



Research article

Unfolding sustainable auditing ecosystem formation path through digitalization transformation: How digital intelligence of accountant fosters the digitalization capabilities

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ABSTRACT

This research aims at indulging a consistent image of how Digitalization Capabilities (DC) demonstrates an impact on Sustainable Auditing Ecosystem (SAE) within public sector organizations (PSOs) in developing countries, especial in an emerging market, and gives insights regarding to divergent impacts of the interconnection between DC and SAE moderated by different levels of Accountants' Digital Intelligence (ADI). The state-of-the-art structural equation modelling (SEM) was employed to statistically analyze the survey data collected from self-administered questionnaire distributed to a convenient sample of 323 respondents. Additionally, multi-group analysis (MGA) was implemented to explore the heterogeneity of data and examined substance of the difference in the parameters caused by the moderating variable. The obtained results advocated that it was paramount for PSOs to increase DC for SAE formulation. The MGA findings highlighted a statistically significant difference in the impacts of DC on SAE between various levels of ADI. The insights acquired from final model emerged as a foundation which might buttress policymakers and PSOs' practitioners in initiatives development pertaining to digitalization for SAE formulation.

1. Introduction

The progressive permeation of digital technologies in the state-of-the-art era has resulted in the strategically paramount role of digital transformation which has brought an array of better chances but also a wide range of challenges [1]. The challenges stemmed from the breakthroughs in digital technologies have raised an urgent claim for almost all of the organizations on the constant innovation to avoid falling behind [2]. In response to these challenges, fostering digital transformation comprising of a reinvention of operating paradigms, skills, and organizational structures has been considered as a vital point for success in business [3]. Of these, cutting-edge DC could provide scope for novel functionality, greater reliability, higher efficiency, and optimization chances to exponentially enrich the value delivered to customers [4] and stakeholders. Nonetheless, these above-mentioned challenges have been too gigantic to resolve in isolation [5]. Instead, approaching the new innovation paradigms which was shaped up on the integrated collaboration, co-creation, value sharing from traditional entities and those created in the digital age to give rise and capture value [6] has emerged.

Despite of the increasingly contemporary academic deliberation on the issue of digitalization and DC, these works directly or

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indirectly stressed on across a wide range of topics in term of the associations between digitalization and relevant capacities with subjects namely value co-creation and service innovation in the setting of manufacturing enterprises [7]. Simultaneously, a relative dearth of empirical studies on DC in the context of PSOs has been chronicled by several researchers. This gap in digitalization literature has been pondered to be worthy of further in-depth explorations to set up a holistic model to guide the PSOs to nurture DC at various organizational degrees and areas of their operations. To that end, this research took the best shot in addressing these following questions.

RQ1. To what extent does the DCs impact SAE?

RQ2. Does the ADI moderate the interconnection between DC and SAE?

By tackling these research questions, this paper would deliver numerous academic and practical contributions. The first contribution in the academic facet was the empirical insight provision on the interconnection between DC and the establishment of SAE. The audit ecosystem could incorporate the capacities of multi-agent systems to interact with the particular data under audit at the certain time, with each agent not only performing the particularly determined audit duties for it but also conducting in concert with several other agents undertaking their certain audit functions so as to reach higher goals than could be accomplished individually [8]. Secondly, the findings of this research also contributed the literature by indicating how to achieve the sustainable development within the PSOs in the developing countries through DC enhancement. This was because there has been a burgeoning apprehension among academician and practitioner communities on the issue of digital inequalities matters and the sluggish pace in which sustainability translations unfolded [9]. Digital transformation has generated the requirements for entities to update the skills of their workforces to maintain and develop their organizational operations [10]. In an effort to gain in-depth insights on the role of the intelligence of the organizational workforces in the digital transformation. The manuscripts' intention was, therefore, to delve into the impact of ADI on the relationship between DCs and SAE. In doing so, this study targeted at contributing to the growing debates of academics and practitioners on what intelligences and skills the labors needed to acquire and master.

Due to the lack of realization on the requirement operating in novel approaches, several organizations had to end up with failure in the attempt of digital transformation [11], this work had a potential to supply practical insights to the practitioners on how to formulate and retain the presence of DC as well as enhance these types of capabilities. Alternatively, as several growing challenges relevant to knowledge-intensive practices due to the organizational digitalization flows [12], the empirics of this research offered practical implications to gain ADI to foster DC and SAE establishment as a consequence through updating the practitioners about the role of ADI. Also, these obtained observations offered practical implications for policy-makers and influencers in intergovernmental organizations to promulgate laws and guidance for digital transformation towards sustainable development.

