

When innovation isn't enough: environmental turbulence and the limits of entrepreneurial success in the Middle East

European Journal
of Management
and Business
Economics

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Received 3 February 2026

Revised 11 May 2026

3 June 2026

Accepted 8 July 2026

Abstract

Purpose – This study investigates how digital literacy, entrepreneurial orientation and digital networks drive entrepreneurial success directly and indirectly through digital innovation among Middle Eastern Small and Medium-sized Enterprises (SMEs), and whether environmental turbulence moderates these direct and mediated relationships.

Design/methodology/approach – Drawing on the resource-based view and dynamic capabilities theory, a moderated mediation model is proposed and analyzed using partial least squares structural equation modeling on data collected from SME founders, co-founders and senior managers.

Findings – Entrepreneurs' digital literacy, entrepreneurial orientation and digital networks each positively influence both digital innovation and entrepreneurial success. Digital innovation fully mediates all three capability-to-success pathways. Environmental turbulence negatively moderates all direct capability-to-outcome relationships and all mediated pathways through digital innovation, confirming full moderated mediation and establishing that high turbulence systematically attenuates the performance returns to internal capabilities.

Practical implications – Policymakers and ecosystem builders in the Middle East should invest in digital skills development and platform accessibility as foundational prerequisites for entrepreneurial performance, while recognizing that capability-building interventions yield diminishing returns without concurrent efforts to stabilize the regulatory and macroeconomic environment.

Originality/value – This study is among the first to validate digital innovation as a mediating mechanism between antecedent digital capabilities and entrepreneurial success in a Middle East and North Africa (MENA) context, and the first to demonstrate that environmental turbulence conditions the full mediation chain rather than discrete direct paths alone. The findings reframe environmental turbulence as a structural performance ceiling that no level of the internal capabilities under analysis full accumulation can fully overcome without parallel institutional stabilization, advancing both resource-based and dynamic capability theorizing in emerging market entrepreneurship.

Highlights

- (1) Digital innovation is the key driver of entrepreneurial success
- (2) Environmental turbulence reduces the value of internal capabilities
- (3) New theoretical evidence in the MENA context
- (4) Public policies must combine digitalization and institutional stability

Keywords Digital entrepreneurship, Environmental turbulence, Digital innovation, Entrepreneurial orientation, Middle East

Paper type Research article

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European Journal of Management and
Business Economics
Emerald Publishing Limited
e-ISSN: 2444-8494
p-ISSN: 2444-8451
DOI 10.1108/EJMBE-02-2026-0059

1. Introduction

The rapid digitalization rate has redefined the international business environment, where digital possibilities are the key to survival and prosperity amid unfavorable shifts ([Shatila et al., 2025a](#); [Baroncelli et al., 2024](#)) and may facilitate the adaptation of entrepreneurs' strategies in face of adverse environmental conditions ([Estrada-Cruz et al., 2026](#)). Recent global changes are influencing entrepreneurial activities through accelerated technological change, unpredictable customer behavior and growing reliance on digital platforms and networks ([Bičo and Knezović, 2025](#)). Digital literacy, entrepreneurial orientation (EO) and digital networks are no longer peripheral; they are the determinants of digital innovation and entrepreneurial success in this new paradigm ([Farquhar et al., 2024](#); [Shatila et al., 2025a](#)). Although the benefits of these capabilities have been well described, little is still known about how such capabilities perform under elevated levels of uncertainty, especially in emerging economies and politically unstable conditions.

The Middle East is one of the most compelling areas for exploring these dynamics. Although there has been increasing attention given to entrepreneurship and digital transformation in policy discussions, the region still faces problems of political instability, regulatory inconsistency, oil-based economic variability and inadequate digital infrastructure. According to the [World Bank \(2022\)](#), more than 60% of countries in the Middle East and North Africa (MENA) region lack the necessary structures to promote the development of digital entrepreneurship. In war-torn and transitional economies, entrepreneurs have to work in a multiplied uncertainty-market turmoil, shortage of funds, ineffective rule of law and poor institutions ([Shatila et al., 2025b](#)). The adverse nature of such environmental turbulence has the potential not only to compound the risks associated with entrepreneurship but also to modify the efficacy of strategic capabilities, such as digital literacy and EO ([Shatila et al., 2025b](#)). However, there is a lack of studies on how digital resources are being used in the turbulent environments of the Middle East.

Prior research has demonstrated that digital literacy enhances entrepreneurial capabilities in utilizing digital tools and leveraging data to identify opportunities and foster innovation ([Van Laar et al., 2020](#); [Saorín-Iborra and Cámara-Campos, 2025](#)). In a similar vein, risk-taking, innovativeness and proactiveness, which define EO, have been found to promote both innovation performance and strategic agility ([Kraus et al., 2019](#); [Laskovaia et al., 2019](#); [Wales et al., 2024](#)). Furthermore, online platform ecosystems and communities facilitate access to external knowledge and market legitimacy ([Giones and Brem, 2017](#)). Still, there are several research gaps. To begin with, these variables are typically studied separately, with little attention paid to their interactive or contingent effects. Second, empirical research seldom investigates the moderating effects of environmental turbulence in the interplay between these variables, despite the theories' tendency to demand the contextualization of resource effectiveness. Third, the regional uniqueness of the Middle East is underrepresented in the literature, resulting in a gap between theory and practice in one of the world's most challenging entrepreneurial ecosystems.

