Blockchain-based smart contract technology application in the insurance industry: The case of "Fizzy"

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Abstract

The paper sets out to present a general overview and specific use-case of blockchain-based smart contract technologies in the context of insurance. It offers clear content on the benefits of this technology, how it transforms the insurance industry, and concrete cases of blockchain application with Axa's fizzy platform. Therefore, the paper presents the case of Fizzy, a new generation travel insurance product that relies on a smart contract-based solution for parametric insurance of flight delays. This parametric insurance lends itself well to blockchain-based smart contracts and opens possibilities for the Etherisc platform. This study aims to understand why the insurance industry must adapt to the changes that blockchain technology might bring and why it is so important. It intends to expose the fizzy process, as well as discussing its potential and analyzing its advantages and disadvantages. The findings of this paper indicate that blockchain-based smart contracts are important and can improve the insurance context too. In particular, the automated settlement of insurance contracts, as in a fizzy platform, for example. This solution can improve the insurance companies' process; for this, its implementation must be correctly aligned with their strategies and insurance needs. Regarding the case of a fizzy solution, essential technical details such as the general design of the smart contract implementations that are employed are not included.

Keywords: *Blockchain, smart contracts, fizzy, parametric insurance, flight delays, Axa, Ethe*

INTRODUCTION

Blockchain technology has emerged as a key topic of the "tech" scene. This technology is compared to inventions such as the steam or combustion engine since it might bring benefits to a variety of everyday activities and business (Gatteschi et al., 2018). Born with the Bitcoin digital currency in 2008, blockchain makes it possible to store data and carry out transactions in a decentralized and secure manner (Zahadat and Partridge, 2018. Considered by many to be a revolution at the height of the Internet, blockchain technology has the potential to impact all business sectors (Iansiti and Lakhani, 2017). From the bank, and the way we exchange money, to social networks and more.

Although the banking sector was the first to deploy the blockchain solution, insurance seems also better positioned to take advantage of this innovation. If the major insurance companies are looking at blockchain technology today, it is because this technology allows emancipating claim phases (Morabito, 2017), and to build new insurance systems via the internet without an intermediary. While peer-to-peer insurance models have already emerged, with "Friendsurance" or "inspeer.me", for example, blockchain is giving it new impetus thanks to automated insurance systems based on "Smart Contracts".

The smart contract refers to the most interesting applications of blockchain technology for the insurance industry (PwC, 2017; Deloitte, 2016; McKinsey & Company, 2017).. It is adapted to ensure the execution of the terms of a contract through the use of cryptographic code. Thanks to smart contracts, blockchain should find other uses in the insurance value chain (Lorenz et al., 2016). Able to manage complex rules between large numbers of insureds, it should help develop peer-to-peer insurance. Parametric insurance (the insurance-linked to an index, such as rainfall, temperature, or humidity) could be facilitated and thus be an alternative to conventional agricultural insurance systems.

Smart contracts perfectly apply to parametric insurance. They automatically trigger the compensation process. For example, for agriculture, a smart contract is connected to meteorological databases. It verifies if all the conditions for bringing the guarantee into play are met, and then compensates the insured without the intervention of an expert or declaration of loss. The same principle applies to flight delay insurance.

To better meet the opportunities and satisfy the needs of new customers, the French insurance company Axa strongly believes in combining the power of advanced data analysis tools and methods with innovative insurance models and blockchain technology. Axa put this conviction into practice with a real product that combines data, the parametric approach, and blockchain technology. This product is called: "Fizzy". This company is then the first insurer to

create this kind of insurance product, which refers to an "Ethereum-based smart contract" that triggers an automatic refund once the delay has been detected.

This paper offers clear content on the benefits of blockchain technology, how it transforms the insurance industry and how this technology can improve insurance models. It examines the power of a blockchain-based smart contract by analyzing a concrete application case created by Axa (fizzy). The focus of this paper is to only explore the case of Axa's insurance product, dedicated to the flight delay, by examining how it works and highlighting its potential and challenges that need to be addressed.

The rest of the paper is structured as follows. Section 1 provides the background of blockchain technology by presenting its disruptive power and its various opportunities in the insurance industry and discussing its challenges. Section 2 examines several platforms and the potential applications of smart contracts as one of the most promising uses of blockchain technology. The process and the potential of Axa's insurance solution (fizzy) are examined in more in section 3. Section 5 mentions and evaluates the usefulness of this insurance solution, its importance, and its limitations. Finally, the conclusion and future work are drawn.

I. Background: Blockchain and insurance industry

To understand the importance and the potential of blockchain technology for the insurance industry, it is necessary to understand its context and applications. This section is dedicated to recognizing the potential of this technology and the opportunities and challenges made through its uses in the insurance business domain.

1.1. Blockchain technology

Blockchain technology was born following the economic crisis of 2008 and the questioning of the financial system. Based on research on cryptocurrencies, i.e. encrypted currencies and operated by digital technologies, blockchain carries new promises of innovation and disruption of dominant economic models. It is considered a revolutionary technology that allows the development and implementation of an "Internet of transactions".

