Transforming the Internal Audit Function (IAF): An Integrated MICMAC-ISM Approach for Unravelling the Relationship Among Challenges

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Abstract. The transformation toward the use of data analytics requires overcoming many challenges. Nevertheless, the interconnections between the challenges are unclear. Gaining knowledge about these interconnections is important to prioritize strategies that aim to stimulate the transformation. This paper unravels the relationship among Audit Analytics (AA) implementation challenges to transform the Internal Audit Function (IAF) using *Matrice d'Impacts Croisés Multiplication Appliqués à un Classement* (MICMAC) – Interpretative Structural Modelling (ISM) (or MICMAC-ISM) to develop a hierarchical model and determine the relationships among the challenges and the degree of power of each challenge. We collect data from internal auditors experienced in using audit analytics. They suggest that cultural challenges, along with technical challenges, are critical for enabling transformation. Moreover, combinations of approaches are required to address the complex interrelationships among challenges to initiate transformation. The analysis suggests that AA implementation requires a top-down approach to address cultural challenges blended with a bottom-up strategy to overcome technical challenges.

Keywords: Audit Analytics · Internal Audit Function · MICMAC-ISM · Transformation

1 Introduction

Audit Analytics (AA) can potentially transform auditing, including Internal Audit Function (IAF). AA can be defined as "*the process of identifying, gathering, validating, analyzing, and interpreting digital data using information technology to further the purpose and mission of internal auditing*" [1]. The use of AA by IAF is more than a mere change of approach. AA reshapes all facets of the organization, including the required auditor's skill, the data collection and analysis, and how to deliver the results [2]. AA also influences the relationships and interactions between IAF and its stakeholders, such as data access and analytics process [3, 4]. The fundamental adjustments imply the need to adapt the current practices, actors, structures, and values [5] for AA implementation, which resembles a transformational effort by IAF.

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AA encompasses various types of techniques, from simple ones like computer-assisted audit techniques (CAAT), to more sophisticated ones like continuous auditing (CA), and advanced use of machine learning for fraud detection [6–9]. This approach enables IAF to improve its services' effectiveness and efficiency through real-time (or near real-time) testing and reporting, expansion of services and testing coverage, and providing insight and foresight for the organization to anticipate future risks and opportunities [9–12]. AA also allows for engagement to be performed remotely [13], which provides a significant benefit in the post-pandemic era.

While the potential benefit of AA is widely recognized, the use of this practice is surprisingly low [12, 14–16]. In this regard, IAF faces many challenges in implementing AA, ranging from organizational (e.g., funding, (internal) audit process, auditor's skills) to technological (e.g., IT infrastructure, data) and even (organization's) cultural aspects [17–21]. However, although challenges of AA implementation are mentioned, the extant literature lacks an understanding of their relationships and significance. Gaining knowledge about these interconnections is important to prioritize strategies that aim to stimulate the transformation. This understanding is needed to lay the ground for developing a transformation framework that can overcome the challenges and assist practitioners in addressing those challenges based on their interrelationships.

Therefore, this paper aims to fill the void in the extant literature by unraveling the relationships among challenges for AA implementation by IAF. For this purpose, this paper is structured as follows. The next section describes the research approach, followed by an explanation of data collection and analysis using the MICMAC-ISM approach to lay out the interrelation of challenges as this research's finding. The subsequent section discusses the resulting model's interpretation along with the scientific and practical implications. The final section concludes the paper and suggests fruitful endeavours for future research.

2 Research Approach

2.1 Literature Research

This research refers to the previous literature review by Ramadhan et al. [1], which covers the extant literature discusses various aspects of AA from different perspectives and overview of challenges. The literature review obtained insight into the challenges related to AA implementation in IAF. It searched the literature using the keywords "audit analytics", "continuous audit", and "audit data analytics", combined with "implementation", "challenges", "factors", and "barriers", which resulted in 15 search strings. This approach aligns with the suggestion from vom Brocke et al. [22] to help ensure the relevance of the search results. The review focused on articles discussing AA in IAF settings. Nevertheless, some general and external audit literature relevant to IAF were found and included. The resulting articles were filtered based on their format and relevance, i.e., scientific publications (journal and conference paper and book section with an explicit method) and primary study of AA in the internal audit field or general audit with relevance to internal audit activity.

