Alexandria Journal
of Accounting Research

Second Issue, May, 2023, Vol. 7

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The Effect of Internal Auditor Assurance and Consulting Roles on Blockchain Applications Related Internal Controls on User's Perception of Information Quality: The Case of the Egyptian Customs Authority

Abstract

Blockchain technology has resulted in drastic changes in business operations and is now being applied in different areas, such as government operations, financial operations, and supply chain management. Blockchain has its own advantages, such as offering tamper-proof audit evidence, decentralization, immutability, and accountability. However, it exposes businesses to different security risks. It is expected that external and internal auditors will respond to this disruptive technology by upgrading their technical skills and understanding of this technology. In addition, auditors will be requested to provide new consulting and assurance services related to this technology when they audit the companies' financial statements.

The objective of this research is to investigate the impact of the consulting and assurance roles of internal auditors regarding blockchain-related internal

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controls in the Egyptian Customs Authority (ECA hereafter) on the decision-maker's perception of information quality, completeness, confidentiality, timeliness, accuracy, validity, reliability, and security, in case the blockchain application is outsourced versus when it is developed in-house by the ECA. Using a two independent experiments, the researchers found that the internal auditor's assurance / consulting role regarding blockchain related internal controls has a positive and significant effect on users' perception of information quality. In addition, the positive effect of internal auditors' assurance / consulting role on users' perception of information quality is more pronounced when the blockchain application is developed in-house by the ECA than when it is developed and managed by an external party.

This research adds experimental evidence to prior literature investigating the added value of internal auditors' assurance and consulting roles. The research results will be of interest to decision makers in the ECA and other public units trying to rely on blockchain technology in their operations. In addition, the results of the research will be of interest of academics, auditors, and policymakers.

Keywords: Blockchain Technology, Internal Auditors, Consulting, Assurance, Egyptian Customs Authority, Outsourcing.

أثر تفعيل الدورين التوكيدى والاستشارى للمراجع الداخلى فى مجال الرقابة الداخلية ذات الصلة بتقنية سلسة الكتل على إدراك المستخدمين لجودة المعلومات– دراسة على مصلحة الجمارك المصرية

ملخص البحث

أدت تقنية سلسلة الكتل لحدوث العديد من التغيرات الجذرية فى العمليات التشغيلية نظرا لتطبيقها بالعديد من المجالات المختلفة، والتى منها؛ العمليات الحكومية، العمليات المالية، وإدارة لسلسة التوريد. **وبالنظر لتقنية سلسلة الكتل** فيتضح إتسامها بالعديد من المنافع الناجمة عن تطبيقها كتقديم أدلة مراجعة يصعب التلاعب وعدم القدرة على التغيير أو التعديل واللامركزية والقدرة على المساءلة. **وعلى الرغم من ذلك** فإن تطبيقها يعرض الشركات للعديد من المخاطر الأمنية. **وبالتالى** فإنه من المتوقع أن يستجيب المراجعين الداخليين والخارجيين للمخاطر التكنولوجية من خلال تنمية مهاراتهم التكنولوجية وزيادة قدرتهم على فهم تلك التقنية. **بالإضافة إلى ذلك** سيتطلب ذلك من المراجعين توفير العديد من الخدمات التوكيدية والاستشارية ذات الصلة بتلك التقنية، عند القيان بمراجعة القوائم المالية للشركات المطبقة لها.

وعليه يستهدف هذا البحث، التحقق من أثر تفعيل الدورين التوكيدى والاستشارى للمراجعين الداخليين فى مجال الرقابة الداخلية ذات الصلة بتقنية سلسلة الكتل فى مصلحة الجمارك المصرية، على إدراك متخذ القرار لجودة المعلومات، **معبرا عنها بكل من؛** الاكتمال، الثقة، الوقتية، الدقة، الصدق، إمكانية الاعتماد، والأمن، **وذلك فى ظل** إسناد تطبيق تقنية سلسة الكتل مقابل تطويرها وتقديمها من قبل مصلحة الجمارك المصرية. **ولتحقيق ذلك تم الاعتماد** على حالتى تجريبيتين مستقليين.**وقد توصل الباحثان إلى** وجود تأثير إيجابى ومعنوى لتفعيل الدورين التوكيدى والاستشارى للمراجع الداخلى فى مجال الرقابة الداخلية ذات الصلة بتقنية سلسلة الكتل على إدراك المستخدمين لجودة المعلومات. **فضلا عن** زيادة التأثير إيجابى لتفعيل الدور التوكيدى / الاستشارى على إدراك المستخدمين لجودة المعلومات فى ظل تطوير تقنية سلسلة الكتل من قبل مصلحة الجمارك المصرية بدلا من تطويرها وإدارتها من قبل طرف خارجى.

وعليه فإن البحث الحالى يضيف دليل تجريبي للدراسات السابقة بشأن التحقق من القيمة المضافة للدورين التوكيدى والاستشارة للمراجعين الداخليين. **لذا ستكون نتائج** ذلك البحث موضع اهتمام لمتخذى القرار فى مصلحة الجمارك المصرية والجهات الحكومية الأخرى التى تسعى للاعتماد على تقنية سلسلة الكتل فى مختلف عملياتها التشغيلية. فضلا عن كونها موضع اهتمام، أيضا، من قبل الأكاديمين، والمراجعين، وواضعى السياسات.

الكلمات المفتاحية: تقنية سلسلة الكتل، المراجعين الداخليين، الدور الاستشارى، الدور التوكيدى، مصلحة الجمارك المصرية، الاسناد.

1. Introduction

Digital technologies, as part of the fourth industrial revolution, such as artificial intelligence and machine learning have resulted in disruptive changes in business operations and have changed whole industries (Kloch and Little, 2019). The advancement in information technology has resulted in the development of several applications that affected businesses' operations worldwide. Blockchain application is one of these developments that caused drastic changes in businesses. Blockchain started in 2008, when Satoshi Nakamoto published his white paper on cryptocurrency. It is one of the currently trending artificial intelligence applications (Zemánková, 2019).

Blockchain was initially introduced to deal with transactions involving cryptocurrencies, such as Bitcoin, and then it was used in business practices, especially in tracking goods and services (Liu, et al., 2022). It is considered to be one of the main pillars of industry 4.0 (Deloitte, 2019). Blockchains can be classified into three main types according to the permission to access and edit. The first type is the permissionless or public blockchain, which is open to all participants to read and write and the identity of participants is anonymous. The second type is the permissioned blockchain, where only approved participants are eligible to read and/or write and the identity of those participants is known. The third and last type is the private or the permissioned blockchain, where its access is centralized to one entity, and parties outside this entity are not allowed to participate (Deloitte, 2019; Liu, et al., 2022).

Blockchains have their unique characteristics, which are decentralization, immutability, accountability, and offering tamper-proof audit evidence. These characteristics provide advantages to this technology. For instance, offering tamper proof audit evidence and immutability will prevent any changes or modifications in the data stored on the blockchain and this will enhance the integrity of the information provided by the network. The infrastructure of the blockchain enhances the auditability of information. Information in electronic documents recorded in the blockchain is traceable and immutable, and

this allows auditors to test the completeness of the information (Dai and Vasarhelyi, 2017).

Despite its advantages, in the form of decentralization, tamper-proof audit evidence, immutability, and so on, there are cybersecurity and privacy concerns (Hasan, 2022). Also, blockchain technology exposes organizations to new and different risks (Deloitte, 2020), such as the risk of error coding, and 51% attack. Accordingly, blockchain users might request advisory or consulting services and assurance services related to blockchain application-related internal controls.

Nowadays, companies are moving towards adopting blockchain technology to benefit from its unique features and advantages. The decision to adopt this technology is that of the companies' management and it is also the management's responsibility to design and operate an effective internal control system. The existence of a high-quality internal audit is crucial for the effective implementation of blockchain-related internal controls.

According to the new definition of internal auditing, internal auditors are expected to play new and value-added roles nowadays. These roles are becoming a necessity with the introduction of artificial intelligence applications, specifically with the introduction of Blockchains and smart contracts[1]. As blockchain applications are having several advantages, they are also having some security concerns. These concerns necessitate the development of unique internal controls that reduce and manage the control risk related to these applications. It is expected that internal auditors can fulfill their roles by providing consulting services on corporate governance, internal controls, and risk management related to blockchain applications. On the other hand, internal auditors may provide assurance services on whether the internal controls, corporate governance, and risk management related to blockchains are designed and operating according to the appropriate criteria and standards.

[1] Smart contract is a computerized transaction protocol that performs certain actions on behalf of the user based on pre-determined terms (Szabo, 1994; Rozario and Thomas, 2019)

It is necessary that internal auditors keep pace with information technology advancements and focus on newer technologies (Deloitte, 2019). Accordingly, they are required to adapt themselves to the opportunities and risks related to blockchain technology (Deloitte, 2019). It is expected that internal auditors provide their traditional assurance service, provide their trusted business advice and participate in the anticipation and evaluation of blockchain risks (Deloitte, 2019).

Internal auditors' consulting and assurance roles on blockchain applications will add value to the organizations and will have a positive effect on the users' perception of the quality of information generated from the blockchain. However, as information technology is becoming more complicated and requires a higher level of expertise and initial investment cost, many organizations are moving towards outsourcing blockchain applications. The Egyptian Customs Authority is one of these organizations. Given this information, how will the positive effect of internal auditors' consulting and assurance roles on blockchain-related internal controls will differ when these applications are outsourced versus the development and management of these applications by the Egyptian Customs Authority.

The research questions may be formulated as follows:

- Will the internal auditor's assurance role on blockchain application-related internal controls adopted by the ECA enhance the user's perception of information quality, in comparison with the case when there is no assurance?
- Will the internal auditor's consulting on blockchain application-related internal controls adopted by the ECA enhance the user's perception of information quality, in comparison with the case when there is no assurance?
- Does the impact of the internal auditor's assurance on the blockchain application-related internal controls adopted by the ECA on the user's perception of information quality differ in case the Blockchain application is in-house developed versus it is outsourced?

- Does the impact of the internal auditor's consulting on the blockchain application-related internal controls adopted by the ECA on the user's perception of information quality differ in case the Blockchain application is in-house developed versus it is outsourced?

This research aims to investigate the impact of internal auditor assurance and consulting roles on the blockchain application-related internal controls adopted by the ECA on the user's perception of information quality, completeness, confidentiality, timeliness, accuracy, validity, reliability, and security. The researchers will analyze whether the internal auditor's assurance and consulting roles on the blockchain application-related internal controls will enhance the usefulness of the information provided by this application and whether this effect will differ whether this application is outsourced or in-house developed by the ECA.

The importance of this research stems from the research gap related to the impact of blockchain technology and the related internal auditors' consulting and assurance roles on users' perception of information quality. Prior studies (for example, Garanina, et al., 2021) called for future research focusing on the effect of blockchain on the timeliness of disclosures and noted that the dilemma of blockchain application in auditing lies in reaching the right tradeoff between the confidentiality of the information and its transparency.

