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The role of entrepreneurial culture, digital orientation, and digital capabilities in fostering digital innovation: a focus on the financial services sector in South Africa

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Abstract: Digitalisation as a 'game-changing innovation' has significantly changed the organisational technology innovation landscape and shaped the research agenda. However, the literature shows a gap in the understanding of various aspects relating to digitalisation and innovation, particularly from an African emerging market perspective. The purpose of this article is to examine the relationship between digital capabilities, digital orientation, and digital innovation, while considering the moderating influence of an entrepreneurial organisational culture. The study is focused on firms in the financial services sector (n = 228) in South Africa. Results reveal that digital orientation and digital capabilities positively increase digital innovation. However, the moderating influence of an entrepreneurial organisational culture on this relationship is not significant, which may be attributed to the prevalence of remote work affecting organisational culture. The findings are valuable to managers who look to advance digitalisation in their organisation and enhance the capabilities needed for increased digital innovation.

Keywords: digitalisation; technology; digital innovation; digital orientation; digital capabilities; entrepreneurial organisational culture; emerging markets.

Reference to this paper should be made as follows: Urban, B. and Mateyo, K. (2025) 'The role of entrepreneurial culture, digital orientation, and digital capabilities in fostering digital innovation: a focus on the financial services sector in South Africa', *Int. J. Technological Learning, Innovation and Development*, Vol. 16, No. 3, pp.217–237.

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1 Introduction

The ever-increasing presence of digitalisation is one of the primary drivers behind learning and innovation in organisations across a wide range of products, processes, and services (Vial, 2019; Rossato and Castellani, 2020). Implementing emerging technologies like artificial intelligence (AI), the internet of things (IoT), cloud computing, and big data analytics is resulting in the digitalisation of firms across the globe (Hess et al., 2016; Hinings et al., 2018; Gaglio et al., 2022). Research highlights that digitalisation is a 'game-changing innovation' which can affect organisations in many different ways and across various sectors (Kunkel et al., 2023; Velyako and Musa, 2023). Indeed, organisations who undergo a "digital transformation show not only a significant improvement in their business operations and the adoption of innovative business models, but such transformation accelerates changes culturally, socially, and technically" (Dana et al., 2022; Garcez et al., 2022). In this regard, scholars note that learning, capabilities, and culture all play a significant role in the development of innovative technologies and show how digitalisation has significantly changed the innovation landscape and research agenda (Awamleh and Ertugan, 2021; Urban and Mbeki, 2022).

Notwithstanding the advances in digitalisation, research attempts to understand this evolving phenomenon comprehensively remain fragmented over different disciplines and seem not to converge on a clear theme or domain (Cortellazzo et al., 2019; Müller et al., 2019). The contemporary literature offers a limited insight into the overall relationship between innovation and digital technology in an organisation, according to Shama et al. (2023). Moreover, this lack of understanding is underscored when considering that in an era of digitalisation the challenge for most organisations is to select, adopt, and effectively utilise innovative technologies to enhance their overall innovativeness (Arvidsson and Mønsted, 2018; Beliaeva et al., 2019). More specifically, there is still a gap in the literature connecting various aspects of digitalisation (Hsieh and Wu, 2019) with innovation, particularly from an African emerging market perspective. Scholars note that the mediocre performance of many African countries' innovation indicators is largely weakened by the lack of endogenous innovation models (Afolabi and Adeyinka, 2024). Consequently, focusing research on innovation and digitalisation problems in the African context provides a novel and important contribution to the literature and practice of technology management, since organisations in these countries often lack digital resources and capabilities (Urban and Mbeki, 2022).

Recognising that there is still a scarcity of studies explaining the relationship between various organisational antecedents and digital innovation, the purpose of this article is to gain a clear empirical understanding of the role that digital capability, digital orientation, and an entrepreneurial organisational culture can play in elevating levels of digital innovation. In this regard, the article directly addresses the call for research on factors influencing digital innovation (Yoo et al., 2010; Hund et al., 2021). By merging the theory of technology innovation with the emerging literature on digitalisation, the article makes a novel contribution to the steady stream of research. This shows how entrepreneurial activities are essential for innovation to thrive, and firms must allocate resources and establish a culture that support entrepreneurship initiatives to make this possible (Nambisan et al., 2017; Urban and Maphumulo, 2022). So, the primary research question driving this article is as follows: *to what extent do digital capabilities and digital orientation influence digital innovation, while considering the moderating role of an entrepreneurial organisational culture on this relationship?*

Due to the growing demand for innovative digital solutions, digital innovation (DI) has emerged as a significant research focus area since approximately 2018, going hand in hand with the expansion of digitalisation in organisations which includes developing digital identity, digital records, digital currency, and digital voting systems (Jahanmir and Cavadas, 2018; Schiavone et al., 2019). Khin and Ho (2018) conceptualise DI as creative information technology solutions that develop and integrate digital technologies enabling the digitalisation in non-tech sectors such as finance, health care, manufacturing, and retail.

In order to make a clear contribution towards developing a body of knowledge on the nexus between technology and innovation, this article uses the theory on dynamic capabilities, which builds on the notion of a firm's technology orientation and dynamic capabilities as contributing to an effective underpinning for economic models of innovation (Teece, 2016). The diffusion of innovation theory is also relevant as researchers highlight how through the evolution of technological advancements, firms are able to find and take advantage of opportunities successfully, and to achieve technological developments through innovative organisational practices (Saemundsson and Holmén, 2011). Such innovations vary depending on the industry in which the organisation works and can be achieved through developing capability subsets that allow an organisation to become more innovative in terms of generating new products, services, or processes (Svahn et al., 2017; Urban and Maphumulo, 2022).

