

DIAMONDS ON THE BLOCKCHAIN

Building a Global Digital Ledger for Valuable Assets

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DEEP Centre

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Realizing the new promise of the digital economy

In 1994, Don Tapscott coined the phrase, “the digital economy,” with his book of that title. It discussed how the Web and the Internet of information would bring important changes in business and society. Today the Internet of value creates profound new possibilities.

In 2017, Don and Alex Tapscott launched the Blockchain Research Institute to help realize the new promise of the digital economy. We research the strategic implications of blockchain technology and produce practical insights to contribute global blockchain knowledge and help our members navigate this revolution.

Our findings, conclusions, and recommendations are initially proprietary to our members and ultimately released to the public in support of our mission. To find out more, please visit www.blockchainresearchinstitute.org.



Blockchain Research Institute, 2018

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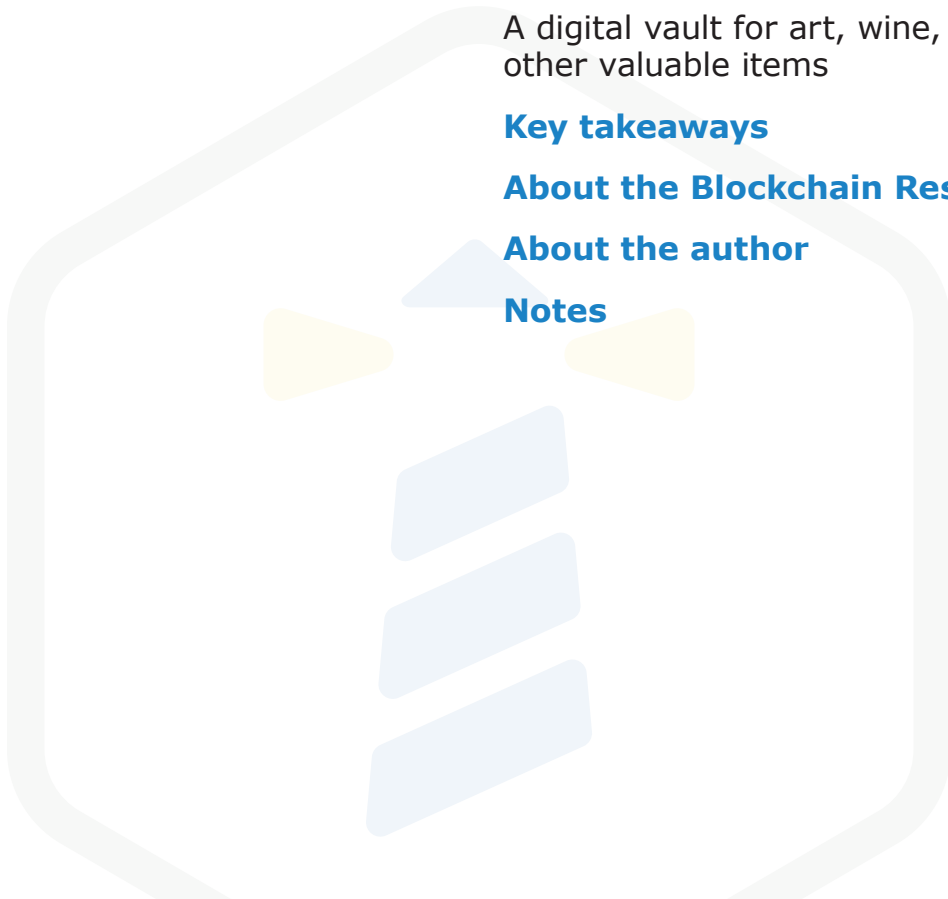
Anthony D. Williams, “Diamonds on the Blockchain: Building a Global Digital ledger for Valuable Assets,” foreword by Don Tapscott, Blockchain Research Institute, 22 Dec. 2017.

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Foreword

Trust and verification are two of the most important benefits of blockchain technology. The vast dollar amount of the diamond industry indicates how valuable a blockchain-based solution can be with respect to fraud reduction and property rights improvement. People will be confident that the stones they purchased are legitimate and stolen property can easily be returned to the rightful owner. This project investigates how Everledger tackles these problems.

We can harness blockchain to authenticate any product. Everledger already verifies authenticity of fine wine; its impact on the diamond industry is even more important. Not only has diamond trade been exceptionally opaque, it has exacerbated human suffering and stripped developing economies of valuable resources without proper compensation. According to the United Nations (UN), conflict diamonds are “rough diamonds used by rebels to finance armed conflict aimed at overthrowing legitimate governments.”¹ They are a scourge to civil society, the exact opposite of the sentiment represented by a wedding engagement ring. The Blockchain Research Institute studies how distributed ledgers can improve human rights. I can think of no more relevant example than rejecting diamonds mined in conflict zones that would otherwise keep despots in power.

