerals in the DRC. Moreover, there are intermediaries involved between each stage. In most cases, intermediaries operate without being registered with the DRC government. At the negociant level, intermediaries operate under a licensed trader. At the comptoir export level, intermediaries operate under an exporter license and iTSCi membership.

In the iTSCi traceability system, supply chain actors (i.e., miners/cooperatives, traders, and exporters) do not have the capacity to identify and document materials in their possession (Pact, 2015). Moreover, ITSCi does not identify nor document mineral flows either. The major role of ITSCi is to ensure that mine sites are conflict-free and comply with due diligence requirements (i.e., slave and child labor, the environment, health hazards, presence of armed groups) via baseline study of mines, and the analysis, management, and transfer of data/information. The main responsibility for the implementation of traceability of 3T minerals in the DRC lies with the DRC government.

Ground operations pertaining to traceability implementation are carried out by the DRC government via three main services (Pact, n.d.). These services are: Service d'Assistance et d'Encadrement de Small Scale and Artisanal Mining (SAESSCAM), Division des Mines, and Centre d'Evaluation, d'Expertise et de Certification (CEEC) (IPIS, 2012; Pact, 2013). The DRC government agents, trained by Pact, are responsible for tagging and data collection. The current system employs two types of tags: mine tag and negociant tag, which are affixed on bags of minerals at the first two stages of the chain (i.e., at mine site and at negociant/trader) (IPIS, 2012; Pact, n.d.). As shown in Figure 1.3., each tag has a unique bar code number that is manually recorded in a uniquely numbered logbook. Data manually recorded are scanned and uploaded into the iTSCi database housed in London (Pact, n.d.), where traceability data are analyzed and managed. Three types of logbooks are used: mine logbooks, negociant logbooks and exporter logbooks. At the mine site, traceability data are recorded in the mine site logbook by the SAESSCAM agent; at the trading house, traceability data are recorded in the negociant logbook by an agent from the Division des Mines; at export, traceability data are recorded in the comptoir export logbook by an agent from the CEEC (Pact, n.d.). Required traceability data recorded in the logbooks are described in Table 1.5.



Figure 1.3. Manual data recording/Paper-based system. Source: iTSCi (2012).

Table 1.5. Data to be recorded at each stage of the supply chain (IPAD, 2010; IPIS, 2012). This shows how the CoC in 3T minerals supply chain is documented.

At mine site	At trading house	At Comptoir exporter
Mineral's trade name	Mineral's trade name	Mineral's trade name
Mine site's name	Trader's name	Exporter's name
Mine site location	Mine tag number	Negotiant tag number
Miner/Cooperative	Supplier's name	Supplier's name
Production method	Date	Date
Mine tag number	Time	Time
Date	Weigh-in	Weigh-in
Time	Grade	Grade
Weight	Price	Price
Grade	Weigh-out	Weigh-out
Price	Loss/gain	Loss/gain
Transport method	Transport method	Export number
Transport route	Transport route	Transport method
Transporter	Transporter	Transport route
Vehicle plate number	Vehicle plate number	Transporter
Security onsite	Security onsite	Security onsite
Taxes paid	Taxes paid	Taxes paid
Buyer's name	Up next buyer's name	Smelter's name

Concerning the cost of running the system, iTSCi traceability is mainly funded by the upstream industry via levy, which is paid on material tonnage. According to the estimates of 2014, 81 % of implementation cost was funded by the upstream industry, 16% by donors and less than 2% by downstream industry. The cost of traceability implementation includes field activities, data collection, reporting and auditing (iTSCi, 2016).

To summarize, implementation of traceability in 3T minerals in the DRC involves two main parties: iTSCi/Pact and the DRC government. ITSCi owns the system, but does not implement traceability of minerals on the ground. ITSCi is responsible for ensuring that mine sites are qualified for traceability, plus data analysis, data management and sharing. Pact is the implementing hand of iTSCi on the ground, as they provide technical assistance to the DRC government (i.e., training, guidance). Traceability of 3T minerals is implemented by the DRC government through three main services: SAESSCAM, Division des Mines and CEEC. The 3T minerals traceability supply chain goes from qualified mine site to export. This chain is officially structured in three stages: mine site, trading point, and comptoir export. However, in practice, the negociants/traders do not go to the mine sites: they use intermediaries to purchase the material. This phenomenon is also present at the comptoir export. Exporters do not deal with local traders, they use instead intermediaries who are identified as “comptoir agréé”. Concerning participation in traceability, the vast majority of miners in the DRC Eastern provinces sell tagged material. In the same way, exporters and local traders participate in the iTSCi traceability scheme. However, the drivers for participation and barriers to traceability across the upstream supply chain are as yet unknown.

Chapter 2: Literature Review

The purpose of this review is to examine academic literature on traceability and related concepts of product supply chains. Additionally, it seeks to find how past studies addressed the factors impacting traceability in product supply chains. The literature review will focus on three main areas identified as important to address the research objectives of this study: 1) traceability; 2) chain of custody; and 3) drivers and barriers to traceability in food, agricultural, and fish/seafood product supply chains.

2.1 Concept of Traceability

At its most basic level, traceability involves a traceable item – referring to a physical object that may require the retrieval of recorded information about its attributes (i.e., history, application or location) at a later time (GS1, 2007). The concept of traceability and its use is confusing, ambiguous and/or contradictory in literature (Olsen & Borit, 2013; Sterling & Chiasson, 2014). While the concept of traceability is widely used and accepted across product supply chains, scholars are far from embracing a common understanding of what traceability means (Karlsen et al., 2013; Olsen & Borit, 2013; Van Dorp, 2002).

Traceability first emerged in the 1930s in Europe to prove the origin of high-quality food such as French champagne (UN Global Compact, 2014). Recently, the need to implement traceability has come up to address issues pertaining to commodity concerns such as transparency of supply chain, identification of a commodity's origin and inputs, food safety and quality (GS1, 2006; Meuwissen et al., 2003). Furthermore, some scholars relate the importance of traceability to the need to document CoC, production practices, and comply with regulatory requirements (Thakur & Hurburgh, 2009). The literature review provides an overview of some prominent definitions of traceability.

ISO 9000 (2000) describes traceability as “the ability to track forward the movement through specified stage(s) of the extended supply chain and trace backward the history, application or location of that which is under consideration”. ISO’s definition introduces two key terms, namely, tracking forward and tracing backward, which are considered critical factors towards achieving complete and effective product traceability (Bosona & Gebresenbet, 2013; Van Dorp, 2003; Young et al., 2008/2010). However, ISO does not indicate what tracking forward entails and what allows for identifying the item/product attribute, including origin, at a later time. Other scholars have expanded on the understanding of traceability.

Sterling and Chiasson (2014, p.7) define traceability more specifically as “the ability to identify the origin of the product and sources of input materials, as well as the ability to conduct backward and forward tracking using recorded information to determine the specific location and life history of the product”. Olsen and Borit (2013, p. 148), for their part, describe traceability as “the ability to access any or all information relating to that which is under consideration, throughout its entire life cycle, by means of recorded identifications”. This definition focuses on the importance of recorded information, which allows for the capture of an item/product’s history. Tracking is defined as the ability to follow the path forward of an item and determine its localization from one or several criteria as it moves downstream in the direction of life cycle flow through the supply chain (Bechini et al., 2005; Bechini et al., 2008; Young & Dias, 2011). Conversely, tracing works backward, and refers to the ability, in every point of the supply chain, to determine the origin and characteristics of a product based upon one or more given criteria (Bechini et al., 2005; Bechini et al., 2008; Young & Dias, 2011). In line with Sterling and Chiasson (2014), several authors argue that for a traceability system to be complete, it must be able to address both tracking forward and tracing backward (Bechini et al., 2005; Bosona & Gebresenbet, 2013; Jansen-Vullers et al., 2003; Van Dorp, 2003).

2.1.1 Traceability in Supply Chain

Supply chain traceability consists of two essential components: internal and external traceability (Figure 2.1.). Internal traceability refers to traceability data recording that takes place at each step of the chain where a traceability participant/partner receives a traceable product/item as input that is subjected to internal processes before it becomes output. Internal processes may include movement, transformation, storage, usage or destruction (GS1, 2007). On the other hand, external traceability refers to the process where a traceable product/item is physically handed over to the next/direct traceability participant/partner (GS1, 2007). Thus, to achieve full supply chain traceability, all supply chain traceability participants must assume their responsibilities pertaining both to internal and external traceability (GS1, 2007; Hu et al., 2013). The main responsibility of each supply chain actor is to ensure the recording of relevant information about the material in their custody.

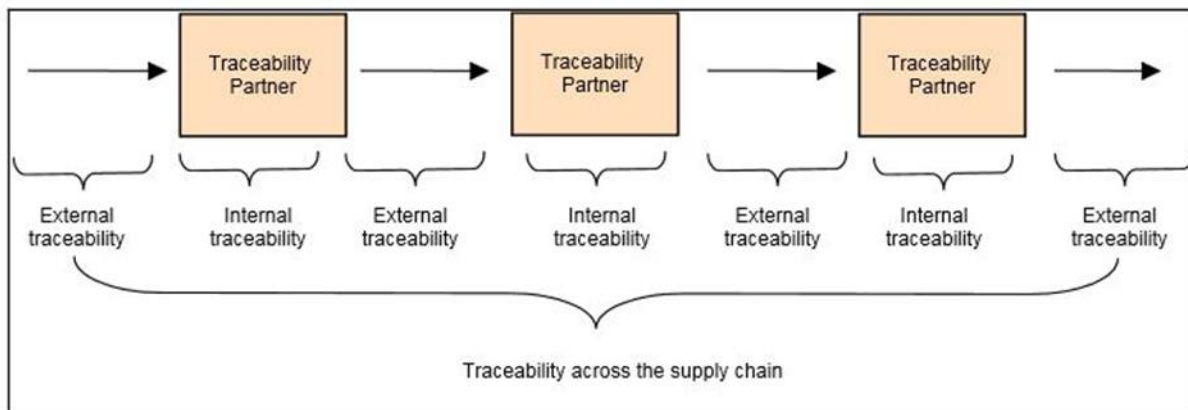


Figure 2.1. Description of internal and external traceability. Source: GS1 (2007).

2.1.2 Traceability Models

Application of traceability models is of great value in product supply chains “...as they provide structure and rules that enable the assurance of provenance of products” (Young et al., 2013, p.4). Three main traceability models are commonly used in terms of how traceability systems track and

trace materials' attributes or sustainability claims: physical segregation, mass-balance, and book-and-claim (Chainpoint, n.d.; Golan et al., 2005; IPIECA Biofuels Task Force & Liz Muller Consulting, 2010; ISEAL Alliance, 2012; UN Global Compact, 2014). These models are explained below.

Physical segregation: in this traceability model, certified materials are physically separated from non-certified materials at each stage along the supply chain (Chainpoint, n.d.; Golan et al., 2014; IPIECA Biofuels Task Force & Liz Muller Consulting, 2010; ISEAL Alliance, 2012; UN Global Compact, 2014). Importantly, the physical segregation model requires that every supply chain actor having custody of a sustainable product be certified, and demonstrate the ability to manage data, accounting, documentation and related processes involved in acquisition/purchase and disposition/sale of sustainable/certified products (IPIECA Biofuels Task Force & Liz Muller Consulting, 2010). This is only applicable to supply chains where actors are responsible for traceability implementation (i.e., food, agricultural, and fish/seafood products supply chains), unlike in conflict minerals, where traceability is implemented by institutions. The UN Global Compact outlines two physical segregation models to traceability: identity preservation (Figure 2.2. and bulk commodity physical segregation (Figure 2.3.) (UN Global Compact, 2014).

Identity preservation: materials of each identifiable sustainable origin are kept separate from those of different origins as described in Figure 2.2. Even products produced according the same sustainability standards cannot be mixed through the entire supply chain (Chainpoint, n.d.; UN Global Compact, 2014). This model guarantees traceability of origin of materials.

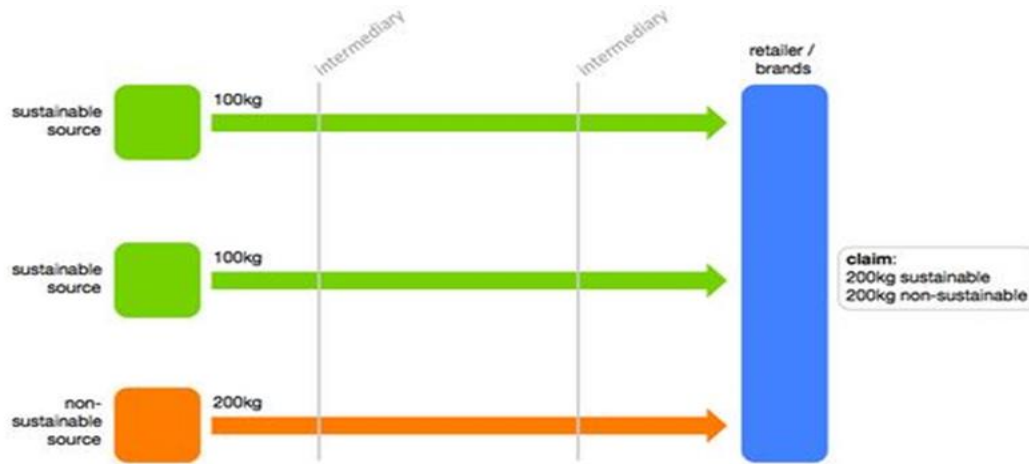


Figure 2.2. Identity preservation to ensure traceability of origin of material. Source: Chainpoint (n.d.).

Bulk commodity physical segregation: Segregation model requires separation of certified from non-certified materials, but allows for mixing of certified materials from different origins. Although all origins comply with the certification standards (UN Global Compact, 2014), this model does not guarantee a high level of precision on the origin of each comingled material (Golan et al., 2014).

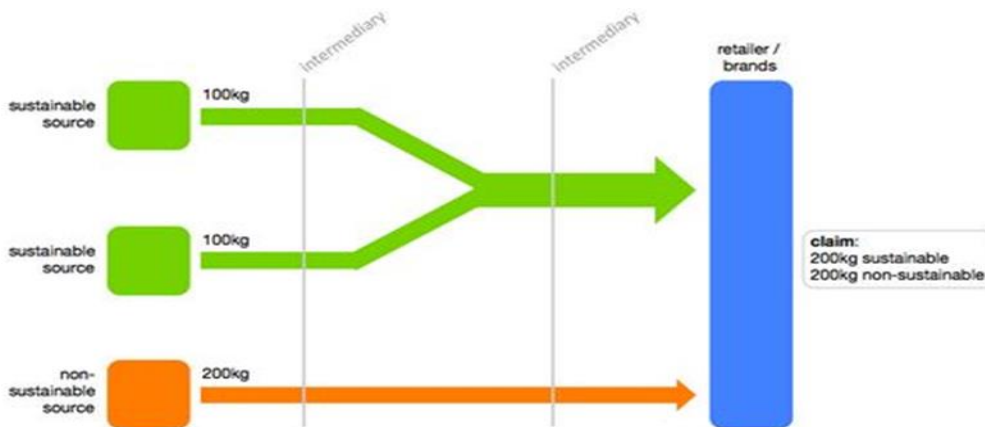


Figure 2.3. Bulk commodity physical segregation model. Sustainable material from different certified origins can be mixed. Source: Chainpoint (n.d.).