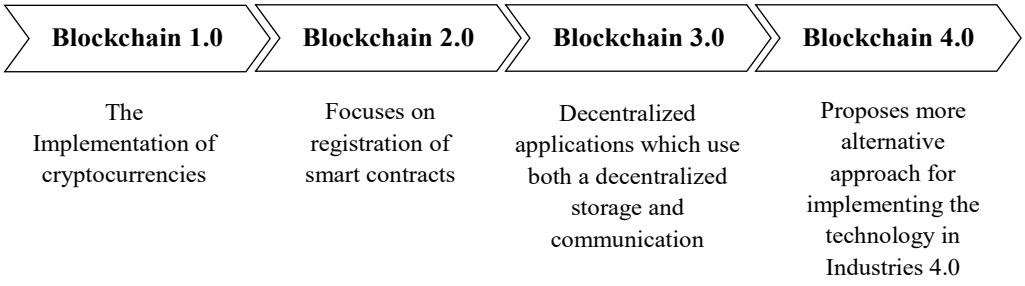
Blockchain is a technology that has been put in place to secure digital currencies, such as "Bitcoin" (Cascarilla, 2015). Before the emergence of bitcoin and its equivalents, the problem was to limit the double-spend problem (Nakamoto, 2018; Garay et al., 2015). To compensate for this problem, a register has been set up to integrate all the transactions that have been made in this currency. Therefore, blockchain technology appeared with bitcoin, the first cryptocurrency.

In theory, blockchain is duplicated and shared among all nodes of a network register; each node can be a user or even a computer. To further simplify our purpose, this famous register

notifies and timestamps each exchange between each node in a "block" (Swan, 2015). As soon as this block is filled, it is "chained" after the previous blocks, so that everything is inscribed and can be visible to all. It is therefore both a time-stamped, secure server and a secure peer-to-peer database that operates without a central control body. We find ourselves in a system of trust ... but without a trusted third party, what a paradox! And what a revolution!

The functionality of blockchain technology has evolved (Swan, 2015). We can now distinguish four stages: from version 1.0 to version 4.0, as depicted in Figure 1. The deployment of cryptography and distributed architectures in liquidity-related applications, such as currency transfer and digital payment systems (Swan, 2015), has formed the technology layer supporting the creation of blockchain 1.0. The first transaction was bitcoin, which uses virtual cryptocurrency. This application has enjoyed a high profile in the public sphere without competing with international currency markets. This evolution represents an alternative to the traditional business model of trusted third parties.

Figure 1: Blockchain technology generations



All economic, commercial, and financial applications require broader functionalities than mere monetary transactions. Blockchain 2.0 was born and allowed the use of smart contract models. Blockchain 3.0 is an application concept beyond cryptocurrency. It relies on smart contracts to develop autonomous decentralized organizations that have their own legal procedures defined upstream by network members. The most application of blockchain technology is smart cities (Pazaitis et al., 2017) that use the internet of things (IoT) and peer-to-peer trade based on blockchain and smart contracts (Efanov and Roschin, 2018). Blockchain 4.0 makes the technology usable in a real-life business context (industry 4.0).

Traceability, transparency, security… the advantages of blockchain technology are many. Some researchers compared this mutation to that which resulted from the Internet in the 90s because of the same potential for innovation.

1.2. Blockchain for the Insurance industry: Opportunities and challenges

Besides allowing the incredible rise of bitcoin and a multitude of cryptocurrencies, blockchain might upset the economy as we know it today. Many companies are surfing this new wave of technology by multiplying the announcements of blockchain creations. This is the case of Kodak, whose stock price jumped over 116% following the announcement of the creation of a blockchain to manage the rights to the image and photographers.

This technology also interests the insurance industry. According to McKinsey & Company (2017),, over 200 solutions based on blockchain technology have been developed around the world, 10% of which apply to the insurance industry. A study conducted by PwC (2017) in a report titled "Blockchain: a catalyst for new approaches in insurance" illustrates that blockchain technology can upend the insurance value chain (Lorenz et al., 2016) by helping to cut acquisition, management, documentation, and compliance costs.

This technology can drive the insurer from the agency-based distribution model to a usage-based business model. It should also facilitate new players and the emergence of new markets. Its decentralized structure, combined with its transparency and security, allows insurers to meet several opportunities, namely:

- ***The creation of more innovative products:*** This new technology expands the field of insurance innovation (Cascarilla, 2015; Institute of International Finance, 2018; Capgemini, 2016; The World Insurance Report, 2017). It facilitates the design and implementation of smart contracts. This system can automatically apply the terms and conditions of a contract without human intervention. It helps to analyze data, using advanced machine learning techniques such as deep learning in analyzing data stored on the blockchain (Vo et al., 2017), and to meet the conditions of payment. It automates everything: the claim, the verification of the files, the calculation of the indemnifications, and the compensation. This solution has existed for several years. It begins, however, to be fully exploited with blockchain technology. The real contribution of this innovation is to bring more trust and security (Gatteschi et al., 2018). These two criteria are essential to automate the process, without resorting to a third party.
- ***Involving the insured in the insurance process:*** Advanced technologies allow insureds to control their personal data and be more involved in the insurance process (Capgemini, 2016; Catlin and Lorenz, 2017). This is the case with peer-to-peer insurance. Blockchain technology can, in this case, thanks to its transparency and security, represent an opportunity for the development of this activity.
- ***Better understand the insured:*** Customer knowledge is no longer the preserve of insurers alone. Several startups, such as "Tradle", are now working on "know-your-customer"

(KYC) blockchain solutions. These initiatives make it possible to collect and analyze the quantity of data freely provided by the insured. The data collected allows for a better understanding of client behaviors (Vo et al., 2017), habits, and needs. Insurers can design more suitable products, offer risk-adjusted premiums and calculate compensation, all in absolute transparency.

