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Leveraging Next-Gen Technology For Supply Chain Security

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LEVERAGING NEXT-GEN TECHNOLOGY FOR SUPPLY CHAIN SECURITY

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ABSTRACT

Global supply chain disruptions continue as part of both a national and global discussion. There is a need for a greater focus on supply chain security as part of this discussion as there is an increasing amount of counterfeit parts and goods within global supply chains. While counterfeit activity is an economic burden to companies and the global market, there are also legitimate concerns on consumer safety, consumer trust and company brand management.

The aim for this paper is to identify the concern and extent of the counterfeit problem and identify the use of next-gen technologies to provide brand protection and combat supply chain disruptions. With a focus on the pharmaceutical industry, the fastest growing segment of counterfeit goods, this paper highlights new brand protection technologies such as the use of QR codes and the 3D printing of custom goods. More importantly, the paper will underscore the need for increased and upgraded digital security measures through the use of both blockchain and Internet of Things (IoT) technology to enhance trust and security throughout the supply chain.

One of the authors is involved in the importation to the U.S. of olive oil from Italy and has adopted anti-counterfeit and brand protection measures to provide B2B and B2C supply chain transparency, traceability and protection. This is important, as by some estimates, as much as 80% of the supply chain of olive oil is fraudulent and counterfeit.

Keywords: Supply chain security, counterfeit goods, next-gen technologies, blockchain, Internet of Things, brand protection, digital security, olive oil fraud

INTRODUCTION

Global supply chain disruptions in such goods as semiconductor chips, wheat, baby formula and toilet paper continue as part of a global and national discussion. According to The Wall Street Journal, there were almost 2.2 million mentions of 'supply chain' on Twitter in just the fourth quarter of 2021 (O'Neal, 2022). This is approximately five times more than in any quarter in 2019. These disruptions have made supply chain a household name around the globe and there is a growing need for a focus on supply chain security as part of this discussion.

Discussion of security in the supply chain is needed as there is an increasing amount of trade in counterfeit goods estimated at more than 3.5% of the world GDP and more than $600 billion a year (Sularia, 2020, March 17; Schlesinger & Day, 2019, March 13). Companies are increasing their anti-counterfeiting budgets to avoid fraudulent parts and goods across their entire value chain, increasing their costs and hurting their bottom line. In addition, the increase in counterfeit goods affects the consumer trust in the product hurting the company reputation and brand. It is reported that almost a quarter of the $1.2 trillion global trade in luxury goods is in counterfeit and fake luxury merchandise (Fontana et al., 2019).

In addition to the loss of billions of dollars, there are increasing concerns over consumer safety and the danger from fraudulent and defective products such as counterfeit airbags, counterfeit lithium-ion batteries and counterfeit cosmetics (US Immigration and Customs Enforcement, n.d.). One of the fastest growing areas of counterfeit goods and concerns is in pharmaceuticals with an estimate of between $75 billion to $200 billion

in counterfeit drugs sold each year (Bhatia et al., 2019, May 17). The problem is that it is hard to distinguish between the real drug and counterfeit drugs including the packaging of the drugs. However, fake drugs can cause real damage and it is reported that counterfeit antimalarial drugs could be responsible for the deaths of up to 155,000 children annually (Merck KGaA, n.d.).

Solutions against counterfeiting are urgently needed to address the overall loss of global economic activity as well as to address the increasing concerns for consumer safety, consumer trust and company branding. There is an increasing focus on the use of next generation anti-counterfeiting technology as part of the solution to this global problem.