In addition, this research is of great significance due to its application to one of the most important governmental sectors in Egypt, which is the Egyptian Customs Authority. This authority is the first one to rely on blockchain technology in collecting the required documents and information.

To fulfill the research objective and to answer its questions, **the rest of the research will be organized as follows**: Section 2 will provide an overview of the Egyptian Customs Authority, analyze prior literature related to blockchain technology and the internal auditors' consulting and assurance roles in this regard and develop the research hypotheses. Section 3 will present the research methodology and experimental design. Section 4 will

analyze the experimental results. Section 5 will conclude and present the research recommendations and implications for future research.

2. Literature Review and Hypotheses Development

2.1. Egyptian Customs Authority

The Egyptian Customs Authority (ECA) is one of the bodies affiliated with the Ministry of Finance in accordance with Law no. 66 of 1963 and Law no. 12 of 1964 and their amendments. Its role extends from collecting fees and taxes to monitoring goods imported and exported to Egypt and from abroad. The ECA launched its National Single Window for Foreign Trade Facilitation (NAFEZA) in 2021 and the Misr Technology Services (MTS) cooperated with CargoX to provide the Customs authority with public Ethereum Blockchain services for the coming five years. Permissionless or public blockchains are quite common in government applications so that services are available to all people (Bonyuet, 2020)

According to the new Customs Law No. 207 of 2020 (Article 83), the minister of Finance decisions No. 222, 328, 340, and 490, of 2021, especially regarding the pre-registration systems of shipments, the ECA applies blockchain technology and use CargoX as the official online document transfer platform as of 1/10/2021. Accordingly, Egypt is one of the first countries to adopt a digital ACI (Advance Cargo Information) system using blockchain technology. This new system is implemented to improve processing and clearance time and reduce costs for companies exporting goods to Egypt. Since the launching of this automated system, the customs processing time has improved by 55% (www.bloomberg.com).

2.2. Overview of Blockchain Technology

Blockchain technology or distributed ledger technology (Ramachandran, et al., 2023) is one of the key pillars of industry 4.0 (Deloitte, 2019). It is one of the currently trending artificial intelligence applications (Zemánková, 2019) that started when Satoshi Nakamoto published his white paper in 2008 (Nakamoto, 2008), introducing Bitcoin. Gurtu and Johny (2019, p. 883) de-

fined blockchain as "a chain of interconnected encrypted blocks". Fanning and Centers (2016, p. 53) defined blockchain as "a distributed database that maintains a continuously growing list of data records that are hardened against tampering and revision, even by operators of the data store's nodes". It is a distributed ledger, where transactions and related data are stored in a series of blocks that form a chain. These blocks are ordered according to the transaction time. The transaction in the blockchain starts when the sender creates a transaction and sends it to the network. Then the participants (nodes) in the network start to validate the transaction and a block is created and added to the blockchain once it is validated (Owens, 2017).

There are unique features of blockchain technology. Blockchain technology is cryptographic, as transactions recorded and stored in the blockchain are encrypted using public-private keys. Also, blockchain technology provides real-time transaction records because the transactions are announced on the network once they occur. Finally, blockchain technology hosts smart contracts by using programming codes that enable transactions to be executed once certain conditions appear.

Also, blockchain is also characterized by its immutability, decentralization, and accountability. Immutability means that when the block is completed and added to the blockchain, it can't be reversed. Decentralization is achieved when all participants have access to the blockchain ledger. Accountability is achieved when the digital signature of the user binds him to the transaction (Rozario and Thomas, 2019). These features make this technology appealing for assurance purposes by providing near real-time financial reports, a secure set of records, a tamper-resistant audit trail, and transparency (Rozario and Thomas, 2019).

There are different types of blockchains according to the permission to access and edit. The first type is the permissionless or public blockchain, which is open to all participants to read and write and the identity of participants is anonymous. In this case, the participants in the network are having the same copy of the ledger, and any entity (individual or organization) can

use its computer or mobile phone to access and participate in the network (Liu, et al., 2022). Despite its advantages, public blockchains have a speed limit in processing a large number of transactions. Bitcoin and Ethereum are examples of permissionless blockchains. The second type is the permissioned blockchain, or what is called the "semi-public", where only approved participants are eligible to read and/or write and the identity of those participants is known. The third and last type is the private or the permissioned blockchain, where its access is centralized to one entity, and parties outside this entity are not allowed to participate (Deloitte, 2019).

There are several advantages lying behind using blockchain technology in government applications. These advantages involve combating government corruption, by eliminating intermediaries and third parties, enhancing transparency, reducing costs, and improving efficiency by relying on consensus algorithms and providing faster, permanent, and auditable reconciliation, and finally enhancing security by storing and managing confidential and sensitive information.

Furthermore, blockchain technology, or distributed ledger technology, has different benefits as a result of its unique characteristics. It is expected that the adoption of this technology, will enhance the information quality stored on the blockchain (Liu et al., 2022) and will, in turn, helps in decision-making (Ramachandran, et al., 2022).

First, the adoption of blockchain technology will reduce the level of information asymmetry between different parties (Lev and Gu, 2016; Kurpjuweit, et al., 2021) because once the transaction is validated and added to the network, it will be available to all parties in the same form and content. This provides security and transparency, as any change in the data will be detected easily (Rudra, 2020) and anomalies and suspicious behavior can be detected easily using data analytics (Liu et al., 2022)

Second, blockchain technology increases the level of accuracy on the transaction processing level (Elommal and Manita, 2022), and this will increase the accuracy, reliability, and faithful representation of information rec-

orded on the blockchain (Kokina and Davenport 2017; McCallig et al., 2019).

Third, the immutability feature of blockchain technology will ensure that information added to the blockchain will not be altered for any reason or attacked by any attackers (Rudra, 2020). This feature will increase the integrity and precision of the information recorded on the network and will reduce the risk of fraud (Abdennadher et al., 2022) and earnings management (Liu et al., 2022).

Fourth, because of the cryptographic encryption technology, blockchain technology ensures financial data privacy as external participants can only access it with authorization (Zhang and Shah, 2022). Consequently, it is expected that the accuracy of the information recorded on the blockchain will help managers in making better decisions and in their future projections.

Finally, because data on the blockchain is available in real-time and users can access it at any time, it is expected that blockchain technology will increase financial reporting timeliness (Liu, et al., 2022)

On the other hand, blockchain technology can impose different risks. ID theft is one of those risks, if the private key is lost or stolen, no one can recover it. Also, some legal activities, such as illegal drugs or weapons can't be traced because sellers and buyers are anonymous. Although it is difficult to hack the records stored on the network, the programming codes and systems may be hacked. Also, the network is subject to a 51% attack[2], which might occur if the hash value is short, or the number of participants is not large enough to avoid this attack (Li, 2017). Also, scalability is one of the problems related to blockchain technology, which refers to the ability of the system to work in case the size or volume of transactions increases. It means that the processing time of the blockchain will not increase even if more resources are added to the network (Noh, et al., 2020). In addition, one of the main chal-

[2] 51% attack or the majority rule attack means that any group with 51% computational power may have the opportunity to modify the history of the blockchain and insert inaccurate data to form fraudulent transaction (Bonyuet, 2020)

lenges that impede the adoption of blockchain technology is the trade-off between transparency and confidentiality, as all participants in the public blockchain have a copy of every transaction (Wang and Kogan, 2018). Finally, programming errors and systems weaknesses are other practical problems (Zemánková, 2019). Collusion risk might happen when most of the blockchain users control the network and retroactively change the transactions (Rozario and Thomas, 2019).

In addition, the decentralization, and the absence of a third party might result in no one being accountable for wrong things. Also, the complexity behind the blockchain technology means that it will be difficult to find experts and so it will be difficult for managers to oversee the application and use of blockchain (Deloitte, 2020).

Companies adopting blockchain technology will need to analyze the risks that are related to blockchain technology adoption and design and operate appropriate internal controls to address those risks and ensure that the company will fulfill its objectives. For example, to reduce fraud and cybersecurity risks, organizations should operate access controls and implement suitable segregation of duties between those who authorize the transaction and those who record it. Also, organizations should adopt preventive and detective controls to prevent intruders from accessing the network or detect any intrusion into it. Furthermore, companies should take steps to manage access to their private keys and implement suitable internal controls to validate the effective design and implementation of smart contracts (Deloitte, 2020).

Blockchain technology is used in different areas, such as finance, electronic voting, smart contracts, public and tax administration, and supply chain management. According to Francisco and Swanson (2018), blockchain technology enhances the level of supply chain transparency that allows supply chain managers to acquire the information that consumers are asking for and this will in turn will add to the company's competitive advantages. In addition, this technology will enable firms to mitigate supply chain risks by offering reliable ways to track the products throughout the supply chain process.

Trust is a key feature of blockchain because the data integrity and distributed nature of blockchain will enable its users to transact with a high degree of trust based on the information provided by the blockchain. Furthermore, the elimination of intermediaries and third parties will reduce human errors. In this field, it is important to know the ownership histories, and blockchain technology will help in improving supply chains by providing a suitable infrastructure to certify, register and track goods and services as they move through the supply chains (Owens, 2017). Blockchain may be suitable for supply chain management, as shipping companies using this technology can share shipping documents, such as bills of lading, sales contracts, certificates of origin, and other related documents immediately and safely (Gurtu and Johny, 2019). This will help in tracking participants performing every action, shipments, and deliveries without the need for intermediaries (Gurtu and Johny, 2019). As a result, the levels of efficiency, trust, and transparency will increase and the cost and risk of documents being delayed, falsified, or modified will decrease (Kshetri, 2018). Blockchain technology will improve trust, security, and transparency (Gurtu and Johny, 2019; Hew et al., 2020) and will improve supply chain visibility and help in supply chain traceability (Francisco and Swanson, 2018).

Based on this discussion, the researchers can conclude that blockchain technology is a disruptive technology that affects business processes and is applied in different areas. It has its own characteristics that result in its advantages, such as decentralization, immutability, accountability, cryptography, and tamper-proof audit evidence. It is expected that the adoption of blockchain technology will enhance the qualitative characteristics of the information recorded on the blockchain by enhancing its accuracy, timeliness, validity, security, reliability, and confidentiality. Despite these advantages, blockchain technology exposes companies adopting it to different technological and security risks. As a result, companies adopting blockchain applications will need to design and implement controls that minimize those risks and will seek advisory and assurance services to ensure that suitable internal controls

are being designed and operating in a way that reduces the effect of such risks and to ensure that the organizations are fulfilling their objectives. It is important to highlight that this new technology has implications and consequences on the responsibilities of both the external auditors and internal auditors and the services they offer to the companies adopting this technology. Accordingly, this research paper focuses on the effect of adopting blockchain technology on the internal auditors' assurance and consulting role in this regard.