The remaining of this manuscript is structured as follows. The next section embraces the theoretical background and conceptual framework. The hypotheses development based on literature review and research model are demonstrated in Section 3. Section 4 presents the research methodology. The main findings and the general discussion of this manuscript are casted light in Section 5. The implications of the current work as well as roadmap design for further research are laid out in the final section.

2. Literature review

2.1. Theoretical backdrop

2.1.1. Dynamic capabilities theory (DCT)

There has been growing concerns on the paramount role of information technology (IT) within PSOs, especially the role of IT in strategic agility generation [13]. DCT which was invented by Ref. [14] was the expansion from resource-based view of the organization [15] was drawn the attention of numerous researchers since its first appearance [16] as it offered a framework for all types of organizations to keep on reconfiguring themselves for rapidly changing environments. Dynamic capabilities were argued to reinforce an efficient and effective transformation as they enabled an entity to allocate and amalgamate its tangible and intangible resources through sensing, seizing and shifting to launch novel product/service creation or formulate new business models/processes [17].

2.1.2. Diffusion of innovation theory (DOI)

The DOI framework founded by Ref. [18] was well-acknowledged as one of the most common frameworks to analyze the process of communicating any innovation by means of a systems' participants [19]. It has been applied in numerous academic works which predominantly tackled with IT innovations at individual and organizational degrees within developed and developing economies Refs. [20–25]. As proposed by Ref. [26], an innovation could be an idea, practice, or subject that possessed distinguishable idiosyncrasies perceived to be novel. In the meanwhile, communication was considered as a process in which members generated and exchanged information with one another to enhance the similar understanding or knowledge [27]. As such, the diffusion of innovation was referred to a type of social process to communicate innovation through a variety of media in a certain period between all the members within a social system [28]. In this study, DC was pondered to be such innovation whilst SAE was deemed as a channel or a system through which that innovation was being diffused.

Building on the standpoints of [29], the aforementioned theories leveraged in the current research just only severed as sensitizing means in a flexible fashion instead of acting as stringent means for theory corroboration.

2.2. Conceptual framework

2.2.1. Sustainable auditing ecosystem

Taken literally, sustainable development was illuminated as the development which could be kept on not only endlessly but also for the provided time period [30]. The most common notion of sustainable development was based on the perspective of Brundtland Commission Report in which sustainable development was identified as the practices of meeting the demands of the present generation was not induced any impacts on capabilities of future generations to afford for their own demands [31] regardless of myriad of conception on this subject. Building on the suggestions of [32], sustainable development targeted at reaching social progress, environmental equilibrium and economic evolution. The audit ecosystem referred to comprehensive approach to the technology-driven frameworks' establishment and development to offer overall management and control of the audit technology elements applied, and synchronization of the practices of the stakeholders [33]. Taken together, SAE could be specified as a specific conformation of the digital ecosystem which facilitated fundamental automated audit functions to resolve constant alternations to the operational environment to reach the in-depth collaboration and value-co-creation in a sustainable manner.

2.2.2. Digitalization capabilities

Digitalization was ascertained as the transformation of analogue beacons into digital fragments [34]. In extensively approaches, digitalization was characterized as all information kinds to the digital language [35]. The thorough concentration of [7] on the growing body of literature in term of the DC demonstrated three main research streams such as competitive advantage establishment inside the organization [36]; competitive advantage formulation outside the organization [37] whilst the last stream focused on how DC drove to value co-creation [38]. Considering these above considerations, the notion of DC in this research was rested on the proposal of [7] which was the dynamic capabilities of the entity to reconfigure the organizational digital resources and routines; seize organizational digital capacities as well as sense chances and menaces.

2.2.3. Accountants' digital intelligence

Intelligence reflected the capacities of resolving matters, or fashion products/services which were appreciated in one or numerous cultural or community context [39]. Put simply, digital intelligence focused on when persons obtained the competence to employ knowledge in such an approach that enabled them to interact in an efficient and effective manner with their surroundings [40]. Besides, digital competencies could be comprehended as technical, cognitive and socio-emotional ability which allowed a person to cope with challenges and tailored to the digital epoch [41]. Hinged on the recommendations of [42], the digital intelligence of accountant in the current research mentioned on the accountant who was capable of interacting within a digital environment in a meaningful manner, handling with great amount of information, discussing with an online audience to share ideas and perspectives and managing the individual life in online environment to reach work-life balance as well.

Starting from the considerations on the lack of established academic background on this specific subject pertaining to the potential role of DC in driving SAE and how ADI could foster this process, conceptual model which placed an emphasis on the influence of DC on SAE, and depicted one ADI moderator that tailored the association of the aforementioned components was proposed. Detailed hypotheses were formulated in the following section.

