



Information Technology (IT) Audit Approach for Mining Companies in Latin America

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Abstract: - The rapid evolution and widespread diffusion of information technology (it) has positioned itself as the predominant trend in the socio-economic development of the 21st century, encompassing virtually all aspects of life. the synergy between accounting and it is undeniable, with clients and auditors seeking to optimize the use of big data and advanced analytics in all their operations. This research makes a significant contribution to the audit arena, targeting internal and external auditors, as well as ceos and it managers. it provides a formal, simplified, comprehensive and adaptable model for various mining organizations, based on it best practices and standards. the methodology used for the creation of a hybrid it audit model was thoroughly reviewed, successfully identifying the standard it risks that impact the financial information of mining companies. The diagnosis of these risks was carried out by applying a research instrument to experts, managers and external it consultants, thus consolidating a valuable contribution to the understanding and management of technological risks in the mining sector.

Keywords: *information technology (it), audit model, mining sector.*

1. Introduction

In recent decades, various entities have experienced detrimental consequences such as frauds, significant economic losses, and cyberattacks on their information technology platforms



(galligan et al., 2019). the primary causes of these setbacks have been the absence of effective controls and inadequate risk measurement, as noted by bailey et al. (2018). porter et al. (2014) argue that technological change, while not inherently relevant, becomes crucial when it affects competitive advantage and the industry structure in which it operates. furthermore, porter et al. (2014) emphasize that not every change related to this approach is strategically beneficial unless carried out with proper planning, organization, direction, and control.

In line with this perspective, lapastora (2014) anticipated that the future of information technology auditing lies in strengthening the auditor's role as a trust generator, adapting to a more complex environment, and expanding the scope and depth of their work. as a complement to this idea, alsabahi (2021), in his study on the pls-sem approach, reveals that self-directed learning is the predominant factor influencing the information technology competence of auditors.

The role of auditors, both internal and external, undergoes significant changes in line with the use of integrated software and financial systems (shaikh et al., 2018). according to the same authors, a detailed understanding of information technologies in each entity has become essential for conducting effective and efficient audits. in this context, albarrán et al. (2017) highlight some of the best audit practices, such as cobit (control objectives for information and related technology), coso (committee of sponsoring organizations of the treadway commission), and itil (information technology infrastructure library).

Based on the foregoing considerations, knowledge gaps are identified, where external auditors face difficulties in understanding and accessing clients' information systems, as well as interpreting and analyzing data due to a lack of skills and knowledge in information technologies (alsabahi et al., 2021). in this context, the proposal of an information technology audit model seeks to address these areas of opportunity. With the above in mind, the objective of this research is to identify the elements that should be audited for the creation of an information technology audit model aimed at external auditors of mining companies.

2. State of the Art

The solid practices and fundamental standards for conducting an effective information technology audit are established in cobit, internationally recognized as a best practice framework for controlling information technology and managing associated risks (sahibudin, sharifi, & ayat, 2008). cobit is employed to implement information technology governance, defining the structure of relationships and processes aimed at directing and controlling the enterprise, with the goal of achieving its objectives and adding value while managing risks and optimizing the return on investment in information technologies and their processes (albarrán et al., 2017). this framework provides a clear distinction between governance and management,



disciplines involving diverse activities, requiring different organizational structures, and pursuing differentiated objectives (galligan, herrygers, & rau, 2019).

cobit provides clear guidance on what information in information technology management is reliable to more effectively achieve a company's business objectives (baisholan et al., 2021). the cobit 5 framework, as explained in albarrán et al.'s work (2017), simplifies a set of carefully explained procedures, including process inputs and outputs, process objectives, key process activities, the fundamental maturity model, and performance measures. as part of it audits, the requirements proposed by coso are considered, mapping processes and documenting them in a document called narratives (tarek et al., 2017).