2.3. Analysis of Internal Auditors' Role in the Era of Blockchain Technology and Hypotheses Development

According to the IIA's International Professional Practices Framework (IIA, 2017), "Internal auditing is an independent, objective assurance and consulting activity designed to add value and improve an organization's processes. It helps an organization accomplish its objectives by bringing a systematic, disciplined approach to evaluate and improve the effectiveness of risk management, control, and governance processes". This definition implies that the role of internal auditors is not limited to financial checks, however, they can play a vital role in their organizations by offering their added value assurance and consulting services in different areas, risk management, control, and governance.

Internal auditors' role has been exemplified with the development of information technology and the automation of business processes. Before discussing the internal auditors' consulting and assurance role in the blockchain era, it is important to analyze how this technology will affect the internal auditors' skills and work and emphasize that the role of auditors won't disappear with the adoption of blockchain technology. Auditors are still required to provide their professional judgments and need to upgrade their skills as advisors and consultants regarding different issues, such as depreciation and amortization methods, accounting policies related to inventories and fair value accounting, and how to recognize and report the different kinds of cryptoassets and transactions (Garanina, et al., 2021). Internal auditors should have an ap-

propriate background in internal audit and accounting background and specific technical skills such as coding and cybersecurity, which are necessary to deal with this technology (Kloch and Little, 2019). In addition, they need to update their understanding of the internal and external risks related to blockchain technology and develop their own framework to verify the blockchain components and to make sure that functioning correctly, such as access rights, encryption, smart contract transaction codes, and control and security procedures (Kloch and Little, 2019; Zhang and Shah, 2022).

It is expected that the adoption of blockchain technology will change the way audit and control activities will be implemented (Gauthier and Brender, 2021). This technology will increase the auditability of accounting information (Dai and Vasarhelyi, 2017) and auditors can benefit from this technology from different perspectives.

First, blockchain technology improves the reliability of the accounting information system (Alles, 2018) and the generated audit evidence, by enhancing its relevance (quality) and sufficiency (quantity). It enhances the integrity of audit evidence because using automated tools will increase the reliability of the data collection process than using traditional data collection methods. Blockchain technology will eliminate the need for confirmations and will increase the accuracy of audit valuation and estimates (Zemánková, 2019). It provides auditors with a tamper-proof audit trail and enhances the reliability of internal and external audit evidence (Rozario and Thomas, 2019). Also, blockchains enable auditors to store financial and nonfinancial information from different sources (Rozario and Thomas, 2019).

Second, the availability of data in blockchain will make auditors save time spent in traditional auditing procedures, such as reconciliations and confirmations, and instead will devote more time to areas that need a higher level of professional judgment (Kokina and Davenport, 2017), thus enhancing the level of audit quality. Also, they will have more time to analyze and interpret data, which makes it more useful for management and other decision-makers (Elommal and Manita, 2022).

Third, blockchain technology will make auditors focus on control testing instead of testing transactions and test all client data instead of relying on sampling (Elommal and Manita, 2022; Hasan, 2022), thus enhancing the level of audit efficiency.

Fourth, blockchain technology will increase financial reporting timeliness and reduce audit lag, as auditors' demand for internal and external audit evidence will be reduced because all data is available on the blockchain (Liu et al., 2022). As a result, audit efforts and fees are expected to be lower in case the firm being audited is using blockchain. Furthermore, blockchain technology will help auditors to move toward continuous auditing by offering real-time access to transaction data and records (Liu, et al., 2019; Zhang and Shah, 2022). This will result in the instant detection of errors and anomalies and improvement in the related internal controls (Elommal and Manita, 2022) and will allow for real-time monitoring and auditing (Sheldon, 2019; Garanina, et al., 2021; Hasan, 2022). In addition, auditors will be able to monitor the changes in the blockchain continuously all over the year, and they can offer faster assurance and can provide timely financial information to managers and other internal stakeholders, and this will in turn enhance the timeliness and relevance of financial information recorded and used in the decision-making process.

Finally, blockchain technology will push auditors towards more consulting and advisory services (Bakshi, 2021). They will provide more value-added services and become more IT-oriented and future-looking (Brender et al., 2019). Here, auditors can help their companies in implementing new technologies and systems, can assess the risk management process related to blockchain, and give their companies advice to improve the internal control and risk management programs (Elommal and Manita, 2022) and solutions to issues related to blockchain applications, such as control design, change management, and governance of blockchains. In addition, auditors might be requested to provide their assurance services concerning the reliability, credibil-

ity, and authorization process of blockchain transactions in the future (Garanina, et al., 2021).

Internal auditors will offer consulting and assurance services in the new digitalized environment. Although the assurance role of internal auditors is considered an important one, however, it is expected that the internal auditors' consulting role will increase as a result of the development in the economic and regulatory environment. Despite this, it is important to note that offering both roles will increase role ambiguity and will threaten the internal auditors' independence and objectivity. Internal auditors' role and scope have changed with digitalization. The demand for internal auditors' consulting roles has increased and for internal auditors to become business partners and not just controllers. However, because the independence and objectivity of internal auditors might be threatened, it is suggested that internal auditors provide their advisory role without bearing any responsibility. Internal auditors are in an advantageous position in the organization, as they have access to all systems and they are inside the organization and report to the audit committee directly (Betti and Sarens, 2020).

Assurance services involve internal auditors' evaluation of evidence related to an entity, operation, function, process, system, or any other subject matter in order to offer an opinion or conclusion concerning this subject matter. Internal auditors determine the nature and the scope of the assurance service. Here, there are three parties involved in this engagement, the party that is involved directly with the subject matter, the internal auditor offering the assurance service, and the party that relies on the internal auditor's assurance report. Prior research investigated the added value of internal auditors' assurance services and found that these services have affected the financial performance of the companies positively (Newman and Comfort, 2018), are perceived to add value from the investors' and stakeholders' perspectives and increase their confidence (Caratas and Spatariu, 2004).

Concerning internal auditors' role in assessing blockchain-related controls, it is expected that internal auditors will play an important role in evalu-

ating the internal controls related to the adoption of this technology. Regarding the data related to blockchain, internal auditors may need to understand the data stored in the related blocks and review the volume of data stored and the speed to process this data. Also, internal auditors will need to verify the appropriateness of the codes to the intended purposes and verify data confidentiality and privacy and validate that related structures are working properly. Concerning data storage, internal auditors are expected to evaluate the data storage controls and business continuity plans. Also, internal auditors will need to evaluate the access controls and make sure that they are adequate and being implemented (Kloch and Little, 2019).

In this research, the three parties involved in the assurance on the blockchain-related internal controls in the Egyptian Customs Authority will be: the blockchain adopter or manager (which might be CargoX in case of outsourcing and CustomsX in case of insourcing), the internal auditor, and the decision maker in the Egyptian Customs Authority who relies on the internal auditor's assurance report to evaluate the quality of information on the blockchain. It is worth noting that internal auditors' assurance role in the blockchain era might be in the form of assuring the effectiveness of the internal controls related to blockchain and risk management programs designed and operating to mitigate the different types of risks related to the adoption and application of blockchains. It is important to note also that although blockchain technology features, such as decentralization, irreversibility, transparency, and tamper-proof data enhance the information quality from its users' point of view, there are several risks related to this technology. These risks might include common IT risks, coding errors, cybersecurity risks, confidentiality risks, risks of fraud, and risks of data manipulation (Corazza, et al., 2023). These risks might reduce the value of information quality stored on the network.

Internal auditors might help in this regard and offer value-added services to their company by offering their assurance service on blockchain-related internal controls. Their assurance role will enhance the effectiveness of the

internal control system and the users' reliance on the information presented in the financial statements. As a result, the financial reporting quality, measured by the quality of accounting information, in terms of its completeness, confidentiality, timeliness, accuracy, validity, reliability, and security will be enhanced, and the blockchain users' perception of the information quality is expected to be affected positively.

Based on the discussion above, the first research hypothesis (*H1*) is stated as follows:

H1: Internal auditor's assurance role on blockchain application-related internal controls will have a significant positive effect on user's perception of information quality in the ECA.

On the other hand, consulting and advisory services are offered based on the request of the engagement client or management, who determines the nature and the scope of the consulting engagement. In the consulting engagement, there are only two parties involved in this engagement, the engagement client, who requested the consultation or advice, and the internal auditor who offers this advice. In this research, the Egyptian Customs Authority will be the party asking for consulting services concerning blockchain-related internal controls and the internal auditor will be the party offering this service. It is important to note that consulting services involve advisory-type services that add value to the organization and contribute toward improving the organization's processes related to governance, risk management, and controls without having management responsibility on the side of internal auditors (IIA, 2017; Newman and Comfort, 2018). They may be requested to provide consulting services and recommendations to help management in improving the control system in certain areas (Shahimi, et al., 2016) because they have adequate knowledge of the company they support (Rooney, et al., 2017).

Accordingly, it is expected that internal auditors' consulting and advisory services related to blockchain application-related internal controls will have a positive effect on enhancing the effectiveness of the internal control system,

which in turn will increase the users' reliance on the financial statements and their contents. As a result, the financial reporting quality, in terms of its completeness, confidentiality, timeliness, accuracy, validity, reliability, and security will be enhanced and accordingly, the blockchain users' perception of information quality is expected to be affected positively.

Based on the discussion above, the second research hypothesis (*H2*) is stated as follows:

H2: Internal auditor's consulting role on blockchain application-related internal controls will have a significant positive effect on user's perception of information quality in the ECA.

Outsourcing[3] information technology processes is an important issue to highlight. As blockchain technology is a new and complicated technology, some companies might go for outsourcing its application and management, as required technological skills might not be available in their information technology team. It is important to discuss the pros and cons related to outsourcing blockchain technology and its insourcing.

Concerning outsourcing information technology, prior research (Pankowska, 2019; Mtsweni, et al., 2021) discussed the advantages and disadvantages of outsourcing information technology. The advantages of information technology outsourcing involve easier access to technical experts and programmers and no need for recruiting highly technical human resources. On the other hand, outsourcing information technology means losing control of the IT process (Mtsweni, et al., 2021). In addition, outsourcing might result in the loss of organizations' valuable and confidential information, as a result of equipment theft or information security breaches, or lack of commitment from the service provider's side (Mtsweni, et al., 2021) that might put the company at risk and might expose the company to the risk of service provider failure (Pankowska, 2019). Also, the reliability of outsourced service

[3] Outsourcing is defined as "subcontracting service and manufacturing works to external business units" (Pankowska, 2019, p. 2)

is not guaranteed as it depends on the service provider (Mtsweni, et al., 2021). There are several barriers that may prevent the company from adopting blockchain technology, such as a lack of blockchain-skilled specialists or experts in the labor market or firm internal technical expertise (Kurpjuweit, et al., 2021)

As for insourcing information technology, prior research concluded that the advantages of having information technology processes in-house involve more control of the processes' application and management and more technological independence. On the other hand, insourcing information technology requires high investment costs and the recruitment of highly technical experts in information technology.