3. Hypotheses development and research model

3.1. Hypotheses development

Should be noticed that digitalization has been the foremost changing of modern society and involved numerous aspects of human life namely the social [43], the economic [44], and the organizational dimensions [45], for value generation and achievement [46]. Taken together, digitalization has been pondered as the trend of shifting analogue data into digital form to perk up business associations between customers, stakeholders and organizations, to deliver added value to the entire economy and society [47]. The quality of financial statements [48] would be gained from the higher organizational DC as all the anomalies detection for financial statement process and control systems would be effectively addressed by advanced technologies [49]. On the other hand, the limitation lied in the fact that financial statements were conventionally generated periodically owing to the expenses of the data procurement would be evaded and the reliable financial statements on a real-time base or right after the incidence of transactions would be performed instead [50]. More remarkably, auditing function would be successfully reinforced with blockchain technology which enabled the comparisons of the relevant accounting entries by means of offering the interlinks between the related records [51]. These practices of information automatic authentication, flowing, warehousing, and reporting in the blockchain-grounded triple-entry accounting information system could together shape a SAE. To that end, the hypothesis of this research is formulated as follows.

Hypothesis 1 (H1). DC has a substantial impact on SAE in a positive manner.

All of the organizations would benefit from the vigorous advantages of the flexibility delivery when the digitalization was deployed [52], it thus assisted to save time on mind-numbing and repetitious tasks [53]. The greater DC that an organization obtained, the more likelihood it would result in advancing the operational processes and suggesting modern resolution to ameliorate efficiency and effectiveness [48]. Concretely, superior insights into the activities of clients and stakeholders could be completely provided by advanced digital technologies to generate a more appropriate analysis of the diverse demands of customer and stakeholders. As stated by Ref. [54], digital intelligence quotient has been considered as a far-reaching collection of digital aptitudes stemmed from common

moral values for individuals to employ, monitor, and give rise to technology to foster humanity. Alternatively, digital intelligence quotient was supposed to be correlated with synchronization of business and IT strategies, ultimate IT projects administration and management [55]. The accounting staff has been supposed to be the staff who earned the in-depth expertise in analytical field [56] and financial information system design, calculation and interpretation [57], participating in organization operations [58] in term of organizational planning and control system [59] as well as taking responsibility of giving advices for the leaders in measurement and management performance [60]. They believed that in-depth insight and utilizing the power of modern IT could become the advantage of public sector accountants. As this advantage could allow the accountant to gain the awareness of risks as well as perform the accounting and control schemes in an efficient and effective manner. Thus, intelligence competencies acted as the backbone of organizational digitization [61]. To put it different, in many cases this could be the important condition for organization to take toward SAE establishment. Taking into account all the above analyses, the hypothesis is shaped as follows.

Hypothesis 1a (H1a). ADI strengthens the positive interconnection between DC and SAE.

3.2. Research model estimation and analysis

The conceptual model was demonstrated in Fig. 1, which mapped the hypothesized interconnections among DC, SAE and ADI.

4. Research methodology

As numerous academic notes have placed emphasis on the advantages of leveraging mixed-methods two-phase design in tackling with the complicated variables involving human awareness and also the exploratory nature of the studies Refs. [62,63]. Furthermore, this type of design produced intensive understandings of the constructs of interest and also enhanced the strength of the obtained outcomes [64]. Keeping these considerations in minds, the mixed-methods two-phase design was employed in the current research.

4.1. Qualitative inspection stage

4.1.1. Procedure

Qualitative design has been commonly utilized to deeply explore an under-researched or unknown phenomenon [65]. As such, the qualitative approach was implemented as it would help the researchers to gather much deeper information pertaining to the standpoints of the participants in order to acquire a better understanding [66] on the relevant issues in this research. The qualitative interviews reflected a discussion with an individual to gain insights into the persons' subjective experiences, opinions and motivations of a specific matter. Interviews could be categorized by the level to which they were structured, open or semi-structured [67]. Of these, semi-structured interviews were featured by open-ended questions and the utilization of an interview guide in which the wide areas of interest, sometimes comprising of sub-questions, were determined. The excellent interviewees would be those who were available, willing to be interviewed and had appropriate experiences and in-depth understandings about the subject of interest [68,69]. Building on these analyses, the semi-structured in-depth interviews were taken advantage in this research. As qualitative approaches looked for an in-depth and detailed understanding, the purposeful sampling has been typically applied [70]. The purposive sampling was opted to recruit the proper panel of experts as it enabled to capture a broad range of standpoints and gather novel ideas for conversation [71]. The subject of this work was represented by leaders of PSOs who could provide informed points of view and in-depth information on the relevant issues from the perspectives of their respective entities [72]. Thus, the leaders in PSOs were interviewed. The criteria for the selection of experts included the managerial seniority which was to warrant the adequate decision-making authority and at least 15 years of working experience in the accounting and management. Concerning to the number of experts, the most common standard has been reaching thematic saturation, which reflected the point at which no novel thematic information was exploited from participants [70]. In the same vein [73], argued the number of experts should fluctuate from 4 to 10 or until the satisfactory level of saturation was accomplished. As such, 8 interviews were performed with 8 leaders in PSOs in Mekong Delta region. The interviews placed the concentration on the magnitude of the fundamental constructs and offered feedback on the survey dimensions' validity, wording, and flow throughout survey establishment to amplify face validity. Their insights assisted to direct and inform the evolvement of hypotheses. This was of value especially in light of the scarce studies on this field and to prevented from overlooking any related issues. Subsequently, initial observations were depicted and discussed with the respondents to revamp credibility through the adoption of member checks [72].