This study addresses these gaps by examining the direct and indirect impact of digital literacy, EO and digital networks on digital innovation and entrepreneurial success, with environmental turbulence serving as a primary contextual moderator. Drawing on the resource-based view (RBV) and the dynamic capabilities theory (DCT), this study examines how digital and behavioral capabilities can be leveraged in conjunction within unstable environments to achieve entrepreneurial outcomes. The Middle East presents an auspicious empirical climate for assessing the generalizability of existing models and producing context-specific knowledge that can inform both theoretical and practical applications.

The research adds four distinctive elements to the body of literature. On the one hand, it represents the further development of RBV and DCT in terms of empirically evaluating the functioning of dynamic capabilities under conditions of environmental turbulence. Second, it incorporates environmental turbulence as a moderator and drops the assumption of equal resource effectiveness. Third, it contributes to the growing body of knowledge in digital

entrepreneurship in developing and unstable regions. Lastly, it offers practical recommendations for policymakers, educators and ecosystem builders in the Middle East who aim to foster resilient, innovation-driven entrepreneurship.

The remainder of this article is structured as follows. [Section 2](#) presents the literature review and hypotheses development, drawing on recent empirical and theoretical studies. [Section 3](#) details the research methodology, including the sample, measures and data analysis techniques. [Section 4](#) reports the key findings of the study. [Section 5](#) discusses the implications and theoretical contributions of this study. [Section 6](#) provides the conclusions. Finally, [Section 7](#) concludes the article by highlighting the limitations and future research directions.

2. Theoretical framework and hypotheses development

2.1 Resource-based view (RBV) and dynamic capabilities theory (DCT)

This study is grounded in the theoretical foundations of the RBV and the DCT, two related perspectives that can be combined to elucidate how firms can achieve innovation and entrepreneurial excellence by building and coordinating internal and external capabilities ([Li et al., 2024](#)). In this context, the conceptualizations of digital literacy, EO and digital networks involve viewing such dimensions as strategic assets that allow a firm to be better positioned to adapt, innovate and expand in the environment of digitally evolving markets ([Kraus et al., 2019](#)). At the intersection of technological, cognitive and communication skills, digital literacy is a vital form of human capital that empowers entrepreneurs to identify opportunities, effectively utilize digital tools and participate in digital transformation processes ([van Laar et al., 2020](#)). Finally, as an empirical phenomenon characterized by risk-taking, innovativeness and proactiveness, EO may be regarded as a behavioral resource that encourages entrepreneurial experimentation and opportunity exploitation ([Wales et al., 2024](#)). Platform ecosystems and virtual collaborations are examples of digital networks that form a type of relational capital, enabling access to outside knowledge, partnering and market channels crucial to entrepreneurial performance ([Giones and Brem, 2017](#)).

Digital literacy can therefore be thought of as an active micro-foundation that endows entrepreneurs with the ability to discern new opportunities, capitalize on them through technological innovation and, thus, adapt business models ([Teece, 2007](#)). These dynamic capabilities are supplemented by EO, which enables adaptation to environmental changes in a brief period. Proactiveness helps identify emerging trends, innovativeness facilitates experimentation with new strategies and risk-taking allows for bold steps in terms of strategy ([Giones and Brem, 2017](#)). Digital networks enhance a firm's dynamic capabilities by facilitating real-time knowledge exchange, promoting collaboration in the innovation process and improving absorptive capacity ([Nambisan et al., 2019](#); [Scuotto et al., 2017](#)). Notably, environmental turbulence, which can be characterized by the unpredictability of technology, competition and consumer behavior, exacerbates the need for firms to continually activate and reconfigure their capabilities.

2.2 Capabilities and entrepreneurial success

In the digital economy, digital literacy is a crucial decision-making factor that significantly influences the success of entrepreneurship, particularly among small-scale firms and startups ([Shatila et al., 2025b](#)). Digital literacy is regarded as a strategic capability, enabling entrepreneurs to be more productive in recognizing, assessing and pursuing opportunities through digital delivery. It supports fundamental entrepreneurial activities, including online marketing, financial planning, customer relationship management and business analytics. In this vein, [Estrada-Cruz et al. \(2026\)](#) highlight the relevance of information and communication technologies and digital skills in early-stage ventures toward strategy adaptation and, consequently, better performance. Recent research supports the beneficial connection between digital literacy and entrepreneurial achievement, and [Audretsch et al. \(2024\)](#) highlight the

potential of digital literacy in fostering resilience. [Shatila et al. \(2025b\)](#) found that the presence of digital competencies in micro and small entrepreneurs has provided significant growth in their capability to adopt e-commerce strategies and stay afloat through the COVID-19 pandemic, while [Nambisan and Baron \(2021\)](#) highlight that digitally fluent entrepreneurs are believed to be better at engaging in digital bricolage, particularly during resource shortages. Based on these arguments, we formulate the following research hypotheses.