The segregation model is employed in organic produce industries, such as cotton, where produce from organic and non-organic farms are strictly segregated. However, organic cotton from different farms and producers are mixed for the purpose of making up a sizeable lot. This model can be applied to conflict minerals where the identification of origin and product differentiation are the main attributes to preserve. In applying this model, small quantities of material from different miners and qualified mines can be mixed to form a sizeable lot. However, the identification of the exact mine of origin would not be guaranteed. Physical segregation is the ideal model, as it allows to trace materials back to farm, fishery or mine of origin. However, the implementation of this model can be resource and cost intensive, as it requires the strict separation of all material origins and high monitoring and control at each step of the supply chain, which in turn necessitates advanced technology and human resources (Global Compact, 2014).

Mass-balance: as shown in Figure 2.4., the mass-balance traceability model allows for materials from sustainable and unsustainable origins to be mixed and flow together across the chain. However, exact accounting of volume ratios is required in order to ensure that the quantity of certified products produced are equivalent to the volume ratio of sustainable materials sold (Chainpoint, n.d.; UN Global Compact, 2014). The mass-balance traceability model allows for the volume ratios/quantity of certified materials to be tracked through the supply chain (IPIECA Biofuels Task Force & Liz Muller Consulting, 2010); however, it does not guarantee traceability of certified materials back to their origins (Chainpoint, n.d.). Moreover, to ensure proper administration of documentation systems and processes, each supply chain participant taking possession of a certified material is required to be certified and registered with the system (IPIECA Biofuels Task Force & Liz Muller Consulting, 2010). This model is cost effective as it only maintains a single stream of products (WWF Global, n.d.).

Mass-balance is used in product supply chains where segregation is difficult to achieve due to either the nature of material or complexity of supply chain. Mass balance is exemplified in the case of cocoa beans, where produce from sustainable and unsustainable farms are mixed and flow

together across the supply chain. This model is preferred to physical segregation because it is inexpensive.

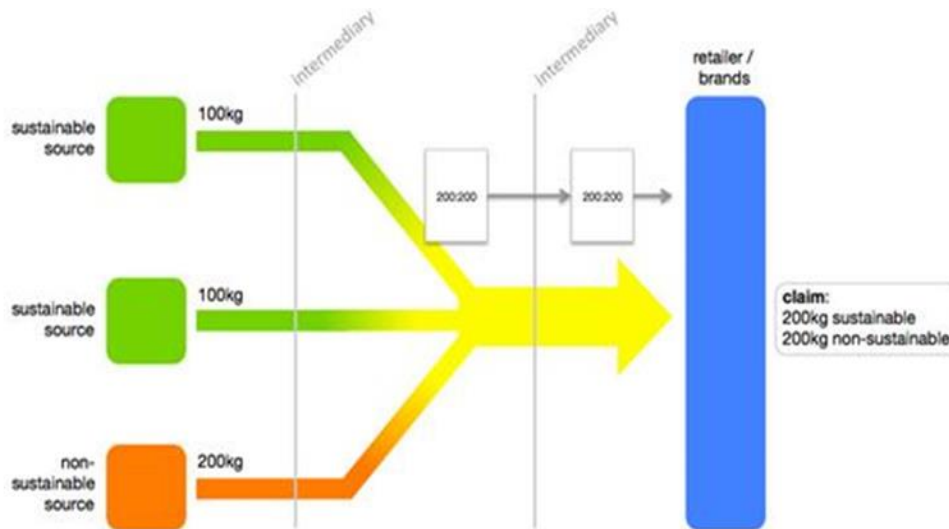


Figure 2.4. Mass-balance traceability model.

Materials from sustainable and unsustainable origins can be mixed. Source: Chainpoint (n.d.).

Book-and-claim: in this traceability model, physical materials and sustainability certificates are traded separately (WWF Global, n.d.; UN Global Compact, 2014). Material from sustainable and unsustainable origins are mixed and flow freely together along the supply chain; and a unique certificate with information on the origin is issued to the primary producer for each unit of sustainable material (IPIECA Biofuels Task Force & Liz Muller Consulting, 2010; UN Global Compact, 2014; WWF Global, n.d.). Mixing of material and certification issuance for sustainable material is depicted in Figure 2.5.

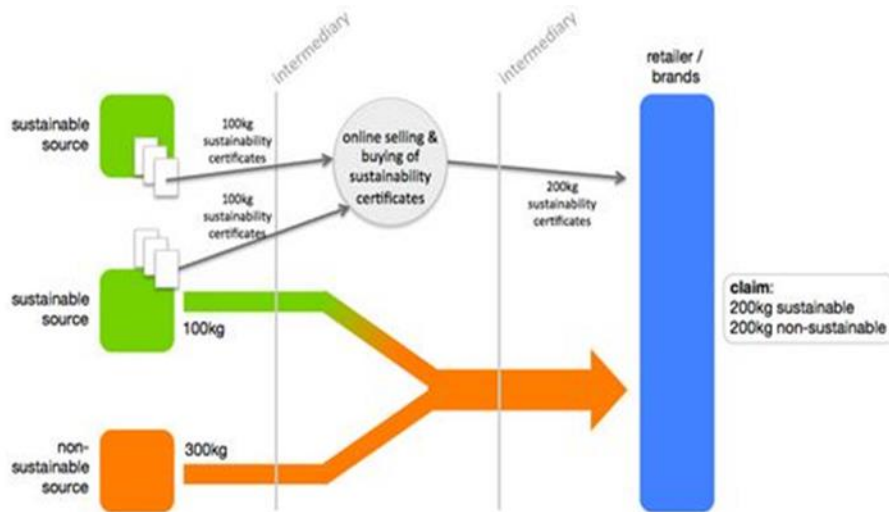


Figure 2.5. Book-and-claim traceability model.

Although material from unsustainable and sustainable sources are mixed, a certificate must be issued for sustainable material. Source: Chainpoint (n.d.).

Attributes of a product are claimed by the supplier using sustainability certificates, traded online between the producer at origin and the supplier (UN Global Compact, 2014; WWF Global, n.d.). Sustainability certificates sold to the supplier are to be submitted to the issuing body for verification; once corresponding units are claimed, certificates are said to be redeemed, and therefore can't be reused (IPIECA Biofuels Task Force & Liz Muller Consulting, 2010). This model is much more cost effective in that no paper trail or material physical separation is required throughout the supply chain (WWF Global, n.d.). This model is employed in the renewable energy production sector, such as solar panels or windmills, where renewable energy is inseparable from the conventionally generated energy once in the grid. Upon feeding green energy into an electrical grid, the green power producer receives a Renewable Energy Certificate, which is traded with suppliers. This certificate is used as proof to claim the purchase of energy from a sustainable energy origin (UN Global Compact, 2014). As opposed to physical segregation and mass-balance, the book-and-claim traceability model is cost effective as it allows for trade in sustainable commodities without the need for segregating and tracing the product across the supply chain.

In summary, the definition of traceability is broad and diverse, because traceability is employed as tool to achieve specific objectives in varying product supply chains (Golan et al., 2004; Karlsen et al., 2013; Moe, 1998). However, there are two core concepts that must be considered to achieve traceability in any product supply chain: tracking forward and tracing backward. Tracking a material along the supply chain is an essential operation in traceability, as it allows for documentation of CoC via recording of traceable data. Tracing, on the contrary, uses recorded information/data to verify the credence of the claimed attributes of a material, including its origin. Thus, for the purpose of this study, traceability is defined as the ability to follow and record the flow of a mineral product at each stage of the chain, from a qualified mine site to export point, which can be used to verify and ascertain minerals' attributes. Regarding traceability models, what makes a specific traceability model preferable to others depends on the type of product under consideration and objectives of the program/system.

2.2 Concept of Chain of Custody

There are several ways of understanding and defining chain of custody. Giannelli (1982) describes CoC as the chronological physical or electronic documentation or paper trail showing the seizure, custody, control, transfer and disposition of evidence. Further, Rotherham (1997) argues that CoC can be broadly defined as a way to provide a linkage between the forest at origin and a forest product at the point of sale. In addition, Kuru et al. (2003) describe CoC as a custodial sequence as ownership or control of the product supply is transferred from one custodian to another along the supply chain. According to ISEAL Alliance (2014), CoC refers to all stages of the supply chain that take possession of the product/material, including manufacturers, exporters, traders and importers.

2.2.1 Emergence and Application of CoC

The origin of CoC in scholarly literature is unclear. Explicit application of CoC emerges with the work of Giannelli (1983) who applies the concept to legal practice in the process of authentication of doubtful evidence. Aside from the judicial context, CoC is used in medicine, museology, archival and history of sources or source criticism disciplines.

The use of CoC to verify and authenticate attributes of articles of evidence is well established in legal litigation (Giannelli, 1996). In this context, CoC was first used to demonstrate that the evidence presented as true is, indeed, authentic and preserved from any adulterations from the point of seizure up to the time of trial in court (Giannelli, 1983). It appears that from the point of seizure to the hearing, the evidence passes through several hands/stages that constitute a chain. Each officer in the chain has the responsibility to document the evidence in their possession before passing it on to the next.

However, CoC documentation is mainly required in two instances. First, in the event that evidence is fungible, due to its predisposition to substitution in whole or in part; second, in case of contaminable evidence, which is subject to the risk of being easily tampered with through mixing or contact with unwanted material (Giannelli, 1996). Studies by Giannelli (1982/1983/ 1991/1996) argue that CoC is a useful tool that allows for the verification of attributes of a fungible or contaminable article of evidence using recorded documentation.

CoC documentation is a common practice in drug testing procedures. In medicine, CoC refers to a process that documents specimen and handling from sample collection to the release of laboratory results. The purpose of implementing CoC in drug testing is to ensure the integrity and authenticity of the specimen. Put simply, the CoC process is used to assure that the specimen belongs to the individual whose information appears on the container label, and no post-collection adulteration has taken place. To implement CoC in drug testing, four requirements are to be satisfied. First, the identification of the specimen collector and of each person who had custody of

the specimen. Second, the time of the procedure must be recorded. Third, the recording of routing and how the specimen was transported. Fourth, the recording of how and where the specimen was stored before analysis (“Chain of Custody for Drug Tests: Origin Diagnostics for Drug Testing”, 2010).

In fields such as archival disciplines, source criticism (e.g., history and biblical studies) and museology, the authentication of archives, records, sources, documents and collections is determined via identification of provenance (Millar, 2002). The term provenance is derived from the Latin verb “provenire”, which means “to come from”, or “to originate”. In the archival and source criticism contexts, provenance refers to the origin or source of something. Provenance can therefore be any individual or organization that created, received, owned or had custody of an item under consideration (Pearce-Moses, 2005). In this context, the focus of provenance is on the history of the creator, owner, and custodian. However, expanding on the latter viewpoint, Millar (2002) argued that provenance must be understood as a combination of creator history, records history and custodial history. To preserve the context of production, ownership and custody, the principle of provenance suggests that records/documents originating from the same source be kept separate from others (Pearce-Moses, 2005).

In contrast, in the realm of museology, provenance is approached from the viewpoint of pedigree and authenticity (Millar, 2002). In this perspective, provenance focuses not on the creator, but on the history of the item itself, which is obtained through “archival records, oral histories, sales receipts, gallery inventories, and even from the marks on the frame and from the stamps and scribbles on the backside of the work itself” (Millar, 2002, p.10).

In summary, in archival disciplines, source criticism and museology, provenance is determined or identified by tracing back the CoC, which is referred to as chain of transfer of ownership and possession, location, publication, production or reproduction and display. As noted in the previous section, traceability is a bidirectional tool involving forward traceability and backward traceability.

CoC is an important aspect of traceability as tool, as it allows for understanding the history of a traceable product. For the purpose of this study, CoC is defined as the unbroken trail of actors that take possession of a material through primary production, purchase, transportation, handling or processing, which is documented via the process of data recording.

2.3 Identification of Drivers and Barriers to Traceability in the Literature

This section explores drivers motivating participation, and barriers inhibiting traceability in product supply chains. Traceability is adopted and implemented as a tool in food and fish/seafood sectors to address specific concerns related respectively with food quality and safety (Manzini & Accirsi, 2013; Meuwissen et al., 2003; Moe, 1998; Opara, 2002, Regattieri et al., 2007), and illegal fishing (Borit, 2009; Borit & Olsen, 2012; Karlsen et al., 2011). However, Heyder et al. (2010) suggest that factors impacting traceability in the food sector are diverse. A summary of factors impacting traceability in food, agricultural and fish/seafood product supply chains is provided in Table 2.1.

Table 2.1. Identified drivers and barriers in the commodity traceability literature

Commodity	Concern	Driver	Barrier
Food and agricultural Products	Food safety and quality Counterfeit and Fraud Adulteration Bioterrorism threat Animal welfare Origin	Mandatory regulation	Cost
		Food safety & quality	Complexity of global supply chain
		Bioterrorism threats	Lack of transparency
		Market access & protection	Manual traceability system
		Chain communication	Mixing of raw material
		Competitive advantage	Lack of technical and managerial skills
		Brand protection	Lack of capacity
		Ensure consumer confidence	Inefficient technology
		Certification	
		Sustainability	
		Minimize liability	
		Product optimization	
		New technology	
		Ensure long-term collaboration and contracts with customers	
		Consumer awareness	
Consumer demand			
Market failure			
Government funding			
Fish/seafood products	Illegal and Unreported fishing Food safety and quality Origin	Mandatory regulation	Cost
		Food safety & quality	Complexity of global supply chain
		Market access	Mislabeled and fraud
		Chain communication	Mixing of raw material
		Removal of illegal fish from the supply chain	Lack of transparency
		Competitive advantage	Inefficient technology
		Minimize liability	
		Ensure consumer confidence	
		Certification	
		Sustainability	
		Product optimization	
		New technology	
		Ensure long-term collaboration and contracts with customers	
		Consumer awareness	
		Consumer demand	
Market failure			

2.3.1 Drivers for Traceability in Product Supply Chains

Previous studies have addressed the drivers that trigger the implementation and participation in product supply chains. This subsection identifies factors that drive participation in traceability in food, agricultural and fish/seafood product supply chains. In the context of traceability, a driver is what causes a system to rise to the challenge faced by the industry. In general terms, drivers are outside the system or what is being driven; yet there are also internal drivers, emerging from within the system to satisfy internal concerns or objectives (Mattevi & Jones, 2015). A sampling of studies featuring drivers for traceability are examined next.

