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Stage-Based Maturity Model Approach for Measuring Enterprise Governance of Information Technology and Supply Chain Sustainability in Middle East and North Africa Region

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Abstract

Purpose: *To propose an easy-to-use and scientifically developed Enterprise Governance of Information Technology (EGIT) Maturity Models (MM) development methodology which can develop stage-based MMs. The proposed methodology enables researchers in developing countries to build and use scientific EGIT stage-based MMs that can support organizations to measure their compliance to the diverse recent EGIT respective regulations easily while adapting with their local context needs and protect their supply chains.*

Design/methodology/approach: *This study is following an experimental approach by using the proposed methodology to develop an EGIT stage-based MM which is deployed and tested in three firms. The participating firms, which play a great role in supply chains, provided valuable feedback at the end of the experiment.*

Findings: *The participating firms provided evaluation of the tested MM depicting its value in measuring EGIT compliance. The findings show a positive and significant relationship between the use of the MM developed by the proposed methodology and the participating firms' capability to measure their EGIT maturity and increase it. Moreover, the proposed methodology enables small and medium-sized organizations to measure their EGIT maturity levels without consuming much time or resources which they cannot afford like large organizations.*

Research implications and limitations: *During the research there were many challenges including and not limited to lack of EGIT MM developed in or for MENA region and EGIT awareness in MENA region. COVID 19 pandemic and its impact on the three participating organizations. The emergence of new regulations in MENA region during the research. Explaining the EGIT MM to different stakeholders with different background. Collecting and analysing the maturity of the three participating organization in all the processes of the four pillars.*

Originality: *In developing countries like Middle East and North Africa Region (MENA) and especially Arab countries, EGIT plays a greater role in achieving new strategic visions set by emerging developing countries which have EGIT limited resources, lack of knowledge, and higher levels of risk. Although there are many MMs for EGIT, we could not find any adopting stage-based maturity measurement technique that was developed in or for the MENA region. Hence, this paper attempts to develop an EGIT Stage-based MM development methodology for Arab countries.*

Keywords: *Maturity Model, EGIT, Information Technology Service Management (ITSM), Business Continuity, Supply Chain Sustainability, Industry Innovation.*

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Introduction

In Alshamy et al.'s recent publication (2021), the researchers identified a distinct requirement for EGIT maturity Models (MMs) in the MENA region countries. This need has become more pronounced, particularly in the aftermath of the COVID-19 pandemic and the resulting disruptions in global supply chains. The escalating number of cybersecurity attacks and the global chip crisis have further emphasized the significance of EGIT as a prominent area of study and research. Becker et al. (2009) defined maturity Models (MMs) as techniques developed and used to determine the level of performance, capability, or maturity of a process or organization. Rosemann and de Bruin (2005) defined maturity itself "as a measure to evaluate the capabilities of an organisation in regard to a certain discipline" (2005). Becker et al. (2010) define MM as "conceptual models that outline anticipated, typical, logical, and desired evolution paths towards maturity" (2009). They are used to discover strengths and weaknesses to enable organizations to define deficiencies or opportunities for improvement. They are also used to determine maturity targets and how to reach them.

In Alshamy et al.'s (2021) last publication, "Assessing Enterprise Governance of Information Technology Maturity Models in the Middle East and North Africa Region", the researchers covered the characteristics of the MENA region and the existing need for an Enterprise Governance of IT (EGIT) MM based on developing, publishing and analyzing two questionnaires (Alshamy 2019) and (Alshamy, 2020) among participants in the same field and related fields. They concluded that the MENA region needs a specific EGIT MM made for its needs, as the number of new strategic visions in many countries in MENA is increasing with a lot of emerging information/cybersecurity, business continuity, data governance, management, and privacy regulations. The number of organizations that need to measure and have EGIT is increasing enormously, and the types of fines and impacts vary and, in many cases, are intolerable including a huge amount of money and imprisonment too.

It has been observed that there is a growing interest in EGIT among organizations in MENA. According to Alshamy et al.'s (2021) findings from the questionnaire, approximately 80% of organizations are either attempting to implement or have already implemented an EGIT MM. These organizations require an MM that can assess their EGIT maturity and provide guidance for enhancing their performance, meeting goals, and complying with emerging regulations, all while optimizing resources and managing risks. Interestingly, none of the MMs examined in this research employ a stage-based maturity measurement methodology; they solely rely on maturity levels. Consequently, interested organizations are compelled to measure all processes/aspects of their organization against each maturity level, which can be a significant undertaking for small and medium-sized organizations. As a result, many organizations face difficulties in implementing EGIT measurements and improvements due to the absence of a simple, single MM.

In this paper, the researchers present the development and evaluation stages which are the first two stages of a five-stage EGIT MM that is developed based on Becket et al.'s (2009) procedure model for developing maturity models. It is a scientific methodology dedicated to developing MMs and backed up by a well-known research methodology called design science research developed by Hevner et al. (2010). It is important to mention that EGIT governance represents the combination of governance, risk, and compliance (GRC).

Based on the importance of EGIT to enterprises regardless of their size or type, and the need to have a simple and easy-to-use stage-based, and multi-dimensional MM, the proposed EGIT MM has the following main advantages:

- Stage-based: The processes and aspects which are assessed against one stage are not assessed again against any other stage.
- Developed using a scientific methodology and general design principles (DPs).
- Easy to implement and use.

The objective of this research is to create a multi-faceted and progressive MM that can assist organizations in developing countries to enhance their EGIT in a convenient and cost-effective manner, while also ensuring compliance with new regulations. Publishing MM in the future to practitioners who can use it and to managers to decide where it matches their organization's needs could be considered a contribution to the fields of EGIT and MM.

The structure of this paper is as follows. Section 2 provides the background information for this study. Section 3 focuses on the related work. Section 4 discusses the proposed solution. Section 5 presents the results of the proposed MM evaluation method. Section 6 further discusses the proposed MM evaluation method. Section 7 presents the conclusions, while section 8 covers suggestions for future work.

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Literature Review

The design science in Information Systems research introduced by Hevner et al. in 2004 has seven guidelines that are used to design and evaluate the researchers' MM scientifically. Hevner's seven guidelines represent a scientific methodology to follow in Information Systems artifact design, and they have already been used by researchers. The guidelines are G1: Design as an artifact, G2: The relevance of problem, G3: Design evaluation, G4: Research contribution, G5: Research rigor, G6: Design as a search process and G7: Communication of Research.

These seven guidelines cover the requirements of developing a design-science artifact, which in the case at hand is an MM, starting with designing the MM that is relevant to a specific problem that does not have any available solution. The design should then be evaluated, and Hevner provided five types of evaluation: observational, analytical, experimental, testing, and descriptive. Although Hevner's design science methodology can be generically used in information systems, the researchers prefer to use it during the development of the proposed MM because it has scientific and chronological characteristics that effectively guide the development process.

Becker et al. (2009) introduced a procedure for developing maturity models for management, which is the second reference methodology the researchers use in developing the MM research methodology because of its scientific method for developing MMs, which is considered more dedicated to the research at hand than Hevner's. The development of an MM involves eight essential requirements. These requirements include R1: Comparing with existing maturity models, R2: Following an iterative procedure, R3: Conducting evaluations, R4: Utilizing a multi-methodological approach, R5: Identifying the relevance of the problem, R6: Defining the problem, R7: Presenting the results in a targeted manner, and R8: Ensuring scientific documentation. Becker has devised a procedure, illustrated in the accompanying figure, for the development and evaluation of MMs.

In Alshamy et al.'s (2021) recent publication titled "Evaluation of Information Technology Maturity Models in the Middle East and North Africa Region", we covered how de Bruin et al. (2005), extensively analysed over 150 Maturity Models (MMs) that have been developed and published in the past few years aiming to provide support to the field of IT management. Additionally, the researchers investigated the research conducted by Becker et al. (2010) who utilized a keyword search approach to explore ten scientific databases. Their search spanned from 1994 to 2009 and resulted in the identification of more than one thousand academic articles potentially related to MMs. However, when they narrowed their focus to 19 pure IS journals, they discovered only 20 articles that specifically addressed MMs.

It is important to note that there is currently no established scientific guidance or methodology for the development or evaluation of MMs. In light of this, the researchers believe that Becker et al.'s procedure model (2009) offers the most comprehensive and reliable guidance for the development of any Enterprise Governance of Information Technology (EGIT) MM. This model stands out due to its incorporation of eight simple and scientifically grounded requirements. In Alshamy et al. (2021) titled "Assessing Enterprise Governance of Information Technology Maturity Models in Middle East and North Africa Region", the researchers covered how we found more than 100 MMs developed and published in the last few years, as stated by Becker et al. (2009). The researchers analyzed the existing MMs and found that they can belong to one of two different schools. The first one is the commercial one, which is based on the efforts of big service providers and bodies of knowledge. The other school is academia, with many researchers who attempted to develop MMs with limited resources and capabilities, unlike the first school. This section summarizes what the researchers reached in their last publication (Alshamy et al., 2021), which led to continue their research journey to develop and evaluate an EGIT MM that can support organizations in MENA region countries to measure their EGIT maturity and easily improve it. The researchers analyzed both types and found that there is a need for an EGIT MM that matches the requirements of the MENA region based on understanding its special context which can be summarized up in:

- Lack of EGIT processes and their proper documentation
- Lack of unified MM for measuring EGIT
- Using different EGIT frameworks and standards
- Lack of EGIT importance awareness among different levels of employees within organizations
- Rare use of EGIT MM due to their resource and time intensive nature which many organizations in MENA region cannot afford
- Based on the fast emerging of new regulations of cybersecurity and business continuity among others, multi-dimensional MM is needed for EGIT maturity measurement and improvement.

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MM Classification

In the realm of market-based MMs, the researchers have examined various frameworks for different purposes. Specifically, they have explored ITIL v3/2011 (Cabinet Office, 2011) for ITSM, COBIT5/2019 (Lainhart et al., 2011) and (Lainhart, Conboy, and Saull, 2018) for EGIT, ISO/IEC 15504-2 (ISO/IEC JTC 1/SC 7 Software and systems engineering 2003) for process improvement and process capability determination, and ISO 19600 (ISO/TC 309 Governance of organizations 2014), which has been replaced by ISO 37301 (ISO/TC 309 Governance of organizations 2021) in 2021 for compliance management. They have found that in the MENA region countries, the ITIL framework is widely regarded as the most suitable for ITSM, while the COBIT framework is considered the best for EGIT. However, it is important to note that these frameworks still require customization to meet the specific requirements of the MENA region. The ITIL process maturity framework (PMF) (Hunnebeck et al., 2011) is an ITSM MM that can be utilized to assess any other domain. It evaluates all processes against each maturity level within its five levels. On the other hand, the COBIT5/2019 (Dhulipalla, 2019) process capability scheme, known as COBIT Performance Management (CPM), is not a straightforward and versatile EGIT MM for MENA region countries. Many organizations in this region lack several of its processes and do not possess sufficient resources to conduct its complex assessment. Additionally, COBIT5 focuses solely on the process dimension, measuring capability rather than maturity. Other dimensions such as information security, business continuity, and compliance are still necessary. It evaluates all processes against each maturity level within its six levels, highlighting the need for a simplified version tailored to the specific needs of the MENA region.

Implementing COBIT 2019 requires training, experience, and adequate resources. It encompasses four dimensions, measuring capability for each dimension and maturity across all combined dimensions. It addresses ITSM, information security, continuity, and compliance as processes rather than dimensions. It evaluates all processes against each maturity level within its six levels. In academic-based MMs, the researchers covered three different categories. Although the first category, which proposes new MMs, and the second category, which compares the already developed MMs, are important, the last category, which provides guidance on how to develop an MM and is essential, as the researchers use its provided guidance in understanding how to develop a scientific MM for MENA region countries. Organizations in MENA region countries are more interested in market-based MMs than academic ones, as they are well-known for their available training courses, exams, and qualification levels that are not provided by academic MMs. Therefore, the researchers compared their MM with market-based MMs to cover the actual required features and aspects.

Table 1. MM Components Covered by Existing Commercial MMs and the Proposed One
[* Partial representation and ** Full representation]

References	MM Components				
	MM Pillars				Stage-based
	ITSM	Information Security Management	Business Continuity Management	Compliance Management	
ITIL PMF	**	*	*		
COBIT 5/2019	**	*	*	*	
ISO/IEC 33003/33020					
M_o_R MM					
P3M3 MM					
ISO/IEC 20000-1	**	*	*	*	
ISO/IEC 27001		**	*	*	
ISO 22301			**	*	
ISO 37301				**	
ISO 31000					
The proposed EGIT MM	**	**	**	**	**

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In the study conducted by Becker et al. (2010), which examined 20 maturity models (MMs) published in 19 different journals, it was concluded that there is a lack of detailed conceptualization and scientific determination regarding the maturity and maturity models. Another study by Becker et al. (2009) attempted to gather information about the design process used by developers of 51 MMs, but only a few provided feedback. The authors also noted that there is a scarcity of information regarding the motivation, development, procedural method, and evaluation results of these models. Additionally, de Bruin et al. (2005) stated that although practitioners and academics have developed numerous maturity models across various domains to assess competency, there has been no collective effort to generalize the phases involved in developing a maturity model for any specific domain. It is clear now that most of the available MMs have not been developed or evaluated using a scientific development methodology, as stated by Hevner and Becker (2004 and 2009), among others. The researchers can exclude major commercial MMs, such as CMMI, PMF, and the process capability model. They could not find a stage-based MM that assesses every single process in a specific single stage to reduce assessment effort and time.

MENA Region Evaluation

No EGIT MM developed in the MENA region or specifically for the MENA region was found, which addressed its unique needs and context. Instead, the researchers discovered a collection of commercial MMs that were developed outside of the region, along with some regulations that were created by certain MENA countries to ensure compliance. Some of these regulations, such as the National Cybersecurity Authority (NCA) cyber-security control and the Saudi Central Bank (SAMA) Information Technology Governance Framework in the Kingdom of Saudi Arabia, were developed within the MENA region. Additionally, the Egyptian Personal Information Protection Act was also developed locally. On the other hand, regulations like the GDPR, which was established by the European Parliament and the Council of the European Union, originated outside of the MENA region but have global effectiveness. While there are currently no regulations or frameworks in the region specifically addressing supply chain, most of them encompass suppliers and provide guidelines on how to effectively manage their services to ensure their impact on daily operations and business objectives is controlled.

Research Gap

Despite the presence of numerous MMs in the information and technology field, none of them fully encompass all dimensions of EGIT, and some do not even target EGIT at all. Additionally, none of these MMs adopt a stage-based approach when assessing EGIT maturity. This highlights the absence of an integrated stage-based EGIT MM specifically designed for the MENA region countries, which could assist small and medium organizations in measuring their EGIT maturity and effectively managing their supply chains. Developing a new MM that does not add value to the existing market or benefit organizations seeking to measure and enhance their EGIT would be futile. Among the existing MMs, only ITIL 2011 and COBIT 2019 can be considered integrated MMs, as they cover various aspects of the proposed MM, albeit without the stage-based approach. The ITIL PMF lacks a stage-based measurement of maturity as it measures all ITSM processes with each maturity model. On the other hand, the COBIT CPM MM employs a complex maturity measurement technique that is not user-friendly for small and medium organizations and lacks a stage-based measurement of maturity. Furthermore, ITIL, COBIT, and other EGIT frameworks or standards fail to address the relationship between EGIT and sustainable supply chains, which are directly influenced by service management, cybersecurity, business continuity management, and compliance management. Taking all these factors into consideration, our proposed MM aims to fulfil the market needs in the EGIT field within the MENA region, with a specific focus on the necessary capabilities for sustainable supply chains. To evaluate the effectiveness of the proposed MM, it is implemented in three organizations directly involved in the supply chain field as suppliers of services or products to other organizations. The feedback from these participating organizations is collected and analyzed to assess the actual need for the proposed MM and determine whether it has been developed and deployed appropriately to meet the requirements of MENA region organizations seeking to measure and enhance their EGIT. Based on the findings, recommendations are provided.

