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How Blockchain Innovation could affect the Audit Profession: A Qualitative Study

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ABSTRACT
Blockchain is transforming not only the way of recording, processing and storing financial transactions and information, but also the way audit firms can practice their profession. The purpose of this article is to examine how this technology will affect the audit profession. Based on a qualitative study carried out on a sample of 17 auditors, this research shows that this technology could affect audit firms at six key levels. Blockchain will allow an auditor to (1) save time and improve the efficiency of their audit, (2) favor an audit covering the whole population instead of an audit based on sampling techniques, (3) focus the audit on testing controls rather than testing transactions, (4) set up a continuous audit process, (5) play a more strategic audit role and (6) develop new advisory services. The results underline the need for the establishment of a clear and coherent legislative system and new audit standards, allowing auditors to embed this technology and enhance audit practices.

KEYWORDS: Blockchain, Auditing, Audit Process, Innovation, Digital Technologies

JEL CODES: M42

Blockchain, as other new digital technologies (robotics, big data, analytics, artificial intelligence, etc.) is revolutionizing not only the way companies are conducting their businesses but also the way information is processed...
and communicated between different stakeholders (Price, 2016; Laperche, Mignon, 2018; Barbaroux, Attour, 2016; Manita et al., 2020). This technology, which was at the origin of cryptocurrencies (mainly Bitcoin), is considered today as one of the most powerful technologies after the Internet (Yermack, 2017). Obviously, audit firms are concerned by these changes. Indeed, blockchain could radically change the working methods of audit firms and the way they design and develop their business (Liu et al., 2019).

Blockchain could lead audit firms both to create potential opportunities to develop new services but also to destroy existing services, which will be totally or partially replaced by technological systems (Appelbaum et al., 2017). Aware of the very significant development potential of this technology, audit firms are investing more than $3 billion a year in it (Smith, 2018). As an example, Ernst & Young (EY), the first firm to accept Bitcoin for its consulting services in 2017, has invested in the development of applications and services to facilitate the use of blockchain technology in its business. KPMG has launched new blockchain-based services with its partner Microsoft to assist companies in implementing business processes (KPMG, 2017). Deloitte created the first blockchain lab in 2016. PWC launched digital asset services in 2016 using blockchain technology. Like other new technologies, blockchain presents challenges and opportunities that auditors must understand and/or acquire, at the risk of seeing their profession practiced by other companies specializing in that technology. Indeed, several authors have stressed that companies must strengthen their agility and their capacity to integrate innovation in an uncertain context. This will be the only way to remain competitive and face the challenges of tomorrow (Ayerbe et al., 2020; Dupont, 2019).

Blockchain involves IT risks (unauthorized access and threats to confidentiality) but could also have an impact on the traditional audit process and on business development. According to Alles (2015), the use of advanced technologies and blockchain by audit clients would be the catalyst for the adoption of these technologies by auditors. Blockchain, associated with other digital technologies, could change the audit process by modifying the way in which the auditor accesses data, collects evidence, and analyzes data (Rozario, Thomas, 2019). Auditors have the choice only to integrate these technologies and to change their organization and their process at the risk of losing their legitimacy in the audit market. Aware of these risks, the Big Four (Deloitte, EY, KPMG and PwC) are, for example, working on a joint pilot project with 20 Taiwanese banks, aiming to offer new accounting services. The objective

of this cooperation is to test a new blockchain platform allowing auditors to directly verify and confirm evidence of transactions and facilitate the external confirmation of balances, which represent an onerous audit task (Zhou, 2018). More concretely, audit firms no longer manually assess audit evidence, as transaction information is easily accessible and can be tracked and validated through blockchain, saving audit firms a lot of time.

In this context, little research has tried to understand the effects of blockchain on the audit profession (Smith, 2018; Liu et al., 2019). Most research has focused on other digital technologies such as big data, analytics, and artificial intelligence in order to understand how they can affect the audit profession by neglecting blockchain (Manita et al., 2020). Blockchain presents some of its own characteristics that distinguish it from other technologies. Blockchain contains information, which is secured by crypto-encryption, authenticated and certified by all users. It should therefore affect the profession differently. Smith (2018) conducted a review of existing research in the fields of blockchain and accounting to discuss the benefits and challenges that this technology could present for the accounting profession. He identifies a series of potential implications of this technology on the accounting profession. He concludes in particular that blockchain will allow the auditor to save time on repetitive tasks such as confirmation and verification of amounts and balances to focus on tasks at a higher level, such as the design of preventive tests and the intelligent analysis of data. Liu et al. (2019) have attempted to discuss the possible opportunities and challenges presented by the two types of blockchain (permissionless and permissioned) for internal and external auditors. Their study concludes with a series of recommendations to professionals to adapt to this technology and develop their businesses. Desplebin et al. (2018) discussed using a prospective approach to the possible consequences of this technology on the accounting and auditing profession. Their study concluded on a series of possible scenarios that could reflect the evolution of the profession in terms of data security, dematerialization of transactions, coordination, and a fair image of accounting information.

This research remains theoretical and is not based on empirical studies. Some research has tried to understand the technology (Carlozo, 2017). Other research represents either a synthesis of articles written on this subject or proactive reflections on the possible implications of this technology on the accounting profession (Liu et al., 2019; Smith, 2018). This choice could be explained by the difficulty of accessing information and the non-use of this technology by most companies. Audit firms (especially the Big Four) are investing a lot of money to understand this technology, acquire skills, and to
develop new tools and control procedures. Therefore, real fieldwork deserves to be done to study in depth the effects of this technology on audit activities. In this context, this research paper aims to examine the auditors’ perception of the possible implications of this technology on their profession, on the audit process, and on the development of their business.