2.2 Analysis of the Challenges

This research adopted the *Matrice d'Impacts Croisés Multiplication Appliqués à un Classement* (MICMAC) – Interpretative Structural Modelling (ISM) (or MICMAC-ISM for short) method. MICMAC-ISM has been successfully utilized in studies on the barriers to innovation or technology implementation e.g., [23–26], which characterizes AA implementation. MICMAC-ISM assists in analyzing the complex and multifaceted system using a systematic approach to acquire practitioners' views on the matter being analyzed [23, 27] (see Fig. 1). This approach is arguably more robust and comprehensive than other multi-criteria decision-making approach like analytic network process (ANP) and analytical hierarchy process (AHP) [24, 26]. Further, practitioners' opinions incorporate their experience and the dynamics in the field over time, which improves the reliability of the analysis result.

For this research, the respondents were practitioners from IAF in a government institution with experience using AA in their internal audit activities. The setting and respondents were chosen since it has the revelatory characteristic of an emergent phenomenon being studied.

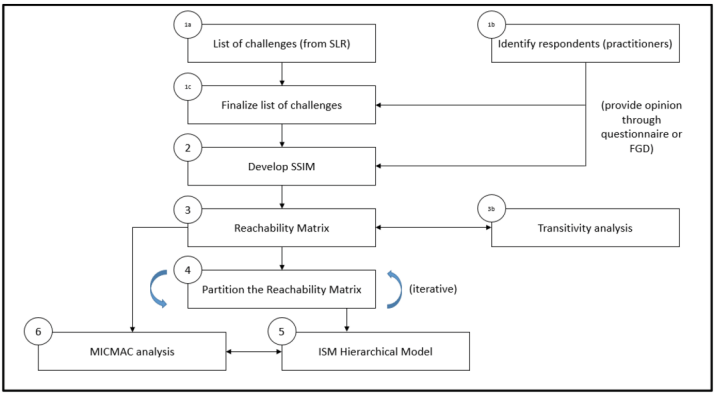

Fig. 1. MICMAC-ISM Steps

The first step was to finalize the challenges based on the practitioners' opinions. The respondent(s) are auditors with more than five years of experience, which included:

a) Auditors from IAF using AA in their (internal) audit projects, and
b) Employees of IAF who are involved in the development of AA in their institution.

This research asked respondents' views on the identified factors, i.e., their significance and additional factor(s), if any, using a questionnaire listing the factors (and a follow-up structured interview). The first step resulted in the final list of challenges.

The second step was to test the contextual relationship among the final list of challenges to develop the Structural Self-Interaction Matrix (SSIM). For this purpose, using the focused group discussion (FGD), participants were asked to determine the relationship between a pair of challenges. The SSIM was determined based on consensus among participants.

The SSIM transformed into a reachability matrix in the third step, i.e., a matrix showing relationships among challenges using binary notation (1 and 0, with 1 influencing another challenge and 0 influenced by another challenge). Transitivity analysis was performed to develop the final reachability matrix (FRM). In the fourth step, the FRM was partitioned iteratively to develop the hierarchy of challenges as the fifth step. Finally, MICMAC analysis used the final reachability matrix (FRM) to identify each factor's driving power and dependency. The MICMAC analysis then determines the position of each challenge as:

1) Autonomous, scored low in both driving power and dependence;
2) Independent, which has a high driving power;
3) Linkage, which is relatively high in both driving power and dependence; or
4) Dependent, scored high in dependence and low in driving power which informs that other challenges mostly influence the (said) challenge.