Solution

Research Method

A comparison between the proposed MM and existing MMs is necessary before developing the MM in more detail to ensure that it is really needed. This comparison is depicted in Table I, and the proposed MM covers

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all components required by EGIT in the MENA region compared to other MMs including stage-based capability. These components were made clear in the two questionnaires developed and shared with the EGIT participants in Alshamy et al.'s (2021) publication "Assessing Enterprise Governance of Information Technology Maturity Models in the Middle East and North Africa Region". It should be noted that although the researchers used existing MMs as a reference, they created a new EGIT MM and did not customize any of the used reference MMs. The researchers' development methodology (Fig. 1) combines the methods of Hevner and Becker to obtain the maximum benefit. Each activity has labels representing compliance with Hevner's seven guidelines and Becker's eight requirements. This development methodology includes five chronological stages covering the life cycle of assessing, developing, evaluating, communicating, and retiring MM when needed.

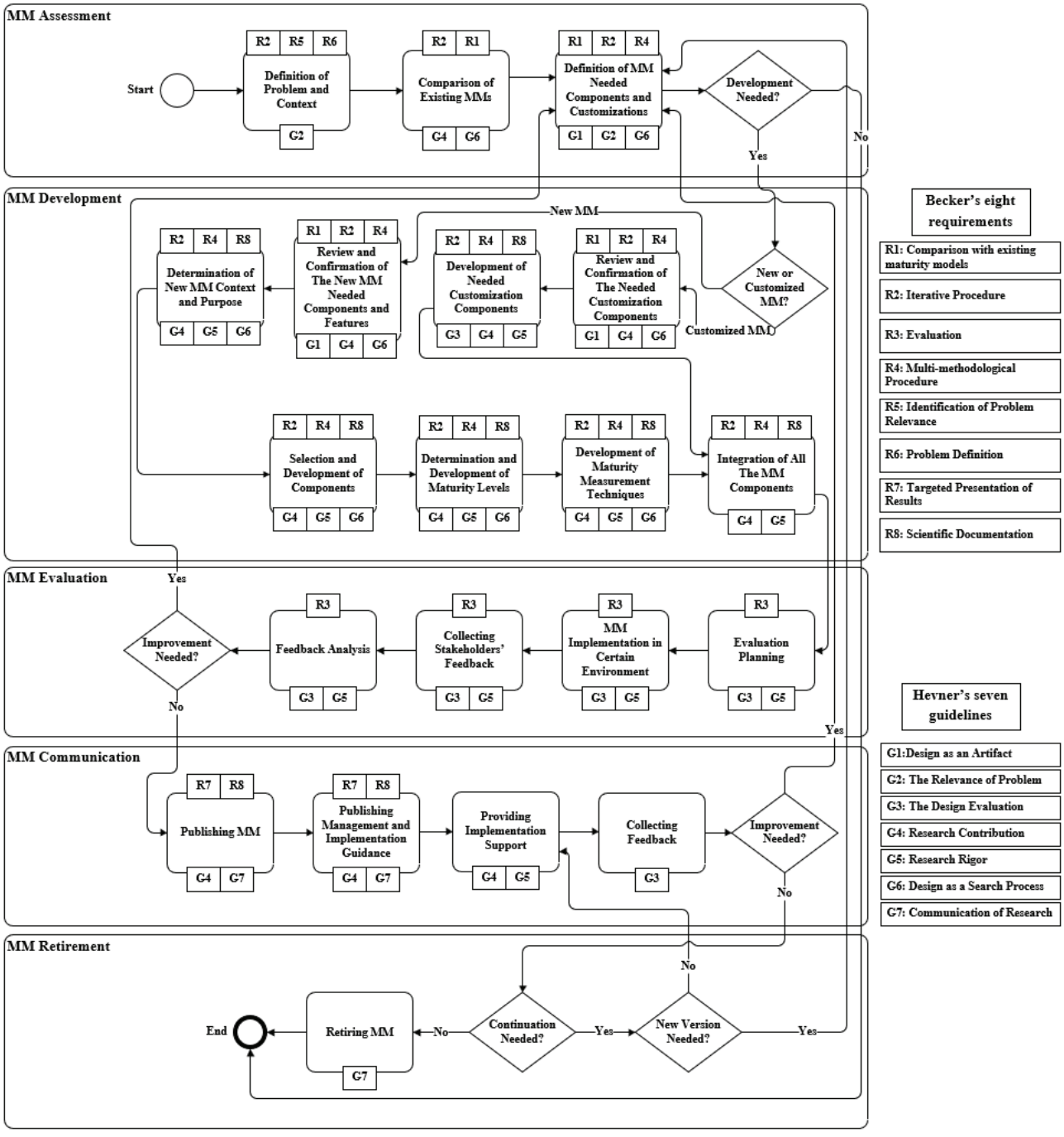

Fig. 1. MM development methodology and lifecycle stages

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The first stage, MM Assessment, covers the problem and context definition, as the development of a new MM should be based on the actual demand in a specific market, and there should be a comparison with similar existing MMs to know what features and components need to be developed or customized in the new one. This helps in defining the components needed to be developed in any new MMs or the customization required to improve existing MMs. Therefore, the initial MM development is based on the market exact demand and the weakness of existing MMs.

The second stage, MM development, covers the development of new MMs or the customization of existing MMs based on the need. The first activity in this stage is to review and confirm the required customization components in any existing MM or the needed components and features of a new MM. To customize an existing MM, the required components were developed. To develop a new MM, there is a group of five activities to develop s new MM and its components. The context of the MM and its purpose is determined from the beginning; in the case at hand, the context is based on MENA region countries and emerging regulations, while the purpose is to help organizations, especially small and medium ones, measure their current EGIT maturity level and support them in choosing and targeting expected or needed maturity levels. Selected components, including principles, dimensions, processes, and other MM components, are developed based on a well-determined and defined context and purpose. The development of maturity levels is based on the required number of levels, the complexity of the context, and the potential audience in the future. Measurement techniques that enable the audience to use MM to measure their respective maturity levels are developed. The last activity in this stage is the integration of all components of the newly developed MM or customized MM.

In the third stage, MM evaluation, the evaluation of MM is offered to a selected group of organizations by providing their top management with the benefits of its implementation. The researchers attempted to have about three organizations of different types and nature to widen the scope of the experiment. Organizations that would like to participate in the MM evaluation are carefully selected, and their needs and feedback are collected and analyzed objectively during the evaluation stage. The MM is implemented in these organizations with the support of top management and respective middle management to measure the level of their EGIT maturity and increase it if required. Measurements are collected, and the results are produced based on all stakeholders' feedback. If MM improvement is needed, then the required updates are implemented by returning to the first stage. If improvement is not required, the fourth stage can be started.

In the fourth stage, MM Communication, MM is published to the market with proper guidance to support organizations' management and practitioners. Although the researchers consider their MM to be easy-to-use, some organizations may need some support in the implementation process if EGIT is new to them or if they do not have competent staff. Implementation support is provided to organizations with less preparedness to enable them to benefit like other organizations with higher maturity and preparedness levels. Feedback is collected regularly every six months to analyze and decide whether the MM needs any improvement. Being a free MM, that can support many organizations of different sizes and nature, enables many organizations to use it and provide feedback for evaluation and improvement purposes. If improvement is needed, then the required updates are implemented by returning to the first stage. If improvement is not required, the fifth stage can be started.

In the fifth stage, MM Retirement, the decision of MM continuation should be made every two years based on the market needs and organizations' feedback. If the MM is no longer needed in the market, then a retirement decision is made. If the MM is still needed, then the provided support to users continue, and if a new version is needed, then the first stage is instigated again.

This paper covers the second and third stages: MM development, and MM evaluation while Alshamy et al.'s (2021) last publication, "Assessing Enterprise Governance of Information Technology Maturity Models in the Middle East and North Africa Region" covers the first stage, MM assessment. In the first stage, the researchers defined the current problem, which is the lack of MM in the MENA region countries that can be used to measure, compare, and improve EGIT in a simple way. A literature review is also provided for the current academic and commercial MMs to discover if they have the required MM features or whether the proposed one can be an addition to the market of MMs. A comparison of the existing MMs and market needs is done by creating, publishing, and analyzing two questionnaires: the first deals with existing EGIT MMs dimensions and their suitability to the MENA region countries, while the second deals with existing MMs and how they can manage compliance. In

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the second stage, the researchers developed a new MM based on existing high-quality MMs frameworks and ISO standards to be considered as an addition to the market of MMs with customization for MENA region countries and its current challenges. In the third stage, they deployed EGIT MM in three organizations to evaluate it in actual environments. All evaluations and feedback comments were collected, analyzed, and discussed to determine whether the new EGIT MM needs further development and improvement.

The Proposed MM Explanation

In developing their research methodology, the researchers used Becker et al.'s (2009) procedure for developing Maturity Models for IT Management due to its scientific method for developing MMs which is considered more dedicated to this research than Hevner et al.'s (2004). The proposed MM has five principles, which are basic and core values that any organization should have and maintain to demonstrate compliance with its goals and objectives. The proposed MM also has four maturity dimensions, called maturity pillars, to be used during any assessment. These dimensions enable organizations to use an easy and affordable integrated MM instead of assessing each maturity pillar separately at a time. However, to measure EGIT maturity, the four pillars should be used in combination. Each maturity pillar has four stages of maturity, which are like other existing MMs which use stages/levels of maturity that have been used for many years. The experimental evaluation approach best suites the proposed MM, and it is used later to support the researchers in collecting and analyzing feedback from stakeholders in the participating organizations in the MM evaluation experiment.

In Section 3.2.1, the principles are briefly explained, and the maturity pillars and their measurement aspects are explained in Section 3.2.2. The four-stage-based maturity levels of each pillar are explained in Section 3.2.3, while the proposed MM stage-based maturity levels and respective processes are explained in Section 3.2.4. The proposed MM interfaces are covered in Section 3.2.5.

Principles

Based on an analysis of both questionnaires developed, shared, and analyzed in Alshamy et al.'s (2021) publication, "Assessing Enterprise Governance of Information Technology Maturity Models in the Middle East and North Africa Region", the MM is built on five principles (Fig. 2) that any organization should have if it would like to continue in the market and remain competitive in the age of disruptive technologies and startups.

All these principles need to be measured and improved to protect their effectiveness and efficiency from decreasing over time. These principles can be measured by conducting internal and external audits with a predefined audit scope and criteria that can discover the level of conformity and integrity among them. Nonconformity is analyzed, and proper corrective actions are developed and approved before implementation. There is a follow-up that is done in view of these corrective actions, and their implementation effectiveness are done before closing any of the nonconformities. These five principles are considered a must not only for EGIT as they are core for sustainable supply chains and all its components.

Fig. 2. The proposed MM principles

Dimensions

The proposed MM is based on the concept of multiple dimensions to enable organizations to measure their maturity from different perspectives, as an organization's maturity cannot be depicted by measuring only one dimension. The proposed MM chooses the most necessary dimensions (Fig. 3): ITSM, Information Security Management (ISM), Business Continuity (BCM), and Compliance Management (CM). Simultaneously, there are three aspects of maturity measurement: process, people, and technology. What is new in the proposed MM is how the three measurement aspects are used to measure the maturity of the four dimensions.

All dimensions and aspects are already developed by other best practice MMs and ISO standards that

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have already been used separately in the MENA region countries. ITSM Process, People and Technology aspects exist in ITIL Process Maturity Framework (PMF) which was developed by Office of Government Commerce (OGC) back in 2007 and they are still used. In 2012, Alshamy used PMF in the research "Information Technology Service Management (ITSM) Implementation Methodology Based on Information Technology Infrastructure Library Ver.3" (ITIL V3). ITSM was selected as one of the pillars based on its importance in managing the IT service lifecycle and all its stages, which are depicted as five stages covering twenty-six processes in ITIL v3/2011. Although there are different sources of guidance and best practice frameworks, those of OGC, currently PeopleCert, are preferred as many people in the MENA region countries know them and their accredited training and examinations are widely available. All the dimensions and aspects of the proposed EGIT MM are enabling organisations to deliver their services and products to internal and external customers of the organization while protecting sustainability.

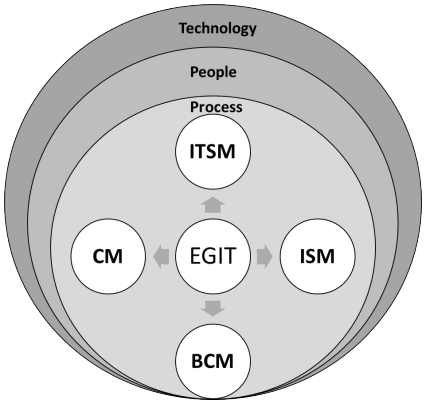

Fig. 3. The proposed MM pillars (Dimensions)

The ISM dimension is measured by many frameworks and ISO standards, the most famous of which is ISO/IEC 27001:2013 (ISO/IEC JTC 1/SC 27 Information security, 2013). No one can deny the importance of information security in our world, whether on business or personal levels, while considering that some organizations consider their data, information, and intellectual property (IP) to be their most precious assets. This dimension guarantees sustainability of the provision of services and products and their benefits which are measured based on the customer security and protection of information assets.

The BCM dimension is also measured by many frameworks and ISO standards, the most famous of which is ISO 22301:2019 (ISO/TC 292 Security and resilience, 2019). The importance of business continuity has increased in the last decade, generally due to the increasing cybersecurity attacks and their impact on business operations in addition to other natural or man-made pandemics like COVID-19 with its worldwide impact, which is still affecting many industries in an unexpected way. Business continuity is one of the main topics for governance in countries and not only for organizations based on the diversified impact on citizens' lives, economy, education, health, and modern lifestyle, among many others. This dimension guarantees sustainability of the provision of services and products by measuring their Business Impact Analysis (BIA) and developing respective Business Continuity Plans (BCPs) and Disaster Recovery Plans (BCPs).

The CM dimension is added due to the increase in regulations and laws that were released in MENA region countries, not limited to, those issued by NCA, The National Data Management Office (NDMO) and SAMA in KSA, the Central Bank of Jordan (CBJ), the Central Bank of Egypt (CBE), the National Electronic Security Authority (NESA), and the Supreme Council for National Security, the National Emergency Crisis and Disaster Management Authority (NCEMA) in the UAE among many others. The compliance dimension uses ISO 37301:2021 as a reference. At the same time, some regulations come from outside the MENA region countries; however, they require the compliance of organizations working in MENA region countries, such as the GDPR issued in the European Union. Compliance does not mean complying with only external regulations and laws; it also means complying with internal policies and procedures. This dimension guarantees compliance to the sustainability of the provision of services and products and their benefits.

Although the four pillars are essential in measuring organizations' EGIT maturity, technology, people, and processes, three aspects are used to enable the achievement of maturity in each pillar. It is impossible to have actual maturity if any maturity pillar is not built on processes that are effectively and efficiently automated and run by competent people. Therefore, the researchers choose these three critical aspects to be used during the assessment and improvement of an organization's EGIT maturity.

Although only four dimensions are chosen, which are the most important, there is still a belief that some organizations may have a special need to add, remove, or change some of these dimensions based on their specific context.

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Four-Pillars Four-Stage-Based Maturity Levels EGIT MM

The proposed MM is a multidimensional model. This means that it has four dimensions (pillars) (Fig. 4) for measuring organizational governance maturity based on information and technology. It has been decided not to use the same six maturity levels used in many MMs, as it will not be easy for many small or medium organizations to measure all their processes and aspects in four pillars against six levels. Therefore, the researchers decided to use only four maturity levels, with each level representing a dedicated stage containing a specific group of processes. These four stage-based maturity levels are initial, established, improving, and optimizing. These four stage-based maturity levels are different from the levels of ISO/IEC 33020:2015 (ISO/IEC JTC 1/SC 7 Software and systems engineering 2015) and many MMs such as ITIL PMF, COBIT 5 process capability model (Peter C. Tessin, 2012), COBIT performance management, and CMMI (Ron Lear, n.d.).