Furthermore, in the context of digitalisation, research is emerging which shows that DI has enabled 'innovation collectiveness' that includes dynamic sets of actors with diverse goals and capabilities (Arvidsson and Mønsted, 2018; Khin and Ho, 2018). Studies show how an innovation-supportive culture provides organisational members with explicit norms and standards for engaging in entrepreneurial practices. Hence, the inclusion of entrepreneurial culture when investigating DI and organisational antecedents is considered pivotal to fostering DI. To realise the full benefits of DI, organisations must invest in transformative tools and processes that enhance customer experience, increase profitability, and remain competitive, in which case developing an entrepreneurial organisational culture is critical (Müller et al., 2019; Wrede et al., 2020). Against the backdrop of investigating DI through an entrepreneurship lens in terms of entrepreneurial culture, this article provides a unique contribution to the literature by linking principally unrelated constructs together for the first time in order to provide unambiguous evidence on this rather contemporary phenomenon of DI.

It is expected that the article's findings will generate a more holistic understanding of the antecedents influencing DI in order to address practical management issues in the South African financial services sector. Digitalisation as a concept has received significant attention in this sector as it can provide innovative solutions and offer financial services at lower costs and higher levels of accessibility to clients in this sector when compared with traditional solutions (Kyari et al., 2021; Santosdiaz, 2021). Digitalisation is disrupting the traditional financial services sector, including banking and insurance, which is increasingly characterised by an entrepreneurial mind-set as these South African financial services firms aim to enhance efficiencies, improve customer service experience, as well as offer new products, services, or delivery methods of financial services (Bertoni et al., 2022). Focusing on a particular sector, should ensure a better reliability of context to be achieved, particularly as levels of innovation and

competitiveness results principally from a narrow cluster of industries, and not from the whole economy (Urban and Maphumulo, 2022).

The article is organised to begin with a brief theoretical overview to show the rationale upon which hypotheses are formulated. In the methods section, sampling measures are described, followed by statistical data analyses. The results are discussed, and the article ends with insights drawn from the empirical evidence, which translates into policy and managerial implications.

2 Theoretical overview

2.1 Digital orientation and digital innovation

Scholars note that for the digital transformation process to fully endorse the fourth industrial revolution (4IR) is difficult for firms in emerging and developing countries. Technological upgrading is needed in contexts in which firms often rely on now ineffective earlier technologies that are characteristic of the third industrial revolution (3IR), such as basic automation and information and communication technologies (ICTs) (UNIDO, 2019). Under such circumstances the scope for developing countries to 'leapfrog' tends to be greater in the use, rather than in the production of the innovative technologies, as few developing countries possess the foundations of accumulated technological, including manufacturing and investment, capabilities that are needed to lead the 4IR (Santiago and Horst, 2018). Hence, firms need to build and accumulate a set of technological capabilities to endorse and realise the 4IR. Moreover, the firms' capabilities need to either be transformed or created to 'retrofit and integrate manufacturing firms' existing production technologies,' while simultaneously focusing on the improvement of inter-firm interactions for technology access and affordability (Peerally et al., 2022).

A useful foundational theory for digital orientation is the dynamic capability theory, which allows the firm to draw on its strategy, technical structures, as well as capabilities and knowledge essential to meet the demands of the market (Chen and Lien, 2013; Lucia-Palacios et al., 2014). Dynamic capabilities are essential components of "resource-based view (RBV) of the firm insofar as dynamic capabilities enable firms to develop and reconfigure their resources and capabilities in the face of changing conditions" (Teece et al., 2016). Dynamic capabilities and the RBV have received a great deal of attention in the literature (e.g., Mikalef et al., 2019), which has evolved to include research on culture and data-driven topics, which are valuable for an understanding of the micro-foundations of dynamics capabilities (Chen et al., 2023). The nature of firm-specific assets has been altered through digitalisation with technology and human capital becoming distinct types of resources. Organisations that have successfully adapted relevant technology are considered to have a digital orientation and are more inclined to adopt innovations specifically if the innovative technology is compatible with the organisation's existing systems and processes (Lucia-Palacios et al., 2014; Balasubramanian et al., 2021). Digital orientation can be described as an organisation's "dedication towards the application of digital technology to produce new products, services, and solutions" (Khin and Ho, 2018). Organisational readiness is an essential element of digital orientation as far as it refers to the "availability of specific organisational resources to adopt new technology innovations" (Balasubramanian

et al., 2021; Zhen et al., 2021). In this regard, technological-sensing and technological-responding capabilities are two underlying dimensions of technological orientation and opportunism (Saemundsson and Holmén, 2011; Geldes et al., 2017). Firms who are able to manage these corresponding capabilities effectively are then able to incorporate innovative technologies into existing or new products or new markets (Chen and Lien, 2013; Urban and Maphumulo, 2022).