Accordingly, it is expected that internal auditors' consulting and assurance services concerning blockchain internal control applications will increase the effectiveness of the internal control system. Also, it is expected that internal auditors' roles will enhance the users' reliance on the financial statements and the information provided and as a result, the financial reporting quality, and the accounting information, in terms of its completeness, confidentiality, timeliness, accuracy, validity, reliability, and security will be enhanced and accordingly, the blockchain users' perception of information quality is expected to be affected positively. However, because auditors will be highly concerned with the blockchain administrator, who is responsible for the blockchain operation and security (White, et al., 2020), and given the pros and cons of IT outsourcing, this positive effect might differ when the ECA outsources its blockchain applications than when these applications are developed and managed by the authority. Outsourcing blockchain applications might expose the related information to confidentiality risk and the ECA will lose control over the blockchain and related documents.

Based on the discussion above, the third and fourth research hypotheses are stated as follows:

H3: The significant positive effect of the internal auditor's assurance role on blockchain application-related internal controls on user's perception of

information quality in the ECA will differ when the blockchain application is outsourced than when it is developed in-house.

H4: The significant positive effect of the internal auditor's consulting role on blockchain application-related internal controls on user's perception of information quality in the ECA will differ when the blockchain application is outsourced than when it is developed in-house.

3. Research Methodology

3.1. Participants

The initial target population of this study was the managers and decision makers at the ECA in Egypt. After making a pilot study on the targeted decision makers, the response rate was very low, and it was difficult to conduct the experiment on the targeted participants. As a result, the researchers chose the MBA students and the faculty members at the Faculty of Business, Alexandria University as a proxy of managers and decision makers to conduct the experimental study (Besuglov and Crasselt, 2021).

The initial sample was 134 participants (84 MBA students with professional background and 50 faculty members). After excluding the participants who failed to answer at least one of the two manipulation check questions correctly, the final sample was 105 participants (70 MBA students and 35 faculty members) distributed among two groups: Group (1) which is the **Assurance Group** and it includes 60 participants, and Group (2) which is the **Consulting Group**, and it includes 45 participants.

3.2. Experimental Task and Design

To test the research hypotheses and investigate the effect of internal auditors' assurance and consulting roles regarding blockchain application related internal controls on users' perception of information quality, two 3X1 within subjects experimental design were designed. The first experiment was for the assurance role of internal auditors and the second one was for the consulting role of internal auditors.

The two independent experiments were being conducted parallel to each other and run through three stages (cases) as follows, where each stage is representing a specific case:

- **Stage** (**1**) (**No Internal Audit**):

Participants in both experiments were presented with the materials explaining the case of the ECA and its reliance on the blockchain application supported by an external party (CargoX Company) to benefit from its advantages and reduce the risk of incomplete or incorrect data. After the participants read the case and understand it thoroughly, they are requested to answer the related questions which are divided into two parts, the first one is dealing with their understanding of the case and how they evaluate the situation of the ECA. Participants are asked to evaluate the risk level, the situation of the ECA as a result of using blockchain technology, the advantages related to using blockchain in the forms of tracking goods in real-time and reducing the potential of fraud. The second part of the questions is related to their reliance on CargoX report to take their decision and their perception of information quality (reliability, confidentiality, accuracy, completeness, validity, timeliness, and security) (Rasool and Warraich, 2018; Al-Dmour, et al., 2019).

- **Stage** (**2**) (**Internal Audit – Outsourcing**):

Participants were presented with an additional information related to internal auditor's role, where the case shows that the board of the ECA asked the internal audit department to offer an assurance (consulting) service related to the blockchain application related controls hosted by CargoX company. After reading the case, participants were asked a manipulation check question related to the type of the internal auditor report (whether an assurance report or a consulting report) to make sure that they have read and understood the case presented to them. Then participants were asked to evaluate the risk level that ECA is facing on a scale ranging from 0 to 100, and whether they agree on the statement saying that ECA is in advantageous position and to what extent they can rely on CargoX report and the related assurance (consulting) internal

auditor report to take their decisions. Finally, they are asked to evaluate the different information characteristics related to information quality in this case.

- **Stage (3) (Internal Audit – Insourcing)**:

Additional information related to the development of the blockchain application was presented to participants, where in this stage, the ECA is able to develop the blockchain application by the information technology team (insourcing) instead of outsourcing it to an external party (CargoX). In this case the blockchain application will be given a new name which is CustomsX. After that, participants were asked a manipulation check question so as to make sure that they have read the case carefully and understood it. The manipulation check question was related to the developer of the blockchain application (whether it is an external party or the IT team at the ECA). Then participants were asked again to evaluate the risk level, whether the ECA is in an advantageous position and their reliance on the CustomsX report delivered by the internally developed blockchain application and the internal auditor's report in taking their decisions. Finally, participants were asked to evaluate the characteristics of information quality as a result of this added information.

It is important to mention that when the researchers test their research hypotheses related to the impact of internal auditor's role (whether assurance or consulting role) on the user's perception of information quality, they compared the responses of the participants related to the questions of risk level and reliance on CargoX report to support their justification of their results. This is in addition to the significant differences in the participants responses related to the characteristics of information quality. It is expected that if participants viewed the value-added role of internal auditors (whether the assurance or the consulting role), they will reduce their assessment to the risk level that the ECA is facing and will increase their reliance on the CargoX report. In addition, users' perception of information quality will be significantly higher when the internal auditor's report is added to the CargoX report than when it is not available.

Outsourcing of Blockchain Application / Internal Auditor's Role	**Outsourcing (O)**	**Insourcing (I)**
Assurance Role (A)	Group (1) X Case (2) (AO)	Group (1) X Case (3) (AI)
Consulting Role (C)	Group (2) X Case (2) (CO)	Group (2) X Case (3) (CI)
No Internal Audit (N)	Case (1) (NO)	

Figure 1: Experimental Groups

Source: The Researchers

Concerning the moderating effect of outsourcing the blockchain application on the relationship between the internal auditor's role and the user's perception of information quality, the researchers are expecting that the risk level assessed by the participants will be reduced significantly as a result of developing and managing the blockchain application by the IT team at the ECA instead of outsourcing it so as to maintain the confidentiality and security of related information. In addition, the researchers are expecting that the reliance on the CustomsX report will be significantly higher than that on the CargoX report and the participants' perception of information quality will be higher in the insourcing case than that in the outsourcing case.

Based on Figure (1), it can be noted that the following experimental cases are developed:

- Case (1) when there is no internal audit report available and the blockchain application is outsourced (**NO**),
- Case (2) when the internal audit report is presented to the participants of the assurance group (**AO**), and the consulting group (**CO**), and
- Case (3) when the developer of the blockchain application is the IT team at the ECA and the internal audit report is presented to the assurance group (**AI**) and the consulting group (**CI**).

3.3. Research Variables:

3.3.1. Independent Variables:

- Internal auditors' assurance role on blockchain application–related internal controls:

This variable was manipulated when the experimental case developed will show that the internal auditor is presenting an assurance report on the block-chain application related internal controls. The researchers will compare the average user's responses to the information quality-related questions in case the internal auditor is providing an assurance report on blockchain application (AO) than when this assurance report is not provided (NO) (Stevenson, 2020).

- Internal auditors' consulting role on blockchain application–related internal controls:

This variable was manipulated when the developed experimental case shows that the internal auditor is presenting a consulting report on the blockchain application related internal controls. The researchers will compare the average user's responses to the information quality-related questions in case the inter-nal auditor is providing a consulting report on blockchain application (CO) than when this consulting report is not provided (NO) (Stevenson, 2020).

3.3.2. Dependent variable:

- User's perception of information quality:

This variable will be measured by the average responses of participants on the following statements:

1) Please assess the degree of the reliability of data provided to the ECA rang-ing from low to high.

0 ------10------20------30------40------50------60------70------80------90------100

2) Please assess the degree of the confidentiality of data provided to the ECA ranging from low to high.

0------10------20------30------40------50------60------70------
80------90------100

3) Please assess the degree of the accuracy of data provided to the ECA ranging from low to high.

0 ------10------20------30------40------50------60------70------
80------90------100

4) Please assess the degree of the completeness of data provided to the ECA ranging from low to high.

0 ------10------20------30------40------50------60------70------
80------90------100

5) Please assess the degree of the validity of data provided to the ECA ranging from low to high.

0 ------10------20------30------40------50------60------70------
80------90------100

6) Please assess the degree of the timeliness of data provided to the ECA ranging from low to high.

0 ------10------20------30------40------50------60------70------
80------90------100

7) Please assess the degree of the security of data provided to the ECA ranging from low to high.

0 ------10------20------30------40------50------60------70------
80------90------100

3.3.3. Moderating variable:

- Outsourcing of Blockchain application:

This variable was manipulated by changing the developer of the blockchain application, where users are presented with information showing that the developer of the blockchain application is CargoX company (outsourcing) or the information technology team at the ECA (CustomsX) (insourcing).

The researchers will compare the participants' responses to the information quality related questions in the second case, when blockchain application is outsourced (AO) (CO) with that in the third case when the application is in-house developed (AI) (CI) respectively (Stevenson, 2020).

Research Model

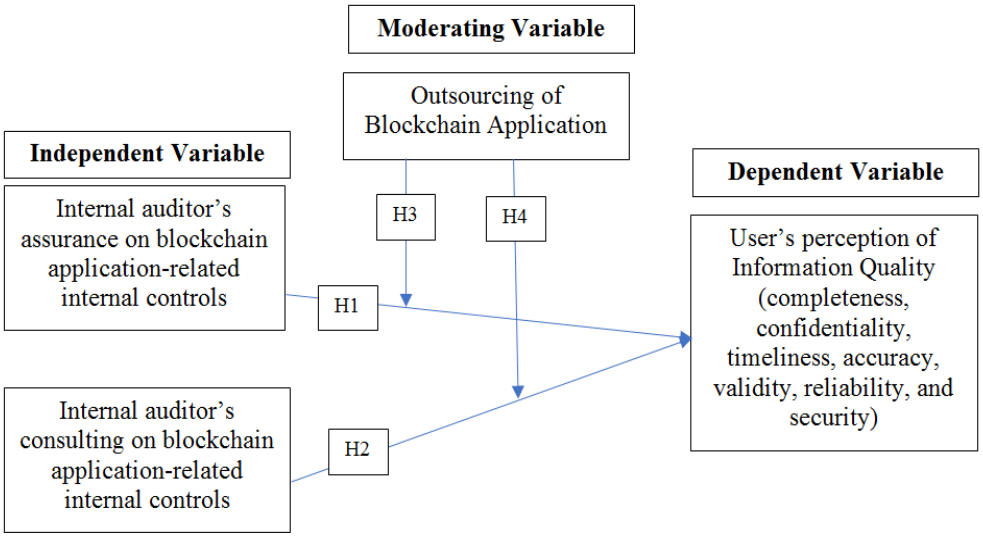

Figure 2: Research Model

Source: The Researchers

4. Experimental Results

4.1. Manipulation and Attention Check Questions

The researchers asked participants in the two groups one manipulation check question in Case (2) (Outsourcing) regarding the type of the internal audit report presented to them so as to make sure that participants know the

role of internal auditors inside the ECA and another manipulation check question in Case (3) (Insourcing) regarding the developer of the blockchain application so as to make sure that they understood that the developer in the third case has changed to be the IT team at the ECA.