I have had the pleasure of working with Anthony Williams for many years including our co-authorship of *Wikinomics: How Mass Collaboration Changes Everything* and *Macrowikinomics: New Solutions for a Connected Planet*. Much of his work—including that at the Markle Foundation, the Lisbon Council, and the BRI—helps others to leverage technology for the common good. This project is another excellent example of that theme.



DON TAPSCOTT

*Co-Founder and Executive Chairman
Blockchain Research Institute*



Case in brief

- » Having thrived for decades on the integral role of diamonds in romantic relationships, the \$80 billion-dollar diamond industry confronted a grave threat to its brand in the early 2000s by embracing a multistakeholder effort to eradicate “conflict diamonds.”
- » The so-called Kimberley Process brought significant progress by requiring diamond-producing countries to certify that exports of rough diamonds are conflict free. However, the largely paper-based diamond certification process has been plagued by corruption, forgeries, and inefficiencies, resulting in many conflict diamonds entering the supply chain illegitimately.
- » Efforts to ameliorate the often-harsh realities of the global diamond trade have also fallen short in the eyes of the industry watchdogs, who point to ongoing violence and human rights violations in diamond-producing countries such as Angola, Zimbabwe, and the Central African Republic as further evidence of the Kimberley Process’s failure.
- » A London-based company, Everledger, is using emerging technologies, including blockchain, to create a global digital ledger for diamonds that enables producers, consumers, insurers, and regulators to track the flow of individual diamonds through the supply chain, from the mines where they are unearthed right through to jeweler’s display case.
- » Incorporating blockchain into the diamond supply chain has several other benefits, such as eliminating insurance fraud and reducing the potential for corruption, money laundering, and other problems associated with the diamond trade.
- » The case sheds light on the potential for blockchain to verify the authenticity, provenance, and custody not only of diamonds, but also of a wide range of high-value items, from luxury automobiles to rare wines and priceless works of art.

Where oversight is scant and corruption is rampant, diamond trade continues to fund war and terrorism against democratically elected or internationally recognized governments and their citizens.



The diamond supply chain and the problem of conflict stones

Like other valuable natural resources, a well-managed diamond trade could fuel economic development and provide funds to improve living conditions, create jobs, and build social infrastructure.

For decades, the diamond industry has deliberately and carefully crafted a brand for diamonds as objects of love. Highly successful marketing campaigns targeting old and young couples alike have ensured that diamonds are an essential and ongoing part of romantic relationships. Meanwhile, diamond suppliers like De Beers operate quietly in the background, attracting little public attention. Yet, the image portrayed by De Beers and other diamond suppliers stands in stark contrast to the frequently harsh realities of the diamond supply chain.

In countries such as Angola, Zimbabwe, and the Central African Republic, where oversight is scant and crime and corruption are rampant, diamonds continue to provide hard currency for rebel groups and terrorists to purchase weapons and wage war on elected or internationally recognized governments.² The result, according to investigative journalists and human rights observers, is prolonged conflicts and terrible human rights violations.³ Violence, mutilation, and even kidnapping (as a means of military recruitment) have destroyed the social and economic foundation in many countries where diamonds are mined. Ironically, a precious natural resource that has enriched diamond producers has also produced some of the harshest living conditions in the world.⁴

Like other valuable natural resources, a well-managed diamond trade is a potentially lucrative driver of economic development, providing the funds required to improve living conditions, to create jobs, and to build social infrastructure. However, the brutal civil wars and human rights violations that diamonds fund in some producing regions are completely at odds with the purity of the images sold to consumers.




Diamond 1186139 by Colin Behrens (ColiN00B), 2016, used under CC0 1.0.



An opaque supply chain comes under scrutiny

In the past, the diamond brand was protected by the extreme opacity of the diamond supply chain. Diamonds moved easily from one country to another, making it difficult to pinpoint their true origin.⁵ The aggregation, sorting, and reselling of diamond in markets such as Antwerp only compounded these difficulties. The rough diamonds that flow through the De Beers supply chain, for example, eventually land in London where they are aggregated and sorted at De Beers' charterhouse street facility, which at any given time may hold up to \$1 billion worth of rough diamonds.⁶ These diamonds are then divided and sold in multimillion-dollar lots to special customers who De Beers calls *sightholders*. Ironically, these sightholders do not actually see these diamonds beforehand. De Beers determines which diamonds go into which lots, and even sets the prices. Customers are buying "sight unseen" at fixed prices, a process De Beers executives termed "feeding the ducks."⁷ This opacity not only made it difficult to track the true source of rough diamonds, it also obscured public visibility into corruption and violence that the trade in diamonds fuels.

"No public company, including us, will be likely to invest in the diamond industry in Sierra Leone into the indefinite future."