Big data, cloud computing, cyber-physical systems, augmented and virtual reality, AI, and the IoT have all been identified as innovative digital technologies. Given the growing coexistence of AI supported systems with human decision makers, invariably leads to more 'intelligent' data analysis, which supports and enhances innovation driven technology (Grover et al., 2018; Behl, 2022). The literature shows that the diffusion of innovation (DOI) theory has a solid theoretical basis and is a useful approach to study digitalisation because it can be considered an innovation. Digital innovations denote an important emerging phenomenon that differs in elementary ways from traditional information systems. Hund et al. (2021) define "digital innovation as the creation or adoption, and exploitation of an inherently unbounded, value-adding novelty (e.g., product, service, process, or business model) through the incorporation of digital technology". The DOI theory concentrates on five attributes, which are relative advantage, technology compatibility, complexity, observability, and trialability, where prior studies have confirmed the importance of these factors in the adoption and diffusion of technologies (Urban and Mbeki, 2022). Similarly, firms that have adapted to digitalisation can be viewed as successfully managing changes that occur within a firm as a result of increased usage of digital technologies, leading to enhanced business innovation and performance (Jahanmir and Cavadas, 2018; Rossato and Castellani, 2020). The technology usually implemented through digitalisation involves the ability to turn existing products into digital variations, which offer advantages over tangible products in terms of more efficient business processes and flows, and therefore, better firm performance (Emily et al., 2015; Rossato and Castellani, 2020). Several studies (e.g., Schiavone et al., 2019) reveal that adaptive strategies are shaped from digital technology to meet market needs and under such circumstances, new, innovative digital products are often created from simple products developed by digital users (Beliaeva et al., 2019; Garcez et al., 2022). The article recognises the relevance of digital orientation, as far as it allows the application of digital technology to produce new products, services, and solutions (Khin and Ho, 2018). It also builds on prior studies, which show that innovative digital solutions are critical enablers of digitalising organisations across sectors engaged in a variety of activities such as logistics, human resource management, manufacturing, marketing, and customer service (Emily et al., 2015; Nambisan et al., 2017) In the first instance it is therefore predicted that:

Hypothesis 1 Firms with higher levels of digital orientation have greater levels of digital innovation.

2.2 Digital capabilities

According to the dynamic capabilities view, the ability to recombine and reconfigure assets and organisational structures in response to changes in markets and technologies is one of the fundamental factors in achieving continuous profitable growth and competitive advantage for a business (Teece et al., 2016). A series of studies show that dynamic

capabilities enable firms to cultivate their capabilities to manage the innovation process which requires significant resources, not the least of which is technological knowledge, capabilities, and expertise (Chen and Lien, 2013; Lucia-Palacios et al., 2014). Technological capability, seen as the ability of a firm to formulate and develop new goods and related processes using its technical resources, is pivotal to the innovation process (Balasubramanian et al., 2021; Urban and Maphumulo, 2022). Bell and Figueiredo (2012) improve the understanding of learning mechanisms in technological capability, which they refer to as 'innovation capability' in their research in the context of emerging economies. They refer to technology using capabilities and technology generating capabilities as two components of general technological capability. Moreover, these authors offer a framework to explain capabilities that are internal to the firm, while recognising that a substantial part of a firm's capability to innovate lies in other organisations outside the firm itself, which means that human and knowledge-based resources are needed to interface with external capabilities. Furthermore, studies such as the one by Peerally et al. (2022), present an updated framework of firm-level technological capabilities that specify digitalisation requirements of the 4IR. Their framework consists of a refined set of human and organisational activities, skills, experiences, knowledge, and resources required by firms for the uptake of increasingly complex 4IR technologies and processes along their digital transformation journey. Other authors have also tried to deepen understanding of the relationship between technological and digital capabilities (see, Zhen et al., 2021) and highlight how management capabilities influence digital capabilities and firm performance. Prior research shows that technological capabilities complement digital capabilities to activate a firm's value proposition. In this regard, because of constant change due to digitalisation, technological capabilities require adaptation at the same pace as digital capabilities (Heredia et al., 2022). Similarly, prior studies on the nexus between technology and digitalisation emphasise that new digital technologies, must be developed through digital capabilities, which are often in short supply, in order to succeed (Behl, 2022; Gaglio et al., 2022). Organisations must develop several capabilities in various fields to undergo digital transformation successfully, which depend on the sector in which the organisation works (Rossato and Castellani, 2020).

Digital capabilities play a vital role as building blocks in organisations to enhance customer experience, operational processes, and business models (Arvidsson and Mønsted, 2018), which are enabled through interactions between suppliers and users, initiating digital yields or services that create value (Ly and Huong, 2024). The components of digital capabilities are acquiring, identifying, responding, and mastering digital technology that can produce new products or services in response to changed situations and manage them efficiently and effectively (Velyako and Musa, 2023). Others name different dynamic competencies for digitalisation, which include agile leadership, ambidexterity, and dynamic capability (Hund et al., 2021; Ly and Huong, 2024). Such a focus on skills and capabilities requires a close integration with legacy ICT infrastructure and systems to interact with DI platforms and systems (Hess et al., 2016; Hinings et al., 2018; Liu and Wang, 2020). Consequently, it is clear that digital capabilities are pivotal in the context of DI, which incorporates the production of market products, business processes, or business models that are the direct outcome of the utilisation of digital technology (Nambisan et al., 2017; Zhen et al., 2021). This leads to the prediction that:

Hypothesis 2 Firms displaying higher levels of digital competencies have greater levels of digital innovation.