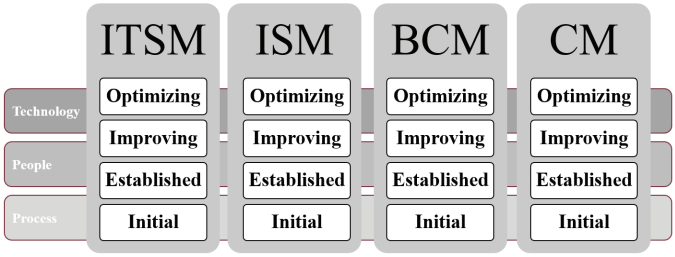

Fig. 4. The proposed MM four-pillar four-stage-based maturity levels EGIT MM

There are three main differences between the proposed MM and all others. The first is the difference in the number of maturity levels, as the proposed MM has only four stage-based maturity levels to enable small and medium organizations to simply use maturity measurement levels without having faraway destinations of maturity, which may not be needed for many organizations. The second is the difference in the names of the maturity levels by using four simple names that depict the maturity of each level, and two of these levels, which are established and optimized are already used by many other frameworks. The third difference, which is unique, is the introduction of stage-based maturity levels instead of normal maturity levels. In all other MMs, each maturity level is used to assess all processes and aspects of a selected reference model, and those processes and aspects that could fulfil these level requirements are moved on to be assessed against the requirements of all other higher maturity levels. In the proposed MM, each stage-based maturity level is only concerned with a specific group of processes and aspects, and whether they fulfil its requirements, then they are not assessed against any other higher level. This means that each stage-based maturity level is dedicated to only a specific limited group of processes, which makes it easy for any organization to avoid a long cycle of assessing the same processes and aspects against different levels of maturity.

The proposed MM has four pillars (ITSM, ISM, BCM, and CM) and three aspects (process, technology, and people). The pillars are normal like those in any other MM, while each of them has four stage-based levels of maturity, which are mentioned above, the three horizontal measurement aspects intersect with the four vertical pillars to shape their maturity.

Each vertical pillar was affected by three horizontal aspects. For example, if the ITSM pillar is discussed, the researchers cannot measure its maturity if they do not consider how processes are automated to increase their effectiveness and efficiency and how they are developed, operated, measured, and improved by people. While the horizontal aspects are used for enabling the maturity level of the vertical pillars, the four stage-based maturity levels depict the maturity level.

Existing MMs assume that an organization cannot reach a specific level of maturity unless it meets all requirements of the previous maturity levels because each level has a different group of requirements for the same process/aspect/component. These requirements are not shared among the maturity levels as they are divided among them starting with the simplest requirements at the starting level, and then the difficulty increases as the maturity levels increase. The proposed MM does not divide the maturity requirements of each process among different maturity levels, as each process is assessed against only one maturity level. Therefore, all requirements of any given process are included in a single maturity level, which includes this specific process. This enables organizations to reduce a lot of time and resources needed to assess their EGIT. Table II represents the four maturity stages of the ITSM, ISM, BCM, and CM pillars, respectively, with their respective processes which deal with supply chain security directly or indirectly.

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Table 2. The Proposed MM Has Four Pillars and Four Stage-based Maturity Levels with Respective Processes

Pillars	Stage-Based Maturity Levels			
	Initial	Established	Improving	Optimizing
ITSM	Organization Context, SM Strategy and Policy	Capacity and Availability Management	Service Level and Business Relationship Management	Portfolio Management
	Incident, Request and Change Management	IT Service Catalogue Management	Release, Testing and Deployment Management	Audit Management and Top Management Review
	Event and Problem Management	Supplier Management	Financial Management	EGIT Integration
ISM	Organization Context, ISM Strategy and ISPs	Network and Teleworking Security	System Acquisition, Development and Maintenance	Outsourced Processes and Supplier Security
	Information Security Risk Management	HR Security and ISM Knowledge Program	Cryptography	Audit Management and Top Management Review
	Information Security Incident Management	Asset and Access Management	Physical and Environmental Security	EGIT Integration
BCM	Organization Context, BCM Strategy and Policy	Business Continuity Risk Management	Business Continuity Communication	Outsourced Processes and Supplier Continuity
	Define Critical Assets	Business Continuity Strategies and Plans	Business Continuity Exercises/Tests	Audit Management and Top Management Review
	BIA	BCM Knowledge Program	Business Continuity Incident Response	EGIT Integration
CM	Organization Context, Compliance Strategy and Policy	Compliance Risk Management	Internal Controls and Procedures	Outsourced Processes and Suppliers Non-Compliance
	Applicable Laws, Regulations and Contracts Definition	Business Compliance Strategies and Plans	Compliance Exercises/	Audit Management and Top Management Review
	Compliance BIA	Compliance Knowledge Program	Managing Non-compliance Incident	EGIT Integration

If an organization has implemented seven processes, for example, which have different maturity levels, the organization has to assess them all against all the maturity levels of any existing MM till each process reaches to the highest applicable maturity level. While in the proposed MM, each process is assessed just one time against its respective maturity level. How can one determine the maturity level of an organization if the processes of this organization are scattered on different maturity levels? If one uses the existing maturity measurement mindset, he/she can determine the maturity level of this organization at the lowest level fully achieved, and he/she may not consider what the organization has achieved at the other higher levels. Unfortunately, this underestimates the effort made by the organization and the respective staff. However, the researchers do not have this mindset in the proposed MM. They have developed another mechanism for measuring the maturity of any organization by evaluating the achievement of each process in all stages. There will be a maturity map depicting the overall maturity of the organization in a specific pillar and this map is called Zoom-In maturity map, while there will be another map covering the maturity of the organization in all four pillars together and it is called the Zoom-Out maturity map.

Each process can have one of three achievement levels:

- N/A, which stands for not achieving the process requirements,
- P, which stands for partial achievement of the process requirements, and
- F, which stands for full achievement of the process requirements.

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Proposed MM Stage-Based Maturity Levels And Respective Processes

Each stage-based maturity level covers only three processes, which are not covered by any other level. Table II depicts the four pillars and the respective 12 processes of each, and how these processes are carefully included in the stage-based maturity level. This proposed MM will enable organizations in MENA region to easily assess the EGIT of their processes without much time and effort. The researchers cover first pillar, which is the ITSM, and how its 12 processes are organized. The first maturity level includes only three processes: organizational context, SM strategy and policy, incident, request and change management, and event and problem management. These three processes are the basics for any organization that needs ITSM capabilities. When an organization is assessed against this level, it can have three status levels for each process which are Not Available (N/A) if they do not invest at all in this process, "Partial" if they cannot fulfil all requirements of this process or "Full" if they fulfil all requirements of this process. The organization can go on and assess the maturity of the processes of the second, third, and fourth levels, which have different processes, even if they do not fully achieve the level for all three processes of level one. This way enables organizations to know their strengths and weaknesses, which may be scattered and not combined in just one maturity stage. It is normal to find an organization with mature processes in a higher maturity stage, while they do not have some mature processes in lower maturity stages. Therefore, the researchers have a maturity map to depict the full image of the organization's EGIT maturity in each pillar. All processes in the four pillars is assessed in terms of the three aspects: process, technology, and people.

Therefore, the 12 processes of ITSM are not assessed on each maturity level like in other MMs. These 12 processes are divided into four maturity stages/levels based on their complexity and dependencies with other processes. Therefore, each process is assessed only once, instead of four times. The other three pillars are handled like the ITSM exactly but with their respective distinctive processes. Thus, organizations can measure their AS-IS and easily define their TO-BE maturity levels. Organizations can now easily set EGIT strategies over time with annual improvement initiatives that can be implemented, managed, evaluated, and corrected easily if needed.

Proposed MM Interfaces

The proposed MM does not reinvent the wheel as it uses current MMs, best practice frameworks, and ISO standards, and adds more features and capabilities. The proposed MM merges, integrates, and improves some existing MMs to provide a more efficient and effective MM for the MENA region organizations. The proposed MM uses the following references:

1. ITIL v3/2011/v4 ITSM framework and ITIL PMF MM.
2. COBIT 5/2019 and process capability/CPM MM.
3. M_o_R and ISO 31000:2009 (ISO/TC 262 Risk management 2009) management of risk MM.
4. PRINCE2 (AXELOS 2017) and MSP (AXELOS 2011) frameworks and P3M3 MM (AXELOS, n.d.).
5. ISO 37301:2021
6. ISO/IEC 27001:2013
7. ISO 22301:2019
8. ISO/IEC 20000-1:2018 (ISO/IEC JTC 1/SC 40 IT service management and IT 2018)
9. ISO/IEC 33003:2015 (ISO/IEC JTC 1/SC 7 Software and systems engineering 3AD)
10. ISO/IEC 33020:2014

All these selected MMs, best practice frameworks, and ISO standards provide support to some components of the proposed MM.

Although there are many other related MM frameworks and ISO standards, these are considered direct sources of guidance based on their success and familiarity in the MENA region market. These four frameworks and their respective MMs and the six ISO standards affect the proposed MM, which has been developed to match the market needs while enabling the organizations to use whatever pillar/s they really need to assess.

The relationship between the proposed MM and the existing MMs and ISO standards in Table I depicts the direct relationship between the pillars of the proposed MM and the pillars of the existing MMs and the requirements of ISO standards. Other ISO standards can be used as references, such as ISO/IEC 38500 (ISO/IEC JTC 1 Information technology, 2008) and ISO 21500 (ISO/TC 258 Project, 2021).

The Proposed MM Evaluation Results

The proposed MM has undergone an evaluation process in three organizations, and the evaluation results are

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presented below. The evaluation process, which is the 3rd stage in the proposed MM development methodology and lifecycle stages, constitutes a full stage and covers the evaluation of the MM before it can be published to the research community and the EGIT MM market. The evaluation starts by planning the introduction of MM to a sample of three organizations that are interested in implementing EGIT MM. These organizations will undergo an experimental implementation of the MM internally with the researchers' support. The introduction procedure will include providing awareness sessions to different levels of stakeholders, including the organization's top management and IT staff, to introduce the MM to them and explain its importance and impact on the organization and its objectives. The need for their participation and cooperation will be explained in the awareness sessions and will be practiced in workshops to increase their preparedness.

Implementation will be performed by arranging and conducting a group of workshops with all respective stakeholders to assess their processes against the MM. At the beginning of these workshops, an example will be elaborated to all participating stakeholders to cover how to use the MM and all its maturity levels. Then, an assessment of their respective processes will be conducted on the MM with the researchers' support. All results of the assessed components will be reviewed by top management to validate the results. If any differences are discovered, the respective components will be reassessed to reach the actual performance.

The MM was introduced to three participating organizations of different sizes and nature. The first is working in the field of security printing and security solutions; the second is managing seaports; and the third is an IT service integrator providing consultancy services. The first is in about seven countries, but the evaluation occurred with the stakeholders of the two headquarters in Egypt and the UAE. The second manages approximately 70 ports worldwide and impacts the worldwide supply chain movement, but the evaluation occurred with the stakeholders of the headquarters in Egypt. The third one delivers IT services and their integration to support their customers' operations in Egypt, Sudan, and the UAE, and the evaluation covers all of them. Everyone delivers different services to their customers, but all of them are interested in measuring the maturity of their EGIT and supply chain capability easily. The first two received support in conducting the evaluation as they requested to have third-party evaluation, while the third one chose to have it first party self-assessment by managing it by themselves after getting the introduction. Table III presents the results of the assessment of the five principles of the three participating organizations. Only one of these organizations, the first one, has fully achieved the five pillars based on the nature of their field of work and its criticality.

Table 3. The Results of Assessing the Five Principles in the Three Participating Organizations
[(p) partial achievement and (f) full achievement]

Organization	The Five Principles Maturity Level				
	Strategy	Change M anagement	Operation Management	Risk Management	Continual Measurement and Improvement
1st	F	F	F	F	F
2nd	P	F	F	F	P
3rd	P	P	P	P	P

Assessing the maturity of EGIT in each organization has specific challenges based on their respective maturity and interests. This also reflects their achieved maturity level, although all of them were interested in increasing their maturity after the assessment. The assessment helped them understand their current state and weaknesses. Table IV presents the results of the ITSM pillar assessment for the three participating organizations. No one has fully achieved this pillar, despite the importance of the processes included. The three organizations can be considered to have some ITSM processes in a manner that supports them in performing their day-to-day operations without reaching a well-documented process with clear roles and responsibilities. Supply chain sustainability is impacted by many ITSM processes including and not limited to Availability and Capacity Management, IT Service Continuity Management, Supplier Management, Incident, Request and Change management and Event and Problem Management.

Table 4. The Results of Assessing the ITSM Pillar in the Three Participating Organizations [(n/a) not available, (p) partial achievement, and (f) full achievement]

Pillar	Stage-Based Maturity Levels	Processes	1st Org. Achieved Maturity	2nd Org. Achieved Maturity	3rd Org. Achieved Maturity
ITSM	Initial	Organization Context, SM Strategy and Policy	N/A	P	P
		Incident, Request and Change management	P	P	F
		Event and Problem Management	P	P	P
	Established	Capacity and Availability Management	P	P	P
		IT Service Catalogue Management	N/A	P	P
		Supplier Management	P	P	P
	Improving	Service Level and Business Relationship Management	P	P	P
		Release, Testing and Deployment Management	P	P	P
		Financial Management	P	P	P
	Optimizing	Portfolio Management	P	P	P
		Audit Management and Top Management Review	P	P	N/A
		EGIT Integration	P	P	P

Table V presents the results of the ISM pillar assessment for the three participating organizations. No one has fully achieved this pillar despite the importance of the processes included, especially the first one, which provides critical security printing services and other security services. The three organizations can be considered to have some information security policies and procedures in a manner that supports them in performing their day-to-day information security operations without reaching a well-documented process with clear roles and responsibilities. Although all of them have invested in information security technical solutions such as anti-virus, firewalls, security information and event management (SIEM), among others, they have not invested in a well-documented and measured management system including defined processes with clear roles and responsibilities. Supply chain sustainability is impacted by many ISM processes including and not limited to Information Security Risk Management, Information Security Incident Management, Asset and Access Management, Cryptography, Physical and Environmental Security and Outsourced Processes and Supplier Security.

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Table 5. The Results of Assessing the ISM Pillar in the Three Participating Organizations [(n/a) not available, (p) partial achievement, and (f) full achievement]

Pillar	Stage-Based Maturity Levels	Processes	1st Org. Achieved Maturity	2nd Org. Achieved Maturity	3rd Org. Achieved Maturity
ISM	Initial	Organization Context, ISM Strategy and ISPs	F	P	N/A
		Information Security Risk Management	F	P	N/A
		Information Security Incident Management	P	P	N/A
	Established	Network and Teleworking Security	P	P	P
		HR Security and ISM Knowledge Program	P	F	N/A
		Asset and Access Management	P	P	P
	Improving	System Acquisition, Development and Maintenance	P	P	P
		Cryptography	P	P	P
		Physical and Environmental Security	P	P	P
	Optimizing	Outsourced Processes and Supplier Security	F	P	P
		Audit Management and Top Management Review	F	P	N/A
		EGIT Integration	P	P	N/A

Table VI presents the results of the BCM pillar assessment for the three participating organizations. Again, none of them has fully achieved this pillar despite the importance of the processes included, especially the second one, which has critical systems to manage a large number of containers and ships per day. The three organizations can be considered to have continuity management technical solutions that support them to have backups, high-availability, and disaster recovery capabilities that can be used whenever needed. They do not have a well-documented process with clear roles, responsibilities, and measurement. Supply chain sustainability is impacted by many BCM processes including and not limited to BIA, Business Continuity Risk Management, Business Continuity Strategies and Plans, Business Continuity Communication, Business Continuity Exercises/Tests, Business Continuity Incident Response and Outsourced Processes and Supplier Continuity.

Table 6. The Results of Assessing the BCM Pillar in the Three Participating Organizations [(n/a) not available, (p) partial achievement, and (f) full achievement]

Pillar	Stage-Based Maturity Levels	Processes	1st Org. Achieved Maturity	2nd Org. Achieved Maturity	3rd Org. Achieved Maturity
BCM	Initial	Organization Context, BCM Strategy and Policy	Partial	N/A	N/A
		Define Critical Assets	Partial	Partial	N/A
		BIA	N/A	Partial	N/A
	Established	Business Continuity Risk Management	Partial	Partial	N/A
		Business Continuity Strategies and Plans	Partial	Partial	P
		BCM Knowledge Program	N/A	Partial	N/A
	Improving	Business Continuity Communication	Partial	N/A	P
		Business Continuity Exercises/Tests	Partial	Partial	P
		Business Continuity Incident Response	Partial	Partial	P
	Optimizing	Outsourced Processes and Supplier Continuity	N/A	Partial	P
		Audit Management and Top Management Review	Partial	Partial	N/A
		EGIT Integration	Partial	Partial	N/A

Table VII shows the results of the CM pillar assessment for the three participating organizations. Again, none of them has fully achieved this pillar, despite the importance of the processes included. Only the first organization has invested in hiring a professional specialist to define the respective regulations and start developing the internal compliance program, while the other two organizations believe that there are no regulations related to them in the countries, they are working in till now. Based on the countries where these organizations work, it is clear why the first one cares about compliance as it exists in the UAE, while the other two exist mainly in Egypt and Sudan. What seems strange to some of them is to consider compliance as an internal pillar, as they think that it should only be managed as an external compliance. All of them are starting to understand the newly published regulations by their governments and try to select the applicable ones to develop their compliance management systems accordingly. Supply chain sustainability is impacted by many CM processes including and not limited to Compliance BIA, Compliance Risk Management, Business Compliance Strategies and Plans, Managing Non-compliance Incident and Outsourced Processes and Suppliers Non-Compliance.