- ***Integrating new customers:*** Blockchain technology also speeds up and simplifies the integration of new customers (Gatteschi et al., 2018; KYC Legal, 2017). It makes it possible to create a common repository bringing together the identity of the customers and the history of their transactions. They can easily switch insurers or sign new contracts without having to repeat the same administrative procedures.
- ***Fraud detection:*** Blockchain seems to solve fight this risk (Gatteschi et al., 2018; Sharples and Domingue, 2016). This technology facilitates the cross-sectoral exchange of data. This makes it possible to freely consult all the required information with health establishments, security services, shopping centers, etc. Verification of the authenticity of the claims (Catlin and Lorenz, 2017; EY, 2016 will be simpler and more effective.
- ***Reducing costs:*** Blockchain the process allows insurers not only to reduce their administrative costs but also to provide more speed and precision in performing certain tasks, such as contract management and claims settlement (Gatteschi et al., 2018; Cascarilla, 2015; Catlin and Lorenz, 2017; Davidson et al., 2016; Engelhardt, 2017). The generalization of smart contracts should significantly reduce the number of employees (Prabhakar, 2017) in the insurance sector.
- ***The accessibility to insurance services:*** The decentralized and open nature of blockchain allows communities underserved by traditional distribution networks to take out an insurance policy anywhere in the world, without cross-border constraints or currency issues.

While blockchain offers many promises for traditional insurance providers, several challenges remain and deserve to be raised. First, new players enter the market and compete with established players. According to the PwC report (2016), 90% of insurers fear competition from InsurTechs.

The adoption of blockchain technology also raises issues of governance and regulation. The establishment of a certain form of “decentralization” (Atzori, 2015) requires defining, implementing, and maintaining, over time, a specific system of governance and management (Swan, 2015; Porru et al., 2017). Therefore, a new decision-making model, a new way of thinking about the strategy or set goals must be defined.

The adoption of blockchain technology calls for a change in the applicable legal

framework (Lorenz et al., 2016). Consensus protocols, which specify the rules governing the proper use and management of blockchain, are already in themselves an agreement between the parties. But they remain concentrated in the hands of the coders, and left to the adherence of the participants, without supervision by a legal regime appropriate and adapted to the international context.

Also, blockchain technology still has to overcome several technical limits before being able to be transposed on a large scale. The first is its executive power while blockchain Bitcoin (the most secure public blockchain) allows, in 2017, for only 7 transactions per second at most, far from the thousands of the Visa payment network. The technology comes with barriers to large-scale implementation, such as platform development, scalability … (Beck et al., 2016; World Economic Forum, 2016). The complexity, uncertainty, transforming potential, and barriers to adoption associated with blockchain technology make it hard to assess its impact on insurers.

II. How blockchain-based smart contracts metamorphose the Insurance industry?

To be more operational as a part of a relationship between insurer and insured, the blockchain process must be based on an external agreement: Smart contracts. This section discusses the importance of the smart contract for the insurance industry and the role of the Ethereum platform in its development by providing some potential examples.

2.1.Smart contracts

Smart contracts associated with the IoT; appear as the application of the most promising blockchain (Pazaitis et al., 2017; Reyna et al, 2018) in the insurance industry. Smart contracts are autonomous programs that automatically execute the terms and conditions of a contract without requiring human intervention. If this concept appeared in 1994, it began to be fully exploited with the emergence of blockchain technology that provides security and replaces the trusted third party previously required.

The smart contract is a blockchain-based computer program that ensures that the terms of a contract are enforced (Swan, 2015). The smart contract is a fully automated process comprising pre-programmed instructions that can complement or replace traditional contracts, as illustrated in Table 1.

Smart contracts go beyond the insurance industry. Any agreement between the two parties has the potential to be digitized and automated. These self-executing contracts assure both parties that once the conditions are met, the contract will be honored with no possibility of fraud,

bad faith, or interference with a third party. This is also the bet of the Ethereum platform (Buterin, 2013; Wood, 2014).

Table 1: Smart contract vs traditional contract

	Smart contract	**Traditional contract**
Relationship terms	Enforce a relationship with a cryptography code	Outlines the terms of the relationship, in most cases enforceable by law
Time	Real-time	Days
Presence	Virtual	Physical
Remittance	Automatic	Manual
Signature	Digital	Manual

New specialized entities operating with blockchain, "oracles" (Gatteschi et al., 2018; Hans et al., 2017), are used to manage smart contracts data and to determine, for example, whether conditions are met to trigger payment. These mechanisms promise major changes for current insurance systems. By automating the execution of contracts, they allow insureds and insurers to emancipate declarative phases: forms, claims, verification, triggering compensation ... Blockchain technology acts as an automated trusted third party opens the way to a reduction in structural costs while making the decision-making processes more reliable and faster. Ultimately, this would generate above all a greater satisfaction of the insured through the establishment of new services more intuitive and faster.