This research has a dual interest. On a theoretical level, it can enrich the literature on the effects of blockchain in the audit sector by explaining how this technology will transform the auditor’s profession and what new challenges it faces. At the managerial level, this research could enlighten audit professionals, not only on the possible evolutions of their audit process, their services, and opportunities for developing new businesses, but also the technological and organizational challenges they will face. This research could also enlighten audit regulators on audit standards to be revised in order to consider technological developments. Finally, it could inform universities and colleges responsible for training auditors on new skills in technological matters, in critical thinking, and in data analysis capacity, which auditors must have or develop to be in line with new market needs and to face tomorrow’s challenges.

The article is organized as follows. First, we define blockchain technology, present the literature review, and the methodology of our research. Then, we present and discuss the main results produced while emphasizing its main contributions and limitations.

**Conceptual Framework and Literature Review**

First, we will present how the blockchain is defined, what are its characteristics and how it works, and then we will focus on the use of this concept in the audit field.

**The Blockchain: Evolution, Advantages and Types**

*What is the Blockchain?*

The blockchain appeared in 2008 with the bitcoin or crypto currency, presented by Satoshi Nakamoto. Cryptocurrency, which uses blockchain technology in a concrete way, has made it possible to carry out private to private transactions directly and without the intervention of an intermediary.
Several researchers define blockchain as “a network of nodes (i.e. users’ computers) working together as peers to produce an immutable transaction history that can be made viewable to the public” (Swan, 2015; Tapscott and Tapscott, 2016; Drescher, 2017; Sheldon, 2018). Blockchain is therefore a technology for storing and transmitting digital data. Knowing the origin of the data in circulation is possible thanks to this technology since each movement is traced using a register. Each new transaction carried out is automatically stored in a block linked to the other blocks relating to previous transactions. A chain of blocks is thus formed from the different blocks linked to each other which forms a blockchain. Therefore, the blockchain allows users to transact directly with each other without the need for a trusted third body (Gruber, 2013; Singh, 2015). According to Delahaye (2014), this technology can be compared to a large notebook or open book which can be consulted by everyone for free and freely, but for which no information can be erased or destroyed.

**The Characteristics and Benefits of Blockchain Technology**

The analysis of blockchain definitions brings out three major characteristics of this technology:

- **a - Transparency and traceability**: The blockchain contains information which cannot be modified or deleted, and which is shared by users. Also, each operation carried out is definitively recorded in the blockchain, thus making it possible to trace the path traveled by each piece of stored information. Indeed, the longevity and the coherence of the system are ensured by reproduction of the record that it creates in the memory of independent computers in one of the others (the nodes of the network). Transparency and traceability would increase user confidence.

- **b - Security or data protection**: The data recorded in the blockchain are secured by crypto-encryption, authenticated, certified and are immutable, because blocking eliminates frictional errors and reduces their risks. Indeed, the need for validation by a set of nodes makes it possible to greatly reduce the risk of malicious acts, hijacking, or hacking. The nodes control each other which makes it possible to do this without a central authority. Also, it is possible to anonymize users.

- **c - Decentralization**: The blockchain makes it easy to transact without the central network, which provides control and governance of the system. In fact, the validation of the operations recorded there is not carried out by a specific actor, but by a constraint whose modalities are defined by the chain. If we combine this technology with smart contracts, the programming of a value exchange between two parties without intermediaries becomes
possible. Eliminating intermediaries would thus make it possible to gain in productivity and efficiency and to reduce transaction costs such as inspection and verification fees, etc. These characteristics make blockchain technology a revolutionary technology that can lead companies to design new methods and work organizations and to change their business models. In this sense, Beck and Müller-Bloch (2017) believe that the blockchain does not represent an incremental technology (consisting in adding some functionalities to an existing technology), but rather a radical innovation because it has set up new functionalities going beyond the existing technologies and practices (Utterback, Acee, 2005; Betz, 2011).

The blockchain allows the recording of the transaction as a single event, which is validated by the community of minors. This process is very efficient for businesses as it saves them the need to enter and store the transaction in multiple databases, saving them time and significantly reducing human errors and fraud.

This technology can certainly generate competitive advantages for companies, but it is not without risk because it requires fundamental organizational changes, new skills, new tools, and working methods that can overturn old practices (Dewar, Dutton, 1986; Adams et al., 2006). The invention of the blockchain is often compared to that of the Internet, given its enormous potential to create radical transformations in several industries (Lepak et al., 2007; McLean, 2016). As a result, blockchain technology will challenge companies and lead them to be more innovative and to rethink their business model at the risk of seeing its survival threatened.

**Blockchain Types**

Two main types of blockchain have been highlighted in the literature: public and private or “permissioned and permissionless blockchain”. In the case of a public blockchain, the architecture is open, which means that anyone can access it and carry out transactions. Indeed, according to O’Leary (2017), public blockchains allow network participants to contribute to the process by accessing or sending transactions. This type of blockchain is used, for example, in Bitcoin (O’Leary, 2017; Smith, 2020).

The private blockchain offers architecture with a register and transaction that are only available to a closed list of actors. Restrictions are thus put in place on the network nodes which allow the validation of transactions and on the identity of the interests of a transaction. We can cite, for example, transactions between several organizations or transactions in a group with different affiliates. Smith (2020) points out that, with this type of blockchain without authorization like the bitcoin blockchain, the company can both
select the members who can join the blockchain and what their rights are. Burns (2019) specifies that the price reductions in the crypto asset space of 2018 allow a focus on the potential of the blockchain, and especially on the real applications of this technology. According to Smith (2020), the authorized model would be more attractive for businesses in terms of trade and adoption. However, this public, private blockchain typology is reductive. Indeed, several classifications are possible depending on the considered criteria, which can be either technical or related to the governance of the system.