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Table 7. The Results of Assessing the CM Pillar in the Three Participating Organizations
[(n/a) not available, (p) partial achievement, and (f) full achievement]

Pillar	Stage-Based Maturity Levels	Processes	1st Org. Achieved Maturity	2nd Org. Achieved Maturity	3rd Org. Achieved Maturity
CM	Initial	Organization Context, Compliance Strategy and Policy	Partial	N/A	N/A
		Applicable Laws, Regulations and Contracts Definition	Partial	N/A	N/A
		Compliance BIA	Partial	N/A	N/A
	Established	Compliance Risk Management	Partial	N/A	N/A
		Business Compliance Strategies and Plans	Partial	N/A	N/A
		Compliance Knowledge Program	Partial	N/A	N/A
	Improving	Internal Controls and Procedures	Partial	N/A	N/A
		Compliance Exercises/	Partial	N/A	N/A
		Managing Non-compliance Incident	N/A	N/A	N/A
	Optimizing	Outsourced Processes and Suppliers Non-Compliance	Partial	N/A	N/A
		Audit Management and Top Management Review	N/A	N/A	N/A
		EGIT Integration	N/A	N/A	N/A

The Proposed MM Evaluation Discussion

At the end of the MM evaluation procedure, there was a feedback collection from all participating stakeholders. Each type of stakeholder would have a specific feedback as top management can be asked about whether the MM helped them measure their organization's EGIT maturity level and enabled them to move forward, while process and component owners and IT technical staff can be asked about whether the MM is easy to use and whether it covers their expectations. At the same time, both levels are asked whether the MM still needs improvement and in which aspect. Table VIII depicts how the three organizations evaluated EGIT MM after using it for the first time. They were provided with ten questions, eight of which could be answered by selecting a level from one to ten. Level one is the lowest while ten is the highest. The ninth question was about whether they wanted to use the EGIT MM on their own in the next time. The tenth question asked them about what the EGIT MM lacked and asked them to provide feedback and comments. The ten questions are:

Table VIII. The Results of EGIT MM Evaluation in the Three Participating Organizations

The EGIT MM Evaluation Questions	The Answers of the Participating Organizations		
	1st Org	2nd Org	3rd Org
Do you think that the stage-based feature of the EGIT MM is easier to use and saves your time?	7	8	9
Do you think that the multidimensional feature of the EGIT MM is easier to use and saves your time?	9	8	9
Do the ITSM, ISM, BCM, and CM dimensions of the EGIT MM suite your organization EGIT needs?	9	8	8
Do you think that the multipurpose feature suite your organization needs?	6	7	8

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How much do you think the assessment of the EGIT MM is easy?	8	8	7
Do you think that the first, second, and third-party assessment feature suites about your organization?	6	6	6
Is the selection of the processes suitable?	8	7	8
Is the order of the selected processes suitable?	9	8	9
Do you like to use the EGIT MM in the future on your own?	Yes, 3rd Party Assessment	Yes, Self-Assessment	Yes, Self-Assessment
What does the EGIT MM lack?	Detailed assessment and recommendations.	should be automated	should be automated

Based on the results of the analysis and how the MM has been accepted by the three organizations, it will be published to the community. The third organization added that the Incident, Request, and Change Management process in the initial stage of the ITSM pillar should be divided into two processes: incident and request management process and change management process. Table IX depicts the average evaluation of EGIT MM received from the three participating organizations on a scale of 10.

Table 9. The Results of EGIT MM Evaluation in the Three Participating Organizations

Feature	Average evaluation out of ten
Stage-based	8
Multi-dimensional	8.6
ITSM, ISM, BCM and CM dimensions	8.3
Multi-purpose suitability	7
EGIT MM easiness	7.6
Process selection suitability	7.6
Selected processes order suitable	8.6

Conclusions

Many organizations are interested in EGIT in developing countries and specially the MENA region due to the emerging regulations and laws related to governance of IT, Information Security/Cybersecurity and Business Continuity which impact supply chains sustainability. Complying to these regulations and laws does not only protect from legal penalties and fines as it guarantees the survival in an ever-changing market with different types of attacks and pandemics. In this paper, the researchers proposed a stage-based multidimensional process based EGIT MM which is needed in MENA region to match its context and capabilities. The selection of the four pillars, ITSM, ISM, BCM, and CM, was a good choice and combining them in a stage-based MM, making it easy for organizations to assess their EGIT maturity from different dimensions without having to measure each process many times. The selection of the processes is good and can be fine-tuned in the future, and the MM can be automated to make it easier for assessors and organizations.

Future Work

Although the EGIT MM has been developed and evaluated with the participation of three organizations, there are several necessary activities to be undertaken in the future:

1. Revamp the incident, request, and change management process by merging incident and request management into a single process, while creating a separate change management process that is more easily assessable.
2. Consolidate the audit management and top management review processes instead of duplicating them four times. This can be accomplished by sharing these two processes across the four pillars.
3. Create an online website to automate the MM and all its components, allowing organizations to assess their maturity in a user-friendly manner. The website should have the capability for multi-purpose, multi-dimensional, and stage-based maturity level assessments, enhancing effectiveness and efficiency.
4. Develop guidance for individuals interested in becoming assessors, providing them with knowledge on how to familiarize themselves with the proposed MM, the required skills and knowledge, and how to effectively utilize it. This guidance will be accessible on the website.
5. Continuously gather feedback from organizations utilizing the EGIT MM and analyze it every three

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to six months to identify trends and address comments and recommendations.

6. Offer support to researchers who are interested in analyzing or developing MMs related to EGIT, leveraging knowledge and experience.

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The Effect of Applied Blockchain on Economic Sustainability

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Abstract

Purpose: *What matters is that blockchain may be used to record anything of value, not only financial transactions. It is becoming increasingly clear that blockchain technology will drastically alter several industries, notably finance. Without a question, the financial industry is leading the way in the use of blockchain technology. Blockchain is quickly transforming the world economy. Given that distributed ledger technology, or blockchain, has the potential to always have a positive impact on society and the economy, this impact is crucial. Actually, there are more than just economic advantages to the blockchain, and some organizations have already begun to use its technological capabilities to solve issues in the real world. To determine the influence of applied blockchain on economic sustainability as well as the benefits and drawbacks of blockchain application for economy, this study will do so.*

Design/ methodology/ approach: *The terms "blockchain" and " economy" were used to find qualitative information in earlier work. Finally, 50 articles in the fields of business, management, and accounting that had undergone peer review as well as book chapters and conference proceedings were chosen. White papers and unreviewed books were removed as non-scientific sources. Qualitative data were collected from previous literature using the keywords "blockchain" and "economy". Then, preliminary data were used, by conducting 15 interviews with experts and managers in the financial sector in Egypt about their opinion on the adoption of artificial intelligence and its impact on economic sustainability.*

Findings: *From the interviews, the study collected more detailed information about the blockchain. This could be represented in three main themes: theme of blockchain advantages, theme of blockchain disadvantages and challenges and theme of blockchain opportunities. Finally, some recommendations were made to decision makers as well as future researchers in this field according to the study results.*

Keywords: *Blockchain, Economy, Qualitative, Systematic, Literature, Review.*

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Introduction

Businesses that have digitalized their systems have been able to use cutting-edge tools to expedite company procedures as well as alter their operating models to reinvent how they conduct business. This is actually because they can now more easily access powerful computing resources and expansive databases (Gomber et al., 2018). According to Russo-Spena et al. (2022), The most valuable firms today are platform- and Internet-based ones. Academics, social media, businesses, and governments are all actively investigating various digital technologies. These include blockchain, artificial intelligence (AI), the Internet of Things (IoT), big data, the web, and cloud computing. According to Benlian et al. (2018), These technologies significantly affect both organizations and people. The Internet of Value, which Tapscott and Euchner (2019) allude to, is made possible in part by blockchain technology and will fundamentally revolutionize society and the economy.

PricewaterhouseCoopers (PwC) estimates that by 2030, blockchain technology might raise global Output by 1.76 trillion US dollars. In 2008, Nakamoto laid the groundwork for the development of the blockchain technology.The basic technology underlying the next-generation Internet will be blockchain, which is now recognized as the fifth basis of the IT revolution, claims Shermin (2017). By 2027, 10% of the global GDP will be recorded and stored on blockchains thanks to the usage of blockchain technology in banking, insurance, medical care, schooling, and government sectors (World Economic Forum, 2015). In 2008, Nakamoto laid the groundwork for the development of the blockchain technology. PricewaterhouseCoopers (PwC) estimates that by 2030, blockchain technology might raise the global Output by 1.76 trillion US dollars. According to Deloitte's global blockchain report from 2020, businesses are more dedicated than ever to integrating blockchain into their operations. As blockchain technology advances, entrepreneurs are finding new ways to create value, foster trust, and strengthen resilience to the digital revolution by fusing blockchain with other forms of technology, such as AI, IoT, or cloud-based computing (Abdelmaboud et al., 2022).

Almost everywhere in the globe, blockchain is one of the trendiest subjects. Particularly from the start of the twenty-first century, there have been several significant advancements and improvements in financial technology like blockchain. It is crucial to understand what it actually signifies and represents in today's global economy. Recent advancements in distributed transaction and ledger systems have been primarily enabled by blockchain technology and distributed database technologies. These technologies lead to opening new doors for open-source prospects, particularly for new kinds of digital platforms and services (Antoniadis et al., 2020).

In other terms, blockchain is a network software system that enables safe online money, asset, and information transfers without the need for a middleman like a bank. The authenticity and reliability of sensitive documents or records, such as passports, visas, driver's licenses, birth and death certificates, registration to vote, contracts, wills, patents, and medical records, can also be preserved using a blockchain. A blockchain can be used as a digital registration to record, transfer, and confirm asset ownership, including ownership of homes, cars, stocks, bonds, mortgages, and insurance, among other things (Sakız and Gencer, 2019).

It is generally acknowledged that the distributed ledger technology (blockchain technology) computational design opens up a wide range of possible applications. For instance, it may assist in facilitating not just peer-to-peer payments but also managing records, tracking physical items, and transferring value via smart contracts, all without the need for a third party or human reconciliation by offering an immutable, distributed ledger. Blockchain applications have advanced thanks to improvements in computer processing power and networked computer systems, and the dominance of smartphones has made digital wallets both practical and more and more relevant. IoT (internet of things) and AI (artificial intelligence) apps that automate the collecting and processing of massive data for usage in blockchain platforms have also proliferated (Troncia et al., 2019). The transportation and logistics sector is beginning to embrace blockchain technology more widely because it allows logistics businesses to implement foolproof digital contracts and can improve the efficiency and transparency of supply chains (Hanfy, K., 2021).

The phrase "Blockchain economy" refers to a shift away from traditional national hard currencies and antiquated legacy ledger systems in favor of cryptocurrencies and digital ledger systems. In the blockchain economy, rather than using conventional software application programs to administer current national currencies, technologies like bitcoin and blockchain serve as the standard instruments for financial management. A scenario and prospective future setting where cryptocurrencies might displace the world's present monetary systems is the blockchain economy. Additionally, individualized financial and governmental services may be better catered to individual requirements using blockchain-based asset transfer. In several economic areas,

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blockchain technology is presently revolutionizing how value is stored, managed, and transferred across digital identities (Sakız and Gencer, 2019).

According to the Future of the Blockchain Market Report, the blockchain-based distributed ledger technology (DLT) is expected to have a favorable effect on the economy. From 2018 to 2024, it will make up to $120 billion in contributions globally. The analysis also showed that the advantages of blockchain meant widespread adoption was quite likely. According to their estimates, the value of blockchain may range from $87 billion to $120 billion by 2024, depending on the businesses that embrace it and the rate of adoption. The financial sector, particularly its infrastructure for financial markets, and the insurance business have both benefited greatly from blockchain technology.

Accordingly, this research examines how blockchain technology may enhance the transparency and trust of economic practices, as well as how its experts can enhance decision-making by using the immutable, append-only, shareable, validated, and agreed-upon data that blockchain can give. On the basis of that, this study is separated into many components. Section (1) represents the overall introduction to this research. Section (2) gives an overview about the blockchain. Section (3) introduces the blockchain in countries. Section (4) investigates the impact of application of blockchain on economic sustainability. Section (5) represents the research methodology. Section (6) consists of the interviews finding and results. Section (7) shows the discussion of the results. Section (8) shows the conclusion of research. Section (9) clarifies the recommendations that are reached from the research. Finally, section (10) represents the limitations of the research and provides some suggestions for future research.

Overview Of Blockchain

A blockchain is a growing collection of connections made possible by cryptographic hashes. Each block contains transaction information, a timestamp, the cryptographic hash of the block preceding it, and other information. Data nodes are represented by leaves in a Merkle tree for displaying transaction data. As a result of the fact that each block has data about the blocks that came before it, they all connect to one another to form an efficient chain (see linked list data structure). As a result, once an exchange has been recorded, it cannot be reversed without also reversing all blocks that come after it, making blockchain transactions irreversible (Zheng et al., 2018).

Research conducted in 2008 under the pseudonym Satoshi Nakamoto originally suggested the principles of blockchain, explaining how cryptology and an open distributed ledger may be integrated into a digital currency application. Its initial development was significantly hampered by bit coin's extraordinarily high volatility and the views of many nations about its complexity. However, the benefits of the bit coin's underlying blockchain technology are drawing more and more attention. A few benefits of blockchain are its distributed ledger, openness, tamper-proof design, information transparency, and decentralization. The blockchain has undergone a steady process of evolution. According to how they are implemented, blockchain is now divided into Blockchains 1.0, 2.0, and 3.0 (Elkady and Samrat, 2021).

Blockchain is a decentralized, unchangeable database that simplifies the administration of the assets and transactional data of corporate networks. The physical (a house, a vehicle, money, or a plot of property) or intangible (patents, intellectual property, trademarks, and intellectual property) nature of an asset might vary.

With almost everything of value being able to be documented and sold on a network based on blockchain technology, there is less risk and more efficiency for everyone involved. Business depends on information. It is great when it is received right away and promptly. The greatest solution for providing this information is blockchain since it provides immediate, accessible, and completely transparent data that are held on an immutable ledger and only available to users of a network with permission. A blockchain network has the ability to track orders, settlements, accounts, and output (Morkunas et al., 2019).

Created by Ben Reeves in 2011, blockchain is an open-source, decentralized network that facilitates safe transactions between businesses and people. This was inspired by the desire to develop a safe system for digital currencies against the risk of copying, which contributed to the creation of "Bitcoin," the first cryptocurrency in history. The technology offers several advantages, chief among them being the reduction of time and expenses, as well as the safe transfer of information via network sharing and encryption (Samir et al., 2023).

Blockchains are mostly controlled and utilized as distributed public ledgers using peer-to-peer (P2P) computer networks. Nodes work together to add and validate additional transaction blocks in accordance with a consensus-based protocol. Blockchains may be considered secure through design and are utilized as an example of a distributed computing system with Byzantine fault tolerance despite the fact that blockchain

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records are not immutable as well as blockchain splits are conceivable.

Individual blockchains have been proposed for use in corporate settings. Theoretically, permissioned blockchains may be more decentralized and, as a result, safer in practice than permissionless ones provided they are well-built, according to some. In computer world, the selling of such privatised blockchains without a strong security system was referred to as "snake oil" (Cachin, 2017).