A study by Xue, Weiwei, Zettan, Peng & Weiguang (2007) on traceability of vegetables in China concluded that social pressure, market and Chinese government regulation are the key drivers that led to the adoption of traceability in the Chinese vegetable sector. Additionally, the study identified social pressure from consumer demand for food safety and quality as the key factor that pressured the Chinese government and vegetable sector to shift from quantity to safety and quality. Along these lines, Olsen (2009), takes the debate a step further as the study found that traceability implementation in food and fish/seafood industries is motivated by seven drivers: 1) legislation, which requires implementation of traceability in food supply chains, 2) food safety, which allows for firms to perform precision recalls in case of a food safety incident, 3) certification, which provides assurance on sustainability attributes of food products, 4) sustainability, which ensures better farming practices, 5) competitive advantage, which is achieved by providing customers with relevant information on the origin and processing of food and fish/seafood products, 6) labour/cost reduction, which is achieved by using internal traceability to achieve various functions within the firm, and 7) chain communication, which allows for information exchange within the chain. Olsen's (2009) seven drivers are echoed in further research on drivers for traceability in food supply chains.

Other researchers, such as Karlsen et al. (2013) supported the finding of the study by Olsen. Karlsen and others identified ten drivers for traceability in food industry, seven of which were

already identified by Olsen. Their findings provide three new drivers, which include: 1) product optimization, 2) bioterrorism threats, and 3) welfare. Furthermore, Aung and Chang (2013) sought to understand the factors motivating traceability implementation in the food supply chain. The study identified eight drivers: 1) legislation, 2) labor/cost reduction, 3) supply chain efficiency, 4) supply chain communication, 5) trade globalization, 6) competitive advantage, 7) quality assurance, and 8) safety. Another important study was conducted the same year to investigate the driving forces behind the implementation of traceability, as well as barriers to it, in the food and agricultural supply chain (Bosona & Gebresenbet, 2013). According to the results of this study, five major drivers motivate the implementation and participation in traceability of food and agricultural product supply chains. These drivers are: 1) food safety and quality, 2) regulation, 3) social concern, 4) economic concern, and 5) technological concern. Mandatory regulations are identified as enablers for food safety and quality in multiple studies. Food and agricultural product firms seek to comply with mandatory regulation requirements to stay in the market (Bosona & Gebresenbet, 2013; Mattevi & Jones, 2015; Preziosi et al., 2014). However, besides regulations and/or requirements, market is seen as a significant driver.

In their study of the Greek fresh produce supply chain, Manos and Manikas (2013) examined key drivers for traceability implementation. Using semi-structured interviews where twenty-two fresh produce firms were interviewed, the results show that the Greek fresh produce firms participation in traceability is motivated by two main drivers, notably: 1) to achieve market consolidation, 2) to secure long-term collaboration and contracts with customers. Further supporting the assertion of economic/market concerns as key drivers, Preziosi (2014) examined the main motivations driving traceability implementation and participation in the Italian food supply chain context. The results of the study show that five key drivers motivate participation in traceability of food in the Italian supply chain: 1) market failure, 2) consumer awareness, 3) mandatory regulation, 4) market protection, and 5) optimization of supply chain and operation processes. Likewise, a study by Bosona and Gebresenbet (2013) found that firms, in food and agricultural products, participate in traceability out of economic interest, motivated by better market access, better prices and

government funding. The market and related economic concerns appear to be a significant driver towards firms' participation in traceability.

In food, agricultural and fish/seafood supply chains, each individual firm in the chain is responsible for tracking and managing traceability data/information. This requires efficient technology, which is a part of traceability cost. Technology is expensive for small firms to purchase, maintain and manage. Some studies found that affordable new technologies, which are cost effective, drive participation in supply chain traceability (Bosona & Gebresenbet, 2013; Opara & Mazaud, 2001).

Building upon previous studies, Mattevi and Jones (2015), seek to understand drivers and barriers to traceability in food supply chains among the UK small and medium enterprises (SMEs). In their study, they classified drivers for traceability into two categories: external and internal drivers. This categorization allows better understanding of how drivers affect traceability implementation. In the food, agricultural and fish/seafood product supply chains, regulation is seen as the external driver that compels supply chain actors to comply with prescribed requirements in order to achieve the desired outcome, such as food safety and quality, prevention of counterfeit products, and/or deterrence of illegal and unregulated fish (Aung & Chang, 2014; Bosona & Gebresenbet, 2013). Ultimately, a significant number of researchers in traceability of food, agricultural and fish/seafood products identify regulation as a key driver for participation in traceability (Bosona & Gebresenbet, 2013; Golan et al., 2004; Mattevi & Jones, 2015; Preziosi et al., 2014). Regulation appears to be a dominant external driver.

Contrary to external drivers, which compel supply chain actors to comply with a set of predefined requirements set by an outside organization in order to achieve a goal, internal drivers arise from within to address specific needs and objectives of the firm (Aung & Chang, 2014; Mattevi & Jones, 2015). The findings of Mattevi and Jones' (2015) study show that there are six internal driving forces that motivate participation in food traceability in the UK context: 1) market access, 2) enhanced competitiveness, 3) preservation and improvement of brand name, 4) minimization of

liability, 5) degree of internationality of supply chain and 6) the degree of complexity of product to be traced. Further, several researchers suggest that participation in traceability is mostly driven by the firm or supply chain actor's interest to access or expand into certain markets where traceability is required (Bosona and Gebresenbet, 2013; Donnelly and Olsen, 2012). Again, market access/economic interest surfaces as a key driver.

In summary, the literature described a diversity of drivers for participation in traceability in different product sectors and contexts. It appears that the nature of the product, supply chain and context influence the motivation for participation. However, common threads were found: drivers such as product quality and safety, consumer confidence, ensuring long term collaboration and contracts with customers, market/economic interest, maximization/optimization of operations, and regulation were commonplace. The most powerful driver overall was external: legal requirement/regulation emerged as the main motivation for participation in traceability in food, agriculture and fishery systems.

2.3.2 Barriers to Traceability in Product Supply Chains

While some studies acknowledge that the implementation of traceability in food, agricultural and fish/seafood products supply chains has helped firms to ensure food safety and quality, origin and product differentiation (Golan et al., 2005; Moe, 1998; Regattieri et al., 2007), other studies have shown that there are several barriers facing traceability in these same supply chains (Alfaro & Rabade, 2009; Bosona & Gebresenbet, 2003; Golan et al., 2005/2014). Barriers that obstruct traceability, include: cost, lack of transparency, lack of capacity, and poor technology. These barriers are expanded upon in the following subsections.

2.3.2.1 Cost

Costs are a central concern in any business endeavour. Researchers in food, agricultural and fish/seafood product supply chains have argued that the implementation of traceability is a cost

intensive and complicated undertaking, involving significant investment in equipment, maintenance, training and personnel (Alfaro & Rabade, 2009; Aung & Chang, 2014; Bosona & Gebresenbet, 2013; Golan et al., 2005/2014; Mattevi & Jones, 2015; Opara & Mazaud, 2001). Moreover, Golan et al. (2005) examine traceability in the US food supply chain, concluding that the cost of traceability is an additional burden to firms, especially SMEs. Similarly, Regan et al. (2012) identified three major costs associated with the implementation of traceability: investment in tools, training and labor. This supports the findings of Opara and Mazaud (2001) that training and investment in human resources and communications technology presents a major challenge for the small scale farmers. However, it is not clear whether the cost affects the implementation of traceability in other contexts, where firms are not responsible for data recording and management.

2.3.2.2 Transparency

Transparency may be thought of as the ability to freely share and access relevant information. Information exchange/sharing in traceability supply chain is an essential characteristic for the effectiveness of traceability (Kelepouris et al., 2007; Opara, 2003; Van der Vorst, 2004). Studies by Thompson et al. (2005) on seafood traceability in the US, plus studies by Donnelly and Karlsen (2010), and Donnelly and Olsen (2012) on traceability of the Norwegian white fish identified lack of transparency as a barrier to the traceability of seafood. This finding is supported by several studies (Bosona & Gebresenbet, 2013; Regattieri et al., 2007; Storoy et al., 2013; Van der Vorst, 2004). Lack of transparency was explained as a barrier to traceability in terms of lack of information dissemination and exchange in the food supply chain due to absence of standardized format for data recording among supply chain actors. To address this challenge, some researchers proposed the implementation of specific tools, including structured data elenchus, vocabularies and ontology (Donnelly et al., 2009). In contrast, to overcome lack of information exchange among supply chain actors, Meuwissen et al. (2003) proposed the use of a centralized database where all traceability data about, for example, a cow, would be uploaded. It is therefore from this database that the cow is tracked forward and traced back to the farm of origin. The advantage of a centralized

database model is that it relieves the supply chain actors from having to individually invest in information systems that support traceability (Kelepouris, et al., 2007). An accessible, centralized database would serve to take pressure off supply chain actors, ensure timeliness and consistency, and greatly enhance transparency.

2.3.2.3 Lack of capacity

Traceability implementation requires technical and managerial skills; when these skills are absent, traceability suffers. Zhang et al. (2010) and Bosona and Gebresenbet (2013) consider the lack of capacity as a barrier to traceability in the food and agricultural supply chain. In their analysis, they explain lack of capacity in terms of a deficit of well-equipped and trained staff able to assume technical and management tasks of traceability. This finding is confirmed in Mattevi & Jones's (2015) recent study of SMEs in the food supply chain.

2.3.2.4 Mixing of material

Traceability requires proper identification and documentation to ensure the differentiation of product along the supply chain. Some researchers found that traceability of food, agricultural and fish product is undermined by the mixing of raw materials in the upstream supply chain, such as at production and processing points (Bailey et al., 2016; Bollen et al., 2007). Bollen et al. (2007) analyse the role of packing procedures and effects of fruit mixing. They concluded that the mixing of fruits during the packing process is a major challenge that undermines effective traceability. When batches of fruit from different origins are mixed before they are labeled, one can no longer identify where each piece comes from with certainty, nor know what attributes the new mix may be expected to have. This finding was supported by a study on traceability in the dried salted fish supply chain by Donnelly & Karlsen (2010). Despite that the fish product was identified and documented, gaps in traceability data were observed at supply chain links where processing, mixing and splitting take place. To improve this, change in management at the packing area was

proposed (Bollen et al., 2007). However, the links where unregulated mixing takes place in other commodity supply chains are unknown.

2.3.2.5 Technology

The tools used to track and document materials make a difference in the success of traceability implementation. According to Manos & Manikos (2010), technology plays a significant role in product traceability implementation. The more advanced the technology, the better the outcome. There is a wide variety of technologies currently used to track and trace products. Traceability technologies include paper-based, RFID, and DNA fingerprinting (Moe, 1998; Regattieri et al., 2007). A paper-based traceability system generally refers to the manual process of identifying and tracking a material along the supply chain. Numerous food, agricultural, and fish/seafood product supply chains employ a paper-based system to track and document materials. However, several studies consider the use of manual traceability as a barrier to effective traceability in the food, agricultural and fish/seafood supply chain contexts (Bechini et al., 2005; Regattieri et al., 2007; Senneset et al. 2007). A significant number of researchers in traceability of food, agricultural and fish/seafood product suggest the implementation of electronic based systems to improve traceability outcomes (Moe, 1998; Opara, 2003); Regattieri et al., 2007; Story et al., 2008; Thakur & Donnelly, 2010; Thompson et al., 2005). Electronic based systems appear to have many advantages over paper-based systems, potentially including ease of recording, transfer and access.

To summarize, the reviewed studies on traceability in food, agricultural and fish/seafood product supply chains revealed multiple and diverse drivers and barriers impacting the implementation and participation in traceability of products (Table 2.1.). The present study fits into this debate over factors impacting implementation of traceability in product supply chains as it seeks to understand drivers and barriers impacting traceability of conflict minerals in the Great Lakes Region of Africa.

2.4 Gap in the Literature

Reviewed studies show that traceability is implemented in food, agricultural and fish/seafood product to address specific concerns, such as food safety, quality and adulteration, illegal fishing and mislabeling, and misrepresentation of origin. The reviewed literature shows scholarship discussing factors impacting traceability in food, agricultural, and fish/seafood product supply chains to understand motivating drivers and barriers to traceability. However, no published studies have been found focusing on factors impacting traceability of conflict minerals in the Great Lakes Region of Africa. This study sets out to address this gap, by understanding the drivers and barriers to traceability of conflict minerals in the Great Lakes Region of Africa so as to provide insights on policies that would support conflict-free supply chains and ensure conflict-free origin of minerals. Additionally, the findings of this research would provide insights to downstream industries seeking for assurance on the conflict-free origin of minerals produced in the Great Lakes Region of Africa. Moreover, this research is important for potential traceability providers who want to improve traceability of 3T minerals in the Great Lakes Region of Africa, and increase the participation and awareness in traceability. This study is also significant for ICGLR in need for strategies to remove conflict-related minerals from the supply chain, and ensure conflict-free sourcing of materials.

2.5 Purpose and Research Objectives

The purpose of this study is to understand factors impacting traceability of conflict minerals in the Great Lakes Region of Africa, in the DRC in particular, and identify potential opportunities for improvement. The focus is on conflict minerals because of the increasingly growing need for conflict-free “supply chain”⁵ and assurance on the conflict-free origin of materials (UN GoE, 2011; Bleischwitz, 2014).

To achieve this purpose, the study has two overall objectives:

1. To identify and examine the drivers that motivate participation in traceability system of conflict minerals.
2. To identify and explain the barriers that inhibit traceability of conflict minerals in the Great Lake Region of Africa, and in the DRC in particular.

⁵ A supply chain refers to a network where various businesses including suppliers, manufacturers, distributors, and retailers acquire raw materials, process raw materials, and deliver final products to retailers (Beamon, 1998; Lambert & Cooper, 2000).

Chapter 3: Methodology

The main purpose of this study is to understand the factors impacting traceability of conflict minerals in the Great Lakes Region of Africa, in the DRC in particular, and identify potential opportunities for improvement. Certification of minerals is out of the scope of this study.

Catanzaro (1988) argues that the selection of research methodology depends on the objective of the study. Research methodology is defined as “the general approach the researcher takes in carrying out the research project” (Leedy & Ormrod, 2001, p. 14). Certainly, some methodologies are better suited to address specific research objectives than others. Given that this is an under-researched topic, without established academic literature, a qualitative, grounded theory (GT), semi-structured interview approach was deemed appropriate for this study.

3.1 The Qualitative Approach

Corbin & Strauss (2014) indicate that the qualitative approach is a methodology that helps the researcher to explore areas/phenomena that are under-researched, and to explore how meanings are constructed. Qualitative research can be undertaken using a variety of approaches, which include case study, ethnography, content analysis, phenomenology, and GT (Creswell (2012); Hsieh & Shannon, 2005; Leedy & Ormrod, 2001; Williams, 2011). In designing this study, five qualitative approaches were considered (Table 3.1).

All five approaches diverge in focus, outcome, data collection and analysis strategies and sampling method. Researchers describe GT as a methodology that uses systematic procedures for data collection and analysis to generate an inductively derived theory from data (Charmaz, 2003; Strauss & Corbin, 1990). Deriving theory from empirical data draws the demarcation line between case study, ethnography, phenomenology and content analysis in one regard, and GT in another.

Table 3.1. Characteristics of different qualitative approaches.

Source: Based on data compiled from Creswell (2013) and Miles & Huberman (1994).