Table 2: Smart Contract applications in the insurance industry

Applications	**Effect**	**Literature**
Claims management	The smart contract will allow complete automation of the complaints' payment procedure and thus a shortening of the payment periods for the insured. Instead of reaching several weeks to several months to be compensated, customers will be reimbursed almost instantly.	Gatteschi et al., 2018; Morabito, 2017; Lorenz et al., 2016 ; Catlin and Lorenz, 2017 ; Davidson et al., 2016 ; Engelhardt, 2017 ; Mainelli and Von Gunten, 2014 ; Tapscott and Tapscott, 2016
Parametric insurance	Using the smart contract is relevant in the case of so-called "parametric" risks in which the measurement of a specific and tangible event can automatically generate compensation to the insured. This is the case for meteorological risks for example: in these cases, the payment is activated by foreseeable natural disasters (wind speed, the location of a hurricane, and magnitude of an earthquake ...).	Carter, 2018; Cohn et al., 2017
Connected objects	The deployment of connected objects in our daily life (cars, homes…) is at the origin of the development of new insurance products based on the smart contract. The placement of sensors at homes makes it possible to measure the losses (pipeline breaks, power failure, or device failure) and send this information to the smart contract, which triggers an automatic compensation.	Gatteschi et al., 2018; Pazaitis et al., 2017; Catlin and Lorenz, 2017 ; Reyna et al., 2018; Christidis and Devetsikiotis, 2016

A smart contract is a contract between two or more parties, electronically programmable

and whose execution is done automatically depending on the occurrence of particular events provided for in the contract. The data needed to execute a contract is reassessed in real-time by a new trusted third party, the oracle (Reyna et al., 2018), which uses a series of sensors (connected objects) (Pazaitis et al., 2017) to trace the events. In the case of cancellation insurance for a train trip, for example, the oracle reports the arrival time of the train in real-time to compare it with the expected arrival time initially (in the contract).

Many applications are possible (see Table 2), such as the travel insurance program built by "Hackathon Blockchain" of "Fintech Week" in London on the Ethereum platform (Nicoletti, 2017). Noticing that 60% of the passengers insured against the delay of their flight never claimed compensation, they created a system of automated insurance based on the blockchain, via the service "Oraclize" (Gatteschi et al., 2018). With this service, passengers are automatically compensated when their flight is late, without having to fill out any form, and therefore the company needs not to process the requests.

There are many other smart contract applications, such as supply chain, e-voting, digital right management, motor insurance, distributed file storage, etc. The true contribution of blockchain technology here is to generate the confidence and security needed to automate the declarative phases with no third party. If in the past insurers have not implemented this product, blockchain now provides a solution that could allow new players to enter this market.

2.2. Smart contracts platforms

In the insurance industry, everything is about personal information and external data. Each insurance contract is unique. No insured has the same profile and history as another. In the same vein, the statistics used by insurers, those that allow them to establish the number of premiums, are constantly changing. These elements, managed almost manually, would benefit from being stored, analyzed, and managed by an algorithm that would allow insurers to have a product adapted to their client's situation and their risk levels, in a quasi-personalized way.

However, in this context, blockchain technology alone is not enough. In 2014, "Vitalik Buterin" launched Ethereum, a blockchain that works through the creation of smart contracts (Buterin, 2013; Maull et al., 2017). It allows contracts to occur when the previously defined conditions are satisfied. The idea with Ethereum is to set up a "Decentralized Autonomous Organization" (DAO). The language used is an integrated Turing programming language (Reyna et al., 2018), enabling the creation of smart contracts and decentralized applications with its own rules for ownership, transaction formats, and transition functions.

Thanks to Ethereum and its Solidity programming language, it is possible to realize much more complex smart contracts allowing the transfer of assets representing something other than

value. Ethereum is a decentralized exchange protocol that not only produces a cryptocurrency but also allows users to create smart contracts (Maull et al., 2017). But, while the platform leaves many freedoms to the actors in terms of application development, security and robustness issues still arise regarding the protocol, the platforms, the contract code, etc. The most popular public platforms that support high-level programming languages to develop smart contracts are summarized in Table 3.

Table 3: Public smart contracts platforms

Platform	Characteristics
Bitcoin	Use to process cryptocurrency Transactions
NXT	Includes built-in smart contracts as templates
Ethereum	Support advanced and customized smart contracts with the help of the Turing-complete programming language

Beyond the empowerment of the smart contracts described above, there is also peer-to-peer insurance. The peer-to-peer defines a computer network model that is peer-to-peer between computers that distribute and receive data. In this network, comparable to the client-server network, each client becomes itself a server. Peer-to-peer allows multiple computers to communicate with each other over a network.

Platforms offer user-to-user insurance without intermediaries (PwC, 2017), such as “Heyguevara” (UK), “Inspeer.me” (France), “Friendsurance” (Germany) (Nicoletti, 2017), etc. Pairing blockchain technology with this peer-to-peer insurance model paves the way for quasi-autonomous and self-regulated insurance systems (Gatteschi et al., 2018), where insurance policies and claims of insureds would be automatically managed (Lorenz et al., 2016; Digital systems & technology, 2017).

Blockchain and smart contracts allow the establishment of DAO, which refers to autonomous entities in the blockchain, without formal legal status. Their operating rules are written in computer code. With insurance, these DAOs can be used to create groupings of insureds, in the peer-to-peer format, without a central control organization, each group being governed by the insureds themselves. In this system, the premiums paid by each insured form a capital used to pay the compensation.