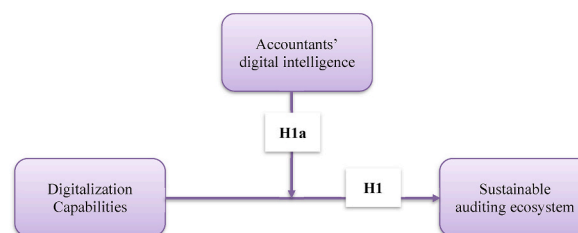


Fig. 1. The conceptual model.

Although the utilized measurement scales were employed from precedent literature, such condition would not exempt the requirement on pre-testing pending the progress for full-scale data capturing [74]. Thus, 50 respondents were invited to participate in the pilot test. The Cronbach's alpha value of all the constructs exceeded 0.7, emphasizing the good construct reliability [75]. Succinctly put, the acquired outcomes from the pilot test revealed that all the questions were relevant, accurate, explicit and well-understood by the participants.

4.1.2. Measurement of the model's constructs

All of hypothesized models' constructs were shaped from precedent findings and self-formulated partially from the qualitative phase to reach the appropriateness with present research context. Alternatively, the five-points Likert scale from "1 = comprehensively disagree" to "5 = comprehensively agree" was put into application for all constructs.

4.1.2.1. Digitalization capabilities. The first-order construct for evaluating the DC structured by 3 s-order constructs inspired from the findings of [7]. More particularly, Digital resources reconfiguration was evaluated by 3-item scale which concentrated on improvisational capabilities; digital environment scanning; timely reconfiguration of resources; Organizational digital capabilities seizing was measured by 4-item scale which emphasized on heterogeneous resources employment, digital competitiveness deployment, managerial cognition, information technology capabilities management; Chances and threats sensing was measured by 3-item scale which focused on ecosystem capabilities, ecosystem effectiveness and integration capabilities.

4.1.2.2. Accountants' digital intelligence. The measurement scale for ADI in this research was formulated by 10 items which were sprung from the contributions of [54] and were exploited in the work of [42].

4.1.2.3. Sustainable auditing ecosystem. The SAE was reflected on the such three sub-dimensions as social aspect, environment aspect, economic aspect which were transmogrified from the integration of the outcomes of [8] and the devotions of [76–83].

4.2. Quantitative inspection stage

4.2.1. Target population and apparatus

For all segments, survey technique was wielded for research data procurement. The statistical data were procured with two sampling units. The primary sampling unit was PSO, and the accountant in the PSO was the secondary sampling unit. The current research was propped on a sample of accountants working in a variety of PSOs in the Mekong Delta region. The survey respondents were limited to public sector accountants in the that region for the controlling purpose the potential effect of culture, the nature of the position, and responsibility. Besides, the extent of the respondents' concerns with digitalization implementation in their organizations was demanded for the right selection on the sufficient knowledge participants to fulfill the questionnaire prior to the main survey. As such, the respondents who were oblivious were excluded from the dataset.

4.2.2. Sampling and data collection

The questionnaires were circulated in person to informants [84] to gain the better chance to inform the anonymity and confidentiality of the outcomes of the current work as well as minimizing the common method variance [85] which induced by the fact that the data were procured from the same sources, and the same informants handled with both the dependent as well as the independent variables [86]. While [87] suggested a 100-observation for each group to carry out multi-group modelling, the vital sample volume of 200 was requested by Ref. [88]. Data procurement was performed between June 2021 and October 2021, and the participants' confidentiality was warranted. The convenient sampling approach was deployed for both the pilot and original phase attributable to its compatibility with paper's target population. The final sample size comprised of 323 valid responses after outliers and missing cases were determined and relinquished, representing a response rate of 89.72%.