2.3 Entrepreneurial organisational culture

Organisation theorists (e.g., Mintzberg, 1979; Miller and Friesen, 1983) prove that the culture of an organisation and the innovation process are inextricably linked. For the organisation to enable innovation, it must advance the formation of cultural norms and adopt entrepreneurial behaviours (Kuratko et al., 2021). These norms in turn might increase the employees' levels of commitment to the entrepreneurial strategic vision (Kuratko et al., 2021; Pan et al., 2021). An effective entrepreneurial culture enables an organisation to adapt quickly to constant market shifts and respond with flexibility and market leadership through creativity and innovation (Kreiser et al., 2021). Studies highlight that firms which display an entrepreneurial culture encourage ideas, experimentation, and creativity (Pan et al., 2021), which develops their employees' capabilities and creativeness (Ly and Huong, 2024).

Recent research proposes that a digital organisational culture is the set of shared assumptions and overall understanding of organisational practices in a digital context, which has been identified as the integrated part of the organisation in the era of advanced technologies (Velyako and Musa, 2023). Firms have to focus on various challenges in order to "develop a culture that supports digital innovation, namely: innovation capability, innovation focus, innovation collaboration, and innovation governance" (Ly and Huong, 2024). Research shows that since DI does not require "a holistic knowledge about the underlying product architecture" (Yoo et al., 2010), individual actors are empowered to participate in complex innovation processes leading to the "democratisation of innovation, as individual actors might recombine and create new expert knowledge, to solve existing, yet unrecognised, problems" (Hund et al., 2021). Through the combination of digital capabilities into physical artefacts, opportunities for novel products and services are formed based on the shared infrastructure of digital technologies (Beliaeva et al., 2019; Müller et al., 2019). Success generated through digital products or solutions depends on the firm's capacity to handle digital technologies, where digital capability is a critical success factor for reaching higher levels of DI (Jahanmir and Cavadas, 2018; Hund et al., 2021). Such emerging studies suggest that an entrepreneurial organisational culture has a hypothetically moderating effect on the achievement of greater DI (Müller et al., 2019; Wrede et al., 2020), while correspondingly, digital orientation and digital capabilities, increase the firm's capacity for innovation (Zhen et al., 2021). Therefore, it is hypothesised that:

Hypothesis 3 An entrepreneurial organisational culture positively moderates the relationship between digital orientation and digital innovation.

Hypothesis 4 An entrepreneurial organisational culture positively moderates the relationship between digital capabilities and digital innovation.

3 Research methods

The research design was cross-sectional using primary survey data collected from the South African financial services sector listed on the Johannesburg Stock Exchange (JSE). The South African financial services sector is categorised by listings of banks, insurance companies and brokerages regulated by The Financial Advisory and Intermediary Services Act (37 of 2002) (SARB, 2019). The rationale for focusing on the financial services sector is that it has become pressing for this sector to become more innovative particularly with the move to digitally enable financial and banking solutions (Kyari et al., 2021). The growth in the South African financial services sector is driven by increasing digital solutions made more accessible to consumers, and by ongoing technological advancements such as digital payments, digital investment platforms as well as the rise of digital assets and 'neobanking' which are likely to reshape the financial landscape (Kyari et al., 2021; Statista, 2024).

3.1 Sampling

As one of the largest exchanges (top 20) in the world by "market capitalisation as ranked by the World Federation of Exchanges, the JSE has provided issuers with access to deep and liquid capital markets in a regulated and secure marketplace for over 130 years" (JSE, 2021). The South African financial services sector was considered the relevant population for the study, with JSE listed firms, categorised as banks, insurance companies, and brokerages, (SARB, 2019) serving as the study's sampling frame. Data was sourced in reference to these JSE listings (JSE, 2021) which revealed there were 325 firms listed, which served as the study's final sampling frame. The study target respondent selection criteria was based on any respondent who is currently working as a manager, executive, or IT expert, and who is a decision-maker within the South African financial services sector landscape. It was expected that by focusing on various levels of leadership and management, including IT professionals, relevant and suitable responses would be obtained, as these respondents are acquainted with digitalisation in their workplace (Cortellazzo et al., 2019).

Research ethics were strictly followed, where consent from firms and individuals was first obtained and confidentially of responses was assured. Questionnaires were initially issued via email and social media platforms such as LinkedIn, Instagram, and Facebook. A total of 1 545 emails were sent to the targeted respondents and after several follow-up requests, 297 responses were received, representing a 19% response rate. After careful sorting of responses for missing data the final number of responses was 228, which served as the study sample used in further analysis.

Sample descriptions reveal that the gender distribution was just about equal (females = 50.55% and males = 49.45%), and most of the respondents were in the 35 to 44-year age group (63.1%), and over half of respondents had completed a first diploma/degree (55.7%). In terms of occupation level, the sample was split between senior managers (34.7%), middle-level managers (36.1%), IT professionals (25.5%), and others in general management (3.1%). Individual firm-level details were not collected due the requirements of the Protection of Personal Information (POPI) Act, a piece of legislation governing the law of data protection and privacy in South Africa (JSE, 2021).

3.2 Research instrument

Data was collected in a structured format using a survey instrument with pre-determined questions. Measures used in the study were based on existing multi-item scales obtained from prior research and measured on seven-point Likert-type scales.

Digital orientation (DO) as the first independent variable (IV) was based on a modified version of the measures used by Zhen et al. (2021) and Urban and Maphumulo (2022). These questions evaluated a firm's propensity towards making use of digital opportunities as well as its dedication to the use of digital technologies in the creation of new products/services/processes. A four-item scale was used for digital orientation, with questions such as: 'we are committed to use digital technologies in developing innovative solutions' and 'new digital technology is readily accepted in our organisation'.