3 Data Analysis and Findings

3.1 Challenges of AA Implementation by IAF

A broad set of challenges emerged from the literature review. Some were organizational, whereas others were technical. Some challenges are related to the organization's operation or within the scope of authority of the organization, such as 'auditors' competence', 'cultural readiness', and 'organization and business complexity' [3, 18, 28, 29]. Other challenges refer to factors that are forced by authoritative entities like 'inadequate audit standard/guidelines' or 'independence impairment' [3, 4]. Moreover, as a technology-based innovation, some AA challenges pertinent to technology, such as 'data security concerns' or 'infrastructure capabilities' [30, 31]. Furthermore, some challenges reflect the problem related to audit activities, such as 'limited AA use-case', 'dynamics in audit process', or 'counter analytics' [3, 17, 32].

We follow up on the initial results with a group of practitioners. The respondents provided their views on the list of challenges using questionnaires and follow-up interviews[1]. Eleven practitioners participated in finalizing the list of challenges through questionnaires and follow-up interviews. All of the respondents have more than six years of experience in the internal audit, are involved in three or more AA projects, and hold relevant professional credentials in the technology-related audit fields, like certified Indonesian government auditor (JFA) or Certified Information System Auditor (CISA).

[1] The data collected from the respondents (presented throughout this paper) were in Indonesian, which was translated into English.

The questionnaire and interview used a 5-points Lickert scale (from 1-very insignificant, 3-neutral, to 5-very significant) and a narrative description to capture the respondents' opinions on the significance of each challenge. The significance of each challenge is assessed based on the view of participants from different organization units, i.e., the audit unit and research and development unit (or "Innovation Unit", in Krieger et al.'s [4] term). We considered the overall average score and the score from each business units to obtain more-balanced views of the challenges' significance to be included in the next analysis.

Further, we obtained follow-up interviews with some of the respondents to capture the importance (or lack of it) of the challenges. The follow up interviews provided additional insight. For instance, respondents #2 and #8 stated that some cultural characteristics like "reluctant to change", "expect instant result", and "fear of missing out", which are common in technology-based innovation in an organization, can significantly hinder AA implementation in IAF (see Table 1).

Table 1. List of Challenges (adapted from Ramadhan et al. [1])

#	Challenge	Description	References	Average Score (Audit)	Average Score (R&D)	**Average Score (overall)**
1	Inaccessible Data (for AA purposes)	Unavailability of digital data for the auditor to collect, evaluate, and analyze in the context of AA (including authorization, approval, and provision)	[18, 33]	4.43	5.00	4.64
2	Data Security Concerns	Concern regarding data confidentiality[1], i.e., the need to ensure data is accessible only to those with proper authorization, might affect data exchange among business/data owners and including IAF	[30]	3.43	4.25	3.73

(*continued*)

Table 1. (*continued*)

#	Challenge	Description	References	Average Score (Audit)	Average Score (R&D)	**Average Score (overall)**
3	Missing Data	Unavailability of data in the digital form required for AA within an organization's data ecosystem (including database or data warehouse)	[3, 18]	4.00	4.25	4.09
4	Lack of Cultural Readiness	Limited organizations' and IAF's awareness of the importance and benefit of AA and commitment to do the necessary process to implement AA	[3, 19, 21, 31]	4.86	4.25	4.64
5	Different Stakeholder's Interests	Problems due to varieties of perceptions, preferences, support, and interests among the related actors on the use of AA by IAF	[28, 34]	4.14	4.75	4.37
6	Auditor's AA-related Skills	The limitation of the Internal auditor's ability to perform the necessary task (e.g., obtain business understanding in IT-based environment, scripting, statistical knowledge) to use AA	[20, 29]	4.14	4.25	4.18

(*continued*)

Table 1. (*continued*)