H1a. Entrepreneurs' digital literacy has a direct positive effect on entrepreneurial success.

EO is one of the most effective predictors of entrepreneurial success ([Nigam and Shatila, 2024](#)). EO involves risk-taking, innovativeness and proactiveness, which assist an entrepreneur in finding and taking action on opportunities before anyone else. In the context of digital and volatile environments, EO plays a vital role in facilitating experimentation with innovative business models and rapid market responses. [Kraus et al. \(2019\)](#) analyze European startups and establish that EO has a significant impact on revenue growth and on the capacity to innovate. The positive contribution of EO to customer acquisition, market development and internal innovation in Small and Medium-sized Enterprises (SMEs) located in developing economies was also validated by [Rostain \(2021\)](#). Despite such a sound empirical base, EO is not always good. Risk-taking without strategic orientation and resources can result in sinister or unfavorable choices ([Wales et al., 2024](#)). Recognizing the existing controversies, we propose the following research hypothesis:

H1b. Entrepreneurial orientation has a direct positive effect on entrepreneurial success.

Digital networks (including the networks of platforms and communities, online communities and B2B cloud-based systems of collaboration) have emerged as the keystone in how entrepreneurs gain access to resources, knowledge and markets. These networks increase structural and relational capital by making trust-based exchange possible, which is essential to the growth of the venture. [Khodor et al. \(2024\)](#) confirmed that firms located in digital innovation ecosystems received high investments in venture capital, experienced enhanced speed of customer growth and achieved higher innovation output. According to the same study, the strategic use of social media presence to encourage brand awareness and interest among investors significantly enhances performance on these stages and increases the chances of future success. [Giones and Brem \(2017\)](#) emphasized that engagement within digital innovation ecosystems helps startups access external ideas and leverage more iterations, particularly when the sector is characterized by high uncertainty. However, the possibility of becoming too dependent on digital platforms can subject entrepreneurs to platform governance risk, where platforms have access to data or visibility into algorithms and their policies restrict entrepreneurs' autonomy and profit margins ([Bogers et al., 2022](#)). Additionally, not every network relationship is equally valid: weak relationships or superfluous connections may lack diversity in knowledge, and over-embeddedness can result in groupthink or strategic stasis. Despite these concerns, based on the literature, we formulated the following hypothesis:

H1c. Digital networks have a direct positive effect on entrepreneurial success.

2.3 Capabilities and digital innovation

Digital literacy is integrated into the master fabric of dynamic capabilities ([Teece, 2007](#)), enabling firms to sense and exploit opportunities for innovation in the dynamic and rapidly changing digital landscape. On a personal scale, digital literacy encompasses cognitive, technical and social-emotional abilities, empowering employees to utilize emerging technologies such as big data, AI and cloud infrastructures. At the organizational level, it improves absorptive capacity and allows the consideration of external knowledge in the innovation process ([Aliasghar et al., 2023](#)). Recently, [Garzoni et al. \(2020\)](#) found that business

organizations with digitally literate leadership responded to the COVID-19 crisis more proactively, redesigning their business models and digitally innovating. However, according to [Bresciani et al. \(2021\)](#), digital literacy cannot support innovation independently of a combination with strategies and allocation of resources into technology. While recognizing the different perspectives, we formulated the following research hypothesis:

H2a. Entrepreneurs' digital literacy has a positive and significant effect on digital innovation.

Due to the digital environment, EO is even more critical, as it enables companies to navigate technological turbulence and capitalize on the opportunities of the digital world, adopting new business models. EO is a manifestation of a firm's tendency to undertake exploratory activities, which best supports digital innovation, defined as the adoption of new digital products, services, processes or business models, due to the nonlinear, platform-dependent nature of digital innovation, requiring rapid iterations. Recently, [Liu et al. \(2025\)](#) examined a sample of technology companies and found that EO explains a high portion of the variation in digital innovation, particularly when digital strategic alignment moderates this relationship. Similarly, [Kraus et al. \(2019\)](#), focusing on European SMEs, found that startups exhibiting an increased level of EO performed better in terms of digital business model innovation due to higher levels of agility and experimentation. Furthermore, the larger the EO, the newer digital innovations were captured, leading us to the formulation of the following research hypothesis:

H2b. Entrepreneurial orientation has a positive and significant effect on digital innovation.

Digital networks enable companies to access external bodies of knowledge, co-create in real-time and collaborate ([Khodor et al., 2024](#)). [Autio et al. \(2018\)](#) concluded that participation in digital platforms significantly strengthened the innovation outputs of the firms via knowledge recombination and acceleration in experimental cycles. In an analogous analysis, [Cenamor et al. \(2017\)](#) found that manufacturing SMEs that integrated into digital supply chains became more innovative in terms of process and service innovation overall, primarily due to increased data visibility and integration. Furthermore, [Nambisan et al. \(2019\)](#) argue that digital networks transform innovation into a system-oriented, rather than firm-based, phenomenon, in which value is co-created by actors within loosely coupled digital-network structures. However, excessive homogeneity can also impede innovation performance through over-embeddedness in homogeneous networks, which are associated with the solidification of cognition and struggles in accessing new knowledge. Moreover, digital network governance, such as platform control, access to data and algorithmic transparency, can filter or even shape innovation incentives. For example, companies that engage in platform ecosystems are typically limited in their autonomy for innovation, particularly when platform owners have monopolistic control over standards and interface scripts ([Bogers et al., 2022](#)). This led to the development of the following hypothesis:

H2c. Digital networks have a positive and significant effect on digital innovation.