Digital capability (DC) as the study's second IV was operationalised as a dynamic capability which describes the ability to create a new business offering or process to enhance customer experience, operational processes, and business models (Chen and Lien, 2013; Geldes et al., 2017). A five-item scale was used to measure this construct with questions such as: 'we place importance on acquiring important digital technologies' and 'we emphasise mastering the state-of-the-art digital technologies'.

Digital innovation (DI) as the study's dependent variable (DV) was adapted from works by Khin and Ho (2018) in order to operationalise DI as creative information technology solutions that develop and integrate digital technologies enabling the digitalisation efforts. A six-item scale was used in this regard with questions such as: 'the quality of our digital solutions is superior compared to our competitors' and 'some of our digital solutions are new to the market at the time of launching'.

The entrepreneurial organisational culture (EOC) measure, as the study's moderating variable (MV), was adapted from prior research by Svahn et al. (2017), Müller et al. (2019) and Ly and Huong (2024) in order to capture elements of both the entrepreneurial culture and digital culture. Digital culture, in this instance, was characterised by lower risk adversity, a stronger focus on experiments, and talent development to support digital initiatives. A seven-item scale was used with questions such as: 'this is a very dynamic and entrepreneurial place' and 'our company considers digital readiness to meet new challenges as important'.

In addition to the main content section of the instrument it was deemed prudent to focus on demographic factors; prior research established a relationship with one or more of the IVs and the DV (e.g., Urban and Maphumulo, 2022), in which case the respondents gender, educational level, occupational level, and/or age, served as control variables.

3.3 Data analysis

The responses were downloaded from Qualtrics and exported to the statistical software programs SPPS 26 and AMOS for analysis. Initially the 'normality' of the data was assessed to establish that the data was accurately modelled and displayed a normal distribution curve (Schindler, 2019). To check for common-method bias (Podsakoff et al., 2012), "several procedural and statistical steps were taken where existing scales were pilot tested to ensure that the scale items were clear and unambiguous to the study respondents". After this procedure, instrument validity and reliability were assessed before moving on to inferential analysis.

4 Results

4.1 Validity and reliability testing

Confirmatory factor analysis (CFA) was used to examine the measuring model and verify the reliability and validity of the constructs under study. Convergent validity on the construct level was established using the average variance extracted (AVE) where for each measured construct the AVE score was greater than 0.50 (Hair et al., 2010). The Fornell-Larcker criterion was used to establish whether the square root of each construct's AVE was greater than its highest correlation with any other construct, and finally, the Heterotrait-Monotrait (HTMT) ratio of the associations was examined to determine the true correlation between latent constructs based on the notion that they are perfectly reliable (Hair et al., 2010). The HTMT ratio for the constructs were observed to be less than 0.7, which is significantly below the maximum threshold of 0.9, thus discriminant validity was established based on the HTMT ratio criterion. The cross-loading analysis for indicator variables was observed to be less than its outer loadings, and thus discriminant validity was established based on the cross-loadings assessment (Hair et al., 2010). The standardised root mean square residual (SRMR) which in terms of model fit data is considered a good fit as the value was ≤ 0.10 (Hair et al., 2010). See Table 1 for full set of model fit indices.

Table 1 Model fit indices

Test for fit	*Result*	*Threshold*	*Verdict*
CFI	0.976	>0.90	Passed
GFI	0.987	>0.90	Passed
NFI	0.960	>0.90	Passed
RMSEA	0.078	<0.08	Passed
SRMR	0.032	<0.08	Passed
NNFI	0.966	>0.90	Passed
TLI	0.966	>0.90	Passed
AGFI	0.976	>0.90	Passed
RFI	0.943	Stegier (2007) suggests proximity to 1	Passed
PNFI	0.683	>0.50	Passed
IFI	0.976	>0.90	Passed
Chi-squared	0.001	Hu and Bentley (1999) suggest proximity to 0	Passed

Source: Primary data

In terms of reliability, the composite reliability (CR) method was employed in addition to calculating Cronbach's alpha values, as reported in the measurement section (Hair et al., 2010). For this study, CR values for named factors were DI = 0.879, DO = 0.866, EOC = 0.894, and DC = 0.956, and all were considered to be at the acceptable threshold to conclude internal consistency reliability (Hair et al., 2010). In summary, as displayed in Table 1, the values show that the measurement models satisfy all the minimum criteria. The collinearity of predictor variables was assessed by calculating the tolerance (TOL) values and the variance inflation factors (VIF) of the predictor variables. If the TOL values are greater than 0.20 and the VIF values are less than five, the predictor variables

will not show any elevated levels of collinearity, on the other hand if elevated levels of collinearity are presented, strategies of creating higher-order constructs, eliminating, or merging indicators will be considered. Based on the VIF analysis, all predictor variables showed a VIF score of less than five (range from 2.124 to 1.502) (not shown) showing no multi-collinearity issues (Schindler, 2019).