The fact that a blockchain is a database where data are inputted and stored makes them relatively comparable. However, the way the data are organized and accessed on a blockchain differs significantly from how they are organzed in a conventional database or spreadsheet. A blockchain is made up of software applications called scripts that carry out the operations one would typically carry out in a database: entering and accessing data and saving and storing them some place. A distributed blockchain requires that all of its copies, which are stored on several computers, agree for it to be considered genuine (Halaburda, 2018). The elements of the blockchain are (Sherman et al., 2019):

1) **The use of distributed ledgers:** All network users have access to the distributed ledger's unchangeable transaction history. Trades are entered only once using the shared ledger, eliminating the redundancy of effort seen in conventional business networks.
2) **Unchangeable records:** A transaction cannot be changed or interfered with after it has been published to the public ledger by a participant. To correct an error in a transaction record, an additional transaction must be entered before both transactions were shown.
3) **Sensible contracts:** To expedite transactions, a smart contract—a set of instructions—is kept on the blockchain as well as automatically executed. A smart contract can set requirements for company bond transfers, indicate how much should be paid for trip insurance, as well as much more.

According to Reason, several banks have indicated an interest in using global databases for banking transactions and are collaborating with businesses to create private blockchains; IBM research from September 2016 reveals that this is happening more quickly than expected. The fact that this technology may be able to speed up back-office settlement processes is only one reason why banks are interested in it. Institutions have also learned to recognize, as the blockchain industry has grown, that technology is the cornerstone of a fundamentally new financial sector, regardless of the implications it entails (Chang et al., 2020).

A German bank called Berenberg thinks blockchain is an "overhyped technology" with many "proofs of concept" but few real-world applications. Initial coin offers (ICOs) and security token offerings (STOs) are two examples of the new class of digital assets known as digital security offerings (DSOs) that have emerged thanks to the blockchain. Both conventional assets, like stock in a firm, and more novel ones, such intellectual property, real estate, works of art, or niche goods, can be tokenized using STO/DSOs. A controlled stock exchange allows for the formal or open execution of STO/DSO transactions. A variety of businesses in this sector offer services for compliant tokenization, private STOs, and public STOs (Kelly, 2019).

Countries Using Block Chain Technology

By creating transparent and impenetrable processes, blockchain technology can help reduce corruption in developing nations. Decentralized and verifiable record-keeping is made possible, which makes it more difficult for corrupt behavior to go unreported. For instance, by securely registering property ownership and transactions, blockchain-based land registries help lower land-related corruption. Blockchain technology implementation in developing nations has difficulties due to poor internet access, a lack of technological know-how, and unclear regulations. Successful implementation requires coordinated efforts from governmental bodies, businesses, and international organizations (Caton, 2019).

By tracking each step of the procurement lifecycle, assuring integrity, and lowering the risk of fraud, blockchain can increase transparency in public procurement procedures in developing nations. Decentralized platforms can offer real-time monitoring and transaction verification, enabling smart contracts to automate and enforce compliance with procurement regulations and fostering fair competition and accountability. Widespread blockchain use in developing nations might be at danger from problems with regulation, scalability, cybersecurity, and the digital divide. Setting up helpful legislative frameworks, investing in infrastructure, and encouraging digital literacy are necessary to address these issues (Wang et al., 2020).

In situations where trust is either absent or untested, blockchain establishes trust amongst several entities. Due to this, these organizations are open to conducting business in ways that include transactions or data exchange that they otherwise could not have done or that would have needed an intermediary. One of the

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most frequently mentioned advantages of blockchain is its ability to foster trust. Early blockchain uses cases that allowed transactions between companies without a direct link but which nevertheless needed to share data or pay bills to demonstrate its benefits. The fundamental examples of how blockchain fosters trust between people who do not know one another are bitcoin and cryptocurrencies in general (Hacker, 2019).

Supplier of digital technology and services, blockchain establishes its usefulness when there is not a single entity that fosters trust. Blockchain not only makes it possible for participants to trust one another while remaining unknown to one another, but it also makes it possible for companies to share data among one another in an ecosystem. One illustration is supplying chain. However, no one is in charge of facilitating all that information exchange. Various organizations, from suppliers and transportation firms to manufacturers, distributors, and retailers, desire or require information from others in the chain. That problem is resolved by the decentralized structure of blockchain (Li et al., 2018).

Another major advantage of the technology is the security of systems that use blockchain technology. Blockchain uses end-to-end encryption to produce an unchangeable record of transactions, preventing fraud and other unwanted behavior. Additionally, unlike traditional systems that only save a single copy of data on servers, data on the blockchain are kept across a chain of computers, making it very hard to hack. Furthermore, advocates claim that by anonymizing information and, in some situations, requesting permission to limit access, blockchain can better handle privacy concerns than traditional systems (Tan, 2022).

The fundamental architecture of blockchain can help enterprises save money. Transaction processing is made more efficient, manual duties like gathering and editing data are reduced, and reporting and auditing procedures are made simpler. Field and other experts cited the cost reductions that financial institutions see as a result of utilizing blockchain, stating that these savings are directly related to the capacity of blockchain to speed clearing and settlement. In a broader sense, blockchain reduces expenses for enterprises by doing the processing that can normally be performed by suppliers and third-party providers in-house. Blockchain, according to some experts, is more expensive than other alternatives, mainly because it necessitates a substantial investment in computer power (Zhang et al., 2021).

Blockchain can execute transactions far more quickly than certain traditional techniques since it does away with intermediaries and automates many human steps. The speed at which a blockchain-based system can execute transactions, however, can vary depending on a number of variables, including network traffic, the dimension of each data block, and the pace at which consensus is reached. When all the stages, including the manual ones, are taken into consideration, some experts have come to the conclusion that blockchain is faster than conventional processes and technology. However, several experts claim that blockchain is frequently slower than traditional banking and data-processing systems for procedures that have already been mostly or completely digitalized (Carter and Jeng, 2021).

This means that once a transaction has been recorded on a blockchain, it cannot be altered or removed. Every transaction is time- and date-stamped, creating a permanent record that may be used to trace data across time and allow for safe, dependable audits of data. In contrast, outdated computer systems and paper-based filing are more prone to errors and are more readily damaged or discarded. As an illustration of the advantages of immutability, it was mentioned how Sweden uses blockchain to digitize real estate transactions to monitor property titles even as they change hands. However, some observers consider immutability to be a disadvantage if, for instance, someone tries to delete false or detrimental information (Rai, 2022).

Individuals now have unmatched control over their digital data thanks to blockchain. In a world where data are a very precious commodity, the technology by its very nature controls and secures the data that belong to countries. With restrictions imposed by blockchain-based smart contracts, individuals and organizations may choose which parts of their digital data they wish to share, with whom, and for how long. A real or digital asset's value is transformed into a digital token through the process of tokenization, which is subsequently recorded and shared on a blockchain. Digital art and other virtual goods have had success with tokenization, but it has wider uses that might streamline corporate transactions (Moradi et al., 2019).

Blockchain-based technologies are being researched and used by leaders in a variety of sectors to expedite laborious procedures and solve intractable issues. Field used the example of using blockchain to validate the data on applications of job applicants. Hiring managers must spend time carefully validating the information due to the frequency of resume fraud. To acquire the truth and to get it quickly and effectively, pilot initiatives that allow participating colleges to store information about their graduates and the degrees they have been granted on a blockchain that can subsequently be accessed by approved hiring managers assist solve both challenges (Spence, 2018).

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Blockchain Application Impact on Economic Sustainability

This section shows the research that has been done on blockchain and its effects on economic sustainability between 2017 and 2023.

In their study. Schmidt and Sandner (2017) examined how blockchain-based apps can affect citizens in developing nations. The first application category deals with issues with weak institutions. The second group attempts to increase financial inclusion for the underprivileged. Peer-to-peer systems are a further instance where start-ups may contribute significantly. Similar initiatives are underway in developing nations, but they must be imported and tailored to the conditions there. It examined software in the third category that gives users direct authority and independence from big businesses and local leaders. The growth of underdeveloped nations might be considerably aided by blockchain technology. It is crucial to remember that significant progress has been made in recent years (and decades), with examples including the emergence of a small, educated middle class in many cities of developing nations. It is crucial to apply blockchain technology and the knowledge gained from these accomplishments. Since it is how this technology is integrated into local systems and how it is used in conjunction with other tools to support these nations development, blockchain technology by itself cannot directly enhance people's lives.

Sayed and Abbas (2018) focused on how the revolutionary adoption of cryptocurrency has affected the economy of the Gulf States. The development and transformation of the economic market in the Gulf States have been made possible by the safety, effectiveness, and faith in cryptocurrency. Dubai, one of the UAE's members, has announced the adoption of cryptocurrency by launching their own version of it called "emCash" to support different governmental and non-governmental operations. The growth of cryptocurrencies in the Gulf States has had both positive effects and downsides that have been shifted onto the regional financial institutions. The crypto form of money is preferred over the original fiat currency, which is still widely used in most economies, because to its advantageous features.

Islam et al.'s (2018) study primarily focuses on the most important information underlying the economic factors, such as the effective blockchain algorithm, design, and mining operation, using materials from journal publications, internet publications, news reports, seminars, and workshops as its sources. This study attempts to understand how the consensus algorithm and increasing use of crypto and fiat currencies are carried out with its current benefits and drawbacks in order to further develop process. Several features of crypto and fiat currencies are rolling on rising economy at this time. Although fiat currency and cryptocurrency operate on distinct platforms, usability is still important for the development of our socio-economic system. However, the drawbacks of illegal transactions might leave people open to potential inconsistencies and lack of oversight.

Holtmeier and Sandner (2019) looked at how cryptocurrencies affect people and companies in emerging nations. The qualitative analysis that follows in this study is based on interviews with experts and is based on a literature review. The social media platforms Xing and LinkedIn were used to choose the interview partners. The participating professionals' backgrounds range greatly, from a representative of a Fintech start-up to a professor to a consultant ambassador. The specialists' areas of residence and employment also vary greatly, ranging from Argentina, Kenya, Switzerland, and Singapore. The goal is to demonstrate to decision-makers how cryptocurrency may be used to lower developmental hurdles.

The study of Cheng and Yen (2020) explored the possibility of predicting bitcoin returns using the economic policy uncertainty (EPU) index. It demonstrated that, in contrast to the United States or other Asian nations, the EPU index of China has the ability to anticipate the monthly returns of Bitcoin. Furthermore, the other major cryptocurrencies cannot be predicted by the China EPU index. Furthermore, only among the major cryptocurrencies is Bitcoin affected by China's restriction on cryptocurrency trade. The coinmarketcap website is where we get the information on cryptocurrencies like Bitcoin (BTC), Ethereum (ETH), Ripple (XRP), and Litecoin (LTC). The construction of the monthly EPU index. In general, Ethereum's timeframe is from September 2015 to June 2019 while this study sample period is from February 2014 to June 2019.

The use of blockchain technology in many fields and areas of the domestic economy is covered in Abdukarimovna (2020). Analysis is done on the outcomes of the successful use of blockchain technology in the micro- and macro-financial system, insurance system, public administration, industry, e-commerce, intellectual property registration, education, and healthcare. The use of IT in the service industry and the dynamics of the structure of communication service income of communication and information firms are both examined. Additionally, econometric models are used to anticipate economic activity in Uzbekistan for the years 2019 to

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2022. These indicators include the number of services offered in the information and communication sector.

To explain how the value of banking equities is impacted by the domestic cryptocurrency, Chi-Ming (2020) uses the Capital Asset Pricing Model and the notion of foreign exchange risk. Previous research suggested that the relationship between financial stocks and economic or personal financial ratios existed, but it seldom addressed the influence of a cryptocurrency variable on the digital economy. By analyzing 67,166 panel data observations from the China and Taiwan markets, this study offers detailed findings to demonstrate that the growth of cryptocurrencies leads to structural change in the financial sector. These crucial conclusions is provided as follows: 1. Compared to the Taiwan market, the China market is substantially more affected by domestic cryptocurrency exposure. 2. Compared to the Taiwan market, the China market's financial equities are more severely shocked by the CAPM three factor variables. 3. Both financial markets differ significantly from one another. 4. The dynamics of the monetary system's evolution and the cryptocurrency market's process of adjustment are crucial answers for both sectors.

Queiroz et al. (2021) intended to look at how blockchain technology (BCT) is used and any potential obstacles in the Brazilian OSCM environment. It created a model by pulling from the supply chain literature, the growing BCT literature, and the unified theory of acceptance and use of technology (UTAUT) model. Using partial least squares structural equation modeling (PLS-SEM), the suggested model was empirically tested using Brazilian operations and supply chain experts. The results showed that the most important constructs that directly influence BCT adoption are enabling circumstances, trust, social influence, and effort anticipation. Unexpectedly, performance expectancy did not seem to be a strong indicator of BCT uptake. This study makes significant managerial implications that may be particularly crucial for emerging economies and advances and stimulates the theory regarding supply chain BCT adoption behavior.

Cunha et al. (2021) provide a fresh paradigm that takes into account elements relating to business, society, economy and finance, technology, and policy in order to evaluate the potential prospects that blockchain presents. It demonstrates the intricate and varied roles that blockchain plays in development and is helpful in directing research efforts, generating actionable suggestions, and fostering development. It developed it systematically, utilizing the authors' knowledge of blockchain technology and development as well as thorough literature research. Blockchain systems that are properly developed and implemented may make significant contributions to addressing societal issues and enhancing the inclusiveness, fairness, and resilience of the society. The solutions that several nations have already implemented across numerous areas (such as public, financial, commercial, technology, and education) show how crucial blockchain is to further progress. Furthermore, less developed nations have a window of opportunity to escape the conventional lag in adopting information and communication technologies and to make quantum jumps that will place them on a level with their more developed rivals.

Cho et al. (2021) focused on blockchain's distinctive traceability to analyze the strategic and economic significance of this technology by integrating it with the value-added tax (VAT) reporting system. The integration of blockchain technology into the VAT system can effectively increase financial transparency and prevent fraud connected to VAT (such as underreported VAT) that may develop as a result of information asymmetry that exists at various supply chain stages. It created a game theory model with a retailer and two vendors in order to analyze the strategic choices made by the parties in relation to the adoption of blockchain technology and the implications on social welfare. Additionally, it demonstrates how factors like adoption costs, suppliers' VAT reporting practices, profit margins for retailers, and vendor competitiveness affect the choice to implement blockchain. Additionally, it discovered that under some circumstances, authorities might boost social welfare by offering incentives to promote blockchain use.

To encourage pro-environmental settings in supply chains of manufacturing enterprises, Mubarik et al. (2021) examined the influence of blockchain technology on green supply chain practices. Additionally, the mediating impact of environmental orientation between blockchain technology and sustainable supply chain practices is investigated. In this context, the moderating influence of technical orientation is also taken. A questionnaire was created by the authors using a quantitative technique that was based on literature. Following that, information is gathered from Malaysian manufacturing companies. Multiple regression and moderation are used in the PLS-SEM analysis of the obtained data. The findings of this study support blockchain's beneficial influence on green supply chain practices. Environmental orientation's moderating function in this connection is also highlighted. Additionally, it is verified that technical orientation acts as a moderator, strengthening the link between blockchain technology and green supply chain practices.

Náñez Alonso et al. (2021) had taken into account a number of factors in their study, starting with the Environmental Performance Index (EPI), including the cost of energy, how it is produced, temperature,

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environmental regulations, human capital, and R&D&I. It then reconstructed this EPI using linear regression using this data, taking into account the aforementioned variables that have a long-term impact on bitcoin mining. After the EPI has been revised, the study concludes that Denmark and Germany are the most environmentally friendly nations for bitcoin mining. In reality, eight of the top 10 nations (Denmark, Germany, Austria, Sweden, Switzerland, Finland, and the United Kingdom) are European; the other two (South Korea and Japan) are Asian.

Matyškevič et al. (2021)'s goal is to examine the effects of one of today's cutting-edge technologies, Blockchain, on economic security. The essay begins with a concept-technological foundation of the nature of blockchain technology, highlighting key elements that have the most important and potentially disruptive effects on several businesses and even the whole economy, including economic security. Second, current issues with this technology are presented. The relevance of this issue notably within contemporary megatrends like Globalization and the Information Society is next discussed, before the multifaceted idea of economic security is defined in the third section. eCommerce, payments, and logistics are the three key businesses and services through which the influence of blockchain has been studied. Finally, the paper's findings recommend combining Blockchain with other Industry 4.0 technologies to get the greatest amount of synergy. According to theoretical, empirical, and anecdotal data, supply chains in developing nations tend to violate sustainability principles more frequently than those in wealthy nations. Recent studies have shown that blockchain technology may significantly advance supply chain sustainability. Kshetri (2021) made the case that the properties of blockchain are particularly crucial for implementing sustainability requirements in poor nations. In order to evaluate product quality, environmental accounting, and social impact measurement, it reviewed several case studies of blockchain initiatives applied in supply chains in poor nations. It has created seven propositions that outline the problems that blockchain may assist solve for different stakeholders when promoting sustainable supply chains in developing nations. The proposals address problems with an adverse institutional environment, high prices, technology limits, unbalanced power distribution among supply chain stakeholders, and networks with porous and opaque value delivery.