2.4 Digital innovation and entrepreneurial success

One of the key factors of entrepreneurial success in the 21st century has turned out to be digital innovation. Considering the DCT ([Teece, 2007](#)) and the Innovation-based Growth Theory ([Aminullah, 2024](#)), digital innovation enhances entrepreneurs' responsiveness to market changes, increases the possibility of creating differentiated values and fosters the capacity to gain competitive advantages. It helps startups and SMEs expand their operations without significant limitations to physical logistics, take advantage of data to make better decisions and reach international markets with the prospects that digital portals offer. According to [Shatila et al. \(2025a\)](#), companies that are more digitally innovative tend to reach higher levels of sales

and market share expansion, especially in knowledge-intensive industries. Research has also shown that digital innovation improves the financial and strategic performance of SMEs by enhancing customer relations and allowing for the personalization of services. [Shatila et al. \(2024\)](#), based on a cross-country study, illustrate that entrepreneurs utilizing digital tools to conduct product and process innovation demonstrated resilience and long-term survival even in emerging markets. Moreover, [Nambisan et al. \(2019\)](#) maintain that digital innovation is both an outcome and a capability, and such a digital capability demonstrates a firm's ability to evolve and experiment in a rapidly changing world. Additionally, [Audretsch et al. \(2024\)](#) highlight the role of digital transformation toward entrepreneurial survival and growth. This led to the development of the following hypothesis:

H3. Digital innovation has a positive and significant effect on entrepreneurial success.

2.5 Environmental turbulence

Environmental turbulence refers to the rapid and unpredictable change in areas such as technology, customer preferences and competition intensity. Considering the contingency theory and DCT, digital literacy enhances digital innovation only in situations where environmental uncertainty requires quick learning, experimentation and adaptation. Digital literacy can lead to marginally higher efficiency at low rates of change and significantly larger, mission-changing innovations in turbulent environments. [Shatila et al. \(2025a\)](#) determined that elevated levels of digital literacy contributed to a significant increase in innovation in unpredictable environments because of the superior capacity of companies to absorb and use digital knowledge. [Shatila et al. \(2025b\)](#) also showed that environmental turbulence reinforced the connection between the digital competence of employees and digital process innovation, especially within knowledge-intensive industries. Therefore, we formulate the following research hypothesis:

H4a. Environmental turbulence moderates the relationship between entrepreneurs' digital literacy and digital innovation.

The connection between EO and increased intensities of digital innovation is predominantly visible; nevertheless, the intensity and direction of that relation vary extensively ([Nwankpa and Datta, 2017](#)). According to [Kraus et al. \(2019\)](#), environmental turbulence enhanced the positive influence of EO on the digital innovation performance of European SMEs. As [Liu et al. \(2025\)](#) demonstrate, the best performance of EO in facilitating digital innovation occurs in the presence of digital strategic alignment in a downstream market environment. Therefore, we propose the following research hypothesis:

H4b. Environmental turbulence moderates the relationship between entrepreneurial orientation and digital innovation.

Turbulent environments require a heightened intensity of external sensing, fast feedback and immediate reatomization of distributed knowledge, among other practices that digital networks can facilitate. By contrast, in a stable environment, such networks can develop diminishing returns and can even prevent innovation, adding complexity or redundancy. As [Cenamor et al. \(2017\)](#) demonstrated, digital supply networks led to a significant increase in innovation in cases where the turbulence level was high, and the pace of information exchange and flexibility became crucial factors. According to [Scuotto et al. \(2017\)](#), digital networks enhance the innovation ability of SMEs more effectively, particularly those operating in a dynamic environment, which is mainly characterized by high technological unpredictability. Therefore, we formulate the following hypothesis:

H4c. Environmental turbulence moderates the relationship between digital networks and digital innovation.

Although digital literacy is often associated with enhanced entrepreneurial performance, it appears to vary considerably in unstable environments. [Shatila et al. \(2025b\)](#) indicate that the impact of digital literacy on business performance is higher in settings characterized by elevated uncertainty, such as digital disruption conditions, inflationary shocks or institutional vulnerability. Contingency theory and DCT suggest that the advantage of digital literacy increases when the environment is turbulent, as rapid changes in markets and technology necessitate constant learning and adaptation. Digitally skilled entrepreneurs are also better positioned to overcome uncertainty, as they utilize online platforms, process real-time information and reconfigure digital resources to support new demands. Evidence of this moderated relationship is beginning to emerge empirically. For example, [Martins \(2023\)](#) discovered that digital literacy increased SME performance in Southeast Asia during the COVID-19 context, although this effect was only evident when market volatility was high. Considering previous research, we formulated the following research hypothesis:

H5a. Environmental turbulence moderates the relationship between entrepreneurs' digital literacy and entrepreneurial success.