#	Challenge	Description	References	Average Score (Audit)	Average Score (R&D)	**Average Score (overall)**
7	Dynamics in Audit Process	Unclear interaction mechanisms and dynamics between the auditor, client, and other stakeholders in internal audit tasks (or other related activities), including the use of AA in internal audit tasks	[17, 19, 35]	3.71	4.50	4.00
8	Organization and Business Complexity	Complex organizational structure and business processes, e.g. involving multiple systems and actors with different rules and regulations, including IT system complexity and variations, influence the effort required to implement AA	[18, 31]	3.71	3.75	3.73
9	Limited Use-Case availability	Limited audit analytics use cases appropriate for an assurance engagement by IAF. Audit analytics use-case includes the engagement objectives, analysis techniques, and data requirements for internal audit tasks	[4, 32, 36]	3.86	3.50	3.73

(*continued*)

Table 1. (*continued*)

#	Challenge	Description	References	Average Score (Audit)	Average Score (R&D)	**Average Score (overall)**
10	Inadequate (Internal) Audit Standard/ Guideline	Lack of (Internal) audit standard and its derivation, including guidelines or procedures; which inform how (internal) audit perform/conduct the use of AA in internal audit tasks, including the impairment in independence and objectivity and how to mitigate it	[3, 4, 19]	3.57	3.75	3.64

[1] In most references, data security often refers to confidentiality, integrity, and availability (known as CIA triad). However, in this paper, security particularly refers to confidentiality.

3.2 Structural Self-Interaction (SSIM) and Reachability Matrix

The SSIM was developed based on the consensus among FGD participants. For this purpose, we conducted FGD to an audit team experienced in using AA in internal audit tasks, from *simple* CAAT to developing a web-based application for CA (with testing automation). The team consists of one audit manager, one audit team leader, and three audit team members (with one skilled as a programmer and two skilled as a data engineer and database administrator). The FGD aims to map the relationship between a pair of challenges to develop the SSIM for MICMAC-ISM analysis. Each relationship is denoted as follows:

1) V, if the challenge on the left side of the table (L) affects the challenge on the top side of the table (T);
2) A, if challenge L is affected by challenge T;
3) X, if both challenges (L and T) affect each other; and
4) O, if both challenges (L and T) do not affect each other.

The resulted SSIM transformed into a reachability matrix using binary notation, i.e., 1 and 0. The reachability matrix was presented as follows:

1) 'V' results in 1 for challenge L and 0 for challenge T;
2) 'A' results in 0 for challenge L and 1 for challenge T;
3) 'X' results in 1 for both challenges L and T; and
4) 'O' results in 0 for both challenges L and T.

Further elaboration used transitivity analysis to develop the final reachability matrix. Transitivity analysis added notation 1 for a pair of unrelated challenges but related through another challenge (see Table 2).

Table 2. Final Reachability Matrix

Challenge	10	9	8	7	6	5	4	3	2	1	Driving Power
1	0	1	1*	1*	1	0	0	0	0	1	5
2	0	1*	0	1	1*	1	0	0	1	1	6
3	1	1	0	1	1*	0	0	1	0	1	6
4	1	1	1	1*	1	1	1	1	1	1	10
5	0	0	0	1	0	1	0	0	0	1*	3
6	0	1	1	1	1	0	0	0	0	1	5
7	0	1*	0	1	1*	0	0	0	0	1	4
8	0	1*	1	1	1	0	0	0	0	1*	5
9	0	1	0	1	1*	0	0	0	0	1	4
10	1	1	1*	1	1	0	0	0	0	1	6
Dependence	3	9	5	10	9	3	1	2	2	10	

*) adding transitivity

3.3 MICMAC (Cross-Impact Matrix-Multiplication Applied to Classification) and ISM Analysis

MICMAC analysis uses the final reachability matrix (FRM) to identify each factor's driving power and dependency. Driving power reflects the measured factor's influence on other factors, which is calculated as the sum of the associate row in the FRM; whereas dependence reflects other factors' influence on the measured factor, which is calculated as the sum of the associate column in the FRM [24, 37]. The result of MICMAC analysis is presented in the Fig. 2 below.