 ROBERT KAPLAN
Director
Rex Diamond Mining Corp.

Public awareness of the problems created by the diamond trade began to increase when well-organized advocacy networks emerged to call attention to what became known as "conflict diamonds." These organizations included nongovernmental organizations (NGOs) such as Partnership Africa Canada, Global Witness, Amnesty International, and Human Rights Watch, along with prominent international organizations such as the UN and the World Bank. A report published in early 2000 by Partnership Africa Canada was particularly damaging.⁸ Robert Kaplan, director of Rex Diamond Mining Corporation, said his company "lost market value of \$600 million in the three days following the *Globe and Mail* article about the report."

"Perhaps more important for the long term," said Kaplan, "is that no public company, including us, will be likely to invest in the diamond industry in Sierra Leone into the indefinite future."⁹

The Kimberley Process and its discontents

The Kimberley Process is an international certification scheme that regulates trade in rough diamonds to prevent the flow of conflict diamonds.

Growing public exposure made it essential for the diamond industry to deal with the conflict diamonds issue before further damage could be done. Two years of lengthy discussions between the diamond industry, 50 countries, and several NGOs, produced the Kimberley Process (KP): a voluntary agreement that established a certification and tracking mechanism for diamonds that can ensure their origins are known.¹⁰ The system, which went into effect in 2003, includes a "chain of warranties" that creates an audit trail for any given diamond that stretches from the mines where they are unearthed to the jewelers' shop where they are cut and polished. The transparency of the certification process, and a commitment to independent monitoring, was intended to establish trust that meaningful action is being taken to reduce the flow of conflict diamond into the supply chain.



Today, KP has 54 participants representing 81 countries, which account for 99 percent of the global extraction, trade, and manufacturing of diamonds.¹¹ Despite its widespread adoption, views differ on how effective the Kimberley certification process has been in eliminating the problem. The diamond industry estimates that conflict diamonds account for as much as 3.7 percent of the world’s multibillion-dollar rough diamond trade. KP claims its certification process has succeeded in eliminating 99.8 percent of these conflict stones from the legitimate diamond trade.¹²

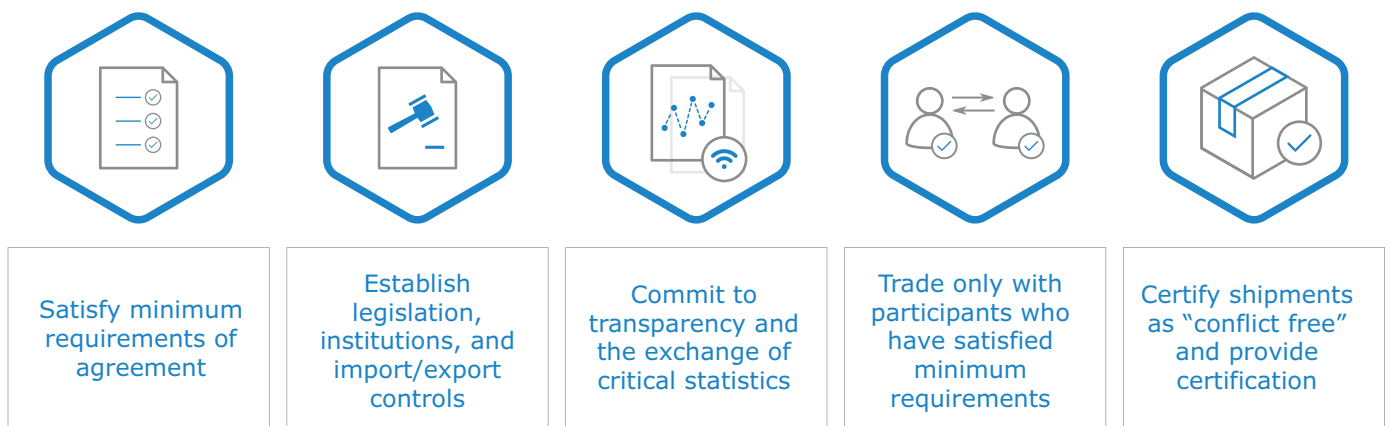
NGOs such as Global Witness and the Diamond Development Initiative, on the other hand, claim the share of conflict diamonds is closer to 20 percent and have documented a long list of apparent instances of noncompliance, smuggling, money laundering, and human rights abuses occurring in countries that claim to comply with the KP’s voluntary requirements.¹³ In fact, Global Witness pulled out of the Kimberley Process in December 2011, arguing that “the industry’s ‘system of warranties’ lacks independent verification” and that the KP had failed to address breaches of its rules, instances of corruption, and state-sponsored violence in diamond producing regions.¹⁴ Andrey Polyakov, president of the World Diamond Council, countered that “well-timed and concerted industry actions have alerted authorities to counterfeit products, stopped the export of conflict diamonds, and encouraged responsible operating practices.”¹⁵

What all participants seem to agree on, including the KP itself, is that this well-intentioned certification scheme suffers from flaws that are undermining its efficacy and credibility. These flaws, in turn,

Figure 1: The Kimberley Process

The Kimberley Process is a binding agreement that requires participants to apply the Kimberley Process Certification Scheme, which certifies every shipment of rough diamonds as conflict free.