One of the great advantages of this insurance is the reduction of structural costs, which allows redistributing automatically to the insureds at the end of the year the capital which has not been used to compensate them: “the gains of the contract”. This collaborative model also shifts the decision-making power of the third-party insurer to insureds. Startups have already been created to offer this kind of service.

This is, for example, the case of “Dynamis” (Davis, 2017), which offers complementary

unemployment insurance based on smart contracts via the Ethereum blockchain. "Dynamis", puts an end to the usual tripartite relationship between payers, insureds, and insurers (Gatteschi et al., 2018; MetroGnomo, 2016). It allows everyone to take part both in the pool of insured and investment gains.

Another example, concerning parametric insurance, "Rainvow" for its part allows indemnifying the insured automatically when a certain event occurs through the smart contracts. Thus, thanks to the Internet of Things (IoT), and to the programming of events, it is possible to register automatic insurance contracts. A striking example is the insurance potential for agricultural production against bad weather. Thanks to sensors, rain, or temperature, for example, the payment of the service to the insured producer can be triggered automatically (Reyna et al., 2018).

Also, the German startup "Etherisc" has designed a flight delay coverage insurance based on the smart contract. This product allows users to be automatically refunded in case of flight cancellation. The data is collected via "Flightstats.com" and is directly communicated to insurers.

Axa has developed a product on the same model, called "Fizzy" (detailed in the next section). It is also a product based on blockchain technology (Axa, 2018). It directly connects the smart contract to air traffic databases. As soon as a delay of over 2 hours is recorded, the refund is automatically activated, with no client's claim.

III. When blockchain and parametric insurance meet: The case of Fizzy

While the previous sections have summarized the potential applications of blockchain technology and smart contract in the insurance industry, this section presents an example case of an Ethereum-based platform that shows the importance of blockchain technology and the smart contract. It maps out the mechanism of this solution, known as fizzy; to emphasize the potential of blockchain technology in the insurance improvement business model.

3.1. Fizzy: A new generation of travel insurance

The example often cited to illustrate insurance models based on smart contracts is that of so-called parametric insurance (Cohn et al., 2017), insurance-linked to an index (Carter, 2018) such as the weather (temperature, level of rain) or delays data (Gatteschi et al., 2018). The smart contract concluded between the farmer and the insurer can, for example, stipulate that the payment is made after 30 days without precipitation. The contract is powered by reliable external data, such as rainfall data from the Meteorological Service, which allows oracles to automatically trigger payment after 30 days of drought, without the intervention of an expert or need for

reporting or claim of the insured.

Parametric insurance is insurance that makes a specific payment whenever a certain condition, often called a triggering event, is met (Carter, 2018; Inmediate, 2018). Axa, the French insurance company, has considered the parametric approach and algorithms (Axa, 2018) as an opportunity, to determine whether a customer (traveler) has had a problem or not, and therefore if he should be indemnified. The insurer has quickly designed a product using both the parametric approach and blockchain, which could reach customers.

In September 2017, Axa has developed an insurance product from "InsurTech" that truly meets the needs of new customers, called fizzy. The goal was to provide travelers with an automated flight delay product that relies on third-party flight delay data and immediately proceeds with landing compensation. No more long questionnaires, claims and waiting for payment. This product is linked to an Ethereum-based platform (Axa, 2018) that analyzes data sources to find information on delayed flights. If these flights correspond to an existing insurance policy, it automatically triggers a payment.

Fizzy is filling a gap and resolving recurring issues related to flight delays, including the much exclusion typically found in traditional insurance contracts. Besides the strictly parametric aspect of its product, Axa seeks to strengthen the trust of its customers by deporting algorithmic processing on the Ethereum blockchain. The underlying message is that once subscribed, the insurance becomes somehow autonomous, without the intervention of the company.

With a flight delay, the traveler does not have to prove it or provide any proof as fizzy is in charge of continuously checking flights and detecting delays thanks to the data collected. The allowance is then proactively pushed into the customer's bank account. Here, Axa is no longer the decision-maker because it is a blockchain technology that decides automatically and indemnifies or not the traveler regarding the data relating to the flights' delays. Blockchain-based smart contract acts here as an independent and automated third party. Axa, therefore, delegates the indemnification decision to an independent network, reinforcing the client's confidence. In this context, we can notice that:

- Using this blockchain-based smart contract removes any document to be completed and there is no more proof of the damage to provide, fizzy has the information and the proof of this information.
- Compensation is triggered, regardless of the cause of the delay. There is no longer any exclusion. Using blockchain makes it possible to introduce a third party who decides on the compensation. This improves consumer confidence in insurers.

It should be noticed that fizzy is independent of that provided by the European Union

(European regulation EC 261-2004) in case of delay greater than 3 hours. Sometimes, travelers can combine these two options. However, it is a revolutionary product not only regarding the technology used but also regarding its vision and market approach.

3.2. How it works?

Axa has understood that blockchain is a new technology that will reinvent the insurance product by focusing it more on the customer. In this context, Axa has developed specific insurance for flight delays with no exclusion. Whatever the cause of the delay: the technical problem, strike, bad weather…, the traveler is covered. The characteristic of this insurance product is that it subscribes to each trip, produced for use and not annual.