The team's consensus suggested that the lack of cultural readiness (C4) is the most independent challenge with strong driving powers, thus influential to other challenges. This notion suggests that addressing this challenge may benefit in solving problems derived from other challenges and eventually help the AA implementation. In contrast, inaccessible data (C1), limited AA-related skills (C6), dynamics in the audit process (C7), and limited use-case (C9) have a high dependence on other challenges, which implies that other challenges influence them. This notion indicates that they need the other challenges to be solved to reduce or eliminate their effect on AA implementation. Therefore, practitioners can focus on addressing other challenges, which will indirectly address these challenges with high dependence.

The final step was to define the levels of the challenges based on the reachability and antecedent set of each factor. The reachability set (R(Ci)) consists of the (analyzed) challenge and other challenges influenced by the said challenge. Meanwhile, the antecedent set (A(Ci)) consists of (the analyzed) challenge and other challenges that affect the said

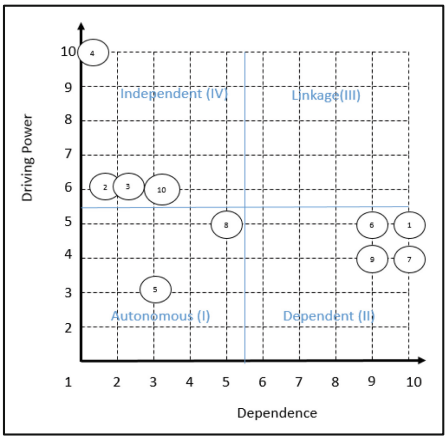

Fig. 2. MICMAC Analysis for AA Implementation Challenges

challenge. The challenges in which the reachability set equals the intersection set are put at the first (highest) level and removed from the list. The process performs iteratively for the remainder of the challenges until all the challenges' levels are defined (until the bottom level). The ISM analysis result is presented in the Fig. 3 below.

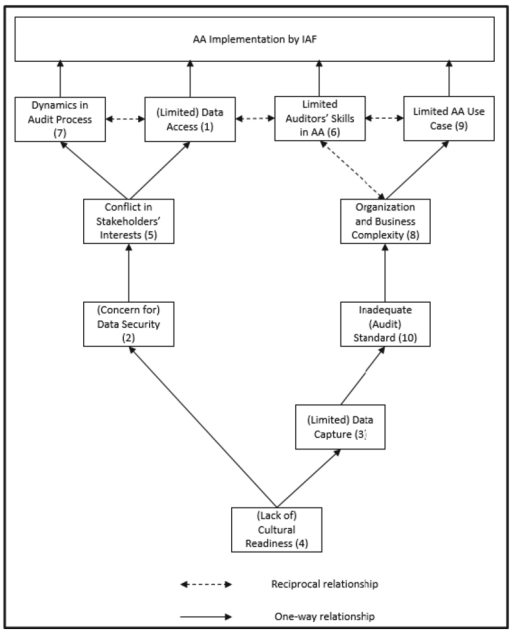

Fig. 3. ISM Analysis for AA Implementation Challenges

The hierarchical model visualizes the interrelations among challenges. The independent challenges with strong driving powers tend to be the foundational challenge (low-level). The team seemed to agree on the importance of the lack of culture (C4) as the foundational level challenge and that the inaccessible data (C1), AA-related audit skills (C6), dynamics in the audit process (C7), and limited use-case (C9) have the most direct impact on AA implementation (high-level challenges). This result reinstates the MICMAC analysis.

4 Discussion

4.1 Model Interpretation and its Scientific Value

AA implementation as a transformational change urges IAF to adjust its culture, process, and resources simultaneously. In this regard, MICMAC-ISM's resulting models help to conceptualize the layers and interrelationships among those challenges. This section elaborates on the meaning of the result of the MICMAC-ISM analysis.