4.2 Descriptives and correlations

Descriptive statistics and Pearson's correlation coefficient for each factor obtained are displayed in Table 2, where the mean scores, in terms of the seven-point scale, denote a skewness towards 'agreement' with each of the statements as per the questionnaires measuring each construct. Also in Table 2, the correlation matrix reveals positive inter-correlations between the main study constructs, with several significant correlation coefficients. With regard to the effect of the control variables on any of the factors, comparisons of means tests were carried out to evaluate the effects of single control variables (age and educational level) on the DV separately from other control variables (Schindler, 2019). To check for sampling bias, t-tests were performed and showed no significant relationship with any of the control variables, and an individual one-way ANOVA test did not find any statistical differences in DI. So, control variables were not used in other statistical analyses.

Table 2 Descriptive statistics and correlation matrix

Constructs	*Mean*	*Std. dev.*	*1*	*2*	*3*	*4*	*5*	*6*	*7*
Digital orientation	3.570	1.000	1						
Digital capabilities	3.719	1.104	1.172**	1					
Entrepreneurial organisational culture	3.118	0.970	1.459**	0.876**	1				
Digital innovation	3.760	1.131	1.126**	1.242**	0.847**	1			
Age of respondent	3.064	0.845	0.265	0.349	0.176	0.134	1		
Educational level	2.704	0.881	0.321	0.151	0.254	0.116	0.211	1	
Occupation level	2.767	0.645	0.183	0.332	0.177	0.210	0.317	0.188	1

Note: **Correlation is significant at the 0.01 level (2-tailed).

Source: Primary data

4.3 Hypothesis testing

In terms of H1, Table 3 provides a summary of the regression model showing a R2 value of 0.453 which shows how much of the total variation in the DV, namely the DO could explain DI. In this instance, the value of 45.3% is moderately high, implying that the

model explained 45.3% of the variance in DI. Autocorrelation refers to the degree of correlation between values of the same predictors, which was assessed with the Durbin-Watson test (Hair et al., 2010) and showed a value of 2.105. A rule of thumb is that values between 1.5 and 2.5 are relatively normal implying no autocorrelation problem. In terms of the analysis of variance (ANOVA) section (not shown) the model was considered to be statistically significant, F (1,225) = 186.025, $p < 0.001$. In terms of the standardised beta coefficient, Table 3 shows that DI and DO were directly proportional to each other and a unit increase in DO would result in DI increasing by 0.673. Based on the positive and significant results (β = 0.673, p-value = 0.001), H1 is supported.

Table 3 Regression model summary H1

Model summary[b]						
Model	*R*	*R square*	*Adjusted R square*	*Std. error of the estimate*		*Durbin-Watson*
1	.673[a]	.453	.450	1.12678		2.105
Coefficients[c]						
Model		*Unstandardised coefficients*		*Standardised coefficients*	*t*	*Sig.*
		B	*Std. error*	*Beta*		
1	(Constant)	.222	.340		.654	.514
	DO	.826	.061	.673	13.639	<.001

Notes: [a]Predictors: (constant), DO.
[b]Dependent variable: DI.
[c]Dependent variable: DI.
Source: Primary data

Table 4 Regression model summary H2

Model summaryb						
Model	*R*	*R square*	*Adjusted R square*	*Std. error of the estimate*		*Durbin-Watson*
1	.681[a]	.464	.462	1.11490		1.901
Coefficients[c]						
Model		*Unstandardised coefficients*		*Standardised coefficients*	*T*	*Sig.*
		B	*Std. error*	*Beta*		
1	(Constant)	1.018	.277		3.676	<.001
	DC	.723	.052	.681	13.958	<.001

Notes: [a]Predictors: (constant), DC.
[b]Dependent variable: DI.
[c]Dependent variable: DI.
Source: Primary data

In terms of H2, Table 4 provides a summary of the regression model showing a R^2 value of 0.464, which shows how much of the total variation in the DV, namely the DO could explain DI. In this instance, the value of 46.4% is moderately high, implying that the model explained 46.4% of the variance in DI. Autocorrelation refers to the degree of

correlation between values of the same predictors, which was assessed with the Durbin-Watson test and showed a value of 1.901. A rule of thumb is that values between 1.5 and 2.5 are relatively normal implying no autocorrelation problem (Hair et al., 2010). In terms of the analysis of variance (ANOVA) section (not shown) the model was considered to be statistically significant, F (1,225) = 194.831, $p < 0.001$. In terms of the standardised beta coefficient, Table 4 shows that DI and DO were directly proportional to each other and a unit increase in DO would result in DI increasing by 0.681. Based on the positive and significant results ($\beta = 0.681$, p-value = 0.001), H2 is supported.

In terms of H3 and H4, moderated multiple regression was used where EOC served as a moderator on the relationship between DO and DI (H3) and DC and DI (H4). The moderator variable was mean centred for this analysis, as this makes interpreting regression parameters easier, particularly when zero does not lie within the range of values relating to the IVs (Hair et al., 2010). Hence, the regression output was configured to allow probing of the IVs and DV depending on significance across the moderator variable's three levels. The model was such that DI = Y, DO = X, and the moderator variable EOC = W. As shown in the summary Table 5, the R-square value shows a 49.65% explanation of the variance in the dependent variable. There was no statistical significance for the interaction term Int_1 ($b = -0.101$, $p > 0.05$), despite the relationship between DI and DO being statistically significant when the moderating variable is controlled for, and hence the MV does not moderate the relationship between DO and DI and H3 cannot be supported.