Also, participants of both groups were asked in Case (1) (NO) only to assess the potential of fraud and benefits associated with using blockchain technology in the form of data transparency, and real time tracking of goods so as to make sure that they understood the pros and cons of relying on such technology. In addition, participants of both groups were asked to assess the risk level that the ECA is facing, to what extent they can rely on CargoX report (in cases 1 and 2) and on CustomsX report (in case 3) and on the internal audit report (in cases 2 and 3) to take their decisions.

Then to test the users' perception of information quality, the researchers asked the participants to assess the reliability, confidentiality, accuracy, completeness, validity, timeliness, and security of data under the three different experimental cases (Stevenson, 2020).

4.2. Descriptive Statistics

In this section, the researchers will present the descriptive statistics of the participants' demographic data of both groups and their responses to the different questions.

It is clear from Table (1) (Panel A) that there are 70 participants out of 105 participants (66.7%) with professional background. 40% of the participants has less than 10 years of experience in their work. Only 16.2% of the participants hold certified degrees, while 83.8% don't hold any professional certificates. 65 males (61.9%) participated in the experimental study. 80% of the participants are having an average or above average experience in IT. As for the experience in blockchain technology, it can be noticed that 42.9% of the participants are having an average or above average experience.

Concerning the average responses of the participants on the supplementary questions in Case (1), it can be observed that in this case, when the Car-

goX report is available while the internal audit role doesn't exist, participants perception regarding the advantageous position of the ECA is ranging from 2 to 3 and they agree that using blockchain technology will help in data transparency and tracking goods in real time (median = 4), however, participants are still concerned that the potential of fraud is likely (median = 4).

Table 1: Descriptive Statistics

Panel A: Demographic Data

Variable		Frequency	Percent	Cumulative
Background	Professional	70	66.7	66.7
	Academic	35	33.3	100
		105	100.0	
Years of Experience	Less than 5 years	20	19.0	19.0
	From 5 years to less than	22	21.0	40.0
	From 10 years to less than	39	37.1	77.1
	From 15 years and over	24	22.9	100.0
		105	100.0	
Certification	Yes	17	16.2	16.2
	No	88	83.8	100.0
		105	100.0	
Gender	Male	65	61.9	61.9
	Female	40	38.1	100.0
		105	100.0	
Experience in IT	Much worse than average	6	5.7	5.7
	Worse than average	9	8.6	14.3
	Somewhat worse than	6	5.7	20.0
	Average	41	39.0	59.0
	Somewhat better than av-	19	18.1	77.1
	Better than average	23	21.9	99.0
	Much better than average	1	1.0	100.0
		105	100.0	
Experience in Blockchain Technology	Much worse than average	15	14.3	14.3
	Worse than average	33	31.4	45.7
	Somewhat worse than	12	11.4	57.1
	Average	30	28.6	85.7
	Somewhat better than av-	6	5.7	91.4
	Better than average	6	5.7	97.1
	Much better than average	3	2.9	100.0
		105	100.0	

Panel B: Categorical Variables (Supplementary Questions)

	Whole Sample		Assurance sample		Consulting sample	
	Median	**Standard Deviation**	**Median**	**Standard Deviation**	**Median**	**Standard Deviation**
Advantageous position	2.00	1.03	2.00	0.93	3.00	1.12
Information transparency	4.00	0.89	4.00	0.85	4.00	0.94
Real-time tracking goods	4.00	0.78	4.00	0.88	4.00	0.62
Potential of fraud	4.00	0.79	4.00	0.82	4.00	0.74

Panel C: Continuous Variables (Main Questions) - Assurance Group

	Case (1)		Case (2)		Case (3)	
	Mean	**Standard Deviation**	**Mean**	**Standard Deviation**	**Mean**	**Standard Deviation**
Risk level	74.33	21.10	46.67	22.89	39.50	31.54
Reliance on CargoX (CustomsX) report	44.83	21.03	66.50	17.55	79.00	18.75
Reliance on Internal audit report			72.67	15.17	80.00	17.07
Reliability	45.00	20.46	70.33	14.84	81.17	16.98
Confidentiality	40.83	26.44	57.67	25.40	82.33	17.31
Accuracy	47.17	21.32	68.67	15.89	81.67	16.48
Completeness	54.83	23.25	70.00	17.47	79.75	18.56
Validity	47.50	20.39	69.67	15.83	81.50	16.96
Timeliness	61.17	22.18	73.17	15.13	82.17	14.97
Security	39.00	25.82	61.67	23.37	82.67	17.55
Quality of information	47.93	17.92	68.25	13.70	81.60	15.80

Panel D: Continuous Variables (Main Questions) - Consulting Group

	Case (1)		Case (2)		Case (3)	
	Mean	**Standard Deviation**	**Mean**	**Standard Deviation**	**Mean**	**Standard Deviation**
Risk level	69.78	19.01	51.33	19.38	44.00	28.56
Reliance on CargoX (CustomsX) report	56.89	19.40	62.89	17.27	76.44	18.24
Reliance on Internal audit report			70.22	17.25	75.56	19.25
Reliability	56.89	22.14	62.22	18.57	78.22	14.19
Confidentiality	46.89	26.36	55.11	24.09	80.44	16.09
Accuracy	59.33	23.49	64.67	17.40	80.44	12.96
Completeness	58.67	23.41	65.78	18.28	79.33	13.04
Validity	58.00	23.32	63.78	16.28	81.11	13.69
Timeliness	70.44	22.76	72.89	15.61	81.11	13.01
Security	50.22	25.27	57.78	22.95	81.56	15.66
Quality of information	57.20	20.63	64.07	15.54	80.32	12.65

As for the main questions related to users' perception of information quality and supporting questions relating to their evaluation of risk level and reliance on the blockchain report and internal audit report, it can be noticed that in Panels C and D, which show the average participants' responses of the assurance and consulting groups respectively on the aforementioned questions in the three cases, participants' evaluation of risk level facing the ECA is higher in Case (1) and then it is reduced in Case (2) and is reduced again in Case (3). Also, participants' reliance on CargoX report is higher in Case (2) when the internal audit report is presented than that in Case (1) when there is no internal audit report. Their reliance on CustomsX report increased significantly in Case (3) in comparison to their reliance on CargoX report in Case (2). Also, participants' reliance on internal audit report is greater in Case (3) in comparison to that in Case (2). As for the participants' evaluation of the different information quality characteristics, Table (1) revealed an increase of the participants' perception of all information quality characteristics as we move from Case (1) towards Case (3). It is important to note that the participants' evaluation of information confidentiality and security have shown a noticeable increase as participants move from Case (2) to Case (3), which is as expected because the ECA starts to develop the blockchain application in-house instead of outsourcing it.

Reliability Statistics

The researchers checked the reliability of participants' responses on the different questions related to the three cases using Cronbach's Alpha. As shown in Table (2), Cronbach's Alpha statistic is higher than 89% for all questions and for the main questions (related to information quality characteristics) of the whole sample and for the assurance sample (Group 1) and the consulting sample (Group 2) (Suryandari and Yuesti, 2017).

Table 2: Reliability Statistics

	Cronbach's Alpha	Number of items	No. of cases
All sample (main questions)	0.929	21	105
All sample (all questions)	0.912	35	105
Group (1) Assurance (main questions)	0.915	21	60
Group (1) Assurance (all questions)	0.895	35	60
Group (2) Consulting (main questions)	0.949	21	45
Group (2) Consulting (all questions)	0.933	35	45

Sampling Adequacy and Factor Analysis

To test the sampling adequacy and check whether the 7 questions related to information quality characteristics are measuring one variable, which is the user' perception of information quality, so as to compute a score or an index of the participant's responses (average of responses of each participant of the 7 questions), the researchers made a factor analysis and calculated the KMO measure of sampling adequacy for each of the three cases. It is clear from Table (3) (Panel A) that the KMO statistic is high (ranging from 88.3% to 93.2%) and significant (Sig. = 0.000), indicating that the samples for the three cases are adequate for analysis (Oberoi, et al., 2022).

In addition, the factor analysis in Table (3) (Panel B) which is made on the participants' responses to the information quality characteristics questions in the three cases showed that there is one variable, which is the user's perception of information quality. Accordingly, a new variable is developed which is the user's perception of information quality through averaging the participant's responses to the 7 questions related to information quality in each case. This variable resulted in a level of user's perception of information quality in the three experimental cases.

Table 3: Sampling Adequacy and Factor Analysis

Panel A: KMO and Bartlett's Test

		No Internal Audit	Internal Audit - Outsourcing	Internal Audit - Insourcing
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.887	0.883	0.932
Bartlett's Test of Sphericity	Approx. Chi-Square	556.892	558.073	919.785
	df	21	21	21
	Sig.	0.000	0.000	0.000

Panel B: Component Matrix

	No Internal Audit	Internal Audit - Outsourcing	Internal Audit - Insourcing
	1	1	1
Reliability	0.871	0.857	0.939
Confidentiality	0.778	0.708	0.890
Accuracy	0.916	0.926	0.945
Completeness	0.837	0.898	0.933
Validity	0.903	0.877	0.925
Timeliness	0.654	0.615	0.878
Security	0.838	0.806	0.919

4.3. Preliminary Analysis

To make a preliminary analysis and investigate whether there are significant differences between the participants' perception of information quality in the three dependent experimental cases in the two experimental groups (Assurance and Consulting), the researchers used Friedman test, which is a non-parametric test used to investigate the significant differences between more than 2 dependent samples.

As presented in table (4), there are significant differences in the responses of the participants in the assurance group concerning their evaluation of the information quality. It is clear from the table that the participants' evaluation of information quality is higher in the second case (AO) (2.13) than that in the first case (NO) (1.08) and their evaluation in the third case (AI) (2.78) is higher than that in the second case (AO) and the differences in the participants'

evaluation of information quality between the three cases are significant (Chi-Square = 88.300, Asymp. Sig. = 0.000).

Table 4: Friedman Test Results Comparing the Participants' Evaluation of Information Quality among the Three Cases (Assurance Group)

	Mean Rank	N	Chi-Square	df	Asymp. Sig.
Quality of Information (NO)	1.08	60	88.300	2	0.000
Quality of Information (AO)	2.13				
Quality of Information (AI)	2.78				

Additionally, there are significant differences in the responses of the participants in the consulting group concerning their evaluation of information quality. Table (5) revealed that the participants' evaluation of information quality is higher in the second case (CO) (1.80) than that in the first case (NO) (1.46) and their evaluation in the third case (CI) (2.74) is higher than that in the second case (CO) and the differences in the participants' evaluation of information quality between the three cases are significant (Chi-Square = 41.699, Asymp. Sig. = 0.000).