COSO (COMMITTEE OF SPONSORING ORGANIZATIONS OF THE TREADWAY COMMISSION):

Following the sarbanes-oxley act of 2002 (sox), companies are required to establish, assess, and report on their internal controls and financial information (sciif) using a recognized framework (lawson et al., 2017). this requirement has led the integrated internal control framework (1992) created by coso committee members to become one of the widely used standards by companies and their external auditors for assessing business outcomes. coso considers crucial elements such as cyber threats and attacks, which continue to increase in number and complexity. as businesses and technology have evolved, the coso enterprise risk management framework has also evolved to address these challenges (galligan et al., 2019). one of these updates is coso ii framework, maintaining its five internal control components and incorporating enhancements and clarifications to facilitate its use and application in entities (cohen et al., 2017). lawson et al. (2017) proposes further framework development by including seventeen control principles, providing focal points and holding management accountable for ensuring relevant components and principles of internal control. additionally, according to galligan et al. (2019), improvements have been implemented to focus more on risk, both in the strategy-setting process and in performance driving.

ITIL (INFORMATION TECHNOLOGY INFRASTRUCTURE LIBRARY):

As an additional standard, itil aims to define best practices for processes and responsibilities intended to effectively manage the organization's it services and meet business objectives (sahibudin et al., 2008). this library includes five core disciplines supporting quality it services: service management, availability, capacity, financial management for services, and service continuity management (axcelos, 2017).

SARBANES-OXLEY ACT

The sarbanes-oxley act was enacted in july 2002 with the purpose of establishing new standards for corporate management and financial reporting in response to corporate fraud scandals that



occurred in the late 1990s (cruz, 2002). furthermore, this legislation requires all public companies to undergo validation by an independent external auditor, who must issue an opinion on their internal control (barrientos and lozano, 2018).

ISO/IEC 27002

Another additional support is the iso/iec 27002 standard, which constitutes a comprehensive guide of best practices detailing control objectives and control recommendations for information security (schmitz et al., 2021). this standard is aimed at safeguarding information security in any organization, with the goal of minimizing the likelihood of incidents such as theft, damage, loss, or plagiarism of information.

All the information cited above provides documentary support for the development of an information technology audit model. it is based on the selection of elements from regulations, best practices, and techniques. it also involves the development of a risk assessment matrix to generate specific audit tests. these tests will allow the evaluation and recommendations regarding the specific information technologies of each company.

MODELS FOR EXTERNAL IT AUDITING AS SUPPORT FOR FINANCIAL AUDITING

Models serve as a starting point for rational management and provide a method for analyzing and synthesizing complex situations and systems (robbins et al., 1996). therefore, an audit model consists of a series of techniques for creating controls and substantive tests. these techniques use risk and materiality matrices to determine the scope of the tests and assess the results (alvin et al., 2007).

Additionally, information technology (it) audits can be conducted within the framework of a business process review or as part of a broader "integrated" audit, where financial and technology auditors collaborate with internal auditors (zhao et al., 2017). in this context, according to mauro (2014), an integrated audit model is characterized by combining elements of financial and operational audits. this approach not only aims to address the financial aspects of the entity but also evaluate its internal control.

From another perspective, an integrated audit model is described by merhout and havelka (2008) as a systematic process carried out by certified public accounting (cpa) firms or by an internal audit expert within the organization. additionally, the notion of continuous or integrated auditing has recently emerged, considered by several authors as a new paradigm in auditing. the implementation of this approach is achieved by incorporating innovative models and methodologies into the audit activity (javier et al., 2017).

Furthermore, to maintain competitiveness, audit firms must adapt their business model and offer updated audit services, employing innovative technologies to propose digital solutions (van den broek et al., 2018). according to porter (2014), competition and the increasing pressure



to provide relevant and reliable information to clients are key factors motivating audit firms to digitize their processes. most audits, including it audits, follow a "risk-based" model, using information security standards or a combination of them (baisholan et al., 2021). digitization has had a significant impact on the labor market (dengler & matthes, 2018) and has transformed the way of doing business in various areas, including audit firms (oyewo et al., 2020). there is consensus about its impact on organization and employee activities (dumitru, 2016). according to meier (2017), a fourth generation of even more innovative tools is currently transforming our habits.