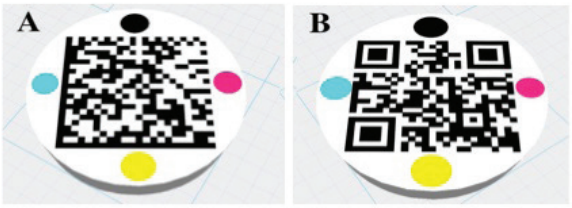
NEXT-GEN TECHNOLOGIES

Over the last decade, there was an increasing focus in the literature on the use of technology within the pharmaceutical industry to address consumer safety and the growing concerns of counterfeit drugs (Han et al., 2012; You et al., 2016). Some of this early technology focused on the use of tamper-resistant packaging and two-dimensional barcodes (Bansal et al., 2012). While useful overall, it did not have a strong enough impact on counterfeit drugs. The technology advanced to use of data matrices and QR codes on the surface or imbedded within small drug doses using inkjet printing (Chen et al., 2019; Edinger et al., 2018).

More recently, the printing of the data matrices and QR codes has advanced to 3D printing onto the surface of the drug tablets scannable by a smartphone and encoding tailored information on the drug product, patient and prescriber (Trenfield et al., 2019). Figure 1 highlights both the data matrix with anti-counterfeit printing (A) as well as the QR code with anti-counterfeit printing (B) on the drug tablet.

Figure 1

Computer aided designs of anti-counterfeit tablets



While the advances in these technologies on individual and personalized drug tablets is impressive, the literature has also called for more novel anti-counterfeit authentication methods applicable on a mass scale within the pharmaceutical industry (Nørfeldt et al., 2019). In particular and in response to a pilot project request by the FDA, more than two dozen pharmaceutical companies (including Pfizer and Eli Lilly) developed a global anti-counterfeit blockchain solution named MediLedger Network to track prescription drugs (Chavez-Dreyfuss, 2020, February 21).

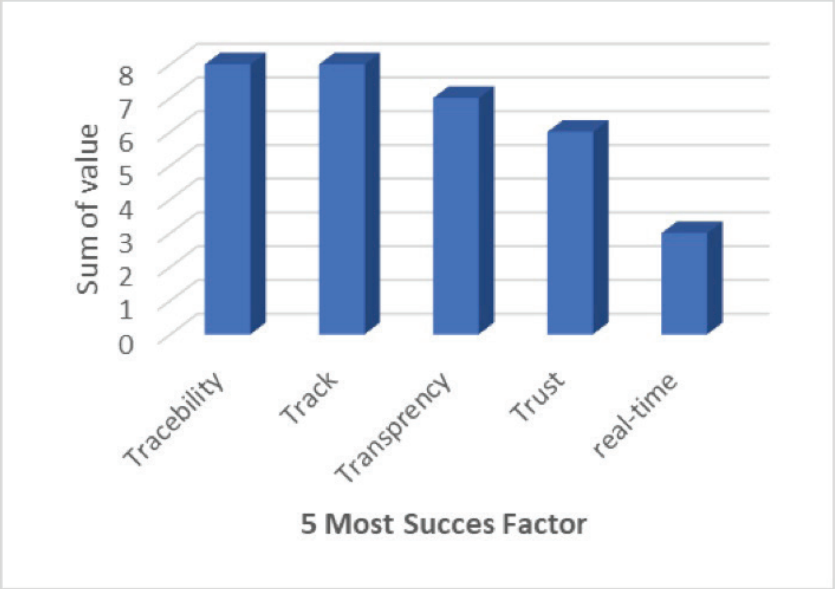
BLOCKCHAIN

The concept of blockchain developed with the origin of bitcoin and is described as a digital ledger providing the opportunity for a global record-keeping system. Chen et al. (2020) point out that it has the potential to address the counterfeit challenges described above by providing a "tamper-proof audit trail of supply chain events and data associated with a product lifecycle, false data generated by the supply chain entities becomes immutable once recorded on the blockchain" (p. 224533). In particular, the literature points to the potential for blockchain to overcome the threat of counterfeit drugs in the pharmaceutical supply chain from manufacturing to distribution (Haq & Muselemu, 2018; Sylim et al., 2018).

Fernando et al. (2019, September 26-27) aimed to find the specific success factors of blockchain technology in the pharmaceutical industry. As highlighted in Figure 2, the five most dominant factors in the application of blockchain technology are: Track, Trust, Traceability, Transparency, Real-Time.