**Literature Revue**

In recent years, blockchain has aroused more and more interest from researchers in different fields such as finance, marketing, supply chain, etc. However, to our knowledge, few studies have looked at its application in auditing. Brender et al. (2019) state that, while in the field of finance reflections on the blockchain have taken place, audit and control areas have been neglected by academic research. Research in this area remains insufficient to cover all blockchain implications for the audit profession.

Most of the current research focuses mainly on the relevance of blockchain in audit processes and its ability to optimize existing audit procedures (Dai, Vasarhelyi 2017; Smith, 2020; Yermack, 2017; Liu et al., 2019; Kokina et al., 2017). Yermack (2017) demonstrates that blockchain could provide assurance on the accuracy and reliability of transactions and enable real-time information disclosure. Kokina et al. (2017) provide an overview of the use of blockchain in large audit firms and discuss its main opportunities and limitations.

Smith (2018) analyzed the possible implications of blockchain technology on the accounting profession. He also did a comparative analysis of how processes would change as this technology becomes more common. Accounting firms invest a lot in blockchain from a financial, technological, or human point of view. However, the experimentation and the implementation of blockchain are in their infancy. The automation of accounting and audit tasks provides challenges and opportunities for accounting and certification professionals which forces them to evolve to keep up with this change. With this change, technology can thus replace certain accounting or auditing tasks and accounting and auditing professionals will play a more strategic role.

Dai et al. (2019) explored how the use of blockchain and smart contracts could reorganize current audit procedures and foster the emergence of a new generation of audit which is Audit 4.0. They present a framework...
that summarizes the areas where blockchain and smart contracts need to be applied to help implement Audit 4.0. They demonstrate that these technologies make it possible to solve two key problems facilitating the implementation of Audit 4.0, which are data integrity and the proper functioning of intelligent audit modules. They also demonstrate that these technologies can help set up continuous and real-time audits, which would facilitate the emergence of a 4.0 audit.

Smith (2020) studied the interaction between smart contracts and blockchain by analyzing how these applications can change the audit process. He stated that to be effective and efficient, the blockchain must communicate with other platforms and must therefore be integrated with the existing technology systems. Smart contracts allow the blockchain to connect with other technological systems, and to adapt blockchain platforms at the enterprise level.

In a prospective approach, Desplebin et al. (2018) illustrated the innovative aspects of blockchain technology that would influence the accounting and audit profession. These authors consider that blockchain will become a “core technology” for the internal control that guarantees the certainty of information for stakeholders: institutions, shareholders, customers, etc. This technology will simplify verification errors and fraud and will ensure the reliability of reporting.

In a study focused on the private blockchain, O’Leary (2017) examined the alternative configurations of different blockchain architectures that can be used for the collection and processing of transactions in different fields, in particular in accounting, audit, supply chain and other types of transaction information. He also proposed possible uses of blockchain for processing transactions with other technologies, such as databases and data warehouses.

Liu et al. (2019) discussed the implications, opportunities and challenges of the two types of blockchain (i.e. permissionless and permissioned) for auditors. According to these authors, new audit activities are emerging with the blockchain. The auditor can thus verify the existence of digital assets and attest to the consistency between information in the physical world and on a blockchain. Also, the absence of centralized authorities in the blockchain can make these tasks difficult for the auditor who is led to develop new methods for verifying the property.

As part of an audit of internal control over financial information, Sheldon (2019) discusses new areas of interest for ITGC (General Information Technology Controls) for auditors, as well as the risk areas that the blockchain could eliminate. This author emphasizes the importance of the vigilance of blockchain users, including businesses, auditors, and regulators. The
reliability of the data produced by the blocking chain depends on the support and proper functioning of the ITGC because the blocking chain remains an element of an IT infrastructure (AICPA and CPA Canada 2017). A good understanding of how this data is controlled, queried, and extracted is important for users who make decisions based on this data and in particular the auditors who can use blockchain extracts.

Rozario and Thomas (2019) examined how blockchain and smart contracts can affect the financial statement audit paradigm. The authors attempted to propose a conceptual framework for an external audit blockchain in which intelligent audit procedures (a kind of smart contract) can autonomously execute audit programs and disclose audit results to different participants in near real time. They showed that the audit blockchain, using financial and non-financial data, has the potential to improve audit quality and reduce the expectation gap between auditors, financial users, and regulators.

Dai and Vasarhelyi (2017) tried to discuss how the audit ecosystem can change with blockchain technology toward more transparency, real-time work, and verification. They consider that with the blockchain we tend toward an automatic insurance system characterized by more precision and speed and thus a transformation of current audit practices. Smart contracts associated with blockchain can be used for the secure storage of accounting data, instant sharing of relevant information with interested parties, and increasing verifiability of business data. It is possible to generate new accounting information systems recording transactions validated on secure registers for companies.

However, all these works are theoretical, and no empirical study has been carried out on the blockchain and the audit. The complexity of this technology and its limited application seem to explain the reasons for the low level of research. Indeed, as Smith (2018) points out, accounting firms have recently started experimenting, developing and implementing blockchains in commercial operations.