QUALITATIVE APPROACHES	Focus	Outcome	Data collection strategy	Analysis strategy	Sampling criteria
Ethnography	Interpret & describe a culture-sharing group	Shared patterns of values, beliefs and language of a culture shared group are described & understood	1. Participant observation 2. Interviews	General inductive analysis	Those who share the same culture
Case Study	Develop an in-depth description and analysis of a case	Characteristics of a phenomenon under study are described	1. Interviews 2. Observations 3. Artifacts 4. Review of documents	General inductive analysis	Those who have experienced the phenomenon on a specific context & relevant documents
Content Analysis	Understand the content of recorded communication	Categories relevant to research objectives are identified	Review of documents	General inductive analysis	Documents containing topics of interest
Grounded Theory	Develop a theory grounded in data from the field	New theory is generated from empirical data	1. Interviews 2. Review of documents	General inductive analysis	Those who have experienced the phenomenon under different conditions & relevant documents
Phenomenology	Understand the essence of individuals lived experience	Characteristics of lived experiences of individuals are described & understood	1. Interviews 2. Review of documents	Clustering of meaning of participants' statements into themes	Those who have experienced the phenomenon of interest & relevant documents

To address the objectives of this study, the GT approach was chosen over other qualitative approaches as the research specifically focuses on exploring and generating new output from raw data (Strauss & Corbin, 1994). Importantly, given that the area of research of the current study has no sufficient prior knowledge, GT was deemed to be a good fit. Along these lines, Creswell (2013) argues that GT is a good approach to use when a theory is not readily available to explain a process. Therefore, it seemed appropriate for this relatively unique and ground-breaking research endeavor.

3.2 Grounded Theory Approach

The GT approach is a type of qualitative research methodology that was first developed by two sociologists, Barney Glaser and Anselm Strauss, in 1967 (Corbin & Strauss, 2014). Glaser and Strauss (1997) hold that GT is an innovative research methodology, as it allows the researcher to extract and build a theory/model from data itself. Despite its innovative approach to qualitative research, GT methodology proves challenging to use, and consequently raises controversy over the use of existing knowledge in a GT study (Dunne, 2011). Thus there is a fundamental concern over the place of the literature review in GT research: a number of authors point out that the key issue in using GT methodology is not whether to use a literature review in GT research, but rather when and how to use it (Cutcliffe, 2000; Dunne, 2011; McGhee et al., 2007).

While most qualitative approaches of inquiry consider an extensive literature review as an essential basis upon which to build a study, Glaser and Strauss (1967, p.37) suggest that: “An effective strategy is, at first, literally to ignore the literature of the theory and fact on the area under study”. In its seminal state, GT lays out three principles. First, the researcher is advised not to conduct a comprehensive literature review in the core area and related areas of the research prior to data collection and coding. Second, the researcher should conduct the literature review in substantive areas only when data collection and analysis is nearly completed. Third, the result of literature review must be woven into theory as data for constant comparison (Glaser & Strauss, 1967). McCallin (2003) argues that the main concern of keeping out of literature review before completing primary research is to prevent the GT researcher to be sidetracked by received knowledge and interpretations that corroborate taken-for-granted assumptions that may not be relevant in the area under investigation. Similarly, Charmaz (2006) notes that completing a literature review after data collection and coding allows the GT researcher to articulate their own ideas, and thus avoiding the integration of any preconceived ideas which may alter the research.

In contrast, Clarke (2005) argues that the idea to delay or prohibit a literature review in the substantive area of research prior to coding is unrealistic and counter-productive, since GT research focuses on an area that is under-studied. This study's methodological approach follows Clarke's perspective, which favors early engagement with existing literature to gain knowledge and understanding about the substantive area of research, dismissing the idea that it may compromise the fundamental innovative idea to generate new theory from empirical data. The integration of existing scholarship/data to help provide information, flesh out concepts, and fuel discussion/analysis is critically helpful when the scarcity of relevant research is considered.

Prior to undertaking data collection through semi-structured interviews, existing literature related to traceability of food, agricultural and fish/seafood products was reviewed to identify studies that sought to understand factors impacting the implementation of traceability, and to evaluate what knowledge gap existed. However, although primary data were used as a basis for the study, the review of literature helped inform the current research with useful concepts that might be directional for categorization purposes.

3.3 Methods

Research method is described as: "The technique or procedure used to gather and analyze data related to some research questions or hypotheses" (Crotty, 1998, p.3). The data collection process is seen as a major source of value and effectiveness within the GT approach as it allows researchers to build theory from data itself (Corbin & Strauss, 1990). GT research employs various sources and types of evidence, including documents, interviews, observations, and videotapes (Strauss and Corbin, 1990). The method used to address the objectives of this study was semi-structured interviews.

The research examines traceability of conflict minerals with specific focus on the 3T minerals supply chain. The focus on 3T minerals is due to their potential visibility across the chain, which is difficult to establish with materials such as gold. In contrast to gold, which trades in concealable

quantity and is easily fused into metal earlier in the supply chain, 3T minerals trade in bulk and are therefore potentially easier to document and regulate (Prendergast & Lezhnev, 2009). In addition, the structure of the 3T minerals market is different from that of gold (Pact, 2013).

Geographically, the area of study is the African Great Lakes Region, which includes the DRC and the adjoining countries (Figure 3.1. The centre of investigation, however, is the DRC (Figure 3.2. where there is illicit 3T minerals exploitation and trade that finances armed conflict. The scope of this research covers only the upstream supply chain; that is, from mine site to smelter. This is the stage in the global supply chain where mineral ores are potentially traceable before smelting, whence they are converted into metals and often mixed and made into different less-traceable forms.



Figure 3.1. The Great Lakes Region. Source: Global Indigo (n.d.). Member States include DRC, Angola, Rwanda, Uganda, Burundi, Republic of Congo, Zambia, Tanzania, Central African Republic, and Sudan & South Sudan. They are all categorized in level 3 countries.

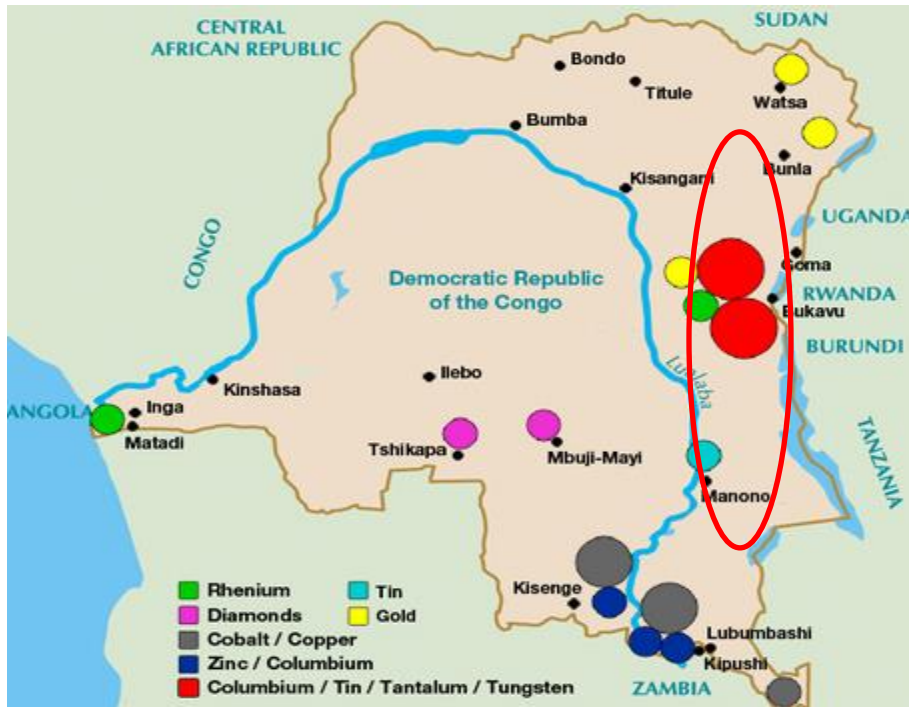


Figure 3.2. The map of the DRC. Surface: 2.345.000Km². Population: 78 million. Source: hmoechkel (2015). The red circle shows the Eastern DRC where the 3T minerals are mined.

3.3.1 Semi-structured Interviews

Collection of data via semi-structured interview requires the researcher to employ a set of predetermined, yet open-ended, questions on topics to be covered (Bryman & Bell, 2015; DiCiccio-Bloom & Crabtree, 2006). Bryman and Bell (2015) consider semi-structured questions to serve as a guide that leads the interviewer into a free conversation with the interviewee. The semi-structured interview was selected for this study to secure primary and quality data from practitioners. Interviews were valuable for three reasons. First, interviews provided information that documentary sources could not display. Second, interviews gave access to different perspectives on the issue under investigation. The researcher was, for example, able to glean information from top management staff, such as auditors, smelters, exporters and miners, who understand the

practice of traceability implementation in the conflict minerals supply chain. Third, interviews allowed the researcher to access different organizations closer to the physical supply chain, including auditors who do not, as a rule, provide publication of their work.

This study used purposive sampling, which is described as a “deliberate choice of an informant due to the qualities the informant possesses” (Tongco, 2007, p. 147). In purposive sampling, the sample is not intended to be statistically representative, thus certain topic-focused criteria are used as basis of selection (Patton, 2002; Ritchie et al., 2013; Singleton & Straits, 2005). Selection of informants was based on three criteria: 1) accessibility to informants and their willingness to provide information; and 2) ability of informants to demonstrate relevant experience in 3T minerals traceability 3) qualitative representativeness of participants involved in 3T traceability activities.

For informant recruitment purposes, sixteen requests were sent out. However, only ten informants responded and all were recruited. Among the ten informants were two in-chain and eight out-of-chain informants (Table 3.2). In the context of this study, in-chain informants are 3T minerals supply chain actors that actually make physical contact with 3T minerals. These include miners, traders, exporters, and smelters. Out-of-chain informants refer to actors that are not directly handling 3T minerals, but rather that provide support or play administrative roles in traceability around the physical supply chain. These include the traceability provider, service providers, and organizations involved in the implementation of the traceability system.

Regarding the in-chain category, only two informants could be recruited. However, the miner interviewed plays a triple role in the chain as miner, trader and exporter. Likewise, the smelter interviewed acts also as a trader and exporter. One of the interviewed organizations provided two informants. Two auditors were interviewed.

Table 3.2. Sampling of informants.

Two types of informants are sampled: in-chain informants and out-of-chain informants.

Type of Informant	In-chain Informants				Out-of-Chain Informants							
	Miner	Trader	Exporter	Smelter	NGOs	PAC ⁶	Gov. Agencies	BGR ⁷	ICGLR ⁸	Serv. Providers	Pact	Auditor
Interviewed Informant					Enough Project							
Number	1			1	1	1	1	1	1	2	2	

Given that the sampled informants to be interviewed were not local to the researcher, face-to-face interviews were impractical. Thus, telephone and Skype interviews with companies' managers, programs' directors and auditors were used. Each interview was planned to ideally last 30 minutes. This is consistent with the recommendation of Frey (2004), who suggested that a telephone interview should be kept within the time-frame of 20 to 25 minutes. However, the researcher must be flexible to get the most out of interviewees in a qualitative GT study, and acknowledging this fact, many went longer than planned.

Interviews were conducted during the months of February, March, April and May 2016. Based on the objectives of the research, interviews focused on exploring drivers and challenges to traceability in conflict minerals supply chain.

Before launching the primary data collection, an interview guide consisting of ten questions was prepared and pre-tested on an auditor. Results of the pre-test interview led to the refinement of questions and the focus on two main open-ended questions (Appendix A). From the outset, the interviewer made clear the nature of the data sought: that is, to understand the factors impacting the current traceability practice in conflict minerals supply chain.

⁶ PAC: Partnership Africa-Canada

⁷ BGR: Bundesanstalt für Geowissenschaften und Rohstoffe (Federal Institute for Geosciences and Natural Resources)

⁸ ICGLR: International Conference of the Great Lakes Region

The interview guide was divided into two main areas of inquiry:

- 1) Drivers that motivate participation in traceability of conflict minerals;
- 2) Barriers that impede traceability in conflict minerals supply chain.

Interviews were recorded using a voice recorder device. Interviews ranged from twenty-five to forty-five minutes. Transcription of recorded interviews was a painstaking and time consuming exercise. Recorded interviews were manually transcribed to text form for content analysis; and written transcripts ranged from 1309 to 4448 words. An average of six hours was needed to transcribe a thirty-five minute interview. After transcription, each transcript was edited.

3.3.2 Analysis Techniques

Inductive content analysis was performed to analyze interviews data. After superficially reading and re-reading the transcripts, a closer reading was conducted to identify relevant text segments related to the objectives of the study. Each informant interviewed was assigned a code starting with the letter I. For example, informant 1 received the code I01. Corbin and Strauss define content analysis as “a systematic procedure for reviewing or evaluating documents - both printed and electronic (i.e., computer-based and Internet-transmitted) material” (Corbin and Strauss, 2008, p.27). Thus, data from interviews were inductively analyzed via a coding process to develop relevant codes. Through inductive analysis fueled by a close reading of raw data as described by theorists (Patton, 1980; Thomas, 2006), useful codes and categories related to drivers and barriers were derived (Table 3.3.). Definitions of categories are provided in Table 3.4.

Table 3.3. Coding of drivers and barriers mentioned by interviewed informants.
 “N” refers to the number of informants responses. Questions allowed for multiple responses.

Drivers for Participation in 3T Minerals Traceability		
Categories	Codes	Description
External driver	<ul style="list-style-type: none"> ▪ Legal requirement N=7 ▪ Social pressure N=3 	<ul style="list-style-type: none"> ▪ Dodd-Frank Act 1502 on conflict minerals ▪ NGOs pressure ▪ Consumer demand ▪ Civil society pressure
Internal driver	<ul style="list-style-type: none"> ▪ Market access N=8 	<ul style="list-style-type: none"> ▪ Ability to sell material ▪ Ability to overcome export requirement
Barriers to 3T minerals Traceability		
Institutional barrier	<ul style="list-style-type: none"> ▪ Lack of capacity and resources N=9 ▪ Lack of Transparency N=5 ▪ Monopoly N=4 ▪ Technology N=4 ▪ Cost N=3 	<ul style="list-style-type: none"> ▪ Deficient monitoring of mines, trade routes & trading points ▪ Lack of equipment (database) ▪ Poor wages ▪ Supply chain structure with unnecessary intermediaries who bring undocumented material into the supply chain ▪ Lack of information/data sharing within the chain ▪ Traceability service provided by a single provider (iTSCi) ▪ Errors and illegible information ▪ Data collection & transmission hurdles ▪ Onerous & time intensive ▪ Decline in funding vs. increase in services to provide
Contextual barrier	<ul style="list-style-type: none"> ▪ Infrastructure & logistics N=3 ▪ Weak/Lack of law enforcement N=2 ▪ Insecurity N=2 	<ul style="list-style-type: none"> ▪ Remoteness of mine sites ▪ Poor roads ▪ Limited access to technology ▪ Buyers of untagged material not prosecuted ▪ Presence of armed groups
People-driven barrier	<ul style="list-style-type: none"> ▪ Misrepresentation of origin N=2 ▪ Corruption N=4 	<ul style="list-style-type: none"> ▪ Mixing of material from unknown sources ▪ Tag sold by tracking agents

Table 3.4. Definition of categories

Category	Definition
External drivers	Refers to motivations from outside the system/firm which compel supply chain actors to comply with a set of predefined requirements.
Internal drivers	Refers to motivations that arise from within the system/firm to address specific needs and objectives of the system/firm.
Institutional barriers	Pertains to the hindrances resulting from actions or inaction, policies and practices of the DRC government and iTSCi.
Contextual barriers	Refers to obstacles pertaining to circumstances/reality on the ground.
People-driven barriers	Refers to impediments caused by the behavior or deliberate actions of humans (i.e., supply chain actors and tracking agents).