Figure 2

Five most success factors in implementing blockchain technology in the pharmaceutical industry



Haq and Muselemu (2018) argue the traceability and track success factors within blockchain technology helps provide a complete source of information and can help to "overcome the threats of counterfeit drugs and distribution deviations that occur in the supply chain."

While we have focused on the use of blockchain as an anti-counterfeit technology in the pharmaceutical industry, the benefits and success factors of blockchain reach across all industries. For example, Honeywell is using blockchain in an effort to increase the security and authenticity within their critical aerospace parts market.

As a trailblazer in the global aerospace industry, Honeywell is now using a first-of-its-kind digitization process:

> Honeywell's new process involves laser-etching a data matrix on the identification plate for a part and then adding a high-security invisible ink on top of the plate. Honeywell's digital blockchain ledger records the digital authenticity record for the part, allowing Honeywell to secure, track, trace and authenticate any part submitted to Honeywell's blockchain process anywhere in the world. (Honeywell, 2019, December 16)

INTERNET OF THINGS (IOT)

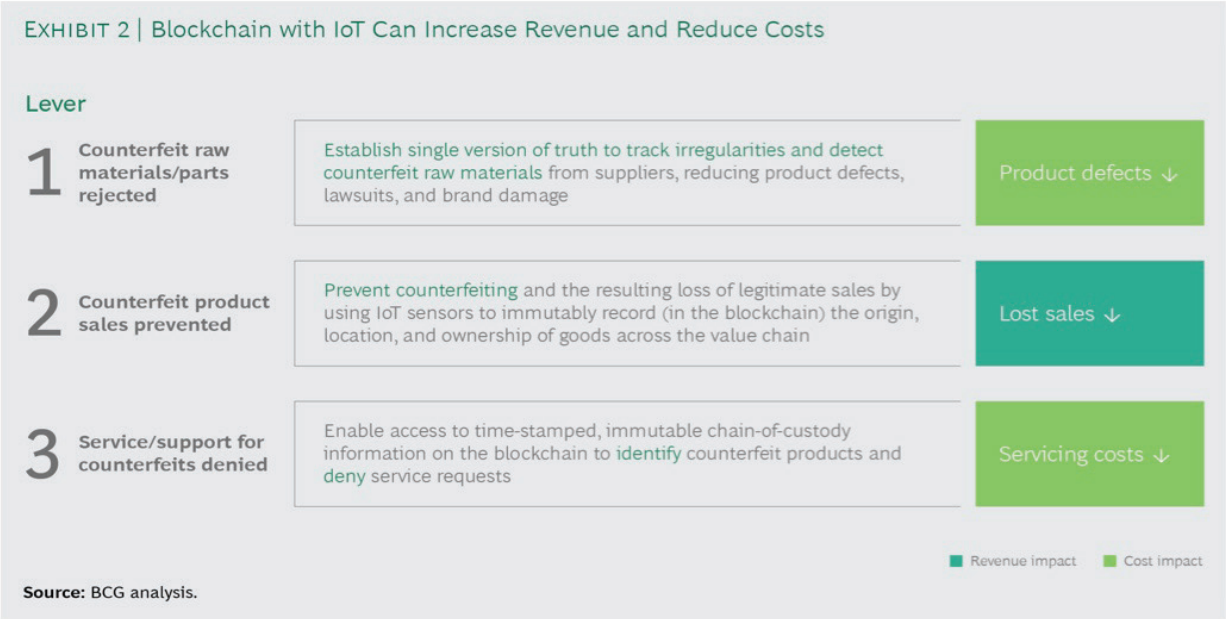
While Chen et al. (2020) argued above for the "tamper-proof audit trail of supply chain events" provided by blockchain technology, the authors also highlight that the "Internet of Things (IoT) technology is also involved to observe, track, and monitor products, activities" (p. 224533). IoT refers to the network of physical objects connected together to provide real-time communication and data throughout the supply chain and value chain network. IoT is closely related to block chain especially with the success factor of tracking products and activities.