Rana et al. (2022) explored the benefits and drawbacks of using Blockchain (BC) in the travel and tourism sector, as well as potential strategies to deal with the difficulties. This study does a systematic literature review (SLR), which entails finding, choosing, classifying, and assessing pertinent papers on a certain topic. The findings show that the majority of academic works provide several models of BC-based systems in order to highlight the advantages of BC implementation and explain its potential. However, because BC is a new technology, there are several obstacles in the way of its complete implementation in the tourist sector. Achieving a cooperative strategy among the stakeholders, intensifying academic research in the area, evaluating new models of BC-based systems, and establishing pertinent policies are potential answers.

Although Dash et al. (2022) stated that the Indians were quite accustomed to using cash, cards, and internet payment methods, the barter system is still prevalent in rural India. India is now developing into a tech powerhouse, and its economy is robust enough to accept cryptocurrencies as a form of payment. This paper has a significant impact in explaining the strengths, weaknesses, market readiness, and necessity to adopt a digital rupee when India's economy is widely regarded as a cash-oriented economy. This is because the Indian finance minister stated the same in February that India is working towards building its legal tender known as Central Bank-backed Digital Currency (CBDC). The research underlines the technical and socioeconomic difficulties that the Indian planners must comprehend before altering the monetary policies of the Central banks. ~~Although Indians are quite accustomed to using cash, cards, and internet payment methods, the barter system is still prevalent in rural India. India is now developing into a tech powerhouse, and its economy is robust enough to accept cryptocurrencies as a form of payment. This paper has a significant impact in explaining our strengths, weaknesses, market readiness, and necessity to adopt a digital rupee when India's economy is widely regarded as a cash-oriented economy. This is because the Indian finance minister stated the same in February that India is working towards building its legal tender known as Central Bank-backed Digital Currency (CBDC). The research underlines the technical and socioeconomic difficulties that our planners must comprehend before altering the monetary policies of the Central banks.~~

Academics have suggested blockchain as one of the fundamental components of corporate governance. Although prior research looked at the influence of blockchain technology on businesses in many different ways, very few studies have looked at how it may affect corporate governance. Eghe-Ikhurhe and Bonsu-Assibey (2022) looked at how blockchain technology affected Nigerian financial organizations' corporate governance. Over 121 replies, it employed multiple regression. An approach called random sampling was used to gather samples. According to results, blockchain technology has a favorable influence on

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corporate governance, pointing to the elimination of agents as middlemen in corporate governance through code, peer networking, and cooperation. The findings assist managers in changing the financial, regulatory, and overall governance structure of financial institutions.

Kwok and Treiblmaier (2023) provided a conceptual framework based on the dynamic capacities theory that investigates the potential of blockchain for promoting economic growth. In particular, it contends that the agent function in the dynamic capabilities' theory may be expanded from the organizational to the national levels. To demonstrate the effects of dynamic capabilities on various facets of economic development, framework combines blockchain as an economic driver as well as dynamic capabilities on higher-order and lower-order various levels (i.e., financial system enhancement, business and investment development, regulatory framework improvement, human capital development, systems and infrastructure improvement). The effectiveness of a national blockchain-based strategy is ultimately moderated by international political and regulatory concerns. Given that blockchain trials are still under progress, there have been instances where deployment may not achieve its promise, resulting in high-profile failures.

Approximately A$250 million was wasted by the Australian Securities Exchange as a result of the project's cancellation to update its post-trade settlement system to a blockchain-based platform. TradeLens, a blockchain platform between A.P. Moller-Maersk A/S and International Business Machines Corp. for tracking international shipments, has been canceled due to a lack of interest from participating businesses. We.trade, a banking alliance comprising Deutsche Bank, Santander, and HSBC with the intention of concentrating on trade financing, and B3i, an insurance alliance with the aim of concentrating on claims settlement, are two further examples that have collapsed. Singapore's goal of becoming a hub for virtual assets has been significantly impacted by fraud committed by cryptocurrency-related businesses like Terra Luna and FTX. Despite the public sector's keen interest in blockchain technology, the OECD noted that results have been mixed. The failure was caused by a number of causes, some of which may not necessarily be related to the nature of blockchain, including multistakeholder buy-in, exaggerated expectations, outdated systems, a lack of regulation, and an inappropriate fit (Kwok and Treiblmaier, 2023).

Mao et al. (2023) examined the relationship between green and non-green digital currency indices to demonstrate the impact of blockchain technology on three green bond indices in two periods prior to the emergence of COVID-19 and the corona period using daily information from the beginning of 2018 to the conclusion of 2022 and the Evidently Unrelated Regression method. According to the early findings, the coronavirus expansion boosted the green bond market susceptibility to the gold index. Additionally, green bonds are much more affected by the green cryptocurrency index (Cardano) during the Corona era. The impact of the Bitcoin index on the index of green bonds during the Corona era is less detrimental than it was during the pre-corona era.

Research Contribution

From the above literature, it is clearly noticed that there is a lack of studies that investigate the impact of blockchain adoption on economic stability inside the accounting sector, as blockchain is still a new field. According to that, the current study puts its aim on filling this gap depending on collecting qualitative data through interview done with managers in Egypt working in the financial industry. Through the interviews, the researcher asks the interviewees about the blockchain, its benefits and disadvantages towards financial industry. The researcher is also trying to identify the effect of blockchain adoption on economic sustainability.

Methodology

Through the use of a systematic literature study, a qualitative method will be employed to investigate the effect of implementing the blockchain on economic sustainability. An SLR can show the present status of research on a subject while highlighting gaps and regions in need of more study in relation to a specific research issue. As a result, the study analyzed 25 papers to look for a link between the variables and some of the prior research that dealt with the examination of the influence of blockchain on economy. Also, the research contained seven articles that dealt with the study of the blockchain and provided a brief overview of it. Additionally, six articles were used to discuss the study of blockchain economy, including the advantages of using it, how to use it, and the outcomes of using it in the field of accounting. Finally, eight studies that looked into the viability of introducing and utilizing the blockchain in the financial industry were consulted for this study. In the section of the study that dealt with earlier literature, the study used 50 studies that were gathered from journals. The adoption of blockchain and its effects on accounting performance were the subject of 15 interviews with specialists and managers in Egypt's financial industry. NVivo software will be used for the theme analysis of these interviews.

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Results and Findings

The goal of the current study is to determine how adoption of blockchain technology affects accounting performance. In light of this, 15 managers and subject-matter specialists who work in the accounting industry are interviewed. There are nine questions created, which are illustrated as follows:

1) How long have you been working in the finanaical sector?
2) Do you hear about using blockchain in finanaical sector? How?
3) In your point of view, will blockchain have the ability to affect the country operations? Why?
4) What type of evidence could be able to collect from blockchain software? (Example; invoices)
5) Do you see blockchain as a useful advanced technology to be applied?
6) Do you see blockchain as a complicated system to be used?
7) Do you see blockchain as a challenge that affects the security of information?
8) Do you recommend using blockchain in countries?
9) What are the factors that could affect the blockchain adoption?

The interviews are analyzed qualitatively, with the use of thematic analysis. A dataset patterns of meaning (themes) may be systematically found, arranged, and analyzed using the thematic analysis approach. The researcher can perceive and understand communal or shared meanings and experiences by utilizing thematic analysis to concentrate on meaning across a dataset. It is not the goal of thematic analysis to pinpoint particular and peculiar meanings and experiences that are present exclusively in a single data item. This technique therefore allows for the identification of commonalities in the way a subject is discussed or written about and the interpretation of those commonalities (Braun and Clarke, 2012).

Although there are many different kinds of theme analysis, the process may generally be broken down into six parts. Initial analysis, data coding, theme identification, and reporting on the results are all steps in thematic analysis (Braun and Clarke, 2012).

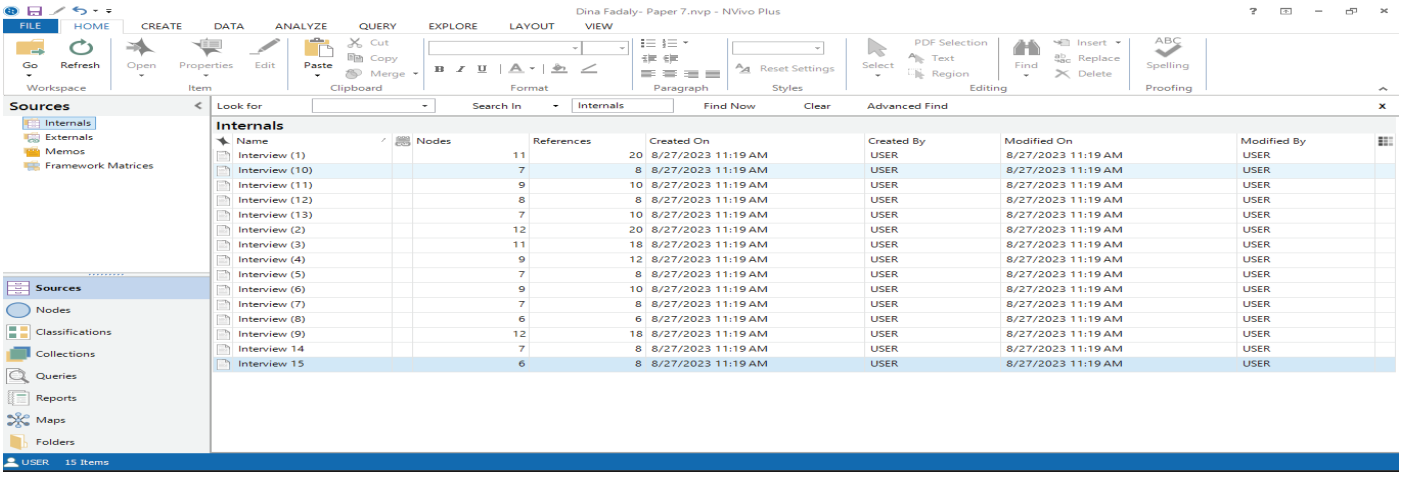

Fig. 1. Files imported into NVivo

1) Familiarization – Research teams or individuals become familiar with the dataset during the initial step of theme analysis. This can include reading the material over and again or even copying it. As a starting point for assigning first codes, researchers may make early notes on the potential patterns they see in the data. The 15 interviews were arranged in NVIVO as shown in figure 1.

2) Coding – The way researchers employ to recognize the concepts and subjects in their data and make quick and simple references to them is coding. Snippets of text data, as well as clips from films and audio recordings, can be given codes. This can be carried out in one of two ways, depending on the style of thematic analysis employed: systematically and rigorously, or more intuitively. In NVivo, this process is shown as in figure 2.

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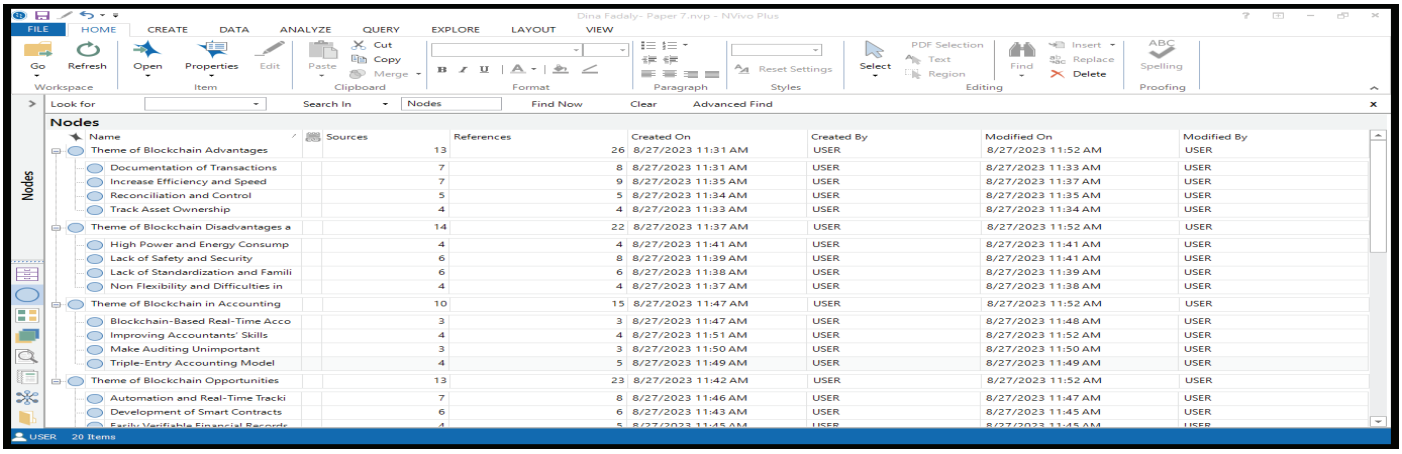

Fig. 2. Theme and codes generation in NVivo

3) Finding the theme - Within the corpus of study data, themes are the general ideas and subject areas. By combining the outcomes of the coding procedure, researchers may create themes that organize the detected codes into groupings according to their underlying meaning or topic matter. The word cloud that was retrieved is displayed in figure 3.

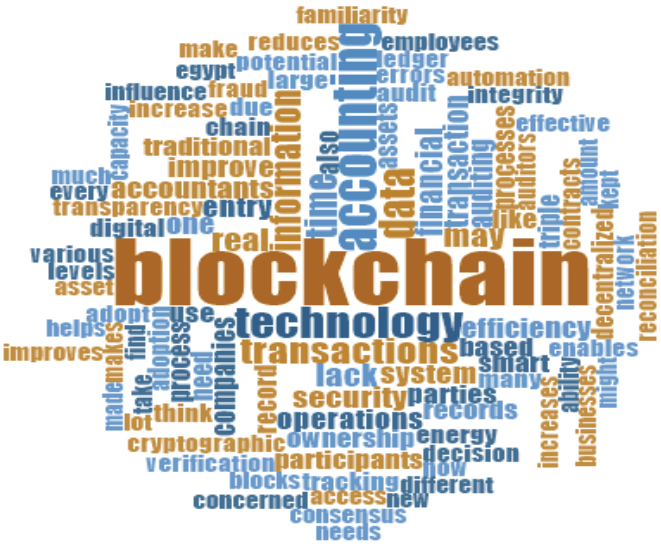

Fig. 3. Word cloud

4) Reviewing themes - Following the definition of the themes, the researchers reevaluate the themes to determine how well they complemented the coded data extraction. At this point, they could begin to sketch out the theme or develop an early theoretical framework. The researchers came up with 3 themes as a result of this stage:

- Theme of Blockchain Advantages
- Theme of Blockchain Disadvantages and Challenges
- Theme of Blockchain Opportunities

5) Themes definition and naming - As researchers spend more time studying the themes, they start to more clearly describe and identify them. The reason themes are distinct from codes is that they directly address the study question and capture patterns in the data rather than merely subjects. The primary themes and the sub-themes (codes) were successfully developed by the researchers through this stage.

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Table 1. Defining and Naming Themes

Major Themes	Sub-themes	Reference	Total
Theme of Blockchain Advantages	Documentation of Transactions	8	26
	Track Asset Ownership	4	
	Reconciliation and Control	5	
	Increase Efficiency and Speed	9	
Theme of Blockchain Disadvantages and Challenges	Non-Flexibility and Difficulties in Correcting Errors	4	22
	Lack of Standardization and Familiarity	6	
	Lack of Safety and Security	8	
	High Power and Energy Consumption Systems	4	
Theme of Blockchain Opportunities	Reduce the Risk of Fraudulent Transactions	5	23
	Development of Smart Contracts	6	
	Easily Verifiable Financial Records	4	
	Automation and Real-Time Tracking	8	

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6) Writing up - The final report, which includes a thorough explanation of the codes and themes, actual data excerpts that serve as examples of the findings, and any other information pertinent to the analysis, is now being developed by the researchers. A literature review identifying earlier studies and the findings that helped define the study issue may be included in the final report. Additionally, it might recommend possibilities for additional research that the themes support and that emerged throughout the course of the study. This step is shown in the following sub-sections;

Theme of Blockchain Advantages

This is the first theme developed from the interviews, where it consists of four sub-themes; Documentation of Transactions, Track Asset Ownership, Reconciliation and Control and Increase Efficiency and Speed. The codes of theme of blockchain advantages are shown in figure 4.