**Research Methodology**

To understand how blockchain could influence the audit profession, we conducted a qualitative study with professionals specializing in blockchain. We have chosen to conduct this study with large audit firms because they are the only ones that can afford to invest in this technology and that are able to answer our questions. We therefore decided to conduct this research with the Big Four and with the firm Mazars, which is the 5th largest international firm
in France in terms of revenue and size. From information in the transparency reports of audit firms and information in the press and social networks, we have identified a list of 43 professionals in charge of new technologies in their firms or involved, according to their CVs, in process blockchain. We contacted them via social networks but also by email and telephone and after several reminders we obtained the agreement of 17 professionals who agreed to grant us an interview. We have therefore conducted 17 semi-structured individual interviews which were entirely recorded and transcribed. These interviews lasted an average of 1 hour 10 minutes. Most of these interviews were realized at the workplace of the interviewees (10 interviews). However, seven were done remotely using Skype or Zoom tools. Regarding the profile of the interviewees (see Table 1), they are all partners or senior managers in charge of new technologies in their audit firms and are involved in the development of the blockchain. They have an average age of 56 years and a number of years of experience, equal to 18.7 years. They are mostly men (15 auditors) and all of them work in audit firms located in Paris.

The interview guide was structured in four themes. The first relates to the opportunities and challenges of blockchain technology in general and more particularly for an audit firm. The second deals with the implications of blockchain for the audit profession. The third concerns the implications of this technology for the control process and the last one concerns blockchain and business development, particularly in advisory services.

Table 1 – Description of the sample

<table>
<thead>
<tr>
<th>Audit firm</th>
<th>Number of interviews</th>
<th>Partners “1-15”</th>
<th>Senior Managers “16-17”</th>
<th>Average years of experience</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deloitte</td>
<td>4</td>
<td>3</td>
<td>1</td>
<td>21</td>
</tr>
<tr>
<td>PricewaterhouseCoopers</td>
<td>4</td>
<td>4</td>
<td>0</td>
<td>17</td>
</tr>
<tr>
<td>Ernst &amp; Young</td>
<td>4</td>
<td>4</td>
<td>0</td>
<td>20</td>
</tr>
<tr>
<td>KPMG</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>18</td>
</tr>
<tr>
<td>Mazars</td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>16</td>
</tr>
<tr>
<td>Total</td>
<td>17</td>
<td>15</td>
<td>2</td>
<td>18.7</td>
</tr>
</tbody>
</table>

The data collected through semi-structured interviews were analyzed using content analysis. According to Evrard et al. (2003), this involves analyzing the content of the speech for a non-directive or semi-directive interview using a set of techniques such as thematic analysis or syntactic and lexical analysis. Based on the transcribed interviews, our data analysis was conducted in two stages. The first step was a vertical analysis carried out intra-interview or interview by interview, while the second step consisted of
a horizontal analysis of all the interviews topic by topic. We thus sought the meaning, relevance, and occurrence of the themes from one interlocutor to the other.

The contents of the interviews were analyzed using a coding technique dividing the relevant content of the transcripts into different subject categories. The coding was carried out by the authors in accordance with the methods proposed by Gillham (2000) and Strauss and Corbin (1998). The main procedures of the coding strategy include:

– one of the authors inductively codes all the interviews to develop a list of categories by topic with descriptions;

– the same author prepares a coding manual and invites his co-authors to code a sample of transcripts;

– the two authors verify and discuss the reliability of the coding carried out. They make the necessary adjustments to the list of categories and to the coding manual until both authors accept the reliability of the codes used. This step helped to purify the list of possible implications of blockchain on the audit profession;

– the two authors re-code all the interview transcripts considering the revised list of categories and the coding manual, making other changes if necessary based on negotiations between them (Appendix 1: Coding and Blockchain’s implications);

– the possible implications were subsequently submitted to two partners to validate the results.

In this research, to avoid the case of an occasional incident, we did not take into account the categories declared by a single respondent. The objective of this research was to identify the maximum possible implications of blockchain on the audit profession. Categories reported by more than one respondent were therefore considered valid.

Findings

Our qualitative study allowed us to identify, as illustrated in Figure 1, six possible implications in which blockchain could affect the audit profession. Among these implications, four relate to audit practices and two to strategic developments of audit firms. The results confirmed that blockchain technology will allow audit firms to (1) save time and improve audit efficiency, (2) favor an audit covering the whole population instead of a sample audit, (3) focus the audit on testing of controls rather than testing of transactions, (4)
set up a continuous audit process, (5) foster a more strategic audit role and, (6) develop new advisory services.

All these implications will improve audit quality and open up a new horizon for audit firms to adapt their working methods and processes and develop their service offerings.

Figure 1 – Blockchain’s implications for the auditing profession

**Time Saving and More Relevant Audit**

Blockchain facilitates the dematerialization of accounting practices and documents. It allows both the dematerialization of transactions and contracts, identity certificates, and control and verification procedures. The original single document is no longer a paper document but an electronic document with a unique and inviolable identification.

The interviewees also declare that the accounting information that represented specific information to each company will be transformed, with the blockchain, into a shared and collectively certified information system. As most of the accounting operations involve a company with external entities, blockchain will make it possible to develop and guarantee joint accounting
validated by the different parties. In this context, the interviewees state that the control procedure can be done remotely, saving significant time and cost compared to controlling paper documents. This procedure also allows simultaneous and secure broadcasting to stakeholders. In addition, the interviewees affirm that blockchain has the advantage of protecting companies against any hacking of their accounting data, which gives more confidence to the data communicated between the different parties. Through blockchain, the auditor has the ability to visualize and extract a variety of reliable information from the client’s blockchain without the need for laborious data collection. This reliable and relevant information sharing via numerous private and authorized blockchains will allow the auditor to save time not only in terms of data collection and understanding of the client’s activities but also in terms of, and testing of, the validation of transactions.