Under the terms of the Kimberley Process Certification Scheme, participants must



See “What is the Kimberley Process?” www.kimberleyprocess.com/en/what-kp.



have leaders in industry, government, and civil society turning to blockchain as a source of solutions. Fortunately, a new company harnessing blockchain is building a global digital ledger for diamonds that will help address the problem of conflict diamonds and a variety of other problem plaguing the industry.

Everledger and the global digital ledger for diamonds

Founded in 2015, Everledger is the first company to build a global, digital ledger that tracks and protects valuable assets throughout their lifetime journey. Everledger starts by collecting an asset's defining characteristics, history, and ownership to create a permanent record on the blockchain. This digital incarnation, or thumbprint, is used by various stakeholders in a supply chain to form provenance and verify authenticity. The challenges in the diamond industry, including those associated with conflict diamonds, made the global diamond supply chain the perfect test case for Everledger's digital ledger.

Establishing provenance and fixing a broken certification process

Provenance is the life story of an item and in the world of luxury goods like diamonds, provenance matters, because we cannot separate the value of an item from its origin and its history. The problem, according to Everledger's founder and CEO, Leanne Kemp, is that the world's provenance is locked in paper, with the diamond certification process a perfect example.

After mining and cutting, diamonds are sent for certification. Certificate houses inspect the diamonds, while laboratories grade them using the 4C's: cut, carat, clarity, and color. Certificate houses then typically serialize the stones and issue physical certificates with all the attributes of the diamond, including the girdle dimensions and hand-drawn line pictures. These certificates follow the diamonds into retail chains and increase the price of the stones considerably.

A major problem with the antiquated process is that there is no central database for information. Diamond traders depend on certificates of authenticity and origin that are still largely paper-based. The paper-based system is not simply inefficient; the physical records themselves are vulnerable to tampering and outright forgeries. "Not only are the certifications not readily available to the public, you have to trust the certificate houses, which are not necessarily immune to corruption," said Kemp.¹⁶

In fact, forged documents accompanying rough diamonds have always been the Achilles heel of the Kimberley Process, making

Provenance is the life story of an item. The problem, according to Everledger's founder and CEO, Leanne Kemp, is that this story is written on paper, with the diamond certification process a perfect example.



it possible for diamonds borne out of some of the worst human suffering to be sold at legitimate outlets worldwide. The KP has worked for over a decade to fight this problem, but has not yet prevailed. Even today, it acknowledges that traders have been presented with fake documents purporting to be Kimberley Process certificates in the DRC, Angola, Malaysia, and Ghana.¹⁷

Putting the diamond supply chain on a single digital network

Everledger's core value proposition is putting the entire diamond supply chain onto the same digital network, creating a single version of the truth for all parties involved in the diamond trade. Using the Hyperledger-based IBM Blockchain on LinuxOne, Everledger's platform meets the diamond industry's requirements with a hybrid technical model that combines the high security of the public blockchain with permissioned controls in private blockchains.

The process of adding certified diamonds to the digital ledger starts at the diamond sorting offices in places like India, Israel, and Belgium where Everledger creates what Kemp called a forensic view of each individual diamond. Using machine vision, Everledger records 40 metadata points to create a unique thumbprint of each stone. The

Figure 2: Everledger's aspiration

Everledger aspires to become the digital vault for a wide range of high value items.

everledger

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Welcome to the digital vault of the future.

Everledger is a global startup that uses the best of emerging technology including blockchain, smart contracts and machine vision to assist in the reduction of risk and fraud for banks, insurers and open marketplaces.

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"With Everledger, we set out to strengthen the integrity of this [Kimberley] process by leveraging IBM Watson to incorporate artificial intelligence into the blockchain."