Table 5 Regression model summary H3

R	*R^2*	*MSE*	*F*	*df1*	*df2*	*p*
0.7046	0.4965	1.1782	73.3002	3	223	0
	Coeff	*se*	*t*	*p*	*LLCI*	*ULCI*
Constant	4.7379	0.077	61.5126	0	4.5861	4.8897
DO	0.7175	0.0658	10.9107	0	0.5879	0.8471
EOC	0.2618	0.06	4.3606	0	0.1435	0.3802
Int_1	0.0101	0.0417	0.2431	0.8081	-0.0721	0.0924

Source: Primary data

Table 6 Regression model summary H4

R	*R^2*	*MSE*	*F*	*df1*	*df2*	*p*
0.7001	0.4901	1.1933	71.4409	3	223	0
	Coeff	*se*	*t*	*p*	*LLCI*	*ULCI*
constant	4.7163	0.0804	58.666	0	4.5579	4.8747
DC	0.6503	0.0616	10.5549	0	0.5289	0.7717
EOC	0.1954	0.0638	3.0644	0.0024	0.0697	0.321
Int_1	0.0315	0.0388	0.8121	0.4176	-0.0449	0.1079

Source: Primary data

In terms of H4, EOC served as a moderator to predict its relevance to the relationship between DC and DI. The same approach to mean-centring and deciding significance that was used for H3 was also applied to H4. The model shows DI = Y, DC = X, and the

moderator variable EOC = W. As shown in Table 6, the R-square value shows a 49.01% explanation of the variance in the DV. There was no statistical significance for the interaction term Int_1 ($b = 0.0315$, $p > 0.05$), despite the relationship between DC and DI being statistically significant when the moderating variable is controlled for EOC does not moderate the relationship between DC and DI, and H4 cannot be supported.

5 Discussions and conclusions

Considering there are a limited number of studies explaining which antecedents lead to higher levels of digital innovation at the firm level, this article makes a unique contribution to the literature by empirically investigating previously unrelated constructs – namely the relationship between digital orientation, digital capabilities, an entrepreneurial organisational culture, and digital innovation – in an African emerging market context. The findings are discussed in relation to each of the study's hypotheses and insights are drawn based on the findings' relevance to theory and prior research which then serve as study implications and recommendations.

H1 was supported and resonates with research confirming that digitally oriented firms are more receptive to digital technology and ultimately have enhanced DI (Khin and Ho, 2018). This positive and significant finding builds on the theory that firms with a robust DO are better positioned to use digital technologies for innovation and competitive advantage. This study's findings confirm that adopting a DO emphasises the importance of prioritising digital technologies and developing the necessary skills, resources, and infrastructure to support digital initiatives, which are crucial for driving DI (Rossato and Castellani, 2020). Furthermore, the positive finding on the relationship between DO and DI suggests that firms receptive to digital technology are highly likely to adopt digital projects swiftly and wholeheartedly, which has broader implications when it comes to digital transformation of society. As more firms become digitally oriented and prioritise digital initiatives, so innovation, productivity, and economic growth can increase (Garcez et al., 2022). Other researchers (see, Kyari et al., 2021) have also reported on the impact of technology in the financial sector from an emerging market perspective and reveal how ICT investment can lead to increased performance. However, when considering the study context in terms of South Africa, the digital divide between digitally oriented and non-digitally oriented firms may also worsen existing inequalities, particularly as firms that lack digital capabilities may struggle to compete in the marketplace and may be left behind in terms of digital transformation (Urban and Mbeki, 2022).

H2 was supported as far as DC are associated with greater levels of DI. This finding is supported in the literature where in order for an organisation to undergo digital transformation and innovation successfully, it must first develop several capabilities, which may vary depending on the sector in which the organisation works, as well as the particular requirements of the organisation (Arvidsson and Mønsted, 2018). Furthermore, prior studies have noted that learning and capabilities play a key role in the development of innovative technologies and this study adds to the growing body of knowledge showing how digitalisation has significantly changed the innovation landscape and research agenda (Kunkel et al., 2023). The positive result for H2 is further aligned with studies which show that DC positively influence firm performance, but only through technological capabilities which proves that digital skills in low human development index (HDI) economies (mostly emerging economies) have a more significant indirect

effect on firm performance than in high HDI countries (Heredia et al., 2022). Furthermore, the advancement of DC is essential to foster innovation and to take advantage of the mediating effect of technological capabilities to advance firm performance. This is even more significant in emerging economies since the employment of digital platforms has a disruptive impact due to reduced costs and ease of implementation (Heredia et al., 2022).

From a theoretical perspective, this finding expands on the current understanding of the importance of appreciating the nuances of digital capability development and suggests that a one-size-fits-all approach to digital capability development may not be practical as far as organisations need to consider the specific requirements and challenges of their industry and organisation when developing DC. This underscores the importance of a contextualised approach to digital capability development that considers each organisation's unique characteristics and context. Prior research reveals that in the financial services sector, firms need to develop DC to offer a better experience to the end customer, including offering new services, or improve the efficiency of their delivery of financial services through the adoption, for instance, of blockchain technologies (Kyari et al., 2021; Santosdiaz, 2021). Additionally, the finding is interesting to interpret in the light of recent research findings, which show that developing countries such as India are leading in research on using technology and DI followed by Malaysia, USA, China, and Nigeria (Shama et al., 2023).