Table (5) Friedman Test Results Comparing the Participants' Evaluation of Information Quality among the Three Cases (Consulting Group)

	Mean Rank	N	Chi-Square	df	Asymp. Sig.
Quality of Information (NO)	1.46	45	41.699	2	0.000
Quality of Information (CO)	1.80				
Quality of Information (CI)	2.74				

4.4. Hypotheses Testing

4.4.1. Testing (H1)

To test the first research hypothesis (*H1*), which expects that the assurance role of internal auditor is valued from the users' point of view and will significantly and positively affect their perception of information quality, the re-

searchers developed a score for the information quality. This score is the average of each participant's responses to the questions related to the characteristics of information quality (reliability, confidentiality, accuracy, completeness, validity, timeliness, and security). In addition, the researchers compared the participant's responses concerning the evaluation of his/her evaluation of risk level that the ECA is facing and his/her reliance on the CargoX report as a result of issuing the assurance report by the internal auditor in the second case (AO) with his/her responses to the same issues in the first case (NO).

The researchers used Wilcoxon Signed rank test, which is a nonparametric test used to test whether there are significant differences in the responses of two dependent samples, to test the significance of the differences in the users' responses on the risk level, reliance on CargoX report and their perception of the information quality between the first case (NO) and the second case (AO).

Table 6: Wilcoxon Signed Ranks Test Results Comparing the Users' Perception of Information Quality in the Assurance – Outsourcing (AO) Case / No Internal Audit (NO) Case

		N	Mean Rank	Sum of Ranks	Z	Asymp. Sig. (2-tailed)
Risk level (AO) - Risk level (NO)	Negative Ranks	48[a]	30.20	1449.50	-5.334[j]	0.000
	Positive Ranks	8[b]	18.31	146.50		
	Ties	4[c]				
	Total	60				
Rely on CargoX (AO) - Rely on CargoX (NO)	Negative Ranks	8[d]	18.50	148.00	-5.256[k]	0.000
	Positive Ranks	47[e]	29.62	1392.00		
	Ties	5[f]				
	Total	60				
Quality of information (AO) - Quality of Information (NO)	Negative Ranks	2[g]	11.25	22.50	-6.571[k]	0.000
	Positive Ranks	58[h]	31.16	1807.50		
	Ties	0[i]				
	Total	60				

[a] Risk level (AO) < Risk level (NO)
[b] Risk level (AO) > Risk level (NO)
[c] Risk level (AO) = Risk level (NO)
[d] Rely on CargoX (AO) < Rely on CargoX (NO)
[e] Rely on CargoX (AO) > Rely on CargoX (NO)
[f] Rely on CargoX (AO) = Rely on CargoX (NO)
[g] Quality of information (AO) < Quality of Information (NO)
[h] Quality of information (AO) > Quality of Information (NO)
[i] Quality of information (AO) = Quality of Information (NO)
[j] based on positive ranks
[k] based on negative ranks

As shown in Table (6), there is a significant difference between the participants' evaluation of the risk level that the ECA is facing (Z = -5.334, Asymp. Sig. = 0.000) and the participants' evaluation of the risk level is at a lower level in the second case (AO) than that in the first case (NO), indicating that the internal auditor's report contributed towards reducing the participants' perception of the risk level that the ECA is facing. In the same context, there is a significant difference in the participants' reliance on the blockchain report issued by CargoX company in the second case (AO), when internal auditors issue their assurance report than that in the first case (NO) when the internal audit report is not available (Z = -5.256, Asymp. Sig. = 0.000). This result is consistent with the participants' evaluation of information quality which is significantly higher (Z = -6.571, Asymp. Sig. = 0.000) in case the assurance report is issued by the internal auditors in the second case than that when it is not available in the first case, which implies that internal auditors' assurance service is highly valued by decision makers and users of blockchain reports.

This result is in line with prior research findings (Caratas and Spatariu, 2004; Newman and Comfort, 2018) which provided evidence that the internal auditors assurance services have a positive effect on their companies' financial performance and investors' and other stakeholders' confidence and add value to their users and decision makers.

Accordingly, the first research hypothesis (*H1*), which states that "*Internal auditor's assurance role on blockchain application-related internal controls will have a significant positive effect on user's perception of information quality in the Egyptian Customs Authority*" **is supported**.

4.4.2. Testing (H2)

To test the second research hypothesis (*H2*), which expects that the consulting role of internal auditor is valued from the users' point of view and will significantly and positively affect their perception of information quality, the researchers used Wilcoxon Signed rank test to test the significance of the differences in the users' responses on the 7 questions related to information qual-

ity between the first case (NO) and the second case (CO) of the second experiment.

As presented in Table (7), participants' perception of the risk level the ECA is facing is significantly reduced (Z = -4.365, Asymp. Sig. = 0.000) when the consulting report is issued by the internal auditors. Consistently, their reliance on the CargoX report (Z = -1.876, Asymp. Sig. = 0.061) and their perception of information quality (Z = -3.043, Asymp. Sig. = 0.002) have increased significantly when the internal auditors' consulting report accompanied the CargoX report issued on the blockchain application related internal controls (CO) in comparison to that in the case when the internal auditor report is not provided (NO). This result indicates that users of blockchain reports perceive the consulting and advisory services of internal auditors as value added services that contribute towards increasing their trust and confidence in the blockchain output and related internal controls.

This result is consistent with prior research findings (Newman and Comfort, 2018) which demonstrate that internal auditors' consultative roles are perceived to add value to their organizations.

Accordingly, the second research hypothesis (*H2*), which states that *"Internal auditor's consulting role on blockchain application-related internal controls will have a significant positive effect on user's perception of information quality in the Egyptian Customs Authority"* **is supported**.

Table 7: Wilcoxon Signed Ranks Test Results Comparing the Users' Perception of Information Quality in the Consulting - Outsourcing (CO) Case / No Internal Audit (NO) Case

		N	Mean Rank	Sum of Ranks	Z	Asymp. Sig. (2-tailed)
Risk level (CO) - Risk level (NO)	Negative Ranks	32[a]	19.03	609.00	-4.365[j]	0.000
	Positive Ranks	4[b]	14.25	57.00		
	Ties	9[c]				
	Total	45				
Rely on CargoX (CO) - Rely on CargoX (NO)	Negative Ranks	12[d]	16.83	202.00	-1.876[k]	0.061
	Positive Ranks	23[e]	18.61	428.00		
	Ties	10[f]				
	Total	45				
Quality of information (CO) - Quality of Information (NO)	Negative Ranks	15[g]	14.73	221.00	-3.043[k]	0.002
	Positive Ranks	28[h]	25.89	725.00		
	Ties	2[i]				
	Total	45				

[a] Risk level (CO) < Risk level (NO)
[b] Risk level (CO) > Risk level (NO)
[c] Risk level (CO) = Risk level (NO)
[d] Rely on CargoX (CO) < Rely on CargoX (NO)
[e] Rely on CargoX (CO) > Rely on CargoX (NO)
[f] Rely on CargoX (CO) = Rely on CargoX (NO)
[g] Quality of information (CO) < Quality of Information (NO)
[h] Quality of information (CO) > Quality of Information (NO)
[i] Quality of information (CO) = Quality of Information (NO)
[j] based on positive ranks
[k] based on negative ranks

4.4.3. Testing (H3)

To test the third research hypothesis (*H3*), which assumes that the significant and positive effect of the internal auditor's assurance role concerning the blockchain application related internal controls will differ when the blockchain application is developed by an external party (CargoX) than when it is developed and managed by the ECA (CustomsX), the researchers used Wilcoxon Signed rank test to test whether there are significant differences in the participants' responses concerning their evaluation of the risk level the ECA is facing, reliance on blockchain report and perception of information quality in the third case (AI) with that in the second case (AO) of the first experiment.

Table (8) shows that participants' perception of the risk level the ECA is facing is significantly reduced (Z = -2.037, Asymp. Sig. = 0.042) when the blockchain application is insourced (AI) than that when it is outsourced (AO).

Consistently, their reliance on the CustomsX report (Z = -4.194, Asymp. Sig. = 0.000) and their perception of information quality (Z = -5.360, Asymp. Sig. = 0.000) have shown a significant increase when the blockchain application is developed and managed by the ECA and the assurance report is issued by the internal auditors on the blockchain application related internal controls (AI) than that when the blockchain application is hosted by an external party (AO). This result is consistent with the researchers' expectation that information users will have more trust in the blockchain application related internal controls when the application is developed in-house. Confidentiality of information is of paramount importance to decision makers at the ECA, especially that this information is highly confidential and requires higher security levels.

Table 8: Wilcoxon Signed Ranks Test Results Comparing the Users' Perception of Information Quality in the Assurance – Insourcing (AI) Case / Assurance – Outsourcing (AO) Case

		N	Mean Rank	Sum of Ranks	Z	Asymp. Sig. (2-tailed)
Risk level (AI) - Risk level (AO)	Negative Ranks	33[a]	24.71	815.50	-2.037[j]	0.042
	Positive Ranks	16[b]	25.59	409.50		
	Ties	11[c]				
	Total	60				
Rely on CustomsX (AI) - Rely on CargoX (AO)	Negative Ranks	9[d]	20.33	183.00	-4.194[k]	0.000
	Positive Ranks	39[e]	25.46	993.00		
	Ties	12[f]				
	Total	60				
Quality of information (AI) - Quality of Information (AO)	Negative Ranks	10[g]	18.70	187.00	-5.360[k]	0.000
	Positive Ranks	50[h]	32.86	1643.00		
	Ties	0[i]				
	Total	60				

[a] Risk level (AI) < Risk level (AO)
[b] Risk level (AI) > Risk level (AO)
[c] Risk level (AI) = Risk level (AO)
[d] Rely on CustomsX (AI) < Rely on CargoX (AO)
[e] Rely on CustomsX (AI) > Rely on CargoX (AO)
[f] Rely on CustomsX (AI) = Rely on CargoX (AO)
[g] Quality of information (AI) < Quality of Information (AO)
[h] Quality of information (AI) > Quality of Information (AO)
[i] Quality of information (AI) = Quality of Information (AO)
[j] based on positive ranks
[k] based on negative ranks

Accordingly, the third research hypothesis (*H3*), which states that "*The significant and positive effect of the Internal auditor's assurance role on block-chain application-related internal controls on user's perception of information quality in the Egyptian Customs Authority will differ when the blockchain application is outsourced than when it is developed in-house*" **is supported**.

4.4.4. Testing (H4)

To test the fourth research hypothesis (*H4*), which assumes that the significant and positive effect of the internal auditor's consulting role concerning the blockchain application related internal controls will differ when the blockchain application is developed by an external party (CargoX) than when it is developed and managed by the ECA (CustomsX), the researchers used Wilcoxon Signed rank test to test whether there are significant differences in the participants' responses concerning their evaluation of the risk level the ECA is facing, reliance on Blockchain report and perception of information quality in the third case (CI) with that in the second case (CO) of the second experiment.

As shown in Table (9), participants' perception of the risk level the ECA is facing is significantly reduced (Z = -2.017, Asymp. Sig. = 0.044) when the blockchain application is insourced (CI) than that when it is outsourced (CO). Consistently, their reliance on the CustomsX report (Z = -4.021, Asymp. Sig. = 0.000) and their perception of information quality (Z = -5.035, Asymp. Sig. = 0.000) have increased significantly when the blockchain application is developed and managed by the ECA and the consulting report is issued by the internal auditors on the blockchain application related internal controls (CI) than that when the blockchain application is hosted by an external party (CO).