4.2.3. Statistical analysis approach

Given that the current study was largely rested on structured questionnaire and procured data utilizing latent variable-based constructs, the SEM was taken into notice for data analysis [89]. Alternatively, the proposed direct and moderating hypotheses in the currently hypothesized model were mathematically estimated by the Covariance-Based SEM (CB-SEM) approach as CB-SEM has been recognized to become appropriate in in-depth investigation into simple formative and mediation [90,91] as well as moderation model. As such, the data stemmed from the survey questionnaire was coded, edited, and analyzed utilizing SPSS software version 26 and AMOS software version 26. The data in term of demographic information of the participants was elucidated through descriptive statistics such as percentages and frequencies with the support of SPSS software version 26. In the meanwhile, AMOS software version 26 was employed to delve into the structural model namely testifying correlation, causation and moderation effects. The maximum likelihood estimate (MLE) was employed to estimate the structural model [92]. More particularly, given that the first stage was to assess the measurement model which investigated the reliability and validity of the hypothesized constructs, the confirmatory factor analysis was carried out to evaluate the measurement model and assess the reliability, convergent validity as well as discriminate validity. In order to illuminate the phenomena, the second step was to evaluate the structural model to determine the significance of the hypothesized path coefficient. The third step was to assess the impact of the moderator. In this regard, the multi-group SEM was leveraged to perform a multi-group moderation analysis [93] with the support of AMOS software version 26. In doing so, it would

enable the researchers to determine the statistical significance of any observed heterogeneity in the outcomes of two sub-groups of data (i.e., pre-specified data groups) as well as the path coefficients and the strength of interconnections. The obtained observations were delineated in the succeeding section.

5. Result analysis and discussion

5.1. Socio-demographic characteristics of the informants

Predominantly, female accounted for the highest proportions of people invited to take part in this research, at around 69.35%. Meanwhile, only 30.65% of the sample was generated by male. Moving on to the year of experience, the group obtained the years of experience from 10 to 20 produced the most participants, at about 49.54%, which was followed by the group “below 10” (21.05%) and the group “over 20–under 30” (23.22%). Whilst, the group “over 30” made up a negligible 6.19%, ranking last among the given categories. Concerning to the qualification, most of the informants hold a bachelor degree, at around 81.11% and the lower figure could be noticed in the percentage of participants acquired the postgraduate degree, at nearly 18.89%. Pertaining to the lifespan, the participants were in their young-to-mature ages (under 40) constituted 70.90% of the total participants, with middle age (40–50) and old age (51–60) contributing 23.53% and 5.57% respectively. The informants were dispersed throughout the region.

5.2. Constituting the convergent validity

Hinged on the suggestions of [94], the two dominant investigations comprised of content validity and construct validity were implemented.

The request of multivariate normality could be assessed by investigating each of the variables for univariate normality [95]. The normality assumption related to the statistical data from the instrument items, the value of the mean was examined through the evaluation of SI and KI for every indicator [96–98]. More concretely, the values of skewness were suggested to range from -2 to $+2$ to demonstrate normal distribution features while kurtosis values were recommended to fluctuate from -7 to $+7$ to become proper for SEM research [99]. In the current research, the values of skewness for 31 items were found between -1.445 and -0.024 . Simultaneously, the values of skewness for 31 items were found between -1.472 and 2.019 .

5.2.1. Content validity

Given that the content validity placed its emphasis on the presence of each instrument item to be stood for a wide range of facets which were demanded to be evaluated, a vigorous content validity substantiated the presence of measurement items to be assessed [100]. The instrument items for each construct of the current framework were heavily relied on the combination of the extensive literature review and experts’ perspectives. On the other hand, a small-scale pilot study was implemented prior to the mass distribution to warrant the validity of the construct assessment and quality of questionnaire amelioration [101]. As such, the content validity was corroborated to be reached in all the constructs of the current research.

Table 1
Results summary of convergent validity and construct reliability.

Construct	Item acronyms	Convergent validity		Construct reliability		Discriminant Validity
		Factor Loadings Ranges	AVE	Cronbach’s Alpha	Composite Reliability	
Digitalization Capabilities						
Digital resources reconfiguration						
Improvisational capabilities	IC	0.707–0.877	0.517	0.828	0.829	Yes
Digital environment scanning	DES	0.739–0.825	0.511	0.833	0.834	Yes
Timely reconfiguration of resources	TRR	0.812–0.891	0.550	0.853	0.855	Yes
Organizational digital capabilities seizing						
Heterogeneous resources employment	HRE	0.804–0.895	0.576	0.875	0.876	Yes
Digital competitiveness deployment	DCD	0.753–0.862	0.562	0.857	0.858	Yes
Managerial cognition	MC	0.724–0.849	0.646	0.842	0.843	Yes
Information technology capabilities management	ITCM	0.709–0.885	0.621	0.872	0.873	Yes
Chances and threats sensing						
Ecosystem capabilities	EC	0.826–0.883	0.660	0.889	0.900	Yes
Integration capabilities	INC	0.790–0.871	0.628	0.811	0.813	Yes
Accountants’ digital intelligence	ADI	0.820–0.878	0.667	0.898	0.899	Yes
Sustainable auditing ecosystem						
Social aspect	SA	0.763–0.845	0.658	0.859	0.860	Yes
Environment aspect	EA	0.789–0.885	0.635	0.832	0.833	Yes
Economic aspect	ECA	0.815–0.896	0.688	0.870	0.871	Yes