BLOCKCHAIN WITH IOT

Rejeb et al. (2019) explores how companies can leverage the combination of both blockchain and IoT within their supply chain network and these technologies together will provide anti-counterfeit measures of security and traceability. The authors point to a study by BCG highlighting the productivity and efficiency gains through the combined use of both of these next-gen technologies:

Figure 3

Benefits of Blockchain with IoT technologies



As shown in Figure 3, the combination of blockchain and IoT have a positive effect on both revenues and costs. Costs are decreased with less product defects and less of a need for servicing of the fraudulent product. At the same time, the revenue increases due to the prevention of the sale of counterfeit goods.

In particular with the pharmaceutical industry, Chen et al. (2020) argue in favor of "an IoT-Based Traceable Drug Anti-Counterfeiting Management System." The problem with the current traceability system is it is built in a centralized structure with a centralized agency. This still raises credibility doubts of the centralized agency. Instead, the combination of blockchain with the IoT drug management system resolves this issue and the two technologies work hand in hand.

OLIVE OIL INDUSTRY

Arguably, the market with the greatest amount of counterfeit goods is the olive oil industry. According to Forbes (Rodriguez, 2016, February 10), it is reported that 70%-80% of the Italian olive oil on the market is fraudulent including many of the well-known and quality brand names. While the United States remains the center of the majority of fraudulent olive oil with more than 350,000 tons of olive oil entering the country per year, even the amount of fake olive oil in the Italian supermarkets is estimated at 50%.

And similar to the pharmaceutical industry, the fraudulent olive oil activity has some life-threatening implications. According to Sommers (2021, March 9), "olive oil doctored with jet engine oil in the early 1960's left 10,000 people in Morocco seriously ill. In 1981, over 20,000 people in Spain were poisoned from toxic rapeseed oil labelled as olive oil. Although today's frauds don't always have such dire consequences, they wreak havoc on economies, livelihoods, and the future of those who produce authentic EVOO [Extra Virgin Olive Oil] — while competing against cheap fakes stealing their "extra virgin" legitimacy."

Profit margins for counterfeit olive oil has soared as high as 700% giving a greater understanding of why organized crime, sometimes known as Agromafia, has switched from drugs to olive oil.

Olive oil is considered the "yellow gold" with profits comparable to cocaine trafficking. And as counterfeit methods become more sophisticated, it gets harder and harder for olive oil and law enforcement specialists to detect fakes (Sommers, 2021, March 9).

One of the authors for this paper is involved in the importation to the U.S. of an olive oil from Italy and is working with anti-counterfeit and brand protection measures including blockchain technology to provide B2B and B2C supply chain traceability, tracking and brand protection. Another market with similarities to the olive oil industry is the wine market where blockchain technology is in use with other counterfeit measures including tamper-proof RFID-tags.

Biswas et al. (2017, November 29-30) explain how blockchain and the RFID-tags assist in the verification of the origin and authenticity of fine wine eliminating attempts to refill wine bottles with a cheaper product. Through the use of blockchain, consumers can trace and track the authenticity of the wine bottles by entering the product ID into a global record-keeping system.

CONCLUSION

As supply chain disruptions continue to impact around the world, the aim for this paper was to identify the supply chain security problem of counterfeit goods. In particular, the paper focused on the pharmaceutical industry where counterfeit goods is a growing and deadly problem. The paper highlighted new technologies in the fight against counterfeit drugs including anti-tampering, bar codes, drug tablet printing and individualized data matrixes and QR codes. Most importantly on a global level across all industries and supply chains, the paper highlights the promise of blockchain technologies combined with Internet of Things to provide a one-two punch against counterfeit activity. The paper finishes by touching on the olive oil and wine industries, arguably the industries with the highest level of fraudulent activity in the global market.

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