As the private blockchain is designed to share unalterable and time-stamped information and documentation from the audited company and third parties (suppliers, customers, etc.), the auditor would save a lot of time for validating balances and transactions... For example, the blockchain would allow the auditor to bypass the manual correspondence test performed on many samples because the full transaction history and supporting evidence would be kept and posted directly as a block in the blockchain.

“Certain audit procedures which used to take a long time in our current procedures will be done quickly or will not be done at all because they are no longer useful today. I am thinking in particular of the preparation of customer opening files, the circularization of third parties, and the validity test of transactions. Data will be extracted quickly and remotely, and many transactions already validated by blockchain players will be greatly reduced.” (Partner 10)

“The auditor’s work would be made easier since he would be required to check fewer accounting entries and will have remote access to information.” (Partner 3)

This time saving will allow auditors to focus on activities with high added value for the client such as the analysis of accounting estimates at the end of the financial year, the evaluation of control systems at blockchain level, and the estimation of risk areas. This will increase the efficiency of the audits carried out and thus improve the audit quality. One of the respondents emphasizes:

“Blockchain can give us the opportunity to perform our analyses and audit tests and focus on risk areas to give relevant recommendations....”
to our customers allowing them to improve their control systems, their information prediction system, or others…” (Partner 4)

**Toward an Audit Covering the Whole Information**

As we have specified above, the validation and recording via the blockchain of information integrated by several users allows a real-time collective certification of this information by all users. This process of building information, combined with the characteristics of tamper-proof and transparent technology, has a significant positive impact on the reliability and sincerity of information. Obviously, these processes will affect audit work. Currently an audit is based on historical data relating to the financial statements for the previous year. It provides only a reasonable level of audit. The auditor’s opinion is mainly based on a risk-based approach using sampling techniques in inspection work. As blockchain technology offers access to all information that becomes instantly available the auditor can, in this case, conduct his audit by using all information. This is very possible when we combine blockchain with other technologies available today, such as big data, robotics, and analytics. Therefore, blockchain will allow the audit process to evolve from a process based on control of a reasonable part of the available information toward control of all information. An interviewee has stated in this context that:

“The blockchain, like other digital technologies, is upsetting audit practices. In addition to offering authentic and coded information, it offers the possibility for an auditor to access all information and to conduct his audit by using all data available. In other words, a whole-population investigation will replace the traditional sampling approach and the audit process will evolve in this sense…” (Partner 3)

“Blockchain technology eliminates the concept of sample auditing, as it offers an up-to-date and unchanging historical record of all transactions.” (Senior Manager 2)

**Toward an Audit Centered on Testing Controls Rather Than Testing Transactions**

Blockchain technology offers several advantages related to the security and reliability of transactions. These advantages are also valid for the accounting record of transactions stored on the blockchain. To ensure the reliability of companies’ financial statements these accounting records also need to be audited. Indeed, certain “chain” transactions could be concluded
between two parties, which are linked to an “off-chain” agreement. In addition, fraudulent transactions could be slipped into “the chain”. As a result, the effectiveness of the internal controls surrounding the blockchain become an essential element on which the auditor must focus in his audit process. In other words, faced with a specific blockchain, the auditor must focus on the quality of the control tests put in place (quality of the blockchain code, protocol changes, distribution of power between peers, etc.) rather than on direct transaction tests to ensure the reliability of the information hosted on this blockchain. One auditor told us:

“The transactions integrated in the blockchain are very often secure and validated by the mining community. As a result, the real question for the auditor would no longer be to verify the authenticity of the transactions concluded, but rather to verify the effectiveness of the control systems put in place to secure them. The audit will therefore focus more on testing control systems implemented in the blockchain rather than on transaction tests…” (Partner 4)

Toward a Continuous Audit Process

Also, another advantage of blockchain technology is to allow direct access to transaction history, which facilitates the work for the auditor. This is especially possible by integrating other technologies such as big data and analytics. Widespread use of the blockchain in business practices will transform the auditor’s process. By creating a stock of available, encrypted information, approved by a kind of consensus that cannot be changed (given the timestamp functionality and the unique hash ID assigned to information blocks), the blockchain offers the audit profession the opportunity to change the audit process. Today the auditor intervenes to verify old information related to the past financial year. With the blockchain, the auditor will have the possibility of setting up a continuous audit process allowing the validation of information as soon as it is produced by this technology. As all the information stored on a blockchain is available, the auditors will be able to access all information without having to request and wait for the information and documents from their clients. Blockchain will therefore allow the saving of time and costs previously spent on collecting and verifying evidence.

In this context, one of the auditors interviewed has said “...Blockchain technology should therefore reduce, by its operation, the need for an a posteriori audit and lead to an adaptation of the audit mission which will become a continuous audit mission…” (Partner 2)
“…Thanks to the instant confirmation of transactions, the blockchain must allow continuous auditing, also called “real-time auditing”. Auditing in the blockchain age would be a permanent audit. It would go from being a periodic or annual exercise to an ongoing question. Monitoring what is happening in real time is a significant departure from contemporary auditing practice, which focuses on retrospective control of what has happened…” (Partner 11)

In addition, blockchain allows us to store and secure stocks of financial and non-financial information, which gives the auditor more opportunity to broaden his audit fields and make it more relevant. This variety of information that is available and stored instantly via the blockchain also promotes the implementation of a continuous audit. Several verifications of information that were part of the traditional audit process (post-closure) will no longer be necessary if this information is stored and can be examined on a blockchain. The inventory count that was done manually can be conducted quickly and continuously with blockchain. This is also the case for confirmations, which will no longer be useful since all the information is verified instantaneously by the blocks of information created. Also, the analysis of the data that was done by sampling will be transformed into continuous analysis covering the totality of the available information. Finally, blockchain will allow the automation of reconciliation, especially when transactions take place between parties within a single blockchain network. All these operations that were not possible with the classic audit should allow an auditor to save time and increase the efficiency and the quality of his audit. In this sense, an auditor told us:

“…The continuous audit process made possible by the blockchain should increase the satisfaction of customers and all stakeholders who will no longer have to wait for the auditor’s retrospective intervention to certify the accounts… This process should also limit errors and fraud…” (Partner 6)

Furthermore, blockchain will allow the proliferation and development of smart contracts, which will affect the audit process. These contracts, which integrate contractual rights and obligations into the network, will be automatically executed by blockchain. These contracts should reduce the costs of fraud, arbitration, and transaction. Signing blockchain transactions via smart contracts will allow the efficient and secure management of transaction and document flows, which saves significant time and energy for the auditor, who can directly access and carry out his data analysis and controls. This should also facilitate the setting up of continuous audit and limit errors.
With a continuous audit, auditors must develop new control procedures which adapt to the new technological environment. Indeed, blockchain gives auditors the opportunity to evolve their audit process, such as examining certain transactions and verifying the existence of digital assets and verifying the consistency between the information on a blockchain and the real world. One of the new audit procedures is the verification of the code and the blockchain structure. Auditors can also use their expertise in auditing IT systems to develop new methods to verify ownership. In this context, training on technological auditing would be essential for future auditors.

**For A More Strategic Audit Role**

Once blockchain technology is integrated and applied more broadly, the role of audit firms would evolve toward a strategic role. Given the availability of data via the blockchain, the auditor will be able to analyze this data, interpret it to give it meaning, and make it useful for management decision-making. In this case, the auditor can move from a simple controller of the reliability of information to a strategic advisor for his client and an essential partner in the evolution of his management and control systems.

Also, the saving of time generated by the use of this technology at the level of certain classic audit tasks (confirmations and verifications of the amounts, verifications of paper proofs, physical inventory of stocks, etc.) allows the auditor to devote this time to conducting higher level analyses, design more preventive tests, and improve the quality of his audit. In this context two interviewees have affirmed that:

“Blockchain, like other digital technologies, is making a major contribution to the automation of accounting and auditing processes. The audit profession must follow this evolution by adapting its mission and making it evolve toward a more strategic role for their client…” (Partner 1)

“The application of blockchain, alone or in conjunction with other technological advances, seems to create a number of opportunities and challenges for the profession. Our clients very often have perceived the audit as a cost center with little added value. Blockchain, with other technologies today, gives the profession the opportunity to make auditing more relevant by conducting advanced and intelligent analyses and controls allowing clients to identify their weaknesses, to advance their control systems, and to develop their businesses…” (Partner 15)

Blockchain appears as an opportunity for audit firms to allow a major reorientation of their activities toward a strategic role. The profession could
Toward the Development of New Advisory Services

Blockchain gives auditors the opportunity to develop their advisory business by offering new services. They can assist their clients in implementing the technology and choosing the best procedure to follow. For clients already using blockchain, audit firms can, on the basis on their assessment of the risk management systems in place, give them advice to improve their internal control and risk management systems. Two of those interviewed told us:

“Once the technology is mastered, audit firms can seize the opportunity to expand their fields of expertise and offer new services for their clients. To do this, auditors should first take a step forward to influence and direct the implementation of the blockchain. In this case, they can assert themselves as essential partners in this technology…” (Partner 10)
“Blockchain could present limits, but also advantages for auditors. Nevertheless, auditors must remain focused on the opportunities to develop their business by offering new services such as implementing new control systems or new blockchain governance or assisting clients in the implementation of this technology, etc.” (Senior Manager 1)

In addition, audit firms can use their sectoral experience to develop new consulting assignments on best practices regarding blockchain usage protocols. They can also offer new services in acting as a planner and coordinator of potential participants of a blockchain. Audit firms could therefore leverage their networks to propose a permissioned blockchain. Finally, audit firms can leverage their expertise on IT auditing to develop new services on an audit internal control of blockchain, including data integrity and security, change management, and blockchain governance. One person who was interviewed mentioned:

“The auditor must adapt to this new work environment and become a real strategic partner of their clients. This requires the development of new consulting missions aimed at supporting their clients in the various phases of construction and validation of information via the blockchain but also in the establishment of good systems of control and governance… To achieve this objective, the auditor must invest massively in the recruiting of new skills to master this technology, but also in the training of existing staff.” (Partner 12)
Blockchain technology offers some opportunities for auditors. However, these opportunities require the anticipation of costs, such as investing in adequate IT solutions and training employees. These costs, which can be significant, will constitute a long-term investment to adapt to new market needs.

**Discussion**

Our results show that the blockchain will influence the auditing profession in at least six key elements:

First, the blockchain will save time for certain controls that can be automated, for data collection and for authenticity tests of documents and transactions. The auditor could therefore devote this time-saving element to bring more added value to his client by strengthening his analyses for other risk areas, or for existing control systems.

Our results are consistent with Liu *et al.* (2019), showing that the blockchain could help audit companies to optimize the time gained thanks to this technology, by devoting it to more rewarding tasks for the client, such as the proposal for advanced forecasting solutions, the in-depth analysis of errors, and anomalies in management and control systems, etc. They are also in line with Rozario and Thomas (2019), who show that blockchain, by automating data flows, would transform the audit process and improve its efficiency.