Participants are concerned with the lack of cultural readiness (C4) as one of the critical challenges, which affects the data-related challenges, i.e., security (C2) and capture (C3). In this regard, the lack of cultural readiness renders the organization focused on confidentiality while undermining the value of data sharing and interconnection. And implies limited initiative to digitalize business processe. Therefore, addressing the cultural issue is one of the critical tasks in initiating AA implementation by IAF.

Interestingly, the extant literature focused on the cultural issue from the auditors' side. This research, however, suggests that it extends beyond the scope of auditors (or IAF as an entity) and reaches its stakeholders. Therefore, addressing cultural readiness should be directed towards the auditors (e.g., to overcome the auditors' resistance) and the stakeholders, such as audit clients or data owners.

The subsequent layers of challenges focused on data-related issues, which influence organizational and regulation-related issues. The participants agreed with those challenges' influence on other challenges. "[…] if the client is overly concerned with their data confidentiality, this (concern) will be reflected in their interests towards AA implementation by IAF […]", said one of the participants. This notion reaffirms the previous discussion to include external stakeholders of IAF (e.g., the client) in the AA implementation effort.

The higher-level challenges consist of technical challenges which are directly influence the use of AA in audit activities. Many other challenges influence those challenges, although they also influence each other. For instance, one participant suggested that "[…] dynamics during audit assignment affect communication between auditors and the client, which may eventually lead to the challenge of data access […]", to which another participant replied, "[…] while I agree with that statement, I can also see that the difficulty in accessing data may lead to more 'dynamics' during the audit assignment […]".

This research contributes to the advancement of this field by theorizing the contextual relationships and interrelation among those challenges to better understand the challenges around AA implementation and how those challenges simultaneously affect AA implementation. This result sheds light on why AA implementation is low despite

its promised benefits. This research also addresses the need to examine the relationships between AA implementation and contextual factors, as [4] suggested. Hence, this result suggests that interdisciplinary research is promising for advancing this field.

This study also contributes to the advancement of the method. To the best of our knowledge, this research is the first to use the MICMAC-ISM approach to unravel the contextual relationships among key challenges of AA implementation. Furthermore, unlike other MICMAC-ISM research, which mainly relies on survey data, we opt to obtain an in-depth view of the contextual relationships among the selected challenges through FGD sessions in the next phase. Therefore, it enables us to obtain the 'quantized' data about the relationships among challenges (i.e., influencing or influenced; presented in binary 1 or 0) and unravel the reasoning behind their view to enrich the analysis. This approach strengthens the use of MICMAC-ISM by decomposing its complex socio-technical challenges and incorporates the contextual factor in analyzing the phenomena; thus, improves the scientific and practical relevance of the findings from this method.

4.2 Practical Implications

This section discusses the implication of the developed model and the possible strategies to overcome the challenges.

AA implementation requires the IAF and the organization it belongs to adjust its current values and practices, which is indicated by the significance of the cultural challenge (C4). The model also acknowledges that technical challenges have an immediate influence on the use of AA in an engagement.

Transformational change requires the organization to develop a sense of urgency, form a coalition, and develop and communicate the vision for change within the organization that wants to transform [38]. This approach will assist in addressing the cultural issue in AA implementation, which may also help address other challenges. For instance, cultural readiness may develop the clients' understanding of the benefit of AA and, further, pave common perception on addressing data security concerns and access provision. These efforts typically require a top-down approach.

However, addressing cultural issues is a long-term effort with no guarantee of an immediate result. Also, there are caveats in the transformation effort's initial steps, such as the lack of patience or overconfidence in the organization's ability to change [38]. Therefore, another strategy is to address challenges with a more direct impact on AA implementation and more manageable processes and results. For instance, the IAF may initiate relevant training related to AA use for the auditors [3, 29]. This approach may help the transformation through visible results such as improved auditors' AA-related skills or concrete ideas for an AA project and address C6 and C9.