In a turbulent environment, proactiveness and risk-taking (as components of EO) may enable entrepreneurs to grasp emerging trends and be agile. In turn, excess EO can be disastrous in stable situations, causing the waste of resources or a miscalculation of strategy. This moderation effect has an empirical basis. For example, [Kraus et al. \(2019\)](#) noted that EO was significantly more effective in inducing entrepreneurial performance in industries associated with technological and market volatility. Identical results were obtained by [Liu et al. \(2025\)](#), who noted that when institutional and digital disruptions were high, the EO-success relationship improved. Despite empirical confirmation of EO's importance, this is not always consistent and it appears to be particularly context-specific. [Hina et al. \(2021\)](#) showed that EO is linked more closely with entrepreneurial success during environmental turbulence, especially in conditions where firms are exposed to either competitive intensity, digital disruption or policy unpredictability. As shown by [Nigam and Shatila \(2024\)](#), in the fast-changing manufacturing industry, EO had a positive correlation with the firm's growth. Still, this association was conditional and positive when the perceived environmental dynamism was strong, supporting the following research hypothesis:

H5b. Environmental turbulence moderates the relationship between entrepreneurial orientation and entrepreneurial success.

Digital networks are effective catalysts of business prosperity, as they deliver access to outside knowledge, resources and markets. Peer exchange enables entrepreneurs in turbulent settings to be more flexible, detect emerging opportunities and process uncertainty more quickly due to digitally mediated communication. According to [Giones and Brem \(2017\)](#), this is possible within digital ecosystems because these allow firms to develop solutions collectively and share risks. [Scuotto et al. \(2017\)](#) demonstrated that SMEs that had previously incorporated digital innovation networks were more successful in operating under environmental turbulence, as they received market intelligence and technical knowledge more quickly. Furthermore, digital networks helped female entrepreneurs to increase resilience (which, as [Audretsch et al., 2024](#) corroborate, is a relevant organizational goal) and market penetration during COVID-19, when their offline activities and operations were disrupted ([Bogers et al., 2022](#)). This led to the development of the following hypothesis:

H5c. Environmental turbulence moderates the relationship between digital networks and entrepreneurial success.

Although it is often considered that digital innovation is a booster that can lead to entrepreneurial success, its influence on performance turns out to be sensitive to the context, particularly in settings involving volatility and unpredictability. Empirical evidence suggests that environmental turbulence can have a considerable influence on determining the direction

and scale of the impact of digital innovation on entrepreneurial outcomes. For example, [Shatila et al. \(2025b\)](#) found, in the case of startups in high-risk economies, that digital innovation was a strong contributor to firm survival and performance only when founders were working without the backdrop of rapid growth and institutional uncertainty. In turn, [Liu et al. \(2025\)](#) documented that in rapidly changing industries, the effect of digital product and process innovation on a firm’s development is significantly enhanced. This led to the development of the following hypothesis:

H6. Environmental turbulence moderates the relationship between digital innovation and entrepreneurial success.

3. Methodology
3.1 Procedures

The nature of this study is quantitative, utilizing a cross-sectional survey design, as it aims to examine how digital literacy, EO and digital networks influence digital innovation and entrepreneurial success, as moderated by environmental turbulence, as depicted in [Figure 1](#). The items of the questionnaire were designed using elements from validated scales. The questionnaire employed a 5-point Likert scale ranging from 1 (Strongly Disagree) to 5 (Strongly Agree). The survey was developed in the English language and reviewed by experts and entrepreneurs to ensure clarity, face validity and understandability.

To ensure that the study captured the essence of entrepreneurship, explicit inclusion criteria were established prior to data collection. Only SMEs were considered eligible, as these organizations represent the primary arena in which entrepreneurial behavior, flexibility and innovation typically unfold. Furthermore, firms had to be relatively young, i.e. founded or co-founded within the past 10 years, to ensure that the sample reflected ventures still engaged in entrepreneurial development. Respondents were required to hold entrepreneurial positions, namely founders, co-founders or senior managers with direct decision-making authority, guaranteeing that the insights collected represented those actively shaping entrepreneurial strategy and innovation; in addition to that, 109 respondents had more than 10 years of experience. Finally, firms were expected to demonstrate engagement with entrepreneurial ecosystems, such as participation in incubators, accelerators, university innovation hubs or entrepreneurship networks. These conditions collectively ensured that the study focused on firms that could be legitimately classified as entrepreneurial.