The insurance company has developed parametric insurance which offers a guarantee against the delays of aerial flight, subscribed in a few gestures, and whose assumption of responsibility of the compensations is entirely automatic. Axa started by launching fizzy, a product dedicated to the flight delay, to better understand, in a very concrete way, blockchain technology, its advantages, and challenges. Axa works with "LaBChain", a blockchain consortium that comprises two parts (Axa, 2018):

- A "think tank": This allows the insurance company to deepen its knowledge about blockchain and collaborates with banks, other insurers, and startups working on blockchain technology.
- A "do tank": That develops and designs proof-of-concept (PoC) and uses cases of blockchain for insurance.

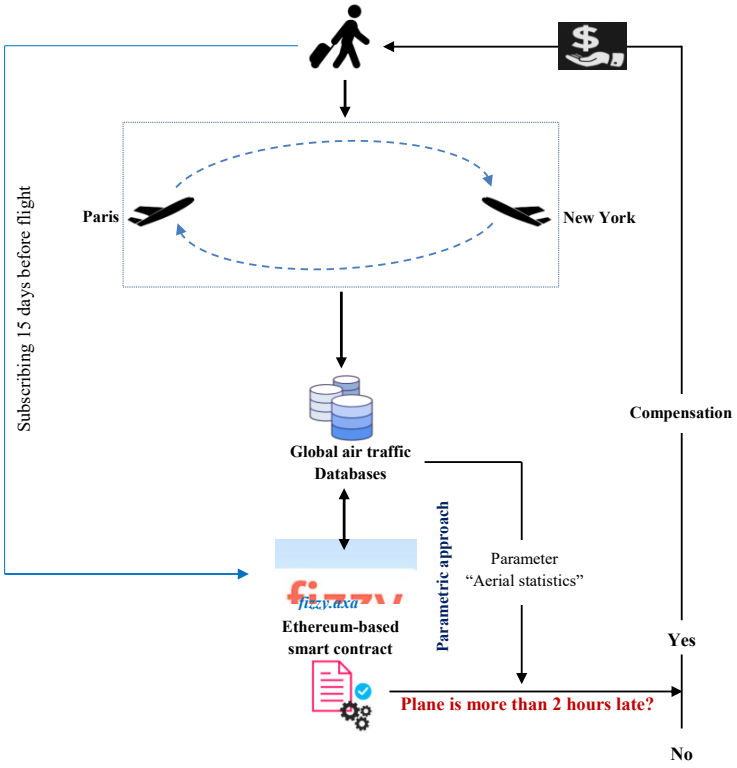
Globally, this product perfectly overcomes the weak points of traditional insurance. It is an Ethereum-based smart contract. Blockchain technology makes it possible to create an exchange network relating to the actors involved in the journey of travelers.

If an individual buys a plane ticket, regardless of the airline, he can go to the fizzy platform to take out delayed flight insurance, 15 days before the departure (Carter, 2018; Axa, 2018). A check is made on the validity of the ticket. He pays an insurance premium of fewer than 10 euros, according to the risks of delay of this flight and the level of compensation. Fizzy processes all the data plane arrivals. Because, it connects this smart contract to the Global Airline databases "Flightstats", and when a delay of over two hours is found, the compensation is triggered automatically (see Figure 2).

The principle is simple: (i) Indicate the information of the flight; (ii) the platform calculates the amount of the compensation, and (iii) the insured will be indemnified if the flight is over 2 hours late. From the technical point of view, the oracles will read in the data (Gatteschi

et al., 2018) whether the flight is on-time and communicate the information to the Ethereum Blockchain (delay: yes/no). Then, the decision will be taken automatically with no intervention.

Figure 2: How fizzy works?



The compensation is guaranteed because the contract has blocked the corresponding sums on the accounts of both the insurer and the insured, pending the outcome. This product, both simple and revolutionary, shows how the blockchain-based smart contract works.

It is to highlight that fizzy is parametric insurance (Inmediate, 2018) because Axa relies on a "parameter", which refers in this case to the aerial statistics, to trigger the execution of the contract. With a delay for whatever reason, the algorithms are automatically triggered and proceed to the immediate payment of the planned sum, by notifying the user of the launch of the procedure a few moments after landing.

Fizzy results from a transversal work that mobilized the resources of several teams. The Innovation division of the insurer, "Axa developed it Next", with "Axa Global Travel Insurance" and the recent entity "Global Parametrics" (Axa, 2018). In the background, the system constantly knows of incidents through a connection to various sources of air traffic data, which have also been used to calibrate the terms of the contract.

IV. Discussion

This section evaluates the potential of the fizzy solution. It highlights its values, its limitations, and the future strategies that Axa must conduct to extend and develop such a solution.

4.1. Context

Since 2008, and the birth of the bitcoin, then Ethereum a few years later, and other technology, such as Hyperledger, Multichain, IOTA … we note a relative specialization of these blockchains according to their architecture technical: with or without blocks, with consensus Proof of Work (PoW), Proof of Stake (PoS) or other types, with or without cryptocurrency, etc. More fundamentally, the rapid development of innovation in cryptocurrencies, blockchain technology, and smart contract technology is leading organizations to rethink their business model and imagine the impact of these structural changes in the long term (PwC, 2017; EY, 2016; Roubini ThoughtLab, 2017).