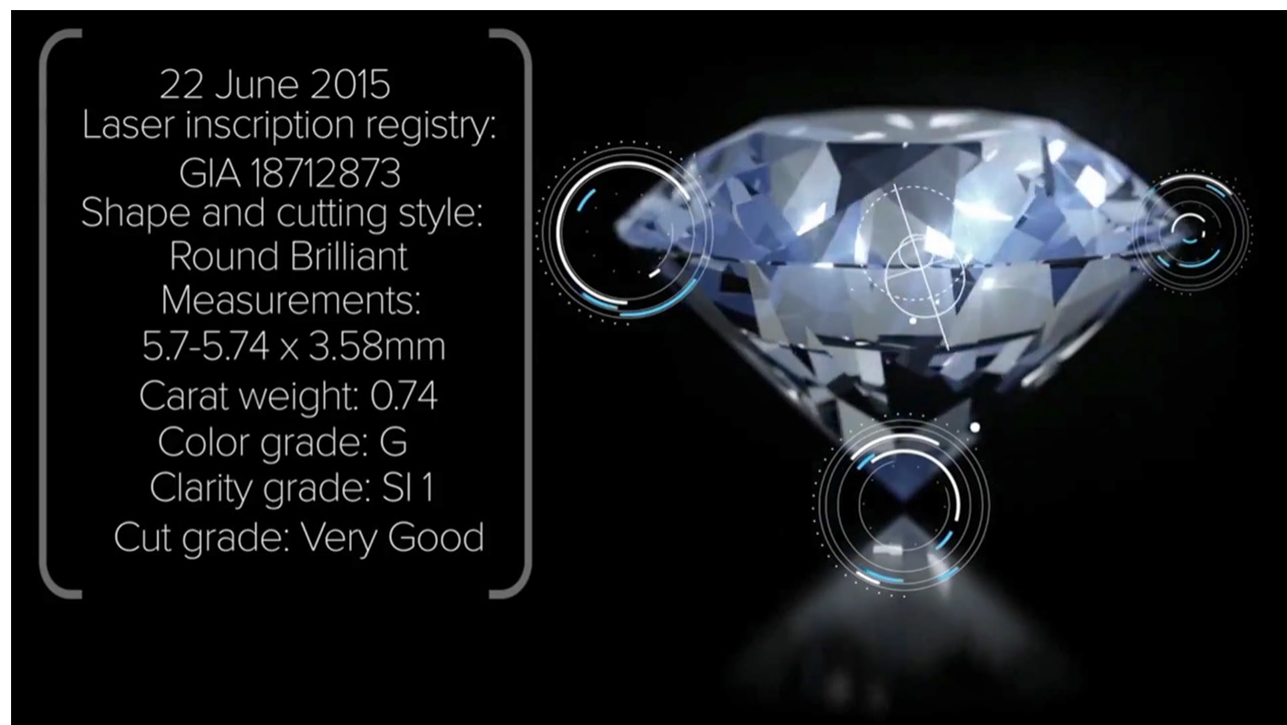
 ARVIND KRISHNA
Senior Vice President
IBM Research

diamond's unique physical properties, along with key details such as its place of origin and chain of custody, are then added to the blockchain, creating an audit trail to make each stone completely traceable.

If Everledger fulfills its ambition, every diamond that makes its way to legitimate international markets will have a secure digital record on the blockchain. To date, over 1.8 million diamonds have been encrypted onto Everledger's digital ledger. Master certificates of the Kimberley Process certified rough diamonds are also digitally stored on the blockchain.

Adding digital records and certificates to a digital ledger is just the first step. A partnership with IBM is extending the capabilities of Everledger's digital ledger even further by using cognitive analytics to automatically spot instances of non-compliance with the Kimberley Process and other international protocols. "With Everledger, we set out to strengthen the integrity of this process by leveraging IBM Watson to incorporate artificial intelligence (AI) into the blockchain," said Arvind Krishna, senior vice president at IBM Research.¹⁸ According to Krishna, IBM Research created a new AI-enabled approach to help ensure that all of diamonds linked in Everledger's digital ledger are authentic and compliant with thousands of regulations, including those imposed by the United Nations to prevent the sale of conflict diamonds.

Figure 3: Everledger makes a unique digital thumbprint for certified diamonds



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"No longer will humans have to spend countless hours checking reams of paper regulations and certificates to ensure a diamond's authenticity, compliance, and worth."

 ARVIND KRISHNA
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IBM Research

In what IBM claims is an industry first, cognitive analytics are performed directly within the blockchain where the data reside, eliminating the need for data to be extracted for analysis, which makes them susceptible to fraud.¹⁹ Krishna explained that Watson cross-references each diamond certificate on the blockchain with a myriad of regulations and records as well as supply chain and Internet of Things data, including time and date stamps and geospatial information. Going a step further, the system can then start to analyze the shared characteristics of noncompliant certificates such as their value, the signatures on their documents, and the countries in which they originated. "No longer will humans have to spend countless hours checking reams of paper regulations and certificates to ensure a diamond's authenticity, compliance, and worth," said Krishna.²⁰ The efficiencies gained from ensuring regulatory compliance using cognitive analytics extend well beyond diamonds to countless other domains of international trade.