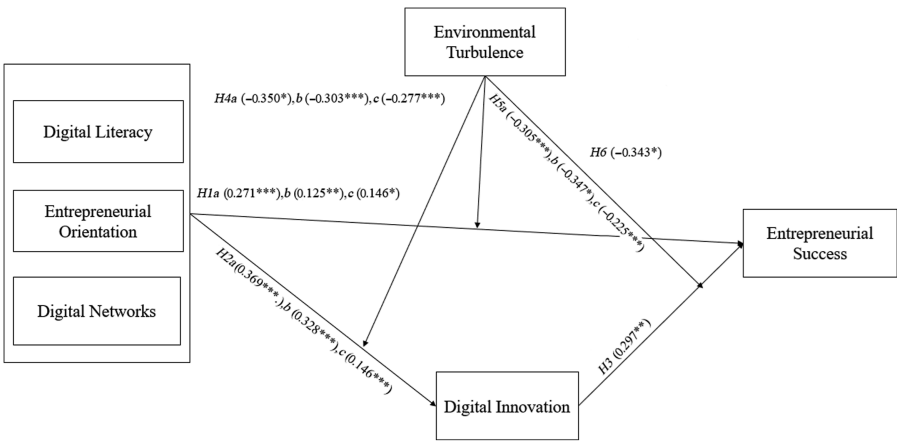


Figure 1. Direct path coefficients

The final questionnaire was sent directly via Google Forms over a six-week period through entrepreneurship networks, business incubators, university innovation hubs and social media platforms used by entrepreneurs in the Middle East. The number of surveys sent out was 510 [1], yielding 480 responses. The study controlled for key demographic and firmographic characteristics. Business-related controls included the age of the business, firm size, industry sector and external funding status. Entrepreneur-related controls comprised respondent age and education level. Incorporating these variables into the analysis ensured that the estimated effects of the primary predictors, digital literacy, EO and digital networks, on digital innovation and entrepreneurial success were not influenced by differences in firm characteristics or founder demographics. Upon screening the questionnaires with incomplete responses and eliminating statistical outliers using the Mahalanobis distance and standardized residuals, 455 valid answers were retained and used finally (Hair *et al.*, 2012).

3.2 Measurement scales

Digital literacy was assessed using six items adapted from Avinç and Doğan (2024), capturing participants' confidence in using digital tools, evaluating digital information and adapting to technological changes. EO was measured using six items reflecting the firm's innovativeness, proactiveness and risk-taking behavior, as proposed by Wales (2016). To measure digital networks, six items were adapted from Scuotto *et al.* (2016), focusing on the firm's use of digital platforms and tools for networking, collaboration and information sharing.

Digital innovation was operationalized using a six-item scale based on Li *et al.* (2018), assessing the extent to which firms integrate digital technologies to enhance innovation processes. Environmental turbulence was measured through six items derived from the work of Jaworski and Kohli (1993) and updated by Jansen *et al.* (2006), capturing the perceived instability in market, technology, regulation and competitive dynamics. Finally, entrepreneurial success was measured using six items based on García-Villaverde *et al.* (2018), reflecting both financial and market-based indicators of firm performance. The items are summarized in Table 1:

3.3 Sample

The sample comprised 455 businesses in various fields and areas, including information technology, production, education, services and retailing. The respondents were mainly founders, co-founders or senior managers of SMEs in politically and economically vibrant regions. The nonprobability purposive method has been employed in this research, as it is suitable for reaching a specific population, in this case, active entrepreneurs with digital engagement. The descriptive statistics are presented in Table 1 of the supplementary material.

3.4 Statistical techniques

This study employs partial least squares structural equation modeling (PLS-SEM), as does previous research on entrepreneurship (e.g. Estrada-Cruz *et al.*, 2026), using SmartPLS 4 to test the proposed model. PLS-SEM is selected over covariance-based SEM for three methodological reasons: it accommodates complex models with multiple constructs and hypothesized paths simultaneously, it does not impose multivariate normality assumptions on the data and it is particularly suited to predictive research aims where theoretical constructs remain under active development (Hair *et al.*, 2019). The two-stage assessment procedure recommended by Hair and Alamer (2022) is followed, whereby the measurement model is evaluated prior to structural model estimation.

The measurement model is assessed across four criteria. Indicator reliability is evaluated through outer loadings, with the 0.708 threshold applied as the minimum acceptable value (Hair *et al.*, 2019). Internal consistency is assessed via Cronbach's alpha, composite reliability

Table 1. Measurement scales

Variable	Statement	Reference
Digital literacy (DL)	I can effectively evaluate the credibility of digital information sources I feel confident using digital tools for communication and collaboration I can troubleshoot fundamental digital tool-related problems on my own I regularly use digital platforms to enhance my learning or work I adapt quickly to new digital technologies I understand the implications of sharing personal data online	Avinç and Doğan (2024)
Entrepreneurial orientation (EO)	Our firm emphasizes new and innovative products and services We actively seek out new market opportunities Top management favors a bold, aggressive posture Innovation is a dominant characteristic of our firm We are willing to take high risks with new ventures Our firm is often the first to introduce new products or services	Wales (2016)
Digital networks (DN)	We use digital networks to establish new partnerships Digital platforms help us maintain relationships with stakeholders We participate in online business communities relevant to our industry We use social media to enhance our network visibility Our firm integrates digital tools to share knowledge with partners We leverage digital networks to access market information	Scuotto et al. (2016)
Digital innovation (DI)	We frequently adopt new digital technologies in the development of our products and services We explore digital platforms to enhance business processes Our firm utilizes digital tools to create value for our customers Digital technologies have improved our innovation speed We continuously develop digital-based innovations We invest in digital skills to support innovative activities	Li et al. (2018)
Environmental turbulence (ET)	Customer preferences in our industry change rapidly Unpredictable competitive moves characterize our industry We experience frequent regulatory and policy changes Technological changes in our industry are unpredictable There is considerable uncertainty in our external environment We face constant shifts in the capabilities and costs of our suppliers	Jansen et al. (2006)
Entrepreneurial success (ES)	Our venture has achieved the financial goals set at the start We have experienced sustained growth in revenue Customer satisfaction has improved over time We have successfully penetrated our target market Our firm is recognized as a market leader in its niche We consistently meet or exceed performance expectations	García-Villaverde et al. (2018)
Source(s): Author's work		