Thus, to stay competitive and stand out among other companies, audit firms must evolve their business model (sahut & peris, 2014). this involves reducing business risks through information technology auditing.

Since the 21st century, risk has become a crucial aspect in business operations. according to the definition provided by the coso organization, enterprise risk management (erm) is a process applied to strategy development and all levels of the enterprise (lawson et al., 2017). technological advances and future-oriented it methodologies have significantly transformed the practice of auditing (brown et al., 2021). technology has completely altered the accounting cycle, its underlying risks, and applicable internal controls (shaikh et al., 2018).

According to moorthy et al. (2011), not conducting audits on information technology today could increase the probability and impact of inherent process risks, leading to potential frauds and economic losses for any company. tsai et al. (2015) point out that the use of an erp system and audit software are crucial variables that reduce risks. additionally, solarte et al. (2015) argues that the concepts of it threats and risks are inherently related and are part of the conception of security, applied in reference to computer security and defined as manual and automatic controls. according to solarte et al. (2015), it risks represent potential problems that can affect information systems, and if adequate measures to safeguard data and information are not implemented, these risks can materialize due to vulnerabilities and threats at any time.

Alvarez (2016) emphasizes that risk reduction through auditing should encompass all relevant processes that make up the entity's business plan. each of these processes may be subject to a quantitative risk assessment regarding relevant and well-defined factors. wand et al. (2018) indicate that during planning and before conducting audit tests, the assessment of technological risk is vital and uses data provided by business process owners and well-defined objective criteria. tarek et al. (2017) suggest that effective risk management is achieved through a risk assessment matrix as the main tool, ensuring that risks are automatically discovered and addressed in real-time. considering the aforementioned, domínguez et al. (2019) also propose a risk assessment matrix that defines the priority of risks by classifying them as high, medium, or low and then determining sufficient audit tests



3. Methods

The present research is of a mixed quantitative-qualitative type, where, according to hernández sampieri et al. (2010), "mixed research methods are the systematic integration of quantitative and qualitative methods in a single study to obtain a more complete 'picture' of the phenomenon."

the participants in our research are employees from the administrative departments of mining units of groups such as fortuna silver mines, inc, taseko mines, lithium americas, inc, minera mercedes, inc., golden queen, inc., dedicated to the extraction of gold, silver, and lithium in cities in countries such as canada, mexico, peru, brazil, and argentina, to name a few. it also includes it directors, it managers, and research professors from foreign universities located in alicante, spain, and the usa. the selected period was the calendar year ending in 2021, during which financial audits of information technologies are conducted in conjunction with the governmental regulations of each country, financial and information technology audit standards in each country and internationally, and the regulations set by regulatory bodies such as the london stock exchange, where the metals extracted by the mines are listed.

the research instrument for the initial part, which is a questionnaire, was developed based on a basic questionnaire for planning a doctoral thesis from the university of alicante, spain, obtaining authorization from dr. josé vicente berná martínez from the university of alicante, spain, and following the guidelines set by cobit. the research instrument was designed for data collection with responses based on the likert scale, with the aim of understanding the need for a tool that validates the security of information technology audits supporting the financial information of gold, silver, and lithium mining units located in canada, the United States of America, mexico, central and south america.

THE CONCEPTUAL MODEL PRESENTED BELOW SHOWS THE IDENTIFIED VARIABLES.

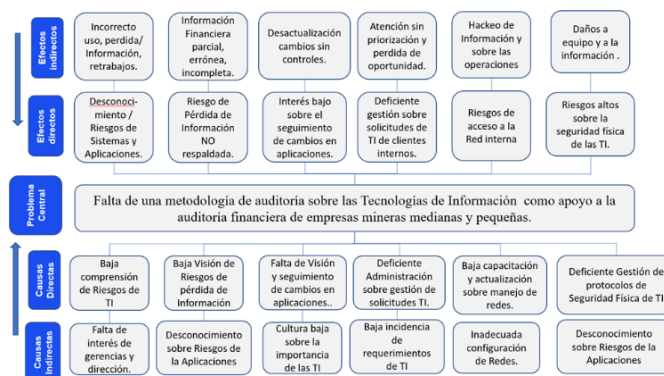


Figure 1. Model.