Creswell (2002) and Bryman et al. (2009) suggest that developing categories involves breaking down, examining, comparing, conceptualizing and categorizing data. Selected data were broken down analytically into units of meaning. Transcripts were coded by hand. The manual coding, although time intensive, was beneficial as it allowed for deep engagement with data, and concurrently, assisted the assigning of codes into categories. Three coding methods were employed: open coding, axial coding and selective coding.

Open coding, the analytical process of assigning labels/codes to units of texts, was used first (Corbin & Strauss, 1990). In the coding process, *in vivo* codes, that is, informants' actual words, were used to describe the data. After the initial coding, units having the same meaning were color coded. Some samples of open coding are provided in Appendix B and Appendix D.

Next, axial coding was employed as a process of bringing together data that were fragmented and labeled during open/initial coding (Corbin & Strauss, 1990). All units having the same color coding were then collated for further analysis. Samples of axial coding can be found in Appendix C and Appendix E.

Finally, selective coding was used to integrate and refine codes (Corbin & Strauss, 1990). As result, overlap and redundancy among codes were reduced to derive significant categories, as

suggested by Creswell (2002). A sample of selective coding is provided in Appendix F. Verbatim quotations were extracted to be integrated into the text as evidence and explanation to findings (Appendix G).

Chapter 4: Results

This chapter presents the results from the ten interviews conducted to answer the research objectives of the study. The purpose of this study is to understand the factors impacting traceability of conflict minerals in the Great Lakes Region of Africa, in the DRC in particular, and identify potential opportunities for improvement. To achieve this purpose, the study aims to identify and examine the drivers that motivate participation in traceability system of conflict minerals; identify and explain the barriers that inhibit traceability of conflict minerals in the Great Lakes Region of Africa, and in the DRC in particular. The results are presented as follows. First, section 4.1 presents the results pertaining to the drivers that motivate implementation and participation in traceability in 3T minerals supply chain. Second, section 4.2 provides results related to barriers inhibiting successful traceability in 3T minerals supply chain.

4.1 Identified Drivers for Participation in Traceability of 3T Minerals

The first question asked to the interviewees was to identify the drivers that motivate participation in traceability of 3T minerals. As shown in Figure 4.1., three major drivers for participation in traceability in 3T mineral supply chain were identified; among the identified drivers, market access ranks highest, followed by legal requirement. Social pressure is ranked lowest. Identified drivers were classified into two categories: internal and external drivers.

4.1.1 Internal Driver

This type of driver arises from the need and objective of the supply chain actor/firm. One internal driver was identified.

4.1.1.1 Market Access

Eight out ten informants said that market access is the major driver that motivates participation in traceability of 3T minerals in the Great Lakes Region, in the DRC in particular. For instance, I01

asserted that: *“Without any type of traceability, we will be in a position where we won’t be able to export our minerals. Therefore full traceability was required, from the mine to the upgrading plant, including transport”*. This statement was seconded by I10 who noted that: *“From the in-region supply chain actors’ perspective, participation in traceability helps us sell and export our minerals, and trade them in the international market”*. However, it was made clear by informants that the drive for market access was stimulated by the market requirement, from buyers, especially US publicly traded firms, to trade in traceable material.

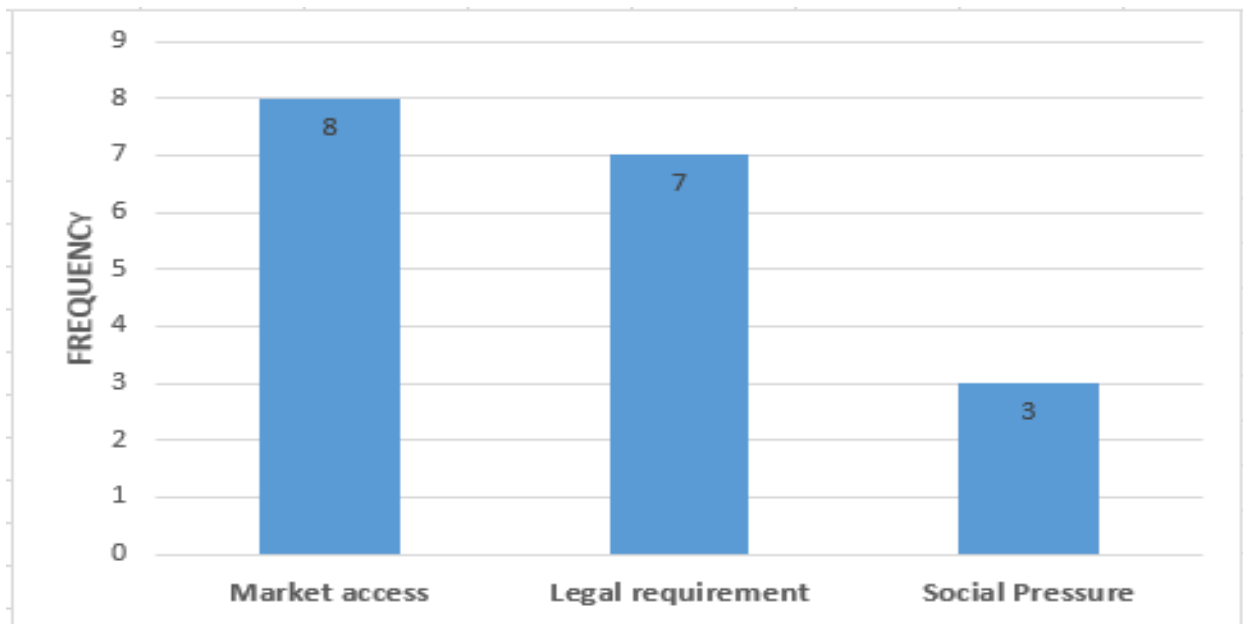


Figure 4.1. Drivers for implementation and participation in traceability of 3T minerals.

In this regard, I02 said:

The main driver that changed everything is the market requirement. The market requirement in turn was driven by the law (DFA). The negociants were compelled to do what the comptoirs exporters wanted, and the exporters were constrained to do what the smelter wanted. The smelters as well were obliged to do what downstream requires.

As example, I02 added: *“When we started to implement traceability system, I went into the mines with a negociant. He stood up in front of the mine and said: Guys you see this tags, I am not buying your minerals unless you have these tags in your bag”*.

In conclusion, market access stood out as the main driver referenced by interviewees. Market accessibility is essential for upstream supply chain actors in the region needing to sell and export their material. The excerpts show how actors engage in traceability to meet economic interests.

4.1.2 External drivers

External drivers arise from outside the supply chain and compel supply chain actors to meet certain requirements. Two external drivers were identified: legal requirement (DFA) and social pressure.

4.1.2.1 Legal Requirement

As displayed in Figure 4.1., seven informants identified legal requirement (specifically the US regulation resulting from the DFA) as the driver that motivated the implementation of traceability in 3T minerals supply chain from mine to OEMs. In this regard, I09 stated:

The law is the driver of traceability implementation in 3T supply chain. I do not believe that if DFA would not have passed in 2010 people would be looking at traceability the way they are doing now. There is therefore a legal requirement for publicly traded companies to exercise due diligence on the origin of minerals they use in the products they manufacture.

This statement was supported by another informant who underscored that: *“It is the Dodd-Frank Act 1502 that was signed into law in 2010 by the US government that motivated the implementation of traceability. Industry was required by the DFA to report that their business has nothing to do with the conflict in the region”* (I07). It was also observed that although regulation (DFA) is not the direct driver for participation in traceability, it had an impact on the 3T minerals supply chain.

As evidence, I02 indicated that: *“The Dodd-Frank Act 1502 pressure led US consumer companies to use market influence to change the behavior of suppliers”*. From this perspective, it can be seen that regulation did not only impact publicly traded companies, but the entire supply chain, even if indirectly.

4.1.2.2 Social Pressure

As delineated in Figure 4.1., three informants identified social pressure as a factor driving traceability participation. Social pressure can be broken down into three pressure groups (Table 4.1.).

Table 4.1. Pressure groups for responsible sourcing of conflict minerals.

Code	Description
Social Pressure	<ul style="list-style-type: none"> ▪ NGOs pressure
	<ul style="list-style-type: none"> ▪ Consumer demand
	<ul style="list-style-type: none"> ▪ Civil society pressure

Social pressure is seen as a factor that impacted traceability implementation in conflict minerals supply chain. According to I02: *“Sometimes civil society pressure and consumers’ demands have an impact, but they do not really change things in the same way that the law does”*. Moreover, some other interviewees, such as I07 noted that: *“NGOs pressure was influential in the development of the US regulation on conflict minerals, which led US publicly traded companies to require traceability of minerals to their suppliers up to the mine”*. From these statements, can be seen that social pressure, in the context of conflict minerals, played a double role. It pressured the industry for responsible practices, but it also influenced the development of regulation (DFA).

The results in this section showed that participation in traceability of 3T minerals is driven by market access, legal requirement, and social pressure. However, the key driver that triggers participation is market access.

4.2 Identified Barriers to Traceability in 3T Minerals Supply Chain

The second question asked to the interviewees was to identify barriers to participation in traceability of 3T minerals. Barriers to traceability are classified into three categories (Figure 4.2.).

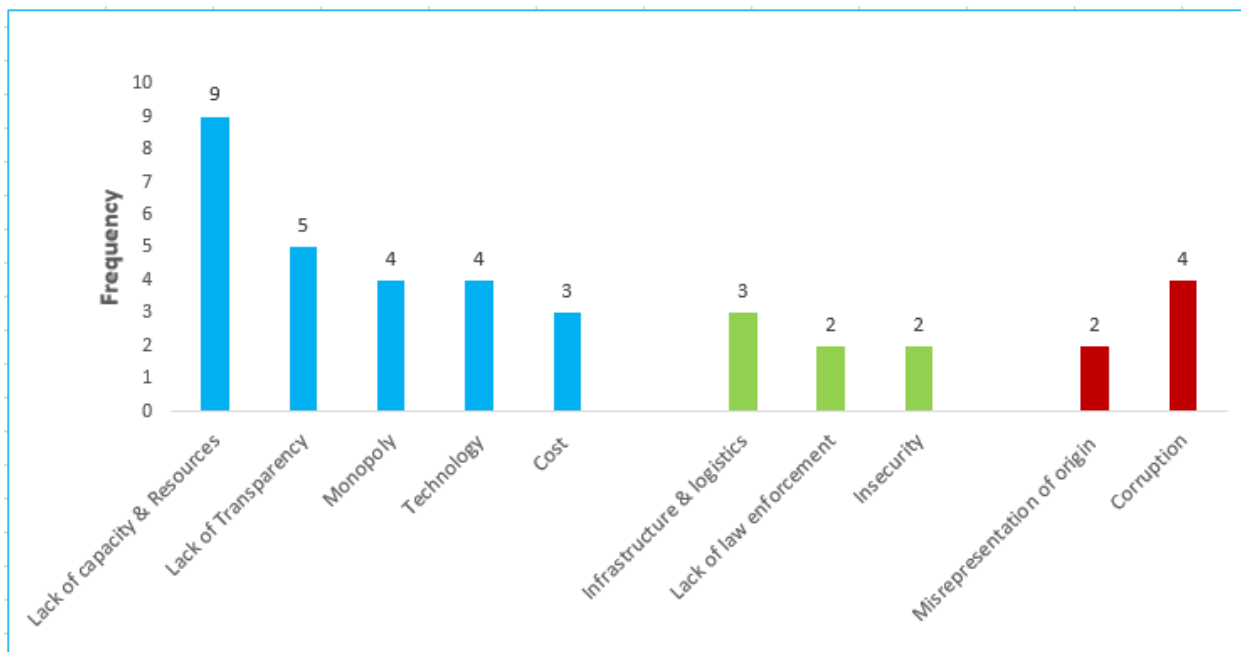


Figure 4.2. Barriers to traceability of 3T minerals.

Barriers are classified into three categories: Institutional barriers in blue, contextual barriers in green, and people-driven in red.

4.2.1 Institutional barriers

Institutional barriers refer to hindrances resulting from action, inaction, policies and practices of institutions involved in the implementation of 3T minerals traceability. Institutions involved in 3T

minerals traceability are the DRC government and iTSCi. Institutional barriers to 3T minerals traceability are displayed in Figure 4.2.; the DRC lack of capacity and resources is the highest, followed by iTSCi lack of transparency, iTSCi monopoly, and technology. Cost is the least commonly referenced barrier.

4.2.1.1 Lack of capacity and resources

Nine out of the ten interviewed informants identified lack of capacity and resources in the DRC as a major barrier impeding efficient implementation of 3T minerals traceability across the supply chain. Responses associated with the DRC lack of capacity and resources as barrier are summarized in Table 4.2.

Table 4.2. Institutional barriers to traceability of 3T minerals

Barrier	Description
DRC government lack of capacity and resources	<ul style="list-style-type: none"> ▪ Deficient monitoring of mines, trade routes, and trading points. ▪ Lack of necessary equipment (database). ▪ Low wage and lack of incentive for tracking agents. ▪ Supply chain structure with unnecessary intermediaries
Lack of transparency (iTSCi)	<ul style="list-style-type: none"> ▪ Limited/lack of information sharing.
Monopoly	<ul style="list-style-type: none"> ▪ Traceability service provided by a single provider, iTSCi.
Technology	<ul style="list-style-type: none"> ▪ Errors and illegible information. ▪ Data collection & transmission hurdles. ▪ Onerous and time intensive.
Cost	<ul style="list-style-type: none"> ▪ Implementation expensive and onerous. ▪ Decline in funding vs. increasing expenditure.

According to interviewed informants, the DRC lacks capacity to effectively monitor trade routes and trading points, to enforce the law over artisanal mining and trade, to prevent and prosecute fraud within the chain, and to control services involved in traceability. For example, I04 noted: *“It is known that at the negociant level, the negociants are bringing in materials from other mine sites that have not been qualified. They mix this stuff with verified mines. However, nothing has been envisaged by the DRC government to prevent that to happen”*. This statement was further supported by another informant who said: *“What we are seeing that hurts the process of traceability is that once the minerals leave the mine site, there are no monitors along the trading route where is a lot of trafficking and mixing of conflict minerals with conflict-free minerals occurs”* (I08).