5.2.2. Construct validity

Construct validity which alluded to the capacity of a measurement instrument to actually evaluate the concepts being investigated could be evaluated by means of two approaches namely convergent validity and discriminant validity [94]. Concerning to the convergent validity, the such four elements were assessed as standardized factor loading; Cronbach’s alpha and composite reliability (CR) values and average variance extracted (AVE) [102]. More concretely, the loading factor of each dimension reached the ideal suggestion of over 0.6 [103]. Average Variance Extracted (AVE) achieved the AVE criteria recommended by Ref. [104] which should be above the cutoff point of 0.50. The Cronbach’s alpha exceeded the cutoff value of 0.70 [75]. The composite reliability was higher than the cutoff point of 0.7 [104]. On the basis of the outcomes demonstrated in Table 1, the perfect convergent validity of measurement scale was put on view.

5.3. Formulating discriminant validity

As suggested by Ref. [105], discriminant validity genuinely evinced distinctiveness of a measurement instrument. Grounded on the criteria of [106], the variance of the concepts with its indicators was proffered to be more than that of other concepts. In addition, the indicator of discriminant validity could be that the square root values of AVE obtained a greater correlation between the pair indicators. Furthermore, all the inter-construct correlation values were recommended to be less than 0.80 [107] or the intercorrelations should be substantially below 1.0 [108]. The outputs were given in Table 2 clearly demonstrated that the constructs achieved the good discriminant validity.

5.4. Fitting the hypothesized model

Given that the χ^2 assessment would be inappropriate with empirical research as it largely depended on the theory of central χ^2 distribution [90], a series of model fit indices were employed to buttress the hypothesis model namely Chi-square to degree of freedom (χ^2/df), goodness of fit index (GFI), comparative fit index (CFI), root mean square error of approximation (RMSEA) and Tucker-Lewis index (TLI) was also included for further model fitness assurance [109]. Altogether, the results exhibited in Table 3 underlined that overall goodness of fit indicators was gratifying.

5.5. Investigating the structural model

5.5.1. Direct effect

In order to authenticate the significance of each component in the hypothesized model, standardized path coefficients were mathematically estimated. The path coefficients scores which fluctuated from 0.2 to 0.39 and oscillated from 0.40 to 0.59 were demystified as weak and moderate, respectively, whereas, these scores stretched between 0.6 and 0.79 were pondered to be vigorous [113,114]. Starting with direct effects, Hypothesis 1 concerned to the positive effect of DC and SAE was substantiated to be buttressed as the outputs illustrated in Table 4 showed that the interconnection between the independent and dependent variables obtained the positive and significant coefficients ($\beta = 0.481$; $p < 0.01$).

5.5.2. Moderating effect

Prior to employing the MGA, the main sample of this research were split into two sub-samples using the median split which proposed by Ref. [115]. It was a suitable tool because the median would not be susceptible to outliers [116,117] and the sub-sample in each group would be guaranteed to avoid biased outcomes [91,118]. On the other hand, sub-samples for multi-group among academic studies have been typically acquired through a median split which resulted in two sub-samples entitled as “high” and “low” [117,119]. Taken together, the participants of this study were dichotomized into two groups rested on the moderator variable - ADI. The two groups were stamped “high ADI” and “low ADI”. Given that the comparison on structural path coefficients could only be carried out in case the model was proved to be structurally disparate [120], the establishment of measurement equivalence was extremely important.

Table 2
Results summary of Discriminant validity.

	IC	DES	TRR	SA	EA	ADI	HRE	DCD	MC	ITCM	ECA	EC	INC
IC	1												
DES	-0.018	1											
TRR	0.075	0.219	1										
SA	-0.041	0.094	0.116	1									
EA	0.206	0.125	0.113	0.109	1								
ADI	0.192	0.057	0.136	0.087	0.126	1							
HRE	0.156	0.051	0.065	0.065	0.078	-0.063	1						
DCD	0.260	-0.003	0.058	-0.008	0.066	0.029	0.112	1					
MC	0.181	0.053	0.125	0.052	0.089	0.003	0.091	-0.009	1				
ITCM	0.050	0.094	0.131	0.120	0.110	-0.104	-0.041	-0.129	-0.018	1			
ECA	0.040	0.107	0.156	0.046	0.081	0.079	0.105	0.004	0.154	0.035	1		
EC	0.049	0.196	0.223	0.059	0.143	0.163	0.196	0.074	0.203	0.141	0.171	1	
INC	-0.060	0.069	0.142	0.056	0.068	0.074	0.064	-0.010	0.145	0.069	0.188	0.118	1

Table 3
Results of measurement and structural model analysis.