In terms of H3 and H4, no statistical significance was clear for the hypothesised moderation effect of an entrepreneurial organisational culture on the relationship between DO, DC, and DI. This finding, albeit unexpected, highlights the importance of understanding the role of EOC in driving innovation. Since an entrepreneurial organisational cultural change requires a break away from established innovation paths, and needs individuals to adapt their institutionalised thinking behaviour, it is difficult to reach. It is plausible that for this study's sample set, the priority focus for the firms in the financial sector was developing a DO and DC initially to boost DI. Any cultural change is a long-term exercise, not just a matter of technological improvement but also requiring a people-centric approach that empowers employees to contribute to the innovation process (Kuratko et al., 2021). Indeed, prior research finds that firms need to reach the optimal balance between control and flexibility in order to support successful DI and must develop managerial practices and systems that identify creativity and differentiation to counter the current status quo of authority structures (Svahn et al., 2017). Another reason for the non-significant results obtained could be the prevalence of remote work and virtual collaboration, which have implications for employee engagement, work-life balance, and organisational culture, all of which reduce the impact that an EOC may have on DI (Müller et al., 2019). From a theoretical perspective, this finding highlights the complexity of the DI process and the importance of understanding the multiple factors that influence DI.

From a contextual understanding, the results are important as the study takes place in the financial services sector in an African emerging economy – South Africa. While research into the antecedents of digitalisation at the firm level are evolving, most studies have focused on developed nations with little attention given to emerging markets such as South Africa. South Africa, in terms of its "emerging market standing, has a relatively advanced economy which compares favourably with those of industrialized countries" (Urban and Mbeki, 2022). South Africa in the wider "Middle East and Africa (MEA)

landscape is ranked as an emerging fintech hub (tier 2) and has an established ecosystem that not only includes its financial services sector but also a large market, making it a potential Fin-Tech magnet for Africa" (Santosdiaz, 2021). Recognising that the digitalisation ecosystem in emerging markets is somewhat unique in the financial services sector in comparison to other high-tech industries (Kyari et al., 2021; Santosdiaz 2021), the study's findings are valuable particularly as the antecedents of DI are not yet altogether understood in emerging market contexts (Urban and Mbeki, 2022). Indeed, the article provides a timely contribution in terms of an empirical investigation on DI from an African emerging market perspective, where scholars have previously noted the unexceptional performance of many African countries' innovation indicators (Afolabi and Adeyinka, 2024).

In terms of study implications, South African firms can benefit by leveraging their DO and DC to obtain increased DI. Moreover, designing and implementing DI can foster international competitiveness for firms in emerging markets as it is increasingly accepted that an emerging technology affects the way of doing business globally. This stance is important as studies reveal that international markets and digital technologies are positively associated with business innovation in emerging markets (Dana et al., 2022). Indeed, the transformations created by the 'digital economy' need firms in resource scarce environments, such as African emerging countries, to adopt a digital orientation successfully (Munyoka, 2022).

The study also has valuable implications for policymaking in developing/emerging countries on developing digital capabilities. In this regard, as the growth of and demand for inclusive and accessible financial services becomes more prominent in Africa, developing policy to foster digital capabilities and DI is pivotal. In South Africa, the digital divide still "poses a threat to the digital inclusion of the disenfranchised" and negatively affects the socio-economic development of the economy (Urban and Mbeki, 2022). Hence, policy development to address this dilemma is urgent in South Africa, which is an African financial services frontrunner, and has adopted several recent regulatory developments as the country prepares to adopt Fin-Tech initiatives fully (Santosdiaz, 2021). However, firms in developing/emerging countries that are not yet digitally oriented may need to invest in developing a DO to remain competitive in the new digital landscape. The African Union has recognised the importance of digital transformation policy for innovation, inclusiveness, and sustainable growth. This presents an opportunity for Africa to catch up with the "Global North by digitalising faster due to fewer legacy challenges. Digital transformation policy is also an important success element in South Africa's National Development Plan, which intends to eradicate poverty and decrease inequality by 2030. Moreover, the National e-strategy (2017–2030) seeks to position South Africa as a significant player in developing digitalisation across all ecosystems and value chains" (Munyoka, 2022). Such policy development may require public-private partnerships for investing in emerging technologies, in order to develop new digital products or services, and ensure value chain collaboration to drive innovation (Dana et al., 2022).

Managers are encouraged to advance a DO that can enhance their ability for DI and develop robust DCs so that they can leverage emergent technologies to develop innovative products, services, and business models. Moreover, it is recommended that organisations thoroughly assess their digital capabilities and find areas where they need to improve to remain competitive in their particular industry. This may involve investing in modern technologies, enhancing digital skills and infrastructure, or developing new

digital products or services. Human resource practitioners can devise and provide relevant courses and training programmes to foster DCs within a firm, thereby educating the workforce to meet the evolving requirements of digitalisation. Indeed, organisations may need to invest in reskilling and upgrading their employees to remain competitive in the digital landscape. Organisations must identify their industry's specific requirements and challenges and expand digital capabilities tailored to their needs. In the context of the study setting, financial sector organisations may need to prioritise digital capabilities relating to crowdfunding and blockchain technology based on the growing number of crypto currencies, as well as focus on skills surrounding data security and privacy related data issues.

Study limitations in terms of the cross-sectional nature of the research design used are noticeable. Longitudinal studies utilising the same sample during multiple periods may produce diverse findings about the moderating influence of culture, which is dynamic and tends to manifest over an extended period. The study focused only on selective organisational antecedents to explain DI, and supplementing these measures with other variables could add value and help explain the results. In this regard, future research could focus on bricolage capability, which is relevant to mobilise resources and overcome environmental constraints.

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