Moreover, informants indicated that the DRC lack of resources is a hindrance to traceability of 3T minerals. Two reasons were evoked: 1) Government services lack adequate equipment such as a database, which allows for traceability data verification and monitoring and 2) tracking agents not being paid/incentivized to carry out their job with integrity. To substantiate these facts, I03 pointed out that: *“ITSCi is continuously improving as to how to manage the system. The challenge for the DRC is the lack of capacity and resources to efficiently manage minerals traceability data. In other words, the DRC has a big problem for data management in that it has no database at all”*. Likewise, I02 added that: *“There is a growing concern with government agents who are not necessarily being paid on time, or not being paid at all. This factor is very demotivating for them”*. Along the same lines, I01 corroborated: *“In my experience, I know that a lot of mines do not have regular government agents on sites. They may show up once a week to tag the material. So, it appears that tagged materials come from that mine, but in reality they may have come from anywhere”*. In addition, some informants noted that the involvement of numerous unnecessary intermediaries poses an important threat to ensuring traceability of 3T minerals. Regarding intermediaries, one interviewee stated: *“The status of verified mine sites is made public. Intermediary traders are supposed to buy minerals from verified mines. However, many intermediaries do not. They buy minerals from any sources, verified or not. This factor present a*

barrier to traceability of minerals” (I06). This suggests that intermediaries play a pivotal role in the mixing of minerals before smelting, which makes it difficult to identify the origin of material.

4.2.1.2 Lack of transparency

Five out of the ten informants identified lack of transparency as a weighty challenge to traceability of 3T minerals (Figure 4.2.). This lack of transparency is attributed to iTSCi, which controls and manages traceability information. According to informants, iTSCi does not share data/information on mineral flows nor on incidents as expected. As evidenced in one informant’s testimony:

It is only now we have come to realize that information sharing is key to ensuring traceability of origin of 3Ts. The first time this process was being set up, neither the secretariat nor the member states had a very good understanding of the requirements on information sharing. Now given the experience there is a need to review the working relationship with ITRI. Member states have now realized that they were not keen when they were discussing with ITRI, particularly on the data sharing (I07).

This statement was supported by another informant who underscored that: *“The current traceability scheme is a complete black box; iTSCi has in fact provided no transparent information whatsoever in terms of where the minerals come from, how they are supplied, where they go.”* (I04). These statements suggest that the attributes of 3T minerals exploited and traded via iTSCi scheme are not cross-checked by supply chain actors nor by the DRC government.

4.2.1.3 Monopoly

As displayed in Figure 4.2., four out of the ten informants felt that having a single scheme that provides traceability services and alone controls minerals from the Great Lakes Region, which mostly are channeled to ITRI association’s members, presents a barrier to traceability. Regarding this, I01 commented:

Lack of competition is a significant challenge to 3T minerals supply chain transparency and traceability. If iTSCi had competitors of any type, we would look at all irregularities going on in the system and say, hold on a second, you are not doing your job properly, I am going to move to someone else. But because iTSCi has no competitor, you take it or leave it. Yet, right now the fact is, without them we can't sell our minerals.

In addition, other informants felt that a single traceability scheme is not enough to efficiently provide a competitive service in the whole region. For, example, I03 observed: “*People are complaining that smuggling, tag trafficking, corruption is still going on. Ideally one single scheme cannot do the job because of the wide scale of artisanal and small scale mining in the region. It is too big and too difficult to handle*”. This statement was supported by another informant who reported the following:

In my experience, one traceability scheme in the whole region is not ideal for two reasons. First, there are a lot of the mine sites out there. Second, there is an obligation to conduct due diligence in all mine sites. In the region you have more than eight hundred mine sites. Tell me, how do you manage to do due diligence, and track efficiently minerals from all these sites. You can't. As consequence, a lot of mine sites do not have tracking agents on site on a regular basis (I01).

Conversely, from interviews it was found that some informants considered that the traceability monopoly as currently practiced in the region does not pose any threats to transparency and traceability. The following statement demonstrates this: “*As for me, I do not see very much iTSCi monopoly as a challenge to traceability of minerals. I do not know how much potential materials there is in the region that could be flowing out of the region that would necessitate the intervention of other schemes*” (I09).

The excerpts provided in this section illustrate the presence of conflicting opinions about the iTSCi monopoly in the region. However, two impacts of iTSCi monopoly are observed: lack of

competitive delivery and restriction of 3T minerals market to ITRI members. From interviews, can be seen the limitation of having a single traceability provider in the region, and the need for competition to ensure competitive delivery.

4.2.1.4 Technology

Technology, in this context, refers to the tool used for traceability data recording and transfer. As shown in Figure 4.2., four of the ten interviewed informants indicated that the manual paper-based process currently employed to identify materials, document the chain of custody, and transfer minerals data/information is in many ways inefficient and subpar. In this regard, one informant involved in the physical supply chain reported that: *“Paper-based system is time consuming. Log sheets take time to arrive at the head quarter where they are then verified, scanned and sent to the iTSCi database in the UK”* (I02). This statement was supported by another informant who stated: *“The use manual process for data recording represents a challenge. Sometimes, since it is a manual process there are gaps in those processes. I have seen where there is documentation missing. And, it takes a little while to capture it”* (I09). These two statements were corroborated by I08: *“Obviously, with the paper-based system currently used, the logbook can be tampered; the agent/government official can change data easily if he wanted to, and no one will ever know. It makes it as well very difficult to search and see different records”*. From these excerpts, it can be seen that the technology currently used for 3T minerals traceability is time intensive, prone to error and delays, and vulnerable to falsification. However, it has yet to be determined whether manual technology is the best recording system to ensure transparency on the origin of mineral and efficiency.

4.2.1.5 Cost

Three informants of out the ten interviewees considered implementing 3T minerals traceability system as cost intensive (Figure 4.2.). Interviewed informants observed a decline in funding, while the accruing expenditure on traceability implementation tends to rise due to the increasing number

of qualified mine sites. The cost barrier was acknowledged by both supply chain actors and traceability providers. I01, for example, stated that: *“One of the biggest challenges is related to the price of minerals. The level of mineral production has reduced due to the price that is currently very depressed. On the other hand, the overall financial cost of running the program does not reduce, but the available funding to keep it going has reduced”*.

This statement was supported by another informant who stated that: *“Cost related to running 3T minerals traceability system is a real challenge. The system has increasing services to be catered, and employs a lot of personnel that need to be paid”* (I07). From both statements, it can be inferred that the disproportion between funding available and the sizeable volume of material to be traced is likely to compromise the quality of traceability service to be provided.

4.2.2 Contextual Barriers

Contextual barriers pertain to challenges relating to the physical reality in the DRC. Interviewed informants indicated that traceability of 3T minerals is implemented in a challenging context. Three specific contextual barriers were identified (Figure 4.2.).

4.2.2.1 Infrastructure and logistics

Three of the ten informants identified infrastructure and logistics as a major issue that compromises efficient implementation of traceability of 3T minerals in the Eastern DRC (Figure 4.2.). As outlined in Table 3.3., infrastructure and logistics barriers were defined in terms of remoteness of mine sites, lack of/limited access to technology and poor roads. With regard to the remoteness of mine sites and poor roads, one informant disclosed that: *“The large territory to cover and long distances to travel represent a real challenge to traceability”* (I10). This statement was seconded by another informant who noted that: *“Remoteness of mine sites and inaccessibility of most roads makes it difficult to collect log book sheets”* (I02). Statements from both informants suggest the existence of physical hurdles for tracking 3T minerals from all qualified mines in the

Great Lakes Region, and in the DRC in particular. Further, other informants pointed out that limited/lack of access to needed technology fosters an environment in which electronic data collection and transfer is a significant barrier. In this regard, one interviewed informant commented that: *“The ideal is to have computer-based traceability system operate everywhere. However for some of the remote mines where there is no electricity, no network, and there is no way of doing maintenance for the handsets”* (I02).

4.2.2.2 Lack of law enforcement

The absence of law enforcement was considered a significant barrier in that offenders who break the law on minerals trade and traceability are not prosecuted accordingly. Two out of the ten interviewed informants felt that if there were some sort of law enforcement, there would be less corruption and trade in material from unknown sources (Table 3.3.). This indicates that traceability of 3T minerals is implemented in the context of lawlessness. One informant working on the ground explained that: *“The DRC adopted the OECD requirements as law. So since is the law, in fact, it is illegal for untagged minerals to be sold within and outside the DRC. However, we have not seen sanctions taken against those trading in untagged material”* (I02). This indicates the legal context in which traceability of 3T minerals is implemented. It can be therefore stated that the implementation of traceability in 3T minerals in the DRC takes place in the context of lawlessness, which inhibits efficient traceability. This barrier is specific to the 3T minerals traceability.

4.2.2.3 Lack of security

As portrayed in Figure 4.2., two informants out of ten mentioned lack of security as a factor that inhibits the implementation of traceability of 3T minerals. According to interviewed informants, the presence of armed groups prevented access to mine sites, whose production is easily infiltrated in the legal supply chain. I02, for instance, stated: *“We have covered most of the easily accessible areas. There are still areas where we would like to work, but we were not able to. This is partly*

down to security. Some areas still have a lot of insecurity which is challenging to traceability because it means we can't get to those sites”.

To summarize, the evidence provided by interviewed informants show that traceability of 3T minerals faces several contextual barriers related to reality in the Eastern DRC, where long distances, poor roads, unreliable power supply and the presence of armed groups constitute significant factors that hamper traceability.

4.2.3 People-driven barriers

People-driven barriers refer to challenges resulting from actions of supply chain actors and tracking agents involved in traceability of 3T minerals in the DRC. Two specific people-driven barriers were identified (Figure 4.2.).

4.2.3.1 Misrepresentation of Origin

Figure 4.2. shows that two out of the ten interviewed informants viewed the mixing and tagging of material from unknown origin with those from qualified mine sites as a factor that obstructs the identification of relevant attributes of 3T minerals. Interview results indicate that the effectiveness of traceability of 3T minerals is undermined by the mixing of material from unknown sources at the negotiant stage. As evidence, I05 stated: *“The trader level is the weakest point of the 3T minerals supply chain. There is an observable chaos at this point of the chain. Oftentimes traders purchase and process undocumented materials. As result, information on the mine of origin gets lost”*. Moreover, other informants noted that misrepresentation of origin is also partly due the structure of the supply chain, which is loaded with intermediaries, through whom unwanted minerals are infiltrated into the chain.

4.2.3.2 Corruption

As shown in Figure 4.2., four of the ten interviewed informants considered the corruption/bribery in the upstream supply chain to be a factor negatively impacting 3T minerals traceability. Interview results suggest that corruption, which involves traders and tracking agents takes place at trading points where materials are to be tagged, mixed and processed. An informant involved in the physical supply chain indicated that *“Another challenge to 3T minerals traceability is that tag is a sellable commodity”* (I01). To underscore the negative impact of the ongoing corruption in 3T minerals traceability, I02 went on to explain: *“Materials being smuggled into Rwanda, where they enter the system, are readily tagged in the Congo”*. This shows that corruption and mixing of material, which involves traders, intermediaries and tracking agents poses a challenge to traceability on 3T minerals.

To summarize, results of this section revealed that ten barriers impede traceability in 3T minerals supply chain. These include: 1) the DRC lack of capacity and resources, 2) lack of transparency, 3) monopoly, 4) technology, 5) cost, 6) infrastructure and logistics, 7) lack of law enforcement, 8) insecurity, 9) misrepresentation of origin and 10) corruption.

Chapter 5: Discussion

The purpose of this study is to understand the factors impacting traceability of conflict minerals in the Great Lakes Region of Africa, in the DRC in particular, and identify potential opportunities for improvement. This study provides a broader understanding of the opportunities, drivers and barriers to the implementation and participation in traceability in product supply chains. By focusing on conflict minerals, the study illustrates how factors impacting traceability implementation and participation can converge and diverge from what is commonly identified in the traceability literature where previous analysis is on agricultural, fish and forest products. The previous chapter presented results from interviews. This chapter discusses key findings of the study in line with literature reviewed and explains the factors impacting the implementation of traceability in 3T minerals. Section 5.1 will address the first objective of the study, that is, to identify and examine the drivers that motivate participation in traceability of conflict minerals. Section 5.2 will examine the second objective, that is, to identify and explain the barriers that inhibit traceability of 3T minerals in the Great Lakes Region, and in the DRC in particular. Section 5.3 will discuss opportunities for improvement. Section 5.4 will provide the study's contribution to the literature. Section 5.5 will provide the study's findings application to industry. Section 5.6 will present the limitations of the study. Section 5.7 will provide direction for future research.

5.1 Drivers for Participation in Traceability of 3T Minerals

The first objective of the study is to identify drivers that motivate participation in traceability of 3T minerals. This section examines how identified drivers are intertwined and explains the reason behind the leading drivers. Ten interviewed informants were asked to indicate the drivers that trigger participation in traceability of 3T minerals. As presented in section 4.1 of the results chapter, three drivers for participation in traceability were identified: legal requirement, market access and social pressure. These results are supported by the extant literature (Aung & Chang, 2013; Preziosi, 2014). A literature suggests that legal requirement is the key driver for participation

in traceability (Bosona & Gebresenbet, 2013; Golan et al., 2004; Mattevi & Jones, 2015, Preziosi et al., 2014). However, the findings of this study show that market access is the key driver for participation in 3T minerals traceability. As shown Figure 5.1, market requirement/pressure from US firms arose the need of suppliers to secure market access via participation in traceability. Informants clearly indicated that supply chain actors participate in traceability for market access purposes. This finding echoes the results of Xue, Wewei, Zettan, Peng and Weiguang (2007), who determined that market is the key driver for vegetable traceability in China. This finding is also supported by the finding in the study of Na (2016) on social responsibility of firms in conflict minerals supply chains that ensuring access to market is key to smelters and refiners compliance. In addition, this finding is also in line with the results of Mattevi and Jones (2015) that market access is an internal driver that motivates participation in traceability. For 3T minerals supply chain actors, accessing the market via traceability is seen in terms of economic interest in that only tagged material can be legally sold and exported. Moreover, although market access emerged as the key driver, the results suggest that there is a domino effect between social pressure, legal requirements in the USA and market access (Figure 5.1.).

This means that to a certain extent it is a combination of social pressure, the US law and market forces that led to the implementation of traceability at large, and to participation in traceability. Although it is believed that social pressure on industry was insignificant as an influence to improve their sourcing behavior, it played a remarkable role in the process of the DFA enactment into law. Moreover, given the concerns related to conflict minerals exploitation and trade (Enough Project, 2014; Prendergast & Lezhnev, 2009; Hates & Burge, 2003), which are addressed via implementation of traceability, it is unexpected to see market access emerge as the key driver for participation in 3T minerals traceability. This suggests a gap in the motivations driving traceability in conflict minerals. It is therefore surprising to observe that none of the informants considered sustainability or removal of conflict-related material from the supply chain as motivations driving participation in traceability.