(rho_a and rho_c), with thresholds of 0.70 and 0.80 applied respectively. Convergent validity is confirmed through average variance extracted (AVE), requiring a minimum value of 0.50 per construct (Fornell and Larcker, 1981). Discriminant validity is assessed primarily through the heterotrait–monotrait (HTMT) ratio, with values required to fall below the conservative 0.85 threshold (Henseler *et al.*, 2015), supplemented by the Fornell–Larcker criterion.

The structural model is evaluated through path coefficients, *t*-statistics and *p*-values obtained via bootstrapping with 5,000 subsamples using a two-tailed test at a 5% significance level. Predictive relevance is assessed through the coefficient of determination (R^2) and Stone-Geisser Q^2 values obtained through blindfolding, with $Q^2 > 0$ confirming predictive relevance for each endogenous construct (Hair *et al.*, 2019). Model fit is evaluated using the standardized root mean square residual from the saturated model, with values below 0.08 indicating acceptable fit (Henseler *et al.*, 2015). Mediation is assessed through specific indirect effects with bias-corrected bootstrapped confidence intervals, with significance confirmed when the 95% confidence interval excludes zero. Moderation is tested through the product indicator approach, with interaction terms constructed for all hypothesized moderating relationships involving environmental turbulence.

To assess common method bias (CMB), Harman's single-factor test was conducted on all study variables prior to structural model estimation. The results revealed that the first unrotated factor accounted for 23.767% of the total variance, substantially below the 50% threshold established by Podsakoff *et al.* (2003). This finding confirms that CMB does not constitute a significant threat to the validity of the study's findings, and that the observed relationships between constructs are not artificially inflated by single-source measurement artefacts.

4. Findings

Table 2 in the supplementary materials presents the factor loadings and variance inflation factors for all retained study constructs. All outer loadings meet or approach the 0.708 threshold recommended by Hair *et al.* (2019), ranging from 0.706 (DI3) to 0.846 (ES2), confirming adequate indicator reliability. Items with outer loadings below the 0.708 threshold were removed iteratively during measurement model refinement, resulting in the removal of three items from digital literacy (DL4, DL5, DL6), two items from entrepreneurial orientation (EO5, EO6), three items from digital networks (DN4, DN5, DN6), one item from digital innovation (DI6), three items from entrepreneurial success (ES4, ES5, ES6) and one item from environmental turbulence (ET6). The retained items reported in the same table represent the final measurement model used for all subsequent analyses. All VIF values fall below 3.3, with the highest recorded at 2.049 (EO4), providing assurance that multicollinearity does not threaten the integrity of the measurement model.

Table 2 reports the internal consistency and convergent validity statistics. Cronbach's alpha values range from 0.729 (DL) to 0.833 (EO), and composite reliability (rho_c) values range

Table 2. Reliability analysis

	Cronbach's alpha	Composite reliability (rho_a)	Composite reliability (rho_c)	AVE
Digital innovation	0.787	0.787	0.855	0.540
Digital literacy	0.729	0.741	0.799	0.570
Digital networks	0.772	0.772	0.820	0.603
Entrepreneurial orientation	0.833	0.838	0.889	0.666
Entrepreneurial success	0.761	0.764	0.863	0.677
Environmental turbulence	0.739	0.807	0.742	0.683

Source(s): Author's work

from 0.742 (ET) to 0.889 (EO), all exceeding the 0.70 threshold (Hair *et al.*, 2019). AVE values range from 0.540 (DI) to 0.683 (ET), all surpassing the 0.50 benchmark established by Fornell and Larcker (1981), confirming convergent validity across all constructs.

Table 3 presents the HTMT ratios for discriminant validity assessment. All HTMT values fall below the conservative 0.85 threshold (Henseler *et al.*, 2015), with the highest recorded at 0.803 between DN and EO, confirming that all constructs are empirically distinct. Environmental turbulence exhibits particularly low HTMT values across all construct pairs, ranging from 0.185 to 0.277, further reinforcing its discriminant validity.

Table 4 presents the Fornell–Larcker criterion results. The square root of the AVE for each construct, reported on the diagonal, exceeds all inter-construct correlations in the corresponding row and column, providing additional confirmation of discriminant validity. The diagonal values range from 0.619 (ET) to 0.823 (ES), consistently outperforming the off-diagonal correlations.