A single digital ledger tackles fraud

While the issues concerning conflict diamonds, black markets and ethical trade capture the headlines, Everledger's bread and butter is tackling the problem of insurance fraud. The insurance sector considers fraudulent claims for lost or stolen jewelry a major problem resulting in billions in annual losses. Conventional industry wisdom has held that about 10 percent of the property/casualty insurance claims are fraudulent.²¹ Based on this estimate, property insurance fraud in the United States alone amounts to approximately \$33 billion in losses a year, with jewelry-related fraud constituting about \$2 billion of that total.²² A 2013 survey of 143 US insurers suggested the losses could be even higher, with 31 percent of insurers estimating that up to 20 percent of claims are the direct result of fraud.²³ Meanwhile, 57 percent of the insurers surveyed said they anticipate a rise in losses due to fraud on personal insurance lines.²⁴

"Using our platforms, insurers can trust that policyholders are not trying to insure a \$40,000 stone when in reality it is a fake diamond."

 LEANNE KEMP
Founder and CEO
Everledger

With respect to diamond jewelry fraud, there are many possible scenarios, such as using fake receipts or fake certification and appraisal records to make a false claim against jewelry that never existed, or staging a robbery when valuable jewelry is falsely alleged to have been stolen. Another type of fraud occurs where one stone is claimed across similar timelines with multiple insurers. Much of this fraud is possible only because of the value of jewelry relies on paper-based records that can be forged or tampered with.

Participants operating closer to the consumer end of the supply chain—including merchants, banks, insurers, and consumers themselves—are intrigued by blockchain because it provides a permanent, secure, and immutable ledger that records assets, participants, and transactions. This means an insurer, for example, can verify that an asset (a diamond in this case) is legitimate, and that makes Everledger's solution a compelling proposition. Kemp explained that at the same time that a policyholder insures the diamond, Everledger is providing verification that the diamond is real. "Using our platforms, insurers can trust that policyholders are not trying to insure a \$40,000 stone when in reality it is a fake diamond.



We can also verify that claims against the policy are legitimized and that diamond hasn't been used in previous multiple claims."²⁵

A digital vault for art, wine, automobiles, and other valuable items

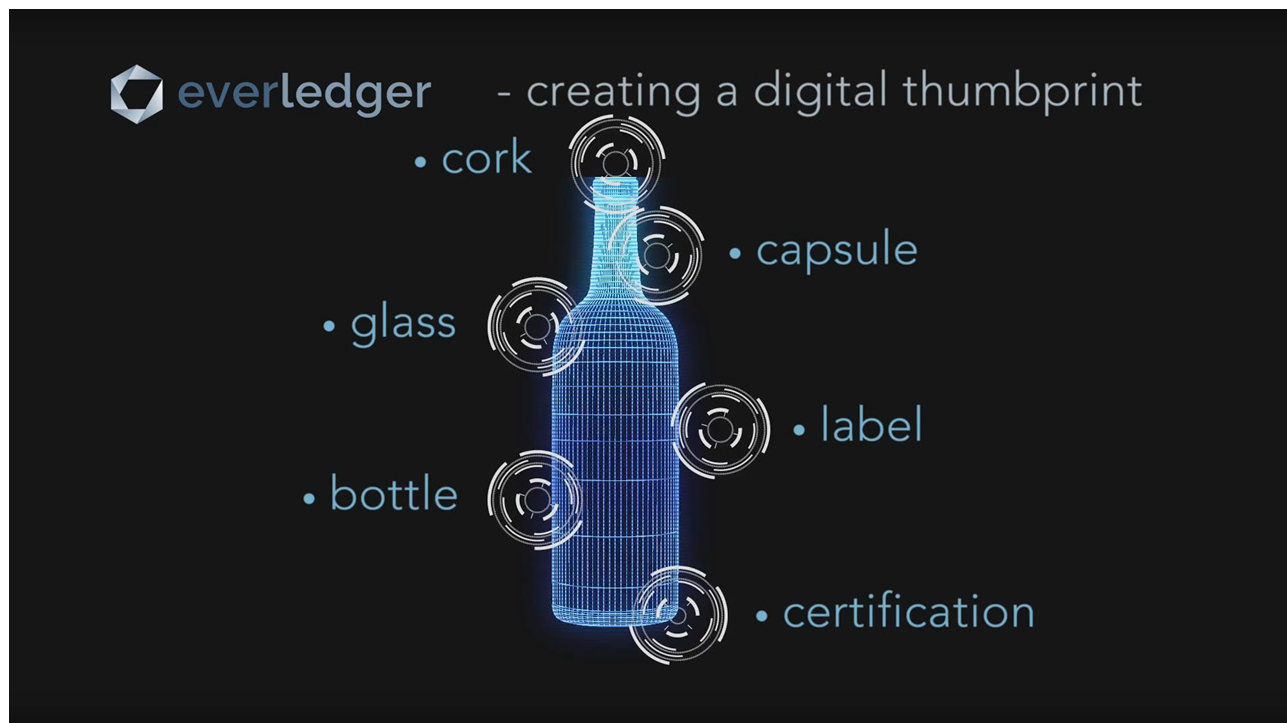
Everledger's ultimate ambition is to become the digital vault for a wide range of tradable commodities and high value assets.