Source: own elaboration.

H0: there is no difference in the internal control of mining companies when they do apply audits on information technology audits as a complement to financial audits.

H1: there is a difference in the internal control of mining companies when they do apply audits on information technology audits as a complement to financial audits.

the procedure used is based on qualitative and quantitative tools.

the procedure for its development is generally based on the international standards on auditing - isas, and the international standards on auditing and information security iaasb, as follows:

- i. Information gathering - literature in virtual libraries and journals of scientific literature, degree theses, articles from specialized journals, interviews with experts, consultation of surveys, and scientific research questionnaires.
- ii. Evaluation - detailed chronological review of the evolution of information technology audits up to their current status and areas of opportunity.
- iii. Development of research construct and its application.
- iv. Analysis of the results.
- v. Development of an efficient audit model for information technology audits as support to financial audits in the mining sector in the americas that verifies the research hypotheses.
- vi. Practical application in mining companies.
- vii. Formulation of conclusions and recommendations.

4. Results

The instrument is evaluated through expert judgment, who will give their opinion and degree of reliability. afterward, reliability was determined through a survey applied to 26 companies; this test was developed using the cronbach's alpha test.

The research instrument was evaluated through expert judgment, which provided reliability through content, which, according to vara (2012), "there are several ways to analyze the content validity of instruments that can be used for any type of instrument, whether qualitative or quantitative, which are; judge or expert criteria and/or normative or certification criteria."

The instrument was additionally validated by experts in the field of information technology from companies related to the mining industry.



Statistically, a basic validation was carried out as follows using the spss program.

cronbach's alpha	n of elements
.894	49

Table 1. Reliability Statistics.

Source: own elaboration

Table 1 shows the value of cronbach's alpha of the instrument, a value of .894 considering that a value of cronbach's alpha <0.5 shows an unacceptable level of reliability; from 0.5 to 0.6 is a poor level; from 0.6 to 0.7 is a weak level; from 0.7 to 0.8 is still not acceptable and from 0.8 to 0.9 qualifies as a good level; from the result obtained in the test, it follows that the instrument is acceptable for giving a value greater than 0.8.

Edad

26 respuestas

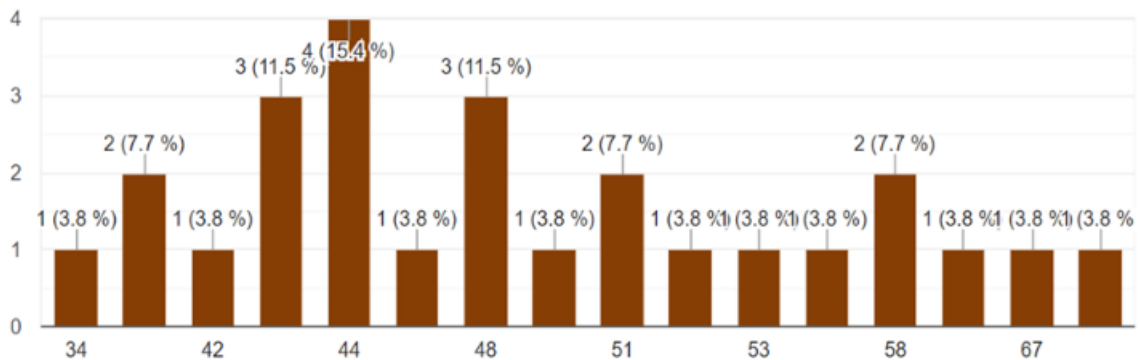


Figure 2. survey results charts

Next, we present our methodological proposal and examples for each of the 6 key processes identified for evaluation as basic and standard strategic it risks in one of the 4 mining groups evaluated. these groups have their corporate headquarters in america, specifically in the cities of vancouver and toronto, canada, and mining units located in the United States of north america, mexico, peru, brazil, argentina, to name a few that were assessed in our examples.