Blockchain refers to a breakthrough technology that has the potential to bring huge benefits to many sectors (Gatteschi et al., 2018). In recent years, blockchain technology is having ever-growing in popularity, in particular for what concerns its applications. It opens up new opportunities for the exchange of values and information, particularly in the insurance sector. We can thus imagine various concrete applications of this technology in the insurance and asset management sector: intelligent digital contracts, securing originals, microtransactions (payments/assets, mobility, new markets), regulations for banks, etc.

If insurance companies are interested in blockchain, it is because it can disrupt their business models. Blockchain also has potentialities that interest the insurers to the highest degree. This can likely be a great tool for multiplying service packages, automating contract execution and combating fraud, etc. While peer-to-peer insurance models have already appeared, blockchain is giving it new impetus thanks to automated insurance systems based on smart contracts.

Entities, or what is called oracles, are used to manage the data of smart contracts (Hans et al, 2017) and determine, for example, if the conditions are well met to trigger the payment. A recent example of the use of smart contracts, oracles, and Ethereum is that of Axa with its fizzy product launched in 2017 (Carter, 2018). There is no doubt that the idea is good and that it is expected to be very successful, perhaps allowing new types of confidence in the world of insurance. But, for some insurance related to specific events, such as flight delays, it is envisaged to have perfectly automatic contracts. There remain two issues:

i. The source of information on flight delays or that triggers the execution of compensation, and;
ii. The tools on which the program that automates the contract is running.

For the first problem, the source of information must be independent of the insurer. It could be the airline or the airport where the plane lands. Sometimes we speak about oracles. For the second, the satisfactory solution to create absolute confidence in the insured is that the program that executes the contract is independent of the insurer. The technology for using smart contracts must ensure a certain level of privacy (Benton and Radziwill, 2017; Xu, 2016; Lin and Liao, 2017). The solution has been around since 2015, it is the smart contracts that work thanks to blockchain technology.

Take the case of the insurance product of Axa, dedicated to fizzy' flight delays, which is connected to the databases and can know if the flight has been delayed or not, and if so identifying the time (how much?). Fizzy satisfies the two concerns mentioned above because it refers to insurance based on a smart Ethereum contract that automatically triggers the indemnification of the insured in case of flight delay.

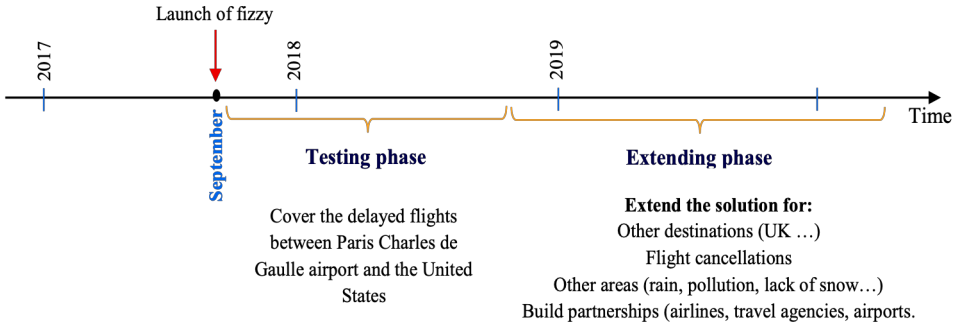
In this case, the oracle is connected to the global Airline databases to retrieve the actual times of a flight and transmit the information to the smart contract which indemnifies automatically the client if the plane is over two hours late. In this context, and to highlight the importance of this solution, examine its potential and point the limitations of this blockchain-based smart contract, the following principles points can be stated:

4.2. The potential of fizzy

The operating principle of fizzy is simple. The client declares his flight number on the fizzy platform; the insurance is registered through a smart contract in Ethereum. In the case of the flight delay, the smart contract will automatically trigger the compensation due based on information from the global Airline databases (Carter, 2018; Axa, 2018).

The argument will focus especially on specialists, but the transparency of the device is guaranteed by the technology implemented, which, in essence, goes as far as allowing independent control of the smart contract governing the product by anyone with the necessary skills. In the testing phase, fizzy concerned direct flights between Paris Charles de Gaulle airport and the United States, or vice versa (Axa, 2018). Then, it was extended by developing partnerships with airlines, travel agencies, and airports (as shown in Figure 3).

Figure 3: The development phases of fizzy



Axa did not choose blockchain used in the Bitcoin's context cryptocurrency, but the Ethereum solution, set up to facilitate the execution of smart contracts. But, as highlighted by (Greenspan, 2015) and (Lamberti et al, 2017), the choice of blockchain should be based on the amount of decentralization required on the one hand, and on-time/cost constraints. Blockchain would make the parametric insurance much easier to set up, since a node of the chain, designated as a trusted informant by the insurer, can activate the compensation for all concerned insureds. Using blockchain makes sense here because the Ethereum platform is public and open.

- This is transparent insurance: the insured knows in advance how much will be refunded in case of delay of his flight.
- No more insurance claim: the repayment is automatic and instantaneous.
- A secure product: The use of blockchain technology allows Axa to guarantee the inviolability of the contracts registered there.
- It is based on a system that only stores the flight number and a customer ID (no personal data). This protects the insured personal data.
- The client's bank details are not registered in blockchain technology.
- With fizzy, the insurer is no longer a decision-maker because it is a blockchain that makes the decision automatically.