Tackling conflict diamonds, as well as mitigating risk and fraud, provided proof that blockchain is integral to enabling supply chain transparency. Everledger's ultimate ambition, however, is to become the digital vault for a wide range of tradable commodities and high value assets. The company is gradually expanding its reach and has partnered with other organizations—Britannia Mining for commodities trading, Chai Consulting for wine, Vastari for art, and SAP Ariba to help track the identity and movement of a variety of other risky goods in their procurement platform across global supply chains.

The fine wine industry, for example, is another where problems with document tampering and fraudulent activity continue to affect the supply chain, with an estimated 20 percent of international sales involving counterfeit wines.²⁶ As with diamonds, the provenance and authenticity of fine wines are fundamental to establishing value.

The Chai Wine Vault, a joint venture of Everledger and fine wine expert Maureen Downey, addresses provenance by issuing a digital certification to bottles authenticated through Maureen Downey's

Figure 4: A digital thumbprint for fine wine



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Chai Method.²⁷ The certification captures 90-plus data points about the bottle, in addition to high-resolution photography and records of a bottle's ownership and storage, and creates a permanent, digital incarnation of the bottle that is written permanently into the blockchain.

This digital proof travels with the bottle as it moves between different supply chain participants, with ownership and storage records updated as the wine changes hands. Licensed retailers, warehouses, auction houses, and other sale platforms can ping the Chai Wine Vault to verify the bottle's identity at any point, thus preserving the bottle's value over its lifetime.²⁸

Like fine wine, fine art dealers, buyers, and exhibitors face similar concerns about the authenticity and provenance of precious works of art. In this case, Everledger's partner Vastari maintains a fine art and exhibition database and acts as a middleman between art museums that are looking for new pieces and private art collectors who want to increase the value of their art by getting it exhibited in public. Together, they are building a global digital ledger of fine art, in which data about the art are written into the public blockchain, as well as Everledger's own permissioned ledger.²⁹ The data consist of four key elements: the provenance, including its history of ownership; the exhibition history; the literary works in which the artwork has been referenced; and the physical characteristics of the work of art such as its size, appearance, and the medium.

Kemp explained that rights to modify or even read data on the permissioned blockchain state are restricted to trusted users. "One might imagine a consortium of 15 art institutions, each of which operates a node and of which 10 must sign every block in order for the block to be valid," said Kemp.³⁰

As for what's next, Kemp said there is a wide range of valuable assets for which an indelible digital incarnation could establish provenance, increase trust, and lower transactions costs in trading

"Our goal is to expand into more markets where provenance matters and continue our sustained efforts in enabling radical transparency along the supply chains."

 LEANNE KEMP
Founder and CEO
Everledger



Diamond 147597 by Lars Plöger (Aenigmatis-3D), 2016, used under CC0 1.0.

relationships. "Our goal is to expand into more markets where provenance matters and continue our sustained efforts in enabling radical transparency along the supply chains," said Kemp.³¹ The key is knowing when and where provenance and transparency matter. From there, Everledger can build a business model around each of the use cases and sector solutions it develops with industry partners. The company expects to generate revenue by selling the data it collects about valuable assets, charging for search and recovery of data, and potentially licensing its platform to third-party developers.

Key takeaways



It takes education and compelling solutions to unlock opportunities for blockchain-enabled innovation.

Traditional industries like diamond mining and manufacturing tend to associate blockchain with cryptocurrencies.

According to Kemp, a first step in fostering the adoption of new solutions is to ensure decision-makers appreciate the broader applications of blockchain. "When we started out with Everledger in 2015, awareness of blockchain was still growing and mostly in relevance to Bitcoin," said Kemp. "We had to educate traditional industries on what we were developing and work hard to understand the potential applications to the problems that needed solving in traditional industries."³² Knowledge networks that bring industry, solution providers, and researchers together could play a valuable role in raising awareness of the broader applications of blockchain.

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 LEANNE KEMP
Founder and CEO
Everledger



Blockchain's essential value proposition for global supply chains is the enablement of trust, transparency, and efficiencies.

Kemp explains that shifting the paper-based processes and documents into a digitized version on the blockchain creates better security and visibility for stakeholders and helps build trust along the supply chain.³³ Trust and transparency, in turn, help grease the wheel of global trade by mitigating risk and fraud in the markets, whether for diamonds, fine wine, precious works of art, or other valuable assets.