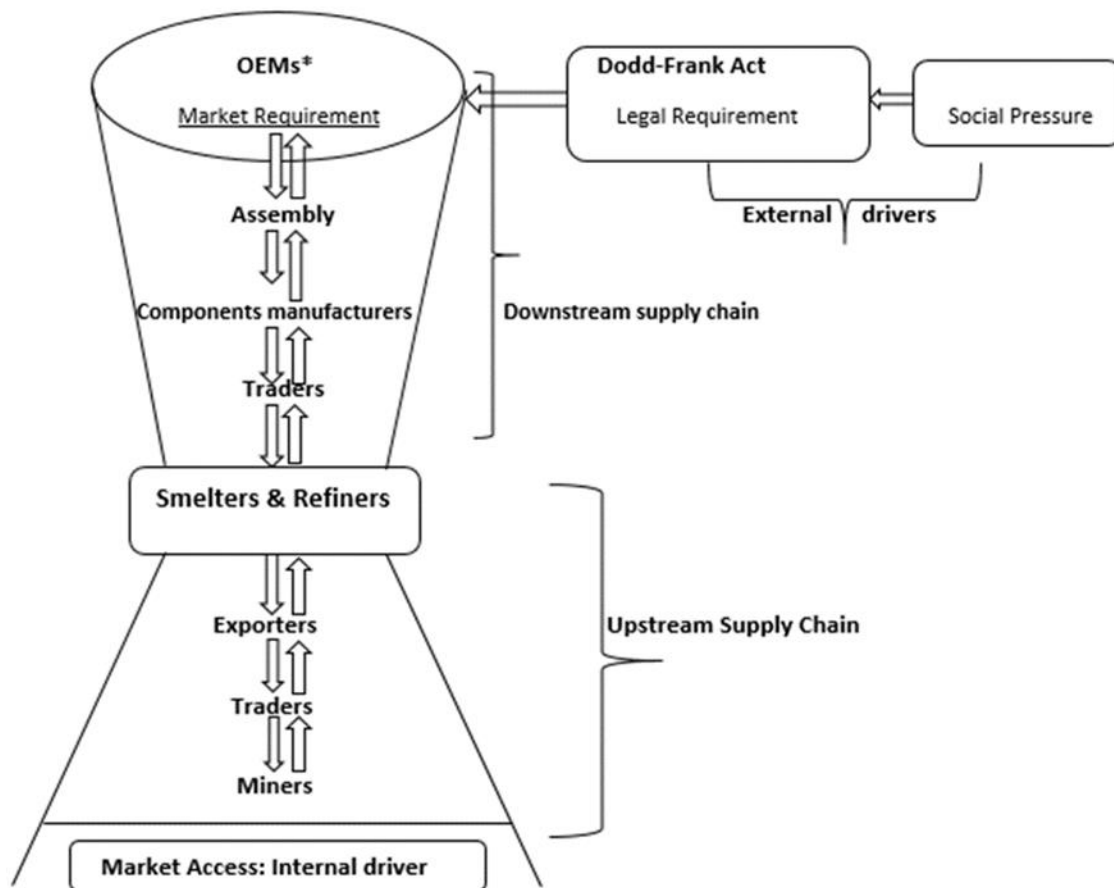


Figure 5.1. Interconnection of identified drivers for traceability of 3T minerals.

(*) OEMs refers to original equipment manufacturers. In this context, they are US publicly traded companies affected by the Dodd-Frank legislation on conflict minerals. Miners, traders and exporters are located in the DRC. Smelters and refiners are located in Asia (e.g., China, Malaysia, Indonesia, and Japan), in Europe (e.g., Germany, Sweden, and Austria), in America (e.g., USA, Bolivia, and Peru). The downward arrow indicates the market influence from down the US firms impacted by the DFA section 1502 to their suppliers to the miners. The upward arrow shows the suppliers, especially upstream actors' response/participation driven by the need to access the market.

5.2 Barriers to Traceability of 3T Minerals

The second objective of this study is to identify and explain the barriers that inhibit traceability of 3T minerals in the Great Lakes Region of Africa, and in the DRC in particular. In this section, the findings pertaining to barriers to traceability are discussed in connection to their underlying causes.

5.2.1 Institutional barriers to traceability

The notion of an institutional barrier resulting from policies, laws, action or inaction of a given institution is present in the literature (Jantarasami et al., 2010; Powell et al., 2009; Robinson, 2006; Watkins et al., 2012). In the case of traceability of 3T minerals, institutional barriers are linked to institutions involved in the implementation of traceability. One particular aspect of traceability in 3T minerals in the DRC is that the DRC government and iTSCi have the sole responsibility for the implementation of traceability. As outlined in *Table 4.2.*, the results show that lack of capacity and resources of the DRC government, lack of transparency on traceability data, monopoly, technology and cost are seen as institutional barriers to traceability of 3T minerals.

Numerous researchers have identified cost, technology and lack of transparency as barriers to traceability in food, agricultural and fish/seafood products (Alfaro & Rabade, 2009; Aung & Chang, 2014; Bechini et al., 2005; Bosona & Gebresenbet, 2013; Golan et al., 2005/2014; Mattevi & Jones, 2015; Regattieri et al., 2007; Senneset et al., 2007; Story et al., 2013; Van der Vorst, 2009). In the context of traceability of conflict minerals in the DRC, a report by Pact (2015) suggested that providing traceability services to all qualified mine sites, trade routes, and trading points is cost intensive. The findings of the present study illuminate how the rising costs relative to the increasing traceability services compared against the decrease in funding poses a significant challenge to traceability. As for technology, the results of this study align with Pact (2015) in asserting that the paper-based system poses barriers to traceability, such as the difficulty transmitting data from remote mine sites, recording errors and illegible information. This finding also compares as well with the conclusion of Syahrudin and Kalchschmidt (2011) that technology

poses a barrier to the traceability of cocoa in Indonesia as cocoa collectors lack adequate data/information recording and transfer systems.

Previous studies found that lack of transparency presents a barrier to traceability in food, agricultural and fish/seafood product supply chains (Bosona & Gebresenbet, 2013; Donnelly & Karlsen, 2010; Donnelly & Olsen, 2012; Regattieri et al., 2007; Storoy et al., 2013; Thompson et al., 2005; Van der Vorst, 2004). Interviewed informants also indicated that transparency is deficient in 3T minerals traceability due to lack of/deficient traceability data/information sharing/exchange. This finding supports the results of Projekt-Consult GmbH (2013) showing that iTSCi does not provide access to the centralized database, while it would be beneficial to compare traceability data for transparency purposes. Traceability of 3T minerals in the DRC would benefit from a transparent system, which considers both sharing of relevant information with eligible stakeholders on one account, and engaging them through feedbacks on the other. Given the importance of transparency in traceability of products, it can be said that transparency presents an opportunity for improvement.

The literature in traceability of product supply chains identifies the lack of capacity as a barrier to traceability, including lack of adequate equipment and trained staff (Bosona & Gebresenbet, 2013; Mattevi & Jones, 2015). The present study shows that the DRC government lacks capacity and resources that manifests in ill-equipped tracking agents, a weak monitoring system, lack of a database, a lack of incentive for staff, a lack of funds to ensure mine sites qualification, a lack of control over traceability activities, and weak policy on intermediaries. The DRC's lack of capacity and resources as a barrier to traceability has been also observed by Pact (n.d). The lack of resources and adequate equipment (i.e., database) boils down to capacity imbalance between the DRC government and iTSCi, which prevents the DRC government from exercising oversight and comparing traceability data with iTSCi's. Based on results, it can be stated that the DRC's lack of capacity and resources is an opportunity for improvement.

The notion of traceability system monopoly is absent in the literature and is thus a novel insight provided by the present study. The results show that minerals are traded under a single scheme that is controlled by an interest group representing 70-80% of worldwide smelters (ITRI smelters association). From the results, it can be seen that the informants indicated that the iTSCi monopoly is an opportunity for improvement. This means that opening traceability of 3T minerals to other providers has the potential to ensure higher transparency on the origin of minerals and competitive delivery.

5.2.2 Contextual Barriers to Traceability of 3T minerals

The significance of identifying contextual barriers for framing policies is acknowledged in sustainability literature (Azhoni et al., 2016). Contextual barriers identified in this study are defined in terms of challenges or limitations emerging from within the DRC-specific environment, which inhibit traceability. The present study concludes that identified contextual barriers (i.e., poor infrastructure and logistics, insecurity, and lack of/deficient law enforcement) negatively impact traceability of 3T minerals. Interviewed informants indicated, for example, that mine sites are difficult to reach, logbook sheets are hard to collect due to poor roads, long distances to travel, and the presence of armed groups. This finding aligns with Pact's (2015) report that some of the greatest barriers to 3T minerals traceability include infrastructure, access, conflict and security.

Additionally, one informant stated that the lack of electric power prevented them from using advanced technology, which would improve traceability outcomes. Another informant commented that in the DRC, people involved in smuggling, corruption and mixing of material from unknown sources are not prosecuted. The point that was being made by informants is that traceability of 3T minerals is not effective as it should be, partly due to lawlessness in the DRC, which is not conducive to efficient traceability.

5.2.3 People-Driven Barriers to Traceability of 3T minerals

This study demonstrates that barriers to traceability of 3T minerals are not only institutional or contextual, but they are also attributed to people involved in the trade at each step of the upstream supply chain. The study findings show that misrepresentation of origin, which involves mixing of material from unknown sources, and corruption, which involves trafficking of tags, are people-related barriers that inhibit traceability of 3T minerals. Previous studies in food, agricultural and fish/seafood product supply chains have identified the mixing of raw materials at the early stages of the supply chain as a barrier to traceability (Armani et al., 2015; Bollen et al., 2007; Donnelly & Karlsen, 2010). In the context of 3T minerals traceability, informants underscored that government agents in charge of tags receive monetary compensation from traders in exchange for tags, which are affixed on unidentified materials supplied by intermediaries.

Sustainability literature from the agri-food supply chain context identifies intermediaries as enablers, as they play a significant role for successful implementation of sustainability strategies across the supply chain. A study by ITC (2016) concludes that intermediaries play a gatekeeper role as they ensure the bridging of various supply chain actors. In contrast, interviewed informants indicated that intermediaries constitute a barrier to traceability of 3T minerals. Intermediaries are mostly not registered/licensed. They are generally used by licensed traders to secure material. According to informants, in most cases intermediaries supply material from undocumented sources. Once this material is mixed with those from qualified sources, the attributes of minerals, including the origin, become difficult to establish.

To summarize, identified barriers to traceability include institutional barriers, such as the DRC's lack of capacity and resources, lack of transparency, monopoly, technology and cost; contextual barriers, which include infrastructure and logistics, insecurity, and deficient law enforcement; and people-related barriers, such as corruption, mixing of undocumented material, and tag trafficking. Among the ten identified barriers, six compare with extant literature, and four are new findings

specific to the conflict minerals context: 1) monopoly, 2) insecurity, 3) lack of law enforcement and 4) infrastructure and logistics. These findings have not been discussed in previous studies.

5.3 Opportunities for Improvement

The results of the interviews show that informants are fully aware of the barriers to traceability, which would ultimately require some degree of improvement. Based on the findings, this study suggests that 3T minerals traceability as currently implemented requires a new approach, which is supported by policies that take into consideration the identified barriers. Proposed opportunities for improvement are derived from the most significant barriers (Table 5.1.).

Table 5.1. Four opportunities for improvement. Barriers ranking from 9 to 4 were considered as areas needing improvement.

Barrier	Improvement required
DRC lack of capacity and resources	<ul style="list-style-type: none"> ▪ Escalate capacity and resources in the DRC.
Lack of transparency	<ul style="list-style-type: none"> ▪ Redesign information/data sharing agreement.
Monopoly	<ul style="list-style-type: none"> ▪ Transition from monopoly to competitive market approach
Manual/paper-based tracking system	<ul style="list-style-type: none"> ▪ Upgrade tracking technology

Escalate the DRC capacity and resources. As seen in the results, the DRC’s lack of capacity and resources ranked highest among all the barrier to 3T minerals traceability. Being the key implementer of traceability in the 3T minerals supply chain in the DRC, the DRC government is expected to rise to the challenge by escalating its capacity and resources using enforceable policies. Escalating the DRC government capacity means that existing policies on artisanal mining and conflict minerals traceability must be redefined and rationalized according to the identified barriers.

Redesign information sharing agreement. Transparency is seen as a significant aspect of traceability (Donnelly & Karlsen, 2010; Thompson et al., 2005). Upstream supply chain actors expected to see minerals information for data comparison purposes. Other informants pointed out that iTSCi makes information public online. However, it is not known whether the information posted online is substantial and reflects the actual information collected on the ground. To ensure transparency and foster trust and communication, the ICGLR, the DRC and iTSCi should redesign the information sharing agreement.

Transition from monopoly to competitive market approach. One of the frustrations interviewed informants expressed was that ITRI association members, that is smelters, effectively control all 3T minerals in the region. In the DRC, 3T minerals trade is a closed market. It is acknowledged, however that iTSCi traceability system helps local suppliers to access the international market. Nevertheless, interviewees believed that bringing in competitors to iTSCi would foster improvement in traceability outcomes via competitive service delivery. To ensure quality traceability service, the ICGLR and the DRC government should take the initiative to bring in other traceability providers.

Upgrade tracking technology. According to Karlsen, Donnelly and Olsen (2011), using advanced technology for product traceability is of great value in that it provides efficient and reliable data recordings and transfer. In the context of traceability of conflict minerals in the Eastern DRC, the manual recording technology currently employed meets minimum requirements; however, interviewed informants pointed out significant drawbacks related to this technology (Table 3.3.). With advances in technology, iTSCi should be able to upgrade the data recording system to ensure efficiency and reliability of traceability data.

5.4 Contributions to Literature

A significant body of scholarship has discussed factors impacting implementation and participation in traceability of diverse product supply chains. This study identified lack of understanding of factors affecting traceability of conflict minerals in the Great Lakes Region of Africa, and specifically the DRC. The present study has addressed the gap by identifying the drivers and barriers precluding effective traceability. This study opens an area of investigation into conflict minerals traceability research. The study can serve as a blueprint, which can be used to examine traceability of minerals in other contexts. This study contributes as well to the debate on factors impacting traceability of product, as it substantiates the understanding of drivers and barriers to traceability of products. One finding shows that the internal driver, which pertains to market access, is perceived as a greater motivation for participation compared to external drivers pertaining to legal requirement and social pressure. In addition, the study demonstrated that barriers to traceability of 3T minerals in the DRC are institutional, contextual and people-driven. The original contribution made by this study is in the finding of four barriers specific to traceability of 3T minerals in the DRC using the GT approach: 1) Insecurity, which relates to the presence of armed groups, 2) infrastructure and logistics, 3) monopoly and 4) weak/lack of law enforcement.

This study provides a new insight on the understanding of barriers to traceability by establishing a relationship of causality between barriers and their underlying causes: who or what is responsible for creating and maintaining each barrier is revealed. Knowing the background behind various barriers provides insight into how they may be addressed. This study therefore contributes to the traceability of products literature.