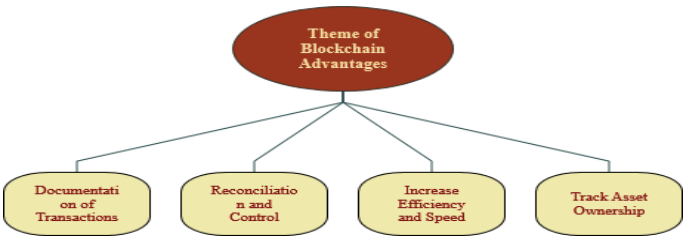

Fig. 4. Theme of blockchain advantages mind map

Documentation of Transactions: A new digital currency dubbed Bitcoin's foundation was built on the blockchain, a distributed worldwide system for recording and validating transactions, which was infamously unveiled in 2008. Blocks, chains, and a network are the three fundamental components of a blockchain. Groups of transactions or interactions between participants on the network are referred to as blocks. These transactions for Bitcoin include money transfers in which one party gives money to another. The evidence regarding this point is shown as follows:

"You may even delay user-to-user payments to stop transactions from receiving confirmations".

"The foundation of blockchain work is the proper production and documenting of data at the right and suitable time, blockchain is a technology that assists experts in collecting and preparing valuable and effective information. As a result, blockchain has the potential to improve the accuracy of information in countries".

"Blockchains may be cryptographically protected with the use of private or public signature technology, making the transactions that are produced impervious to fraud".

"Blockchain will encourage an increase in the amount of transactional-level that is done, in conjunction with other automation trends like machine learning".

"Operations become quicker and more effective due to blockchain's ability to automate transactions, streamline procedures, and do away with middlemen".

"Blockchain provides some tasks such as documenting transfers".

"Blockchain technology may provide operations and supply chain managers a number of benefits, including faster reaction times, safe and secure data, correct visibility across nodes, transparent transactions, and the confidence of supply chain participants."

"Every transaction is collected into a "block" that includes a collection of information, such the transaction's specifics and a timestamp. The term "blockchain" refers to the chain of blocks that results from connecting these blocks in a chronological order."

Track Asset Ownership: The inability to change or counterfeit something once it is on the blockchain is a basic characteristic of the technology. The technology has also started to be used as a tool for ownership verification. Unless the owner validates a change, ownership of an item is unchangeable after it has been published on the blockchain. The blockchain may be used to store digital items. The ownership record may be kept with all of that data as well. The evidence regarding this point is shown as follows:

"It is concerned with asset ownership transfer and the upkeep of an accurate financial ledger. Accounting is concerned with the measurement, communication, and analysis of financial data in general."

"Blockchain is excellent at tracing the ownership of goods, both real and digital. Industries like art, housing, and intellectual property may guarantee provenance and authenticity by generating digital representations of items and documenting ownership shifts on the blockchain."

"It will definitely be useful in the process of tracking assets, so based on what I heard it is tracking the ownership of assets and this is in the process of analyzing the data."

"Blockchain helps in provenance of tangible assets and tracking the digital assets, transactions and asset ownership."

Reconciliation and Control: With the use of blockchain technology, all participants in a transaction might have access to the full remittance information, cutting the time and manual work required for

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payment reconciliation to minutes rather than days. Corporates will have better insight and control over their worldwide cash positions inside their supply chain if the reconciliation process is speeded up. They cannot overlook the advantages because they will avoid protracted invoice disputes, cut down on collection lines, and assess credit lines more quickly. The evidence regarding this point is shown as follows:
"Blockchain has the potential to improve the accounting profession by lowering the expenses of maintaining and reconciling ledgers and offering perfect assurance over asset ownership and history".
"By paying attention to the reconciliation that blockchain technology places as a priority, controlling the data as a whole, and the ease of achieving the desired results".
"In order to avoid the need for human entry, some reconciliation jobs can be fully automated, while others can only be confirmed by active nodes that belong to members with greater authority".
"This enables businesses and experts to automate tasks like payroll and reconciliations".
"The influence of blockchain on reconciliation is particularly remarkable. As, traditional methods entail cross-referencing data between parties, which frequently results in differences. The blockchain on the other hand allows all participants to share the same source of information and facts, which reduces the chance of mistakes and disagreements."

Increase Efficiency and Speed: By itself, a blockchain will be more effective with fewer mistakes and disagreements. By doing away with middlemen and utilizing smart contracts, it helps to increase transaction speed. Even better, you may combine blockchain technology with other technologies for more advantages. The evidence regarding this point is shown as follows:
"This would free up a lot of time for the expert to focus on other things and increase the processes speed."
"Blockchain can improve the reliability of accounting data while also saving time by providing a superior alternative to present accounting and auditing processes. Because the fundamental goal of accounting has always been to create and deliver information to both internal and external decision makers, accountants are often concerned with the accuracy and usefulness of information collection."
"Blockchain technology has the ability to improve corporate operations in a variety of ways by enhancing efficiency, transparency, and security while removing the need for intermediaries."
"Auditing may enhance audit effectiveness with AI approaches by using verifiable and auditable blockchain."
"It helps in increasing the levels of efficiency in companies that adopt it abroad."
"Blockchain improves the traceability, security, transparency, and trustworthiness of data exchanged throughout a corporate network. It also reduces costs through new efficiencies."
"It is an effective system that increases the efficiency of the organization by increasing the speed of doing business."
"Blockchain has the potential to improve auditing itself. Auditors are able to undertake continuous monitoring and quickly identify irregularities due to real-time access to transaction data. By reducing the time gap between transactions and audits, this shift toward real-time auditing gives a more accurate and current picture of an organization's financial health."
"By giving economists clarity over who owns something and if there are responsibilities, blockchain technology has the potential to significantly improve efficiency."

Theme of Blockchain Disadvantages and Challenges

This is the second theme developed from the interviews and it consists of four sub-themes; Non-Flexibility and Difficulties in Correcting Errors, Lack of Standardization and Familiarity, Lack of Safety and Security and High Power and Energy Consumption Systems. The codes of theme of blockchain disadvantages and challenges are shown in figure 5.

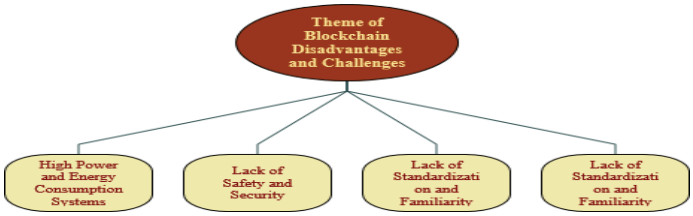

Fig. 5. Theme of blockchain disadvantages and challenges mind map

Non-Flexibility and Difficulties in Correcting Errors: Because of the misuse of a blockchain analysis tool, investigators were misled into believing that all addresses in the wallets of the merchant services provider belonged to Rub Ratings. Rub Ratings was just one of many clients of the merchant services provider that received funds at addresses hosted by the latter. Because of the mistake, fake news stories were published, and law authorities could have been misled into subpoenaing Rub Ratings rather than the merchant services company, which might have been able to offer additional details on the account using the disputed address. The evidence regarding this

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point is shown as follows:

"Once you enter information on a blockchain, it becomes unchangeable. If any errors or information need updating, it is simply impossible to do so."
"The flexibility factor of the blockchain is not high, and there is difficulty in correcting some errors that appear in the accounting operations, so I think that it leads to a decrease in its efficiency".
"Organizations would save money on expenses like administrative fees that are related to manual input errors".
"Due to cryptographic hashing, it is practically hard to change the data contained in a block once they have been added to the chain, which is one of the features that makes the blockchain not flexible and has no ability to collect errors."

Lack of Standardization and Familiarity: Despite the abundance of networks, there is no global standard. Because there is no global standard, there are issues with interoperability, rising prices, and complicated processes. Blockchain technology has no specific version, which discourages new investors and developers from entering the industry. The evidence regarding this point is shown as follows:
"The usage and implementation of blockchain technology are prohibited by various regulatory requirements in different nations and areas. Therefore, these countries have a lack of standardization and familiarity of Blockchain".
"The lack of standardization in thought about the adoption of new technologies by decision makers can be considered an element that controls the adoption of the blockchain, and this is due to the lack of familiarity levels with this technology".
"There are some countries that adopt it, but I do not have much information about blockchain because it is not familiar in Egypt".
"It is a bit complicated, and this is based on the fact that there are a large number of companies that find it unfamiliar so that I do not have much information about it or about how to use it".
"The lack of experience and lack of knowledge about this technology could be a reason for not adopting it, and this is because it is not yet familiar in Egypt".
"The blockchain adoption faces many challenges, firstly the technical intricacy of blockchain technology might be a hurdle for many accountants and auditors. Secondly, the lack of familiarity with blockchain concepts and practices. Third, the lack of standardized protocols and processes across multiple blockchain platforms creates difficulties. Finally, the lack of globally agreed standards makes integration and interoperability between blockchain systems and traditional software more difficult."

Lack of Safety and Security: While cryptocurrencies offer pseudonymity, many prospective blockchain applications demand that smart contracts and transactions be unmistakably connected to actual persons, presenting serious privacy and data security concerns. Today, many firms must abide by legal restrictions. With regards to crucial information, their clients have faith in them. However, this information will not be completely private if it is all preserved on a public ledger. Here, blockchain technology in private or consortium settings may be used. The evidence regarding this point is shown as follows:
"In order to preserve the integrity of the ledger, blockchain technology depends on a decentralized network of participants, which raises questions about data privacy and confidentiality'.
"Blockchain technology is well renowned for having excellent security. You should be aware of a weakness in its defenses, though. A blockchain's validation procedure is carried out by powerful computer equipment used by miners. A 51% assault can be launched if a miner has the processing capacity to control more than 50% of a blockchain's mining hash rate".
"Cryptographic capabilities that can tokenize and monitor any item digitally in a safe way are already integrated into every blockchain".
"The science of cryptography assures the security of sensitive personal, institutional, or organizational data through the use of cryptographic procedures, which may take the shape of communications between parties or the storage of processed data".
"Modern technology always has a small one that anyone can hack to access the data they need, so I think it is very unsafe".
"There is a slight lack in the blockchain in terms of security and privacy of information. It also stems from the use of the network in operations and uploading data"
"The lack of privacy and security in the blockchain, due to its use of a wide range of networks to find and analyze information".
"I have many concerns related to the safety and security of data in the blockchain system. I'm telling you that based on truth, as the real application of blockchain has proved lack in security."

High Power and Energy Consumption Systems: The fact that Proof of Work, the most popular consensus method, consumes a lot of energy is another cause for concern. This makes it difficult for average users to access PoW networks, promotes the creation of massive mining pools, inhibits decentralization by pressuring users to join these pools, and creates environmental issues. The evidence regarding this point is shown as follows:
"Different design decisions have a huge impact on how

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much energy blockchain technology uses. This makes it a crucial factor to take into account when developing blockchain-based IT solutions. I contend that the use of non-PoW consensus in commercial applications, as is the case with blockchain technology, already significantly reduces sustainability concerns."
"The large consumption of energy and power is one of the factors that may affect the decision of companies to adopt the blockchain, and this is because the firms or offices are not large in Egypt, so there will be a lack of providing this amount of energy and power needed to run the blockchain inside them."
"The adoption of the blockchain in companies needs a certain energy system, as the consumption of the power of the blockchain devices is very high."
"The technology infrastructure of companies is not qualified to adopt such a blockchain inside it, as it consumes a large amount of energy, and it needs a large force to operate it."

Theme of Blockchain Opportunities

This is the third theme developed from the interviews and it consists of four sub-themes; Reduce the Risk of Fraudulent Transactions, Development of Smart Contracts, Easily Verifiable Financial Records and Automation and Real-Time Tracking. The codes of theme of blockchain opportunities are shown in figure 6.

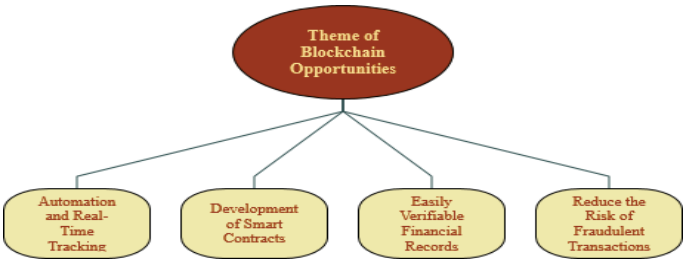

Fig. 6. Theme of blockchain opportunities mind map

Reduce the Risk of Fraudulent Transactions: Blockchain could be useful in preventing fraud. Even though blockchain offers a lot of valuable capabilities, fraud detection and prevention rely heavily on a few qualities. A distributed digital ledger called blockchain is where data are kept. All authorized members have access to the network data and transactions and can distribute files across machines. Data management and authorization are done in a transparent manner. Authorized users from many departments, including supply chain management and sales, may access and manage both recent and historical data on the network. With no requirement for a central authority, any authorized team member may now identify errors or questionable transactions. Blockchain thereby eliminates any human error and time wastage in fraud detection. The evidence regarding this point is shown as follows:
"Blockchain can assist avoid fraud and corruption by guaranteeing that transactions are safe, transparent, and verifiable by offering an immutable record. The capacity of blockchain technology to create a decentralized network that permits peer-to-peer transactions is one of its key benefits."
"I suspect it does technology and has some security risks from tracking fraud."
"Helping to limit special frauds that can take place during electronic transfers."
"Data on the blockchain are significantly more credible because they promote accountability, ensure record integrity, and provide an incontrovertible record, which reduces the danger of fraud and misrepresentation, despite the increased risk it introduces."
Development of Smart Contracts: A smart contract is a written contract between two or more parties that are kept on a blockchain like Ethereum or EOS. Every such agreement has a predetermined set of guidelines and criteria, and it automatically comes into effect when those requirements are satisfied. The whole blockchain network consensus serves as a guarantor for these contracts. They cannot be changed unless the entire network agrees to the modification. As a result, smart contracts are among the most effective and secure methods for establishing contracts between parties. The evidence regarding this point is shown as follows:
"It seeks to influence the accounting and record-keeping processes associated with the traditional accounting profession. This is through the process of developing so-called smart contracts that greatly assist accounting operations".
"The most popular keyword right now is "blockchain," which has close ties to the terms "smart contract," "cryptocurrency," "bitcoin," and "Internet of Things (IoT)".
"Evidence is represented in electronic documents, digital papers and invoices, for example the development of smart contracts".
"When specific criteria are satisfied, transactions using smart contracts are automatically completed".
"One of the most important types of evidence that I think will be in the accounting field is smart contracts, as they will be developed to keep pace with accounting work".
"The automation capabilities of blockchain, notably through smart contracts, streamlined operations like invoicing, payment, and contract execution."
Easily Verifiable Financial Records: The verification of financial data is made simpler by blockchain transparency and cryptographic verification

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procedures. Audits need less time and resources when transactions and financial data are independently and effectively verified by auditors. This simplicity of verification improves audit effectiveness while also bolstering compliance efforts and fostering confidence in the veracity of financial reporting. The evidence regarding this point is shown as follows:
"Because a big part of audits is validating the existence and correctness of financial records."
"Additional security measures might need to be put in place by experts to secure sensitive financial data."
"An item becomes a permanent and fixed record of a transaction once it is added to the blockchain."
"It also contains the financial records that the company deals with, and it is easy to verify and find information instead of the traditional methods that consume a lot of time to find the information we are looking for."
"The transparency of blockchain, together with its cryptographic verification processes, facilitates the verification of financial records. Auditors may validate transactions and financial data independently and effectively, minimizing audit time and resources. This simplicity of verification not only improves audit efficiency, but it also increases compliance efforts and encourages faith in the integrity of financial reporting."
Automation and Real-Time Tracking: The use of blockchain as a complete registration and inventory system has enormous potential. It provides businesses with a trustworthy, impenetrable platform to monitor a variety of assets, from raw materials to intellectual property. This openness reduces disagreements and disparities while increasing responsibility. Real-time tracking benefits sectors like supply chain management by eliminating inefficiencies and increasing overall operational transparency. The evidence regarding this point is shown as follows:
"It may also result in the formation of new organizational forms, like decentralized autonomous organizations".
"It saves a lot of time, and this is because of the documentation process for transactions and its ease of dealing with it".
"Emerging technologies may alter the way that work is now done; they speak of a "blockchain-based ecosystem" where accounting data is first validated, then safely kept and made available in real time for decision-making and reporting".
"Blockchain technology enables automated consensus for transaction entry, which may be managed at various node levels. This level of automation enables businesses to provide various levels of control to employees".
"It will facilitate the real time of tracking and auditing, and this is due to the process of automating transactions".
"This difference will be made by digitizing and automating all operations within companies".
"On the blockchain, every transaction is time-stamped, traceable, and accessible to all participants with the proper permissions. It is now simpler for auditors to check the correctness and integrity of financial data thanks to this feature simplified audit trail."
"The real-time transaction processing and verifiable audit trails provided by blockchain improve efficiency and transparency."