Blockchain and AI provide synergistic solutions for data intensive supply chains.

The marketplace for blockchain solutions is increasingly competitive, so winning companies can't stand still. Kemp said Everledger is continuously investing in R&D to extend the capability and effectiveness of its products and the technologies that underpin them, including artificial intelligence and cognitive analytics through partnerships with leading companies such as IBM. "Ultimately blockchain and AI can work together in synergy for data scalability and querying purposes," Kemp explained. "With any supply chain intensive business,



including the diamond industry, there are huge data sets being created. By modelling those datasets, we can channel the information to help customers understand exactly the information they need from the supply chain; what, why, where, when, and how, which is the provenance of the item."³⁴



Successful blockchain solutions need a business case that sells itself.

Traditional industries like diamond mining and distribution are not normally synonymous with risk-taking and innovation. Indeed, a general culture of conservatism when it comes to investments in technology puts a premium on the business case that solution providers such as Everledger can bring to decision-makers in these industries. In building a global digital ledger for valuable assets, Everledger's business model rests on providing a zero-sum game for the industries it serves. "The costs to our clients of our technology are more than offset with benefits and savings associated with the reduction of risk and fraud and reduction in friction across the supply chain," said Kemp.³⁵

"Find a way to cut through the hype and arrive at a solution that adds value to clients. This is a marathon, and finding the right people who have the same purpose, passion, and goal to join you is essential."



LEANNE KEMP
Founder and CEO
Everledger



Commercializing blockchain solutions is a marathon, not a sprint.

"There is a lot of pressure being a start-up, in particular focusing on blockchain," said Kemp. "We started with lofty ambitions: solving global problems like blood diamonds with a novel technology that most people thought is interchangeable with cryptocurrencies. It was never going to be easy." Kemp pointed out that, while awareness of blockchain has increased exponentially in the past couple of years, it is still considered a nascent technology for many industries. "One of the key challenges is to find a way to cut through the hype and arrive at a solution that adds value to clients. This is a marathon, and finding the right people who have the same purpose, passion, and goal to join you is essential."³⁶





About the Blockchain Research Institute

Co-founded in 2017 by Don and Alex Tapscott, the Blockchain Research Institute is a knowledge network organized to help realize the new promise of the digital economy. It builds on their yearlong investigation of distributed ledger technology, which culminated in the publication of their critically acclaimed book, *Blockchain Revolution* (Portfolio|Penguin).

Our syndicated research program, which is funded by major corporations and government agencies, aims to fill a large gap in the global understanding of blockchain technology and its strategic implications for business, government, and society.

Our global team of blockchain experts is dedicated to exploring, understanding, documenting, and informing leaders of the market opportunities and implementation challenges of this nascent technology.

Research areas include financial services, manufacturing, retail, energy and resources, technology, media, telecommunications, healthcare, and government as well as the management of organizations, the transformation of the corporation, and the regulation of innovation. We also explore blockchain's potential role in the Internet of Things, robotics and autonomous machines, artificial intelligence, and other emerging technologies.

Our findings are initially proprietary to our members and are ultimately released under a Creative Commons license to help achieve our mission. To find out more, please visit www.blockchainresearchinstitute.org.

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About the author

Anthony D. Williams is co-founder and president of the DEEP Centre and an internationally recognized authority on the digital revolution, innovation and creativity in business and society. He is co-author (with Don Tapscott) of the groundbreaking bestseller, *Wikinomics: How Mass Collaboration Changes Everything*, and its follow-up, *Macrowikinomics: New Solutions for a Connected Planet*.

Among other current appointments, Anthony is an expert advisor to the Markle Foundation's *Initiative for America's Economic Future*, a senior fellow with the Lisbon Council in Brussels and the Institute on Governance in Ottawa, and chief advisor to Brazil's Free Education Project, a national strategy to equip two million young Brazilians with the skills required for a 21st Century workforce.

Anthony was recently executive editor for the Global Solutions Network at the Martin Prosperity Institute, a committee member of the National Research Council's Committee on Science for the EPA's Future, a visiting fellow with the Munk School of Global Affairs at the University of Toronto and Program Chair for the 18th World Congress on Information Technology in Montreal. His work on technology and innovation has been featured in publications such as the *Huffington Post*, *Harvard Business Review*, and the *Globe and Mail*.

Notes

1. UN General Assembly, "General Assembly urges finalization of international certification scheme for rough diamonds," Plenary, 96th Meeting (AM), Press Release GA/10011, United Nations, 13 March 2002. www.un.org/press/en/2002/GA10011.doc.htm, accessed 14 Dec. 2017.
2. "The Game of Stones," Global Witness, n.d. www.globalwitness.org/en/campaigns/central-african-republic-car/game-of-stones, accessed 23 Nov. 2017.
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