The goodness of fit measures	Minimum cutoff	Measurement model	Structural model	Requested by
χ^2/df	<3	1.759	1.973	Ref. [87]
TLI	≥ 0.9	0.925	0.959	Ref. [110]
CFI	≥ 0.9	0.951	0.977	Ref. [110]
GFI	≥ 0.9	0.902	0.910	Ref. [111]
RMSEA	<0.08	0.027	0.036	Ref. [112]

Table 4
Results on the structural coefficients of the hypothesized model.

Hypothesis No.	Hypothesized path			Standardized Coefficients	S.E.	C.R.	Inference
H1	DC	→	SAE	0.481**	0.059	6.354	Supported

Notes: *p < 0.05; **p < 0.01; ***p < 0.001.

Simultaneously, it was worth noting that measurement error could be inflated if measurement invariance would not be set up; this could result in biased outcomes (Type II errors) [118]. Therefore, any disparities in model estimation parameters between the two subgroups must be ensured that these were not stemmed from the discrepancies in content or perceived disparities in relation to the meaning of the measures shaping the model for these groups.

The χ^2/df discrepancy was gauged at model degree if the conforming p-value for the χ^2/df discrepancy obtained was significant, the path demonstrated moderating impact induced in light of the moderator. Hinged on the acquired data analysis in Table 5, the χ^2/df discrepancy ($\Delta\chi^2/df = 0.018$) was statistically significant at $p < 0.05$ between the Variance Measurement and the Partial Measurement invariance model, indicating the vigor of the path coefficient indeed varied between the two sub-samples [75]. Alternatively, the pertinence of the multi-group SEM analysis was evaluated utilizing such goodness-of-fit indices as TLI, CFI and RMSEA as recommended by Ref. [121]. As such, variance measurement paradigm was plumped for the conclusion on difference of in the research models' component of the two median samples. As it could be clearly seen from Table 5, the fit indices of the two model demonstrated a good model fit. Given that non-standardized estimations should be concentrated in MGA [122], path-by-path difference comparison was further executed through a pairwise comparison with the coefficients [123]. The two paths depicted in Table 5 were recorded to considerably different, nevertheless, it could be approved due to the comparatively small sample size. In the nutshell, ADI illustrated the moderated impact on the direct paths from DC to SAE. Thus, H1A was buttressed.

5.6. General discussion

The analyses of the current research yielded several interesting observations. In accordance with researchers' expectations, DC was substantiated to demonstrate a significant impact on SAE in a direct and positive manner. These findings were partially in line with previous work Refs. [124] which placed an emphasis on the fact that digitalization and sustainable development have been closely linked. Simultaneously, taking into consideration on the positive interlink between DC and SAE, the findings of this work further substantiated and expanded the antecedent researchers' points of view Refs. [125] on the interconnection between digitalization, sustainability, and ecosystems. It would be worth noting that DC acted as a direct and positive enabler which facilitated the PSO to establish and operationalize SAE. Accordingly, the higher DC would become not only a facilitation but also a pre-cursor to SAE formulation. Building on the perspective of the magnitude of DC, the significant positive impact of DC on SAE recommended that it would be imperative for PSO to enhance their DC through dedicate their resources to maximize the inherently organizational capabilities.

More interestingly, the current research not only casted light on the earlier formulated interconnection in a novel type of organization and setting, but also assessed how this interconnection was impacted by the most concerned variable. In doing so, this study generated another impression in the digitalization context through focusing on the moderating role of ADI. In conformity with our

Table 5
Results on the moderating impact of degree of ADI.

Causal relationship	Low ADI (n = 154)		High ADI (n = 169)		Difference between parameters (High ADI –Low ADI)		Hypothesis testing results
	Estimate	P	Estimate	P	Estimate	P	
	DC => SAE	0.524	0.074	0.452	0.027	-0.072	
Model fit	Chi-square/df df		P	TLI	CFI	RMSEA	
Variance Measurement	1.727		0.000	0.956	0.973	0.023	
Partial Measurement invariance	1.709		0.000	0.954	0.971	0.023	
Differences	0.018		0	0.002	0.002	0	

predictions, the ADI was evinced as moderating mechanisms in the interconnection between DC and SAE in a significantly positive manner. More concretely, CB-MGA approach divulged that the difference in the parameters between the two groups (high ADI vs low ADI) was statistically significant. The observations of this research further authenticated and broadened the antecedent researchers' standpoint Refs. [126] on the role of digital intelligence in digitalization context. On the other hand, this finding also gave hint to how PSO could effectively outperform in SAE establishment and operationalization through leveraging the DC. Admittedly, the growing technology implementation has increased the relational requirements of digital workforce. More precisely, the digital intelligence would assist the accountant to scan the environment and enrich their knowledge regarding accounting, auditing and digitalization. Additionally, it would condition the accounting staff to reach the envisioned outcomes, handle data, ingeniously represent information. Moreover, it could allow the accounting staff to involve with each other, with stakeholders as well as customers, with information and with ideas as well in an effective manner. By doing so, they would be very likely to collaborate with co-workers across the ecosystem and therefore expedite PSOs to leverage the DC to reap the best outcome in SAE formulation.