This research finding confirmed prior research results (Mtsweni, et al., 2021) which highlighted that possibility of losing confidential information as a disadvantage of outsourcing information technology applications. Users and decision makers of IT applications value the confidentiality and security of

information when these applications are developed and managed in-house than when they are outsourced to an external party.

Table 9: Wilcoxon Signed Ranks Test Results Comparing the Users' Perception of Information Quality in the Consulting – Insourcing (CI) Case / Consulting – Outsourcing (CO) Case

		N	Mean Rank	Sum of Ranks	Z	Asymp. Sig. (2-tailed)
Risk level (CI) - Risk level (CO)	Negative Ranks	26[a]	22.48	584.50	-2.017[j]	0.044
	Positive Ranks	15[b]	18.43	276.50		
	Ties	4[c]				
	Total	45				
Rely on CustomsX (CI) - Rely on CargoX (CO)	Negative Ranks	9[d]	11.61	104.50	-4.021[k]	0.000
	Positive Ranks	30[e]	22.52	675.50		
	Ties	6[f]				
	Total	45				
Quality of information (CI) - Quality of Information (CO)	Negative Ranks	5[g]	8.40	42.00	-5.035[k]	0.000
	Positive Ranks	36[h]	22.75	819.00		
	Ties	4[i]				
	Total	45				

[a] Risk level (CI) < Risk level (CO)
[b] Risk level (CI) > Risk level (CO)
[c] Risk level (CI) = Risk level (CO)
[d] Rely on CustomsX (CI) < Rely on CargoX (CO)
[e] Rely on CustomsX (CI) > Rely on CargoX (CO)
[f] Rely on CustomsX (CI) = Rely on CargoX (CO)
[g] Quality of information (CI) < Quality of Information (CO)
[h] Quality of information (CI) > Quality of Information (CO)
[i] Quality of information (CI) = Quality of Information (CO)
[j] based on positive ranks
[k] based on negative ranks

Accordingly, the fourth research hypothesis (*H4*), which states that "*The significant and positive effect of the Internal auditor's consulting role on blockchain application-related internal controls on user's perception of information quality in the Egyptian Customs Authority will differ when the blockchain application is outsourced than when it is developed in-house*" **is supported**.

4.5. Other Analyses

In this section, the researchers will made additional analyses to add more insights to the research results. These analyses involve using parametric test which is t-test so as to test the significant differences between the participants'

responses in the different experimental cases. Also, the researchers will investigate the significant differences between the internal auditors' assurance and consulting roles on the users' perception of information quality. Finally, the researchers will investigate whether the effect of internal auditors' roles on the users' perception of information quality will differ according to participants' experience level (experienced versus inexperienced) and according to their background (professional versus academic).

4.5.1. Using T-Test to Test the Research Hypotheses (Assurance Role)

After using one sample t-test to examine the added value of the internal auditor assurance role regarding the blockchain related internal controls (Sanchez, et al., 2012), Table (19) confirms the research results and provided evidence that the internal auditors' assurance role has a positive and significant effect on users' perception of information quality (Mean = 68.25, t = -9.108, Sig. = 0.000).

Table 10: T-Test Results Comparing the Effect of Internal Auditors' Assurance Role on Users' Perception of Information Quality

Paired Samples Statistics					
		Mean	**N**	**Std. Dev**	**Std. Error Mean**
Pair (1)	Quality of Information (NO)	47.9295	60	17.92137	2.31364
	Quality of Information (AO)	68.2500	60	13.69688	1.76826
Pair (2)	Quality of Information (AO)	68.2500	60	13.69688	1.76826
	Quality of Information (AI)	81.6073	60	15.79449	2.03906

Paired Samples Test									
					95% Confidence interval of the differ		**t**	**df**	**Sig. (2-tailed)**
		Mean	**Std. Dev**	**Std. Error Mean**	**Lower**	**Upper**			
Pair (1)	Quality of Information (NO) - Quality of Information (AO)	-20.32	17.28	2.23	-24.78	-15.86	-9.108	59	0.000
Pair (2)	Quality of Information (AO) - Quality of Information (AI)	-13.36	14.66	1.89	-17.14	-9.57	-7.058	59	0.000

Concerning the moderating effect of outsourcing the blockchain application, the researchers run t-test to investigate whether insourcing the blockchain application will have a significant effect on the users' perception of information quality and found that there is a significant difference in the users' perception of information quality when the internal auditor is providing an assurance report and the blockchain application is developed by the ECA versus when it is outsourced (t = -7.058, Sig. = 0.000).

4.5.2. Using T-Test to Test the Research Hypotheses (Consulting Role)

After using one sample t-test to examine the added value of the internal auditor consulting role regarding the blockchain related internal controls (Sanchez, et al., 2012), the results presented in Table (11) confirm the research results and provided evidence that the internal auditors' consulting role has a positive and significant effect on users' perception of information quality (Mean = 64.0742, t = -3.714, Sig. = 0.001).

Regarding the moderating effect of outsourcing the blockchain application, the researchers run t-test to investigate whether insourcing the blockchain application will affect the users' perception of information quality and found that there is a significant difference in the users' perception of information quality when the internal auditor is providing a consulting report and the blockchain application is developed by the ECA versus when it is outsourced (t = -6.950, Sig. = 0.000).

Table 11: T-Test Results Comparing the Effect of Internal Auditors' Consulting Role on Users' Perception of Information Quality

Paired Samples Statistics						
		Mean	**N**	**Std. Dev**	**Std. Error Mean**	
Pair (1)	Quality of Information (NO)	57.2060	45	20.62542	3.07466	
	Quality of Information (CO)	64.0742	45	15.53994	2.31656	
Pair (2)	Quality of Information (CO)	64.0742	45	15.53994	2.31656	
	Quality of Information (CI)	80.3171	45	12.65310	1.88621	

Paired Samples Test									
					95% Confidence interval of the differ		t	df	Sig. (2-tailed)
		Mean	Std. Dev	Std. Error Mean	Lower	Upper			
Pair (1)	Quality of Information (NO) - Quality of Information (CO)	-6.87	12.41	1.85	-10.60	-3.14	-3.714	44	.001
Pair (2)	Quality of Information (CO) - Quality of Information (CI)	-16.24	15.68	2.34	-20.95	-11.53	-6.950	44	.000

4.5.3. The Impact of Internal Auditors' Role on Users' Perception of Information Quality (Outsourcing Blockchain Application)

The researchers investigated the significant differences between the internal auditors' assurance and consulting roles on the users' perception of information quality in case the blockchain application is outsourced to an external party (CargoX). The researchers used Mann Whitney test, which is a nonparametric test used to examine whether two independent samples are coming from the same population (Nachar, 2008), to test the significant differences between the participants' reliance on the internal auditors' report and their assessment of information quality in the case when blockchain application is outsourced (Case 2) in the first group (assurance) (AO) and the second group (consulting) (CO).

It is clear from Table (13) that there is no significant difference between the internal auditors' assurance and consulting roles concerning the users' reliance on the internal audit report (Z = -0.625, Sig. = 0.532) nor their perception of information quality (Z = -1.529, Sig. = 0.126).

Table 13: Mann Whitney test Results Comparing the Internal Auditors' Assurance and Consulting Roles (Outsourcing Blockchain)

	Audit Role	N	Mean Rank	Sum of Ranks	Mann-Whitney U	Wilcoxon W	Z	Asymp. Sig. (2-tailed)
Reliance on Internal Auditor Report	Assurance	60	54.58	3274.50	1255.500	2290.500	-0.625	0.532
	Consulting	45	50.90	2290.50				
	Total	105						
Quality of Information	Assurance	60	56.93	3416.00	1114.000	2149.000	-1.529	0.126
	Consulting	45	47.76	2149.00				
	Total	105						

4.5.4. The Impact of Internal Auditors' Role on Users' Perception of Information Quality (Insourcing Blockchain Application)

The researchers investigated the significant differences between the internal auditors' assurance and consulting roles on the users' perception of information quality in case the blockchain application is developed by the IT team at the ECA (CustomsX). The researchers used Mann Whitney test (Nachar, 2008) to test whether there are significant differences between the participants' reliance on the internal auditors' report and their assessment of information quality in the case when blockchain application is insourced (Case 3) in the first group (assurance) (AI) and the second group (consulting) (CI).

Table 14: Mann Whitney test Results Comparing the Internal Auditors' Assurance and Consulting Roles (Insourcing Blockchain)

	Audit Role	N	Mean Rank	Sum of Ranks	Mann-Whitney U	Wilcoxon W	Z	Asymp. Sig. (2-tailed)
Reliance on Internal Auditor Report	Assurance	60	55.73	3344.00	1186.000	2221.000	-1.096	0.273
	Consulting	45	49.36	2221.00				
	Total	105						
Quality of Information	Assurance	60	55.73	3343.50	1186.000	2221.500	-1.061	0.289
	Consulting	45	49.37	2221.50				
	Total	105						

The results in Table (14) didn't reveal a significant difference between the internal auditors' assurance and consulting roles concerning the users' reliance on the internal audit report (z = -1.096, Sig. = 0.273) nor their perception of information quality (Z = -1.061, Sig. = 0.289).

4.5.5. Does The Effect of Internal Auditor' Roles on the Users' Perception of Information Quality Differs According to Experience Level?

To give more insights to the research findings, the researchers examined whether there are significant differences between the internal auditors' assurance and consulting roles concerning their effect on risk level assessment, reliance on blockchain application report and perception of information quality according to the experience of respondents (Ullah, et al., 2021). To do so, the researchers divided the sample according to the participants' experience into two subsamples, the first one (Inexperienced) involves participants with experience less than 10 years (42 participants) and the second one (Experienced) involves 63 participants with experience more than 10 years. Then the researchers used Mann Whitney test to investigate the significant differences between the two subsamples.

Table (15) (Panel A) shows that inexperienced participants don't find significant difference between the assurance and consulting roles on the different aspects. That is there is no significant difference between the internal auditors' assurance and consulting roles concerning their assessment of risk level the ECA is facing (Z = -0.135, Sig. = 0.892), reliance on CargoX report (Z = -0.192, Sig. = 0.848) or internal audit report (Z = -0.986, Sig. = 0.324) nor their perception of information quality (Z = -0.053, Sig. = 0.957).