5.5 Application to Industry

Understanding factors that impact traceability in conflict minerals supply chain is of great significance to the industry seeking to source minerals from legitimate origins and avoid conflict-related material. This study provides insights on aspects needing improvement by identifying barriers hindering the proper course of traceability. If identified barriers are addressed accordingly, the industry, downstream in particular, could be assured of the legitimacy of attributes of the minerals they purchase. In addition, the findings of this study regarding barriers inhibiting traceability of 3T minerals, and the subsequent strategies/recommendations proposed to address them as opportunities for improvement, can stand as an example for the broader minerals trade, and potentially for other industries as well. Mining operations in other conflict-plagued regions may experience similar challenges, and therefore find the solutions proposed within to be a highly applicable road map for positive change. Even industries operating in places where conflict and human rights abuses are not prominent issues may gain insight into certain problems they face, and may even be able to use this research as a guide towards productive resolutions.

5.6 Limitations of the Research

The main limitation of this study is sample size and make-up of the group of key informants interviewed. Conflict minerals, specifically 3T minerals, are traded in a complex global supply chain involving various actors spread all over the world; thus, finding and securing informants was a challenge. The sample size of ten informants included two in-chain and eight out-of-chain informants, limits the general reliability of results. Given the spectrum of the 3T minerals supply chain, a larger sample size would have been much better. However, recognizing this limitation, the interviewed informants provided high quality information, which was carefully combed through. The information gleaned from informants was used to maximum effect, including as many relevant quotes as possible. In addition, new insights into 3T minerals traceability supply chains were obtained.

The second limitation of the study was found to be the scarcity of scholarly literature on traceability of conflict minerals. Despite the limitations, this study is nonetheless a step towards better understanding an under-researched domain.

5.7 Direction for Future Research

Traceability of conflict minerals is at its early stage. The findings of this first study in this area of research indicate a wealth of possibilities for future research endeavors. The most prominent of these are listed below.

- 1) Given the fact that this study is the first of its kind, and considering the small sample size used to carry out this study, there is a need to re-evaluate the identified factors impacting traceability in 3T minerals using a larger sample size in order to improve the findings.
- 2) Subsequent studies would benefit from expanding the scope of investigation from mine site to OEMs in order to have the downstream supply chain actors' perspective on drivers and barriers to traceability of conflict minerals.
- 3) Given that barriers to traceability of 3T minerals are intrinsically linked to institutions, context and people, it would be interesting to investigate how these three areas intersect and impact each other.
- 4) Given that market access, which translates into economic interest, was unanticipatedly found to be the major driver that motivates participation, it would be important to explore the economic impact of traceability of 3T minerals on the DRC. Such a research would seek to understand whether the DRC, specifically mining communities have improved economically.

Chapter 6: Conclusion

6.1 Introduction

The purpose of this study is to understand the factors impacting traceability of conflict minerals in the Great Lakes Region of Africa, in the DRC in particular, and identify potential opportunities for improvement. Previous studies have focused on drivers and barriers to traceability in food, agricultural and fish/seafood products. No studies addressing factors impacting traceability of conflict minerals were found. This study sought to understand drivers that motivate participation, and barriers inhibiting traceability of conflict minerals in the Great Lakes Region, and in the DRC in particular. To address the research question and objectives of the study, grounded theory was employed using semi-structured interviews. Two core open-ended questions were asked to ten in-chain and out-of-chain informants. The results show that participation in traceability of 3T minerals is driven by legal requirement, market access, and social pressure. The results also indicate that ten main barriers hamper traceability of 3T minerals in the DRC: DRC's lack of capacity and resources, lack of transparency, and monopoly, technology, cost, and infrastructure and logistics, lack of law enforcement, insecurity and misrepresentation of origin, and corruption. The present study has furthered the understanding of factors impacting traceability of product across supply chains by identifying drivers for participation, and barriers inhibiting traceability of 3T minerals. Main findings of the study and recommendations to policy makers and industry are provided in the next sections. Section 6.2 recapitulates the major findings of the study. Section 6.3 provides recommendations to policy makers and industry.

6.2 Main findings

The present study is the first to address drivers and barriers to traceability in 3T minerals supply chain. Interviewed informants clearly indicated key reasons for participation, and major barriers to traceability. The most prominent findings are provided below.

1. It is acknowledged that the DFA and social pressure played a significant role in the adoption and implementation of traceability in conflict minerals supply chain, informants indicated that their participation in traceability of 3T minerals is driven by market access.
2. The vast majority of informants felt that the most prominent barriers to traceability include the DRC's lack of capacity and resources, iTSCi's lack of transparency, monopoly, technology, and cost.
3. The study found that identified barriers to traceability are institutional, contextual and people-driven.
4. Apart from identified barriers to traceability of conflict minerals in the DRC, this study found four barriers that are not found in the existing body of literature: insecurity, infrastructure and logistics, monopoly, and weak/lack of law enforcement.
5. Although, intermediaries are considered as enablers in the existing literature, this study found that intermediaries constitute a barrier to traceability. According to informants, intermediaries who are used by official/licensed traders bring material from unknown sources into the legal supply chain.

6.3 Recommendations to Policy makers and Industry

This study provides recommendations based on its findings to policy makers and to industry.

Recommendation to policy makers. As demonstrated by the results of this study, responsibility for the bulk of barriers to traceability rests with the DRC government. The DRC government and

the ICGLR should adjust and rationalize existing policies in light of the identified institutional and contextual barriers. Specifically, the ICGLR's RCM could use the findings of this study to devise policies that would help ensure transparency on minerals origin, CoC compliance and regional supply chain monitoring. Informants felt that intermediaries are unnecessary in the 3T minerals supply chain. Thus the need to improve the structure of the supply chain. In order to streamline the structure of the supply chain, the DRC government in particular needs to draw up policies that eliminate intermediaries. There is also a need for the DRC government to set up policies able to enforce the law over artisanal mining and traceability of minerals; this would help control people-driven barriers. Lastly, in order to reduce tag trafficking, the DRC government needs to devise policies that require accountability of tracking services.

Recommendation to industry. The findings of this study show the limitation of the DRC government resources, and the deficient funding for traceability implementation in the DRC. There is therefore a need for downstream industry to increase their participation in funding in order to ensure improved traceability. In addition, given the chaos observed at the trading level, where material from unknown sources are infiltrated in the legal supply chain via intermediaries, exporters/international trader can, for example, adopt the closed-pipe system. This approach directly connects an international trader/exporter with miners at a qualified conflict-free mine of origin. This type of supply chain has been implemented by Kemet since 2010 (Kemet, n. d.). Kemet is a US-based electronic components manufacturer. By using the closed-pipe supply chain, Kemet has succeeded to avoid intermediaries by directly trading in minerals at the mine level. The advantage of a closed-pipe supply chain is that it allows downstream actors/firms to ensure verifiable conflict-free status of their products.

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Appendix A: Open-ended questions for interview

1. What are the drivers that motivate supply chain actors to participate in 3T minerals traceability system?
2. Based on your experience, identify and describe the barriers that hinder traceability of 3T minerals in the Eastern DRC.

Appendix B: Sample of open coding for drivers

Excerpts from interviews/Raw data	Code
I02. DFA1502 pressure led US consumer companies to use market influence to change the behavior of suppliers. Sometimes consumers' demands have an impact, but they do not really change things in the same way that the law does.	<ul style="list-style-type: none"> ▪ Dodd-Frank Act 1502 ▪ Market influence
I05. Companies participate in 3Ts traceability to meet market requirement for traceable material	<ul style="list-style-type: none"> ▪ Market requirement
I06. Traceability was imposed by DFA. If we do not follow what the law prescribes, we won't be able to sell and export our materials	<ul style="list-style-type: none"> ▪ Ability to sell and export
I07. It is the Dodd-Frank Act 1502 that was signed into law in 2010 by the US government. Industry was required by the DFA to report that their business has nothing to do with the conflict in the region.	<ul style="list-style-type: none"> ▪ Dodd-Frank Act
I07. There is also civil society organizations that played an important role on the industry to make the industry more responsible and transparent in the way they operate in the region.	<ul style="list-style-type: none"> ▪ Civil society
I09. Another driver is social pressure. A lot of sustainability is driven by customers wanting to buy sustainable products. However, it is really hard to understand how much that is a driver.	<ul style="list-style-type: none"> ▪ Social pressure ▪ Customer/consumer demand
I09. Even though it is not a legal requirement in all countries, is only in the US, the supply chains are still big now that most companies are involved and requiring their supplier to be able to trace their minerals. So it is driving participation in supply chain traceability.	<ul style="list-style-type: none"> ▪ Legal requirement
I07. There is also the market requirement, miners, exporters cannot sell or export their minerals if there are not traceable. Upstream SC actors are to satisfy the demand of downstream firms, needing traceable material.	<ul style="list-style-type: none"> ▪ Market requirement
I08. Having traceable minerals will help a lot of artisanal miners to sell at a better price, and therefore secure a better income	<ul style="list-style-type: none"> ▪ To sell at better price ▪ To secure income
I03. The activities by civil society about being responsible in supply chains is key. Legal and market requirements are, to a certain extent, reflecting the public opinion.	<ul style="list-style-type: none"> ▪ Civil society ▪ Legal requirement ▪ Market requirement

Appendix C: Sample of axial coding for drivers

New code	Collation of similar codes
Legal requirement	<ul style="list-style-type: none">▪ DFA 1502▪ Legal requirement
Social pressure	<ul style="list-style-type: none">▪ Civil society▪ Social pressure▪ Consumer demand
Market access	<ul style="list-style-type: none">▪ Market influence▪ Market requirement▪ Ability to sell and export▪ To sell at better price▪ To ensure income

Appendix D: Sample of open coding for barriers

Excerpts from Interviews/ Raw data	Code
I04. ITSCi is a complete black box; there is no transparency whatsoever. It was the intent of the ICGLR standards to have a great deal of transparency in terms of mineral flows. ITSCi has in fact provided no transparent information whatsoever in terms of where the minerals come from, how they are supplied, where they go.	<ul style="list-style-type: none"> ▪ ITSCi lack of transparency
I04. There is no oversight over iTSCi scheme. It is held privately and exclusively. There is no information exchange.	<ul style="list-style-type: none"> ▪ No information exchange (iTSCi)
I04. There are a couple of barriers to minerals traceability. First, lack of traceability competition. Second, lack of capacity of governments/ member states.	<ul style="list-style-type: none"> ▪ Lack of competition ▪ DRC government lack of capacity
I07. Cost related to running 3T minerals traceability system is a serious concern. The system employs a lot of services and personal that need to be paid.	<ul style="list-style-type: none"> ▪ A lot of service needing to be paid
I02. We have covered most of the easily accessible areas. There are still areas where we would like to work, where we have not done yet which is partly down to security; to some parts still have a lot of insecurity which is challenging because it means we can't get to those sites.	<ul style="list-style-type: none"> ▪ A lot of Insecurity
I02. Government agents involved in mineral identification and data collection are not necessarily being paid on time, or not being paid at all which is very demotivating for them.	<ul style="list-style-type: none"> ▪ Unpaid tracking agents
I06. The status of verified mine sites is made public. Intermediary traders are supposed to buy minerals from verified mines. However, many intermediaries do not. They buy minerals from any sources, verified or not. This factor present a barrier to traceability of minerals.	<ul style="list-style-type: none"> ▪ Intermediaries buy material from nay sources
I04. It is known that at the trader's level, the "negociants"/intermediaries are bringing in materials from other mine sites that have not been qualified. They mix this stuff with minerals from verified mines. However, nothing has been envisaged to prevent that to happen by the current system.	<ul style="list-style-type: none"> ▪ Mixing of material from non-qualified mines

Appendix E: Sample of axial coding for barriers

New code	Collation of similar codes
Transparency	<ul style="list-style-type: none"> ▪ ITSCi lack of transparency ▪ No information exchange (iTSCi)
Monopoly	<ul style="list-style-type: none"> ▪ Lack of competition
Cost	<ul style="list-style-type: none"> ▪ A lot of services needing to be paid
Insecurity	<ul style="list-style-type: none"> ▪ A lot of insecurity
DRG government lack of capacity and resources	<ul style="list-style-type: none"> ▪ DRC government lack of capacity ▪ Unpaid tracking agents
Misrepresentation of origin	<ul style="list-style-type: none"> ▪ Mixing of undocumented material

Appendix F: Sample of selective coding

Category	Code
Institutional	<ul style="list-style-type: none">▪ Transparency (iTSCi)▪ Monopoly▪ Cost▪ Lack of capacity and resources (DRC government)
Contextual	<ul style="list-style-type: none">▪ Insecurity
People-driven	<ul style="list-style-type: none">▪ Misrepresentation of origin

Appendix G: Sample of verbatim quotations

Informant	Sample quotation
I01	For without any type of traceability, we will be in a position where we will not be able to export our minerals. Therefore full traceability was required, from the mine to the upgrading plant, including transport.
I01	Lack of competition is a significant barrier to 3Ts traceability and transparency. If iTSCi had competition of any type, we would look at all irregularities going on in the system and say, hold on a second, you are not doing your job properly, I am going to move to someone else. Yet, right now the fact is, without them we can't sell our minerals.
I02	Sometimes consumers' demands have an impact. The very creation of DFA was partly brushed due to consumer pressure. Consumer pressure came from a very strong lobby that was led by various NGOs.
I03	ITSCi/Pact are continuously improving as to how to manage the scheme. The challenge for the DRC is the lack of capacity to efficiently manage the scheme. In other words, the DRC has a big problem for data management.
I04	The current traceability scheme is a complete black box; that is, there is no transparency whatsoever. It was the intent of the ICGLR standards to have a great deal of transparency in terms of mineral flows, and publication of data from minerals flows. However, ITSCi has in fact provided no transparent information whatsoever in terms of where the minerals come from, how they are supplied, where they go.
I06	The status of verified mine sites is made public. Intermediary traders are supposed to buy minerals from verified mines. However, many intermediaries do not. They buy minerals from any sources, verified or not. This factor present a barrier to traceability of minerals.
I04	It is known that at the trader's level, the "negociants"/intermediaries are bringing in materials from other mine sites that have not been qualified. They mix this stuff with minerals from verified mines. However, nothing has been envisaged to prevent that to happen by the current system.
I02	There a growing concern with government agents who are not necessarily being paid on time, or not being paid at all. This factor is very demotivating for them. So even though iTSCi provides training and support to government agents, there are still issues with people not getting paid.
I03	The challenge of the traceability system as currently implemented is that you have two different parties involved in implementation of the system. First, ITRI and Pact. They are at the same time owners and operators or managers of the scheme. Second, you have the DRC government.
I06	ITSCi does not share its information. ITSCi knows that often there is no correspondence between the output of a mine and the number of people working in the mine. But no action is taken. The biggest problem is that there is no body to check on ITSCi. ITSCi is not accountable to anybody.
I07	Monopoly is one of the barriers to traceability. In reality, there is a double monopoly here. Monopoly in providing traceability services, but also monopoly of market at the international level because now ITRI has like 70-80% of smelters who are members. These sourced materials are traced and tracked only by iTSCi which means that ITRI has as well a monopoly in the international market. Not any other traceability provider can access this 70-80% of smelters at the international level.
I10	We participate for economic gain. If we do not participate in traceability system we can't sell nor export our minerals.