DISCUSSION

The investigation provides a greater understanding of blockchain technology in accounting. Fifteen managers of accounting in Egypt were interviewed, and a thematic analysis was done. Three themes emerged from the analysis, and they are as follows:

1. Theme of Blockchain Advantages
2. Theme of Blockchain Disadvantages and Challenges
3. Theme of Blockchain Opportunities

Theme of blockchain advantages refers to the advantages by blockchain adopters in Egypt, which consists of four codes (Documentation of Transactions, Track Asset Ownership, Reconciliation and Control and Increase Efficiency and Speed). The second theme which is blockchain disadvantages and challenges refers to the challenges that blockchain can create that represent a barrier to blockchain adoption, which consists of four codes (Non-Flexibility and Difficulties in Correcting Errors, Lack of Standardization and Familiarity, Lack of Safety and Security and High Power and Energy Consumption Systems). The third theme is blockchain opportunities which refers to opportunities gained from adoption of blockchain, which consists of four codes (Reduce the Risk of Fraudulent Transactions, Development of Smart Contracts, Easily Verifiable Financial Records and Automation and Real-Time Tracking). Finally, a

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mind map is done that summarizes the themes and codes of the interviews. The mind map is shown in figure 7:

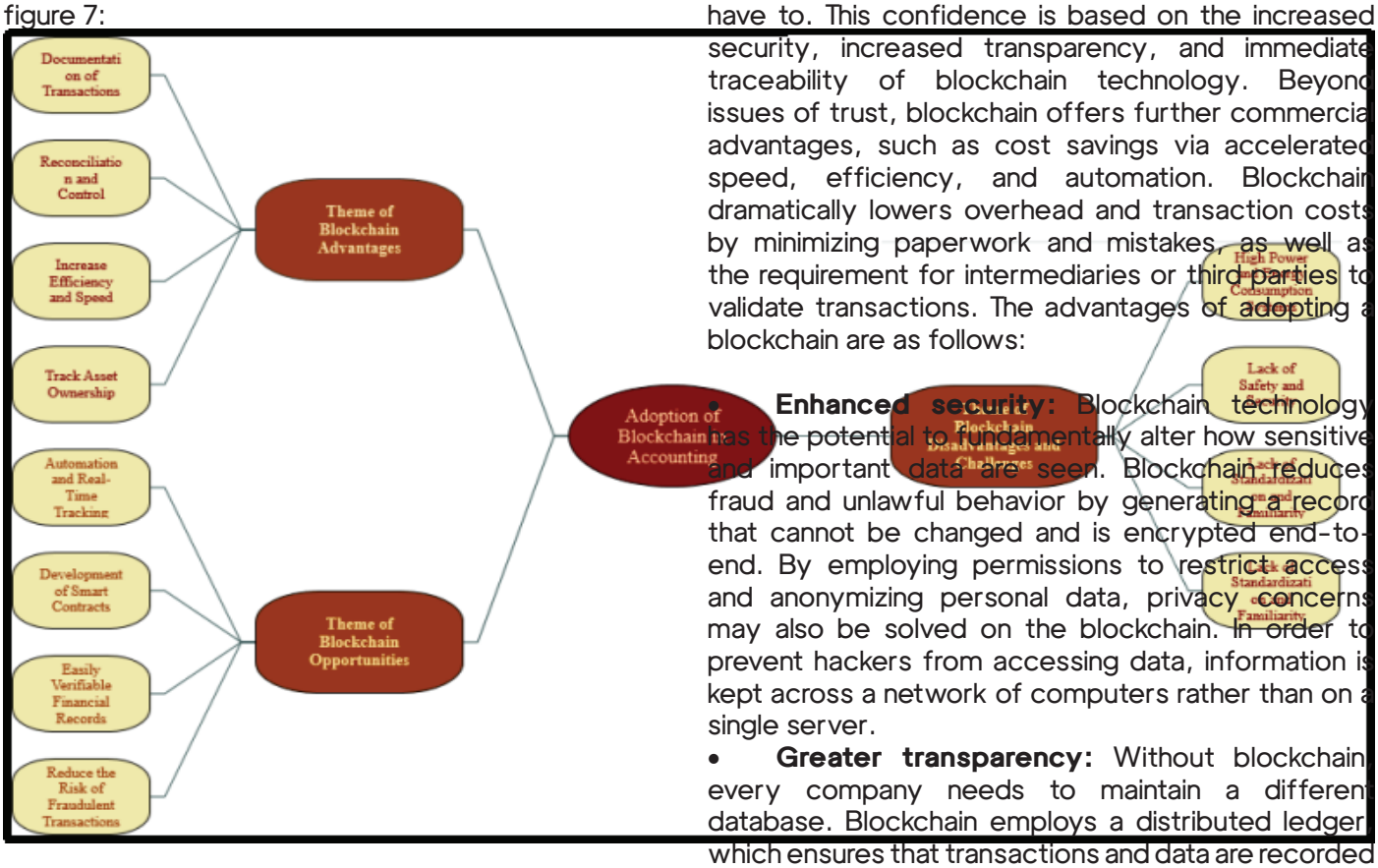

Fig. 7. Research summarization mind map

Conclusion

Following a thorough review and analysis of the prior literature, it was determined that no companies had fully adopted the blockchain within them. As a result, the majority of the literature relied on studying the impact of the blockchain on the field of financial and economy in sufficient detail through the literature due to the lack of trustworthy quantitative data to gauge the extent of the impact of adopting the blockchain in country economy. Some benefits and drawbacks of implementing the blockchain in country economy were identified based on the qualitative examination of the prior literature.

Advantage of Blockchain Technology for Accounting

Blockchain for business employs an open, unchangeable ledger that only members with authorization may view. Members of the network have control over what data each organization or member may view and what actions each member may take. Because business partners do not have to trust one another, blockchain is frequently referred to as a "trustless" network rather than they do not have to. This confidence is based on the increased security, increased transparency, and immediate traceability of blockchain technology. Beyond issues of trust, blockchain offers further commercial advantages, such as cost savings via accelerated speed, efficiency, and automation. Blockchain dramatically lowers overhead and transaction costs by minimizing paperwork and mistakes, as well as the requirement for intermediaries or third parties to validate transactions. The advantages of adopting a blockchain are as follows:

- **Enhanced security:** Blockchain technology has the potential to fundamentally alter how sensitive and important data are seen. Blockchain reduces fraud and unlawful behavior by generating a record that cannot be changed and is encrypted end-to-end. By employing permissions to restrict access and anonymizing personal data, privacy concerns may also be solved on the blockchain. In order to prevent hackers from accessing data, information is kept across a network of computers rather than on a single server.
- **Greater transparency:** Without blockchain, every company needs to maintain a different database. Blockchain employs a distributed ledger which ensures that transactions and data are recorded consistently across all locations. Full transparency is provided since any network user with permissions may see the same data at once. All transactions are time- and date-stamped records with immutability. Members may access the whole transaction history thanks to this, which almost eliminates the possibility of fraud.
- **Instant traceability:** Blockchain establishes an audit trail that records an asset origins at each stage of its travel. This helps to give the proof in businesses where customers are worried about environmental or human rights concerns around a product, or in industries plagued by fraud and counterfeiting. Blockchain makes it feasible to directly communicate provenance information to customers. Data on traceability can reveal weak points in any supply chain, such as those where items may be stored on a loading dock while being transported.
- **Increased speed and effectiveness:** Traditional paper-intensive procedures take a long time, are subject to human mistake, and frequently need for third-party mediation. Transactions may be finished more quickly and effectively by automating these operations with blockchain. The blockchain may hold documentation and transaction information together, doing away with the necessity for paper exchange. Clearing and settlement may happen considerably more quickly because there is no need

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to reconcile several ledgers.

- **Automation:** With "smart contracts," transactions may even be automated, enhancing productivity and accelerating the procedure even further. The subsequent stage in a transaction or process is automatically initiated after pre-specified requirements are satisfied. Smart contracts lessen the need for human involvement and rely less on outside parties to confirm that a contract provisions have been adhered to. When a consumer files a claim for insurance, for instance, the claim may be immediately settled and paid once the customer has submitted all required evidence.
- **Secured backups and tamper-proof ledgers:** Blockchains store information in blocks. Timestamps are used to link blocks and the records that are included inside them. As a result, transactions or operational events are recorded in an immutable manner on the blockchain. The transaction record is backed up and frequently saved in several copies throughout the network because it is also dispersed across numerous machines. The blockchain data are further secured by the encryption of every transaction and block. As a result, it is challenging for users to alter the blockchain transaction records. Employers no longer need to worry about their staff making mistakes or unauthorized alterations to accounting transactions. They can also have peace of mind knowing that their whole accounting database is protected by backups. Because of this, businesses are motivated to offer goods easily on a single platform, creating a digital economy for accounting transactions. To get greater long-term returns on their investments, businesses and their partners may diversify their portfolios of digital assets.

Disadvantage of Blockchain Technology for Countries Economy

Blockchain technology has been a game-changing innovation that provides exceptional security. The fact that this technology was used in the bitcoin industry increased its level of popularity. This technology does have another side, though. In addition to its advantages and uses, blockchain technology has several drawbacks. The blockchain technology has a few downsides that one should be aware of, as follows:

- **Private keys:** Private keys let the blockchain network retain its high level of security. When one verifies a blockchain address, it is helpful. Additionally, one receives a private key when he/she opens a cryptocurrency wallet. It is a password that gives one access tohis/her wallet money. By chance, one cannot withdraw money from his/her account if he/she loses this key. Therefore, one must save many copies of it just in case he/she misplaces the original and need to use one of the backups. The disadvantage is that if someone gains access to one of these copies, his/her cryptocurrency wallet is compromised. Furthermore, once a private key has been produced, it is hard to change it, unlike your social media or email account password.
- **Possibility of network security being compromised:** Blockchain technology is well renowned for having excellent security. One should be aware of a weakness in its defenses, though. A blockchain validation procedure is carried out by powerful computer equipment used by miners. A 51% assault can be launched if a miner has the processing capacity to control more than 50% of a blockchain mining hash rate. One may even delay user-to-user payments to stop transactions from receiving confirmations. Additionally, one may undo completed transactions to spend bitcoin twice. On larger blockchains like Bitcoin or Ethereum, a similar assault is unlikely to occur. New blockchains or forked cryptocurrencies, however, may sustain severe harm because of this behavior. Additionally, there have been cases of fraud using several cryptocurrencies.
- **High costs of implementation:** A corporation must spend a lot of money to deploy blockchain. Most businesses are reluctant to employ this technology because of the costly expenditure. One must employ core blockchain developers and blockchain software developers if one is a business owner trying to adopt blockchain. This will cost a lot of money. The next step is to develop blockchain-based apps. There are further hardware requirements.
- **Ineffective mining technique:** A process known as Proof-of-Work is used to mine each block on a blockchain. For each miner to participate in the mining process, a powerful computer is required. One miner receives the block rewards even if several miners compete to mine the block. There is a significant loss of resources and energy.
- **Environmental effects:** High-powered systems must operate continuously for mining, minting, and transaction validation. These procedures need substantial investments in addition to plenty of power. Serious environmental effects might result from this. In the Inner Mongolia area, China has outlawed blockchain mining due to the excessive environmental effects.
- **Storage issues:** On a blockchain, every piece of information is distributed throughout the network nodes. In this way, a miner computer hard drive houses all of the data on a certain blockchain. Data will grow along with the user base; therefore, the hard drive space will also require an update. There may come a moment when a blockchain's overall data volume exceeds the capacities of the available hard

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disks.

- **Anonymity:** The fundamental benefit of blockchain technology is anonymity. People might not be able to trace one's true identity but consider this from the standpoint of money laundering. Anywhere in the globe, a person with an anonymous identity can send money, and nobody will be able to trace such transactions beyond the wallet addresses. Investigations frequently reveal that fraudsters are leveraging blockchains as platforms for money laundering.
- **Immutability:** Information entered on a blockchain cannot be changed once it is there. It is simply not feasible to update any inaccuracies or facts. On the other hand, this characteristic is a benefit of blockchain since the data cannot be compromised in any manner. But every coin has two sides, and one needs to be aware of both.
- **Scalability:** The amount of data that each block can hold varies. Transaction validation becomes extremely laborious and slow as a result. On a blockchain, it is impossible to raise the block size. Ethereum, which is well renowned for its poor network speeds, may now have its transaction speed increased thanks to features in networks like Polygon. Although this may be a short-term fix, the root of the issue is still unresolved.
- **Hard forks:** When the majority of blockchain participants wish to enact new rules, hard forks happen. It may also occur if a significant blockchain organization decides to launch a brand-new coin. In this scenario, the previous and new cryptocurrencies function independently. Due to the new coin initial lack of availability on exchange platforms, many users encounter issues.
- **Regulations and legal requirements:** In many regions of the world, regulations for blockchain continue to provide difficulties. Additionally, the usage and implementation of blockchain technology are prohibited by various regulatory requirements in different nations and areas. Of course, blockchain technology is the wave of the future. However, one must be aware of its drawbacks if he/she want to buy in or use it. Technology is still in the early stages of development and is evolving quickly.

Recommendation

Governments, business, academia, and civil society, among other participants in the blockchain ecosystem, can follow the recommendation in this statement. The recommendation aims to provide a clear and cogent policy framework for responsible blockchain innovation and adoption to prevent and mitigate risks while preserving incentives for innovation, collaboration, and competition in light of the growing use and rapid development of the technology and its applications. This recommendation, which is the first cross-sectoral international policy standard for blockchain, acknowledges the wider ramifications and uses of the technology while acknowledging that previous international policy standards have mostly focused on financial market challenges. The recommendation tackles six crucial problems that affect all blockchain actors:

- **Coherence and Compliance:** Establishing procedures to evaluate and guarantee blockchain applications adherence to pertinent policy, legal, and regulatory standards, especially those operating internationally.
- **Governance, accountability, and transparency:** Ensuring that the governance frameworks of blockchains and their applications are transparent, well-defined, and compliant with legal and regulatory requirements by:

a) Adopting a multi-stakeholder, inclusive approach to blockchain governance and developing policies to ensure accountability, including in the event that a blockchain or its applications are winded down;
b) Granting blockchain stakeholders the necessary transparency regarding the use of blockchains, their design and operation, their governance frameworks, associated incentive mechanisms, and the identities, roles, and responsibilities of the relevant blockchain actors involved in any given blockchain, particularly with regard to accountability to their compliance obligations;
c) Conducting initial and ongoing assessments of Blockchains for compliance with this recommendation, with a focus on continuous verification and validation over the course of their lifecycle through proportionate approaches, such as assessment by design, and promoting transparency of the results of such assessments to the fullest extent possible while also allowing for remediation, where necessary; and
d) Being accountable and prompt when disclosing any modifications to the blockchains governance frameworks or code.

- **Interoperability:** Improving the safety and individual management of personal data while facilitating the interoperability of blockchains, especially through open standards, with non-blockchain systems, and with current information technology (IT) systems.
- **Digital Privacy and Security:** When using Blockchains, ensuring digital security and protecting user privacy include:

a) Putting mechanisms in place to comprehend

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and address concerns linked to digital identity management, access control, governance, and infrastructure that are pertinent to blockchains and their applications;

b) Assuming responsibility for risk management, backed by business continuity, and in accordance with applicable privacy and digital security standards and risk management functions, including acting transparently, for instance by promptly reporting on digital security incidents, including those affecting privacy;

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