It is important to note that, for confidentiality reasons, we will show as much approved information as possible, omitting key information unauthorized for disclosure.



Sequentially, the methodology addresses the following sequential steps:

Risk assessment

Mapping of processes and their associated controls.

Determination of controls and scopes for review

Audit evaluation

Matrix of observations and improvement suggestions.

Risk assessment:

It begins with the creation of a "risk assessment matrix" for the most important it control subprocesses that impact the financial aspect of companies in the mining sector, namely:

AS: application security

CM: change management in applications

HD: help desk

PS: physical security of the data center

BR: backup and recovery

NS: network security

The it platforms on which the information is based for each location are identified. refer to table 1 "risk classification and evaluation matrix."

The main and most common platforms on which information is based are, enumeratively but not limitatively, the following:

ERP (enterprise resource planning): a modular system that serves as the repository for information and interlaces and validates it. currently, every mining company has one, such as sap, peoplesoft, oracle, and microsoft dynamics.

Alternative support systems: these are systems that have a specific weight in some key operation and that communicate information from the main erp system or application through interfaces.



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sub.procesos	corporativo canadá		ubicación lima peru		ubicación méxico			ubicación usa	
	siom / hms excel navroll - adn network	san siom excel navroll - shr / network	san siom / hms excel navroll stock option network	san siom / hms excel navroll network	san siom / hms excel navroll network	san siom / hms excel navroll network	san siom / hms excel navroll network	san siom / hms excel navroll network	
general ledger									
maintenance	<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>			<input type="checkbox"/>	
journal entry	<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>			<input type="checkbox"/>	
month end	<input type="checkbox"/> <input type="checkbox"/>		<input type="checkbox"/> <input type="checkbox"/>		<input type="checkbox"/>			<input type="checkbox"/>	
consolidation	<input type="checkbox"/> <input type="checkbox"/>								
financial statement preparation									
treasury	<input type="checkbox"/> <input type="checkbox"/>		<input type="checkbox"/> <input type="checkbox"/>		<input type="checkbox"/> <input type="checkbox"/>			<input type="checkbox"/> <input type="checkbox"/>	
master data / depreciation			<input type="checkbox"/>		<input type="checkbox"/>			<input type="checkbox"/>	
impairment									
purchase to payables	<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>			<input type="checkbox"/>	
lease		<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>	
master data / payroll	<input type="checkbox"/> <input type="checkbox"/>		<input type="checkbox"/> <input type="checkbox"/>		<input type="checkbox"/> <input type="checkbox"/>			<input type="checkbox"/> <input type="checkbox"/>	
stock administration & equity									
transaction	<input type="checkbox"/> <input type="checkbox"/>								
income tax provision & compliance	<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>			<input type="checkbox"/>	

Table 2. Process Evaluation.

Source: Own Elaboration.

5. Discussion

Based on the subprocesses, tests on it controls were designed, seeking evidence in the information provided by the company, and validating whether or not it complies with the audited control. similarly, to the formats of the previous application examples, they are presented in their standard review information format, which, depending on the specificity, may increase or be modified to a lesser extent. through the use of "review templates," the evaluation of evidence is tracked, documenting and recording the results of each specific review point.

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Finally, in results review meeting, an observations and suggestions report is presented to the general management and its directions. Due to confidentiality issues of mines, inc., only the format of this report is presented, concluding with 20 observations of minor significance and low impact.

The main methodological foundations for the creation of a hybrid information technology audit model were successfully reviewed. Standard IT risks affecting financial information related to mining companies were identified. Risks were diagnosed through the research instrument applied to 25 experts, directors, and external IT consultants who approved the validity and usefulness of an IT audit model. The model was tested in the last 3 years in mines inc mining group companies, as well as in other 5 mining groups, with success.

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