Table 15: Mann Whitney Test Results of the Effect of Internal Auditors' Roles on Users' Perception of Information Quality (Inexperienced Vs. Experienced Participants)

Panel A: Ranks and Test Statistics (Inexperienced)

Inexperienced	Audit Role	N	Mean Rank	Sum of Ranks	Mann-Whitney U	Wilcoxon W	Z	Asymp. Sig. (2-tailed)
Risk Level - Outsourcing	Assurance	28	21.68	607.00	191.000	296.000	-0.135	0.892
	Consulting	14	21.14	296.00				
	Total	42						
Reliance on CargoX	Assurance	28	21.75	609.00	189.000	294.000	-0.192	0.848
	Consulting	14	21.00	294.00				
	Total	42						
Reliance on Internal Auditor Report	Assurance	28	22.79	638.00	160.000	265.000	-0.986	0.324
	Consulting	14	18.93	265.00				
	Total	42						
Quality of Information	Assurance	28	21.43	600.00	194.000	600.000	-0.053	0.957
	Consulting	14	21.64	303.00				
	Total	42						

Panel B: Ranks and Test Statistics (Experienced)

Experienced	Audit Role	N	Mean Rank	Sum of Ranks	Mann-Whitney U	Wilcoxon W	Z	Asymp. Sig. (2-tailed)
Risk Level - Outsourcing	Assurance	32	28.09	899.00	371.000	899.000	-1.742	0.082
	Consulting	31	36.03	1117.00				
	Total	63						
Reliance on CargoX	Assurance	32	35.05	1121.50	398.500	894.500	-1.361	0.173
	Consulting	31	28.85	894.50				
	Total	63						
Reliance on Internal Auditor Report	Assurance	32	33.42	1069.50	450.500	946.500	-0.642	0.521
	Consulting	31	30.53	946.50				
	Total	63						
Quality of Information	Assurance	32	35.83	1146.50	373.500	869.500	-1.686	0.092
	Consulting	31	28.05	869.50				
	Total	63						

On the other hand, Table (15) (Panel B) shows that experienced participants revealed significant differences concerning the effect of internal auditors' role on their assessment of risk level and perception of information quality. It is clear from the table that the risk level assessment of experienced respondents has decreased significantly (at 10% significance level) ($z = -1.742$, Sig. = 0.082) in case the auditors are offering their assurance on the blockchain related internal controls (Mean rank = 28.09) than in the case when they are offering their consultations (Mean rank = 36.03). This result is consistent with that of Ullah et al. (2021) which found a significant difference between managers'

trust in new technology adoption according to their experience level, where experienced managers' trust in new technology adoption and innovation is lower to that of less experienced managers. Consistently, experienced respondents' perception of information quality has increased significantly (at 10% significance level) (z = -1.686, Sig. = 0.092) when the internal auditors are providing their assurance report on the blockchain related internal controls (Mean rank = 35.83) than when they are providing consulting services (Mean rank = 28.05).

4.5.6. Does the Effect of Internal Auditors' Roles on the Users' Perception of Information Quality Differs According to Respondents' Background?

In addition to the effect of the respondents' experience, the researchers investigate whether there are significant differences between the internal auditors' assurance and consulting roles concerning their effect on risk level assessment, reliance on blockchain application report and perception of information quality according to the background of respondents. To do so, the researchers split the sample according to the respondents' background into two subsamples, the first one (Professional) involves respondents with professional background (70 participants) and the second one (Academic) involves 35 participants with academic background and used the Mann Whitney test to test the significant differences between the two subsamples.

Table (16) (Panel A) shows that academic participants don't find significant difference between the assurance and consulting roles on the different aspects. That is there is no significant difference between the internal auditors' assurance and consulting roles concerning their assessment of risk level the ECA is facing (z = -1.380 Sig. = 0.167), reliance on CargoX report (z = -0.837, Sig. = 0.403) or internal audit report (z = -0.206, Sig. = 0.837) nor their perception of information quality (z = -0.725, Sig. = 0.468).

On the other hand, Table (16) (Panel B) shows that professional participants revealed significant differences concerning the effect of internal auditors' role on their reliance on CargoX report and perception of information quali-

ty. It is clear from the table that the reliance on CargoX report has increased significantly (at 5% significance level) (z = –1.982, Sig. = 0.047) in case the auditors are offering their assurance on the blockchain related internal controls (Mean rank = 39.73) than in the case when they are offering their consultations (Mean rank = 30.18). Consistently, professional respondents' perception of information quality has increased significantly (at 5% significance level) (z = –2.498, Sig. = 0.012) when the internal auditors are providing their assurance report on the blockchain related internal controls (Mean rank = 40.91) than when they are providing consulting services (Mean rank = 28.69).

Table (16) Mann Whitney Test Results of the Effect of Internal Auditors' Roles on Users' Perception of Information Quality (Professional Vs. Academic Participants)

Panel A: Ranks and Test Statistics (Professional)

Professional	Audit Role	N	Mean Rank	Sum of Ranks	Mann-Whitney U	Wilcoxon W	Z	Asymp. Sig. (2-tailed)
Risk Level - Outsourcing	Assurance	39	34.91	1361.50	581.500	1361.500	-0.276	0.783
	Consulting	31	36.24	1123.50				
	Total	70						
Reliance on CargoX	Assurance	39	39.73	1549.50	439.500	935.500	-1.982	0.047
	Consulting	31	30.18	935.50				
	Total	70						
Reliance on Internal Auditor Report	Assurance	39	37.49	1462.00	527.000	1023.000	-0.936	0.349
	Consulting	31	33.00	1023.00				
	Total	70						
Quality of Information	Assurance	39	40.91	1595.50	393.500	889.500	-2.498	0.012
	Consulting	31	28.69	889.50				
	Total	70						

Panel B: Ranks and Test Statistics (Academics)

Academic	Audit Role	N	Mean Rank	Sum of Ranks	Mann-Whitney U	Wilcoxon W	Z	Asymp. Sig. (2-tailed)
Risk Level - Outsourcing	Assurance	21	16.07	337.50	106.500	337.500	-1.380	0.167
	Consulting	14	20.89	292.50				
	Total	35						
Reliance on CargoX	Assurance	21	16.83	353.50	122.500	353.500	-0.837	0.403
	Consulting	14	19.75	276.50				
	Total	35						
Reliance on Internal Auditor Report	Assurance	21	17.71	372.00	141.000	372.000	-0.206	0.837
	Consulting	14	18.43	258.00				
	Total	35						
Quality of Information	Assurance	21	16.98	356.50	125.500	356.500	-0.725	0.468
	Consulting	14	19.54	273.50				
	Total	35						

5. Conclusions, Limitations, Recommendations, and Implications for Future Research

The objective of this research is to investigate the effect of internal auditors' assurance and consulting roles related to blockchain application related internal controls on users' perception of information quality with an application on the ECA, and whether their roles will differ when the blockchain application is developed by an external party (outsourced) in. comparison to that when it is developed by the IT team at the ECA (insourced).

To fulfil the research objective, the researchers provided an overview on the ECA, analyzed prior literature related to blockchain technology, internal auditors' assurance, and consulting roles and how they are affected in the era of blockchain technology. Finally, the researchers presented prior research literature concerning the outsourcing of information technology applications to highlight their pros and cons and develop the research hypotheses.

Then, the researchers designed two independent experiments of 3X1 within subjects experimental design to investigate the internal auditors' assurance and consulting roles in this regard. Based on a sample of 105 participants from the MBA students and faculty members at the faculty of business, Alexandria university, the researchers found experimental evidence that the internal auditors' assurance and consulting roles have a positive and significant effect on users' perception of information quality. In addition, the researchers found evidence that users' perception of information quality tends to be highly affected when the blockchain application is developed in-house than when it is outsourced.

To add more insights to the research findings, the researchers made additional evidence and found that there are no significant differences between the internal auditors' assurance and consulting roles concerning their effect on users' perception of information quality. The additional analysis revealed also that there is a significant difference between the internal auditors' assurance and consulting roles concerning their effect on experienced users' assessment of risk level and perception of information quality. Experienced users' assess-

ment of risk level facing the ECA is reduced significantly when the internal auditors are providing their assurance role concerning blockchain application related internal controls. Finally, the researchers found evidence that professional participants' reliance on CargoX report and perception of information quality have increased significantly when internal auditors are providing their assurance role (in comparison to their consulting role) regarding blockchain application related internal controls.

Based on the research results, **the researchers suggest the following recommendations**. *First*, the formation of a professional organization for the internal auditing profession in Egypt. The role of this organization is to support internal auditors working in Egypt through arranging for training workshops and upgrading their technical capabilities and professional skills, especially in the high-tech era. *Second*, replacing the financial controller in the ECA with the internal auditor. The internal auditor can then offer his/her consulting and assurance services to add value to the authority and help it in fulfilling its objectives. *Third*, developing the internal auditing curricula offered at both the undergraduate and postgraduate levels in the Egyptian universities. These courses will enhance students' awareness of the IT challenges facing the internal auditors recently and will improve their academic background concerning the internal auditors' roles in the digitalized environment. *Fourth*, arranging for scientific conferences by the accounting departments in the Egyptian universities that focus on the internal auditing profession and the challenges it faces as a result of the IT revolution. *Finally*, more attention should be placed on conducting empirical research in the area of internal auditing.

The research and its results have several limitations. *First*, the researchers designed two 3X1 within subjects experiments to investigate the effect on internal auditors' assurance and consulting roles regarding blockchain application related internal controls on users' perception of information quality. Although within subjects experiments are advantageous in comparison to between subjects experiments in that they avoid the effect of other fac-

tors to affect the participants' responses, however, carryover or learning effect is one of the main disadvantages of using within subjects experiments and replicating the experimental cases on the same respondents. *Second*, the participants who responded to the questions in the experimental cases are MBA students and faculty members and not real managers and decision makers at the ECA. Although a considerable percentage of the participants is having a professional background, but their experience as managers and decision makers might be lower than real managers at the ECA.

These limitations provide adequate avenues for future research. *First*, as this research is conducted on the case of the ECA, the researchers recommend future researchers to replicate it on other governmental ministries and sectors, such as the telecommunication, health, and education ministries. As the ECA took the initiative to adopt the blockchain technology in its operations, it is expected that the other authorities in other ministries will follow the steps taken by the ECA and adopt this technology to benefit from its advantages. *Second*, as this research is conducted on MBA students and faculty members, the researchers recommend future researchers to replicate this study on real managers and decision makers. *Finally*, it would be interesting if future research investigates the effect of internal auditors' assurance and consulting roles in other aspects, such as external auditors' reliance decision, and managers' decisions and company performance.

Table 17: Summary of Research Hypotheses and Results

No.	Hypothesis	Expected	Decision
H1	*Internal auditor's assurance role on blockchain application-related internal controls will have a significant positive effect on user's perception of information quality in the ECA.*	Positive and significant effect	Supported
H2	*Internal auditor's consulting role on blockchain application-related internal controls will have a significant positive effect on user's perception of information quality in the ECA.*	Positive and significant effect	Supported
H3	*The significant and positive effect of the internal auditor's assurance role on blockchain application-related internal controls on user's perception of information quality in the ECA will differ when the blockchain application is outsourced than when it is developed in-house.*	Significant effect	Supported
H4	*The significant and positive effect of the internal auditor's consulting role on blockchain application-related internal controls on user's perception of information quality in the ECA will differ when the blockchain application is outsourced than when it is developed in-house.*	Significant effect	Supported

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