Second, blockchain will allow the auditing of all customer data instead of sampling. This will allow the auditor to detect most of the errors and anomalies in the client’s systems and thus improve the quality of his audit. This is in line with the work of Liu *et al.* (2019), which shows that the blockchain will allow full coverage of client data and make the audit more relevant.

This result is consistent with Kokina *et al.* (2017), who show that the advantage of the blockchain is that it allows all the exceptions in a transaction population to be generated, and not from a sample.

Third, blockchain will transform the audit process, which will be more focused on the testing of controls than the testing of transactions. As the transactions will be secure and validated by the blockchain, thanks to the mining community, the auditor will redirect his audit toward a more in-depth analysis on the quality of the control systems implemented, such as the quality of the blockchain code, the protocol changes, the distribution of power between peers, etc. This will obviously improve the relevance of the audit. This result confirms that of Liu *et al.* (2019), who find that the
blockchain will reinforce the testing of control systems rather than transactions, which will be validated by the various actors of the blockchain.

Fourth, blockchain technology will allow the establishment of a continuous audit based on current data, and one which is done in real time. By replacing the apostolic audit of historical data, this new approach will improve the efficiency and relevance of the audit, enabling the auditor to be an essential actor in the blockchain process. This audit will allow the timely detection of anomalies and errors and the systematic improvement of the client’s internal control systems.

This is in accordance with Kokina et al. (2017), who state that blockchain offers the possibility of performing audits more frequently, or even continuously, because the transaction blocks cannot be modified before the audit. This result is also in line with Dai et al. (2019), who demonstrate that the blockchain can be used by auditors to perform audits and real-time monitoring, pushing the profession toward a new generation: “Audit 4.0”. This result is also in line with Dai and Vasarhelyi (2017) and Rozario and Vasarhelyi (2018), who consider that the blockchain not only allows the timely examination of transactions, but also the automation of recording and verifying transactions.

Obviously, the biggest benefit of this approach is to allow a reliable and real production of financial statements.

Fifth, the blockchain will allow the auditor to play a strategic role for his client. The availability of data and the saving of time on other tasks will give the auditor the possibility to make in-depth analyses of the data and to draw relevant and useful interpretations for decision making, to develop performance and the prediction of trends, etc. This analysis and the advice given to the client will improve the usefulness and relevance of the audit, which was considered by some stakeholders as a service with little added value. This technology will therefore allow the auditor to establish their legitimacy as an essential and strategic player for their client. These results are consistent with those of Rozario and Thomas (2019), who show that blockchain has the potential to improve audit quality and reduce the expectations gap between auditors, users of financial statements, and regulators.

Finally, blockchain technology offers the auditor the opportunity to extend his offer by proposing new services such as real-time auditing, assisting clients to set up technology or to adopt best practices, coordination of participants of blockchain, change management and blockchain management, etc. This result is also consistent with Liu et al. (2019), who predict that blockchain will improve new advisory services and therefore develop the auditor’s business.
For audit firms, to meet the challenge of developing their audit process and offering new services, two prerequisites are essential. First, audit firms must take the lead and invest massively to appropriate and master the technology. This involves recruiting new technological skills but also specializing in data analysis, the acquisition of start-ups specialized in blockchain, and the training of existing staff so that they can adapt to future challenges. Next, audit firms must develop a culture of innovation in all business units to guarantee the evolution of their service offering and adapt to new market needs.

In addition, this technological development will pose the problem of legislative, regulatory, and normative development accompanying the exercise of the audit profession.

As auditing is a regulated and standardized activity, this technology requires the legislator to adapt its trade regulations to encompass technological constraints and the problems of accessing the entire client’s data. In addition, certain audit standards covering, in particular, the audit process (mainly ISA 315, ISA 320, ISA 330, ISA 501, ISA 500) must also be developed by integrating the possibility, for example, of carrying out a continuous audit or the possibility of processing the completeness of the data, of strengthening the IT control tools, etc. (Manita et al., 2020). Finally, the adoption of this technology will also raise ethical questions. The legislator must also intervene to supervise the ethical practices of the profession to handle all risks of independence and violation of client secrets, etc. Several challenges remain to be addressed to support the development of the audit profession.

**Conclusion and Limitations**

**Conclusion**

The aim of this article was to study how blockchain technology will influence the audit profession to understand the main changes for which auditors must prepare. This study contributes to the literature on the digital transformation of audit firms and the literature on blockchain as a particular technology. It extends the discussions on the possible implications of the blockchain on the audit process and on the evolution of the service offer within audit firms (Rozario, Thomas, 2019). It shows that the adoption of blockchain as a system for processing, storing and communicating information will have several effects on the audit profession and open the way to the development of new services.
This research also contributes to enriching the literature on audit quality (Dai, Vasarhelyi, 2017; Manita et al., 2020). It shows that the blockchain, through the implementation of a continuous audit process, the performance of audit tests on all company's data, and the securing of transactions by the various stakeholders, could significantly improve audit quality.