The fizzy product combines two promising innovations both for the insurance and finance sectors.

- First, it uses parametric insurance (Carter, 2018) where the triggering of the client's compensation depends on the occurrence of an event (a flight delay of over two hours). The client needs not to prove any damage. He will be indemnified because he has covered himself against this risk.
- Second, the product uses blockchain technology (Axa, 2018), which acts as a third-party certification between the insurer and the insured, thanks to its decentralized, tamper-proof, and blockchain registry function.

Beyond that, fizzy makes it possible especially to simplify the relationships, optimize complex procedures, and speed up the procedures of compensation. The added value of fizzy lies in:

- The evaluation and updating of the risk;
- The setting of a price for a given risk and;
- The provision of capital to cover risks

Concerning compensation, the added value is technical and comprises proactive, automatic, and immediate compensation.

4.3. Limitations and future plan

It turns out that Axa is not the first to do so since it is a case of use that has already been developed and from which Axa has largely inspired. When it comes to giving examples of the use of blockchain in the insurance sector, the ones that stand out systematically are that of "InsurEth" (Lorenz et al., 2016; Catlin and Lorenz, 2017; Hans et al., 2017; Lamberti et al., 2017) developed during a hackathon in London in 2016 or even "FlightDelay" created in 2016. These two projects are already providing delayed flight insurance on blockchain technology.

A fizzy solution is a smart contract, which runs automatically as soon as the parameters are met, i.e. as soon as the delay is noticed, thanks to flight-tracking tools. But, in concrete terms, the client must subscribe online 15 days before departure. For example, if an individual wants to go to New York from Paris in fifteen (15) days, he has to subscribe on the fizzy platform today.

This is one limitation of this product. At this stage, it will be impossible to do that one week or even a few days before the departure. Fortunately, such a vision is already explored, through partnerships with airlines, travel agencies, airports, etc.

Also, the solution is, for the moment, limited to the flights in both directions between Roissy-Charles de Gaulle airport and the United States. This refers to around forty destinations for nearly 20.000 flights per year.

In addition, the compensation proposed by Axa is the same, regardless of the length of the delay: over 2 hours, over 3 hours, over 4 hours … If this delay is between 2 and 4 hours, it can be, in some ways, beneficial for the insured. However, if the delay is greater than 5 or 6 hours, for example, it is a serious concern.

Also, the principle of passenger compensation is nothing new. European regulation EC 261-2004 even provides for such compensation as soon as a delay reaches over three hours. Thus, under EU Regulation 261/2004, passengers are entitled to up to 600 euros in compensation when their flight lands at their destination over three hours late.

With fizzy, the amount of compensation varies according to the flight's price and the

probabilities of delay expected by the insurer which are definitively set upon subscription. The contents and the gain must be clear and understandable, especially for the insured, and comply with the international regulations. Travel insurance is a very complex segment. It is almost always international and requires the intervention of a large number and a variety of actors.

Governance and legal issues also arise. How to apprehend the use of this blockchain-based smart contract in the absence of specific rules? How can the security and privacy of personal data be guaranteed? Although the security of the data is often presented as one of the great strengths of blockchain technology, the development of cyber-attacks cannot be ruled out. Also, technical limitations make it difficult to develop blockchain technology on a large scale because it requires very high computing power.

Another important issue related to the ability of this model to support scalability, because fizzy's funds are necessarily limited, which requires the launch of other equally revolutionary initiatives. Globally, we cannot evaluate the efficiency of fizzy since the solution is under the phase test. Also, some of Axa's statistics show that after six (06) months, the impact of fizzy is very limited, with around 10.000 euros of incomes (insurance premiums paid).

However, according to Axa R&D director 'L. Benichou' (Axa, 2018), the application of this solution blockchain is not limited to travel only, because Axa pretends also to extend it to flight cancellations. Besides, the objective of the company is to extend the platform for other sectors and on wider areas, such as rain insurance, pollution insurance, and insurance lack of snow, tsunami insurance, and volcanic ash insurance, etc.

CONCLUSION

With blockchain, individuals can exchange cryptocurrency without a central authority. It verifies all transactions. One can introduce a condition in this payment system. This is called a smart contract: a computer code informs blockchain that an event occurs to trigger a payment. The companies that will benefit from the creation of distributed value are those that will follow the new uses of consumers and that will be innovative. Think about the fall of Kodak, which is a striking example.

The smart contract could upset the insurance market provided that its use takes into account certain commercial, legal and regulatory considerations. Its use would bring significant cost savings both for insurers and insureds and improve the customer experience. Insurers have every interest today to experiment around blockchain technology and smart contract to define the applications that will correspond to the uses of the coming years.

Like banks, insurance companies have to test this new technology within their organizations; otherwise, the market will probably sanction them in a few years. Partnering with

accelerators and blockchain startups, creating developer communities, and venturing into the gamble of open source, which is a great catalyst for innovation, can also be an opportunity for insurers to quickly take advantage.

This paper has shown that blockchain technology applications can be used in the insurance context to improve innovation. It focused on how blockchain-based smart contracts can widely influence the operations of the insurance, particularly the insurance dedicated to flight delays. The example of fizzy described in this paper concentrates on its general functionality and its specific uses. Other properties or impacts of this Ethereum-based platform, such as financial added-value, the incomes of its implementation are beyond the scope of this paper.

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