The implication of AA implementation as a transformational change may also require adjustment in regulatory settings, e.g., internal audit standards at the industry level or internal audit charter containing internal audit result communication and follow-up protocol at the organization level [12, 39]. Moreover, this regulation should encompass the responsibilities of all related parties, i.e., the responsibility of the governing body and audit clients, such as providing (data) access for internal audit purposes [40], and the IAF to mitigate the risks associated with the transfer and use of (internal audit) client's data, such as security and contextual integrity risks [41–43]. Furthermore, the

emergence and growth of predictive and prescriptive analytics may obscure the barrier between assurance and consulting activities [3]. Therefore, a regulatory update might be required to safeguard IAF's conformity with independence and objectivity standard. In addition, the required skills to implement AA may also transcend beyond the internal hiring and training strategy by IAF. Hence, there is a need to adjust and improve academic and professional curricula to incorporate AA-related skills for auditors [44, 45]. These types of efforts combine top-down and bottom-up approaches, incorporating mid- and long-term strategies aimed at a more fundamental change in organizational aspects and short-term effort with expected immediate technical results.

In practice, this combination of approaches can be translated into an AA implementation roadmap involving various stakeholders in its development and incorporating different elements. For instance, a long-term roadmap can contain a communication plan to persuade all actors to embrace AA. It also comprises competency requirements and a training plan for auditors and pilot projects as a quick-win strategy to acclimatize the organization and IAF with AA's actual practice and benefits. Furthermore, this roadmap may include efforts to update the professional standards and curricula. The formalized and enacted roadmap represents the top-down or strategic approach, while the pilot project (combined with the training plan) supports the roadmap from the operational or bottom-up perspective.

4.3 Limitations and Future Research

We identify several limitations of this study. First, the specific context of the research may suffer from the findings' limited generalizability and external validity. In addition, the identified key challenges in this study derived from the respondents within this study context, which may be different in another setting. Moreover, this research's approach also suggests that the result of MICMAC-ISM considerably depends on the respondents' knowledge and experience of the analyzed matter and may limit its applicability in a particular context. In addition, although mitigated by the use of multiple respondents and consensus among respondents, this method also acknowledges the nature of possible subjectivity of the respondents.

Therefore, working on the limitations above, future research may enhance this field by examining the challenges of AA implementation in a different setting, which includes the identification of challenges and the analysis of contextual relationships among the challenges. An in-depth case study to reflect on this research's result will also be beneficial for the advancement of this field and may reaffirm or extend this research's findings. In addition, to address the possible limited expertise of practitioners, future works may opt to use experts who meet the criteria suggested by [46]. Finally, developing a framework for AA implementation based on the hierarchical model of the challenges will be fruitful in advancing this research field.

5 Conclusion

This paper views AA implementation as a transformational change for IAF. The developed MICMAC-ISM model assists AA implementation by unraveling how the challenges are interrelated and influence AA implementation.

This research analyzes the relationship between the ten challenges of AA implementation. This way, different layers of challenges to AA implementation were identified, from the foundation level with the strongest driving power to the top level directly impacting AA use. We found that the cultural readiness issue (C4) is a critical challenge to address in an AA implementation. The next layer is data-related and organizational issues, which are influenced by cultural issues but indirectly influence technical challenges. The final layer is technical challenges with a more direct impact on AA implementation, such as data access (C1), AA-related skills (C6), or limited AA use-case (C9). The interrelation and hierarchy of challenges help practitioners and academics to understand the contextual factors around AA implementation better. The resulting MICMAC-ISM model also emphasizes the nature of AA implementation as a digital transformation effort for IAF.

Therefore, this research suggests combining a top-down and bottom-up approach and long and short-term efforts to address challenges and implement AA as a transformational effort. Finally, this research finds that AA implementation requires action beyond IAF as an organization and the organization to which the IAF belongs and suggests that AA implementation needs to reach policymakers and professional bodies, such as to develop a sound internal audit standard to mitigate risks associated with AA and improve academic and professional curricula for the internal auditor.

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