6. Concluding remark

6.1. Implication

6.1.1. Academic implication

The obtained outcomes of this research painted an impressive picture of the linkage between DC and SAE. In particular, organizational capacities have made the operations management become efficient and effective [127] whereas DC focused on transforming organizational operations by means of perking up or exploiting advanced processes. Additionally, digital technologies which were ultimately embedded in organizational operations [127] would transform the way of capturing and producing value, communicating, and interplaying with one another within an organization [128]. At the same time, it would shift the processes and internal structures whilst unleashing advanced functionalities, both inside and outside organizational frontiers [129]. Thus, DC would act as an asset of strategic importance for PSOs. In this logic, DC would support PSOs in creating a modern form of collaboration and would lead to perfect collaboration within and across entities, more personalized fashions of involving with stakeholders, higher staff innovation and productivity, and more rigorous understandings from data that enabled an entity to evolve and give rise to a fruitful opportunity of achievement. This collaboration could associate with a partnership between PSOs pertaining to auditing to inspire the SAE in which effective environment would generate and offer access to consulting in relation to auditing practices. The synergy of this interaction would facilitate organizations to survive and grow in a sustainable manner.

Moreover, research outcomes corroborated the moderating role of ADI on the interconnection between DC and SAE. According to this evidence, digitally intelligent accountants would become catalyst to assist their organization to make the most of DC to shape up the in-depth collaboration with all actors in SAE. This was because digital intelligence quotient was verified to be related to synchronization of business strategies and IT projects administration [55]. Digital intelligence would condition the staff to enhance their skills in the implementation of software and IT technologies to produce added value for their organizations [130]. Remarkably, this form of intelligence also linked to the skills and aptitude requested to tackle with the troubles stemmed from digital ecosystem [42]. In this sense, ADI could be pondered as a better approach to wield the captured information and process fruitfully to adapt to the external environment. It also allowed the accountants to sense and seize implicit and explicit knowledge as well as facilitated the accountant to focus on the competence of the mind to obtain the determined targets. Simultaneously, it would help the accountants to become more intelligent to handle the radical changes, neutralize threats and take advantage of valuable chances in the today's critical environment. To that end, ADI could be considered as a new approach contributed to the success of leveraging DC for the purpose of SAE formulation and operationalization in an efficient and effective manner.

6.1.2. Practical implication

The procured observations of this research hinted at more emphasis on embracing digital technologies to better suit new digital requirements which in turn resulted in the DC improvement should be taken into notice by the PSOs. In light of the significance of DC, the organizational resources should be made to use for maximizing the organizational inherent capabilities through setting training programs for upgrading the skills, talent, knowledge and experience related to digital technologies, accounting and auditing for the accounting staff or engaging in alliances or joint ventures with other actors within the SAE. Several in-house programs or guidelines in place should be built up to foster the ADI, especially in the ongoing digital transformation setting. The findings also encouraged government agencies to release initiatives of reskilling and upskilling for the PSOs' workforce through taking the more funding for digital upskilling into consideration.

6.2. Limitation and orientations for further research

There were several inherent drawbacks in this research which left room for further works. Firstly, this manuscript rested only on a relatively small sample of accountants of PSOs across Mekong Delta region which would limit generalizations. Thus, this type of topic would benefit from a widened scope of the research geography, larger sample size and the perspectives collection of other departments in the PSOs. Secondly, the generalizability of the observations may have been ameliorated through other sampling approach deployment rather than convenience sampling. Thirdly, there would be a claim for numerous follow-up studies to complement and widen valuable understanding on the paradigm of the existence of the moderating impacts through several other procedures regardless of the advantages of MGA. This was because this type of approach failed to produce a plotting of the moderation interconnections. Last

but not least, the cross-sectional design might limit in-depth insight into the phenomenon due to constant change of auditing ecosystem and digitalization transformation. As such, a detailed longitudinal analysis was suggested to take into consideration in the future works.

Author contribution statement

Pham Quang Huy: Conceived and designed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

Vu Kien Phuc: Performed the experiments.

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Declaration of interest's statement

The authors declare no competing interests.

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