Finally, on a practical level, this research informs the profession on the possible implications of the blockchain on the audit process and advisory services. It has identified five areas where practices must evolve to better satisfy audit clients and make the audit more relevant. It has shown that the audit process must evolve toward a continuous audit, which would focus, not on historical data, but rather on recent data. It should also evolve into an audit examining all data and not samples representing a small part of the data. Finally, it must significantly ease the information validation tests and focus more on existing control tests and on in-depth analyses that bring significant benefits to clients. This research has also shown that the blockchain will transform the auditor's role from a simple controller to a real strategic advisor who would support companies in the development of their business and their information and control systems. This research informs the legislator and the regulator (PCAOB) on the need to update audit standards, ethical rules, and regulatory texts of the profession to incorporate the specificities of this technology. There are therefore significant challenges for the profession. Auditors are increasingly confronting a market where blockchain technology is becoming widely used, almost in all industries. As a result, auditors have no choice and must invest heavily in this technology in order to broaden their skills and knowledge in this field and be able to anticipate and respond to their client demands. Otherwise, auditors will see other players specialized in digital services come to compete with them. To do this audit firms must invest in recruiting technological skills and adapt their internal organization to set up its continuous audit offer. They must also acquire skills in blockchain governance in order to become a main and essential player in the development and validation of information. In addition, audit firms should establish a culture of innovation and customer satisfaction at all levels of their services. Finally, they could combine blockchain with other technologies (big data, robotics, analytics) to develop new advisory services such as control design, assistance for the implementation of blockchain technology, change management, and blockchain governance.

Limitations and Future Research Directions

Our research has certain limitations. First, it cannot exceed the exploratory framework given the limited number of our sample (17 people interviewed).
Then, as our research focused on a technology whose application is not generalized, the perceptions of professionals involved in the implications of this technology on their audit profession may change. The results must therefore be taken with all the necessary precautions.

Also, this research does not address the negative implications of the blockchain on the audit profession or the question of costs. Indeed, some authors predict several negative effects of blockchain on the accounting and auditing profession and consider that it will disrupt the whole accounting and audit profession (Yermack, 2017; Schmitz, Leoni, 2019). These authors consider that, while blockchain is a promising technology for increasing trust between different stakeholders, the benefits it can give to the profession and its ability to detect fraudulent transactions remain limited. We have chosen to study the possible transformations of the profession while insisting on future challenges.

New lines of research are possible. First, we can study the effects of blockchain on internal control and on the process of preparing financial statements. We can also study how this technology will affect the recruitment policies of firms. Finally, we can study the implications of blockchain on small audit firms that do not have the same human and financial resources as the Big Four.

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**Appendix 1 - Coding and blockchain’s implications**

<table>
<thead>
<tr>
<th>Order codes</th>
<th>Blockchain's implication for audits</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Passage to electronic documents with a unique and inviolable identification.</td>
<td>Time saving and more relevant audit</td>
</tr>
<tr>
<td>- The control procedure can be done remotely saving significant time and costs</td>
<td></td>
</tr>
<tr>
<td>- Certain controls will be done quickly or will not be done because no longer useful.</td>
<td></td>
</tr>
<tr>
<td>- Fast and remote data extraction</td>
<td></td>
</tr>
<tr>
<td>- Transactions already validated by blockchain players</td>
<td></td>
</tr>
<tr>
<td>- The opportunity to perform data analyses and auditing</td>
<td></td>
</tr>
<tr>
<td>- Access to all information that becomes instantly available</td>
<td>Audit covering all data</td>
</tr>
<tr>
<td>- Audit conducted by using all information</td>
<td></td>
</tr>
<tr>
<td>- From the control of part of data to the control of all information</td>
<td></td>
</tr>
<tr>
<td>- Going beyond traditional sampling methods</td>
<td></td>
</tr>
<tr>
<td>- Quality of the control tests put in place</td>
<td>Audit centered on testing of controls rather than testing of transactions</td>
</tr>
<tr>
<td>- Quality of the blockchain code</td>
<td></td>
</tr>
<tr>
<td>- Focusing on protocol changes</td>
<td></td>
</tr>
<tr>
<td>- Focusing more on testing control systems implemented</td>
<td></td>
</tr>
<tr>
<td>- No need to verify the authenticity of the transactions concluded</td>
<td></td>
</tr>
<tr>
<td>- Real time audit</td>
<td>Continuous audit process</td>
</tr>
<tr>
<td>- Instant information validation</td>
<td></td>
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<tr>
<td>- Continuous audit</td>
<td></td>
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<tr>
<td>- Reduction in the need for an a posteriori audit</td>
<td></td>
</tr>
<tr>
<td>- Widening audit scope</td>
<td></td>
</tr>
<tr>
<td>- The automation of accounting and auditing processes</td>
<td></td>
</tr>
<tr>
<td>Order codes</td>
<td>Blockchain's implication for audits</td>
</tr>
<tr>
<td>----------------------------------------------------------------------------</td>
<td>----------------------------------------------------------</td>
</tr>
<tr>
<td>- Auditor moving from a simple controller of the reliability of information to a strategic advisor for his client</td>
<td>More strategic audit role</td>
</tr>
<tr>
<td>- Strategic role for clients</td>
<td></td>
</tr>
<tr>
<td>- Audit with more added value for clients</td>
<td></td>
</tr>
<tr>
<td>- More relevant audit by conducting advanced and intelligent analyses for clients</td>
<td></td>
</tr>
<tr>
<td>- Offer new services by acting as planner and coordinator of potential participants of a blockchain</td>
<td>The development of new advisory services</td>
</tr>
<tr>
<td>- Client assistance in the implementation of blockchain technology and in the choice of the best procedures</td>
<td></td>
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<tr>
<td>- Develop advisory business by offering new services</td>
<td></td>
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<tr>
<td>- Use sectoral experience to develop new consulting assignments on best practices regarding blockchain usage protocols.</td>
<td></td>
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<tr>
<td>- Improvement of client internal control and risk management systems</td>
<td></td>
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<tr>
<td>- Develop new services on audit internal control of blockchain</td>
<td></td>
</tr>
<tr>
<td>- Training services on blockchain</td>
<td></td>
</tr>
</tbody>
</table>