Table 5 reports the coefficient of determination and predictive relevance for the two endogenous constructs. Digital innovation achieves an R^2 of 0.406 and an adjusted R^2 of 0.403, indicating that the antecedent constructs explain approximately 40% of its variance. Entrepreneurial success achieves an R^2 of 0.429 and an adjusted R^2 of 0.424. Both constructs demonstrate positive Q^2 values of 0.228 and 0.278, respectively, confirming adequate predictive relevance of the structural model (Hair *et al.*, 2019).

Table 6 presents the direct and specific indirect path estimates. Among the direct paths, all hypothesized relationships are supported. Digital innovation positively predicts entrepreneurial success ($\beta = 0.297, p < 0.001$), while digital literacy, digital networks and EO each exert significant positive effects on both digital innovation and entrepreneurial

Table 3. HTMT

	Digital innovation	Digital literacy	Digital networks	Entrepreneurial orientation	Entrepreneurial success
Digital literacy	0.748				
Digital networks	0.608	0.474			
Entrepreneurial orientation	0.648	0.456	0.803		
Entrepreneurial success	0.755	0.743	0.582	0.573	
Environmental turbulence	0.217	0.277	0.210	0.185	0.248
Source(s): Author's work					

Table 4. Fornell–Lacker

	Digital innovation	Digital literacy	Digital networks	Entrepreneurial orientation	Entrepreneurial success	Environmental turbulence
Digital innovation	0.735					
Digital literacy	0.538	0.755				
Digital networks	0.443	0.329	0.777			
Entrepreneurial orientation	0.527	0.355	0.604	0.816		
Entrepreneurial success	0.585	0.527	0.419	0.459	0.823	
Environmental turbulence	0.173	0.197	0.154	0.155	0.194	0.619
Source(s): Author's work						

Table 5. *R* square and Q power

	<i>R</i> -square	<i>R</i> -square adjusted	SSO	SSE	Q ² (= 1-SSE/ SSO)
Digital innovation	0.406	0.403	1820.000	1405.684	0.228
Entrepreneurial success	0.429	0.424	1365.000	984.924	0.278

Source(s): Author's work

Table 6. Direct and indirect paths

	Original sample (O)	Standard deviation (STDEV)	<i>T</i> -statistics (O/ STDEV)	<i>P</i> -values	Validation
<i>Direct paths</i>					
H1a DL → ES	0.271	0.063	4.325	0.000	Supported
H1b EO → ES	0.125	0.056	2.221	0.026	Supported
H1c DN → ES	0.146	0.052	2.068	0.039	Supported
H2a DL → DI	0.369	0.058	6.341	0.000	Supported
H2b EO → DI	0.328	0.058	5.658	0.000	Supported
H2c DN → DI	0.146	0.050	2.913	0.004	Supported
H3 DI → ES	0.297	0.074	4.003	0.000	Supported
H4a ET x DL → DI	−0.350	0.158	−2.215	0.027	Supported
H4b ET x EO → DI	−0.303	0.108	−2.805	0.005	Supported
H4c ET x DN → DI	−0.277	0.107	−2.588	0.010	Supported
H5a ET x DL → ES	−0.305	0.103	−2.961	0.003	Supported
H5b ET x EO → ES	−0.347	0.150	−2.313	0.021	Supported
H5c ET x DN → ES	−0.225	0.156	−4.014	0.000	Supported
H6 ET x DI → ES	−0.343	0.143	−2.398	0.017	Supported
<i>Specific indirect paths</i>					
DL → DI → ES	0.125	0.031	3.964	0.000	Supported
DN → DI → ES	0.043	0.019	2.238	0.025	Supported
EO → DI → ES	0.102	0.033	3.095	0.002	Supported
ET x DN → DI → ES	−0.082	0.020	−4.110	0.000	Supported
ET x DL → DI → ES	−0.094	0.019	−4.992	0.000	Supported
ET x EO → DI → ES	−0.089	0.026	−3.466	0.001	Supported

Source(s): Author's work

success. The moderation paths reveal that environmental turbulence significantly and negatively moderates all direct relationships, with interaction effects ranging from -0.277 to -0.350 on digital innovation and from -0.225 to -0.347 on entrepreneurial success, confirming that high environmental turbulence attenuates the impact of internal capabilities on outcomes. Among the specific indirect paths, digital literacy ($\beta = 0.125, p < 0.001$), digital networks ($\beta = 0.043, p = 0.025$) and EO ($\beta = 0.102, p = 0.002$) each exert significant indirect effects on entrepreneurial success through digital innovation, confirming the mediating role of DI. Furthermore, all three moderated indirect paths are significant, with ET x DN ($\beta = -0.082, p < 0.001$), ET x DL ($\beta = -0.094, p < 0.001$) and ET x EO ($\beta = -0.089, p = 0.001$) → DI → ES confirming that environmental turbulence conditions the mediation chain, attenuating the indirect capability-to-success pathways under high turbulence conditions.

The main paths are visualized in [Figure 1](#):

5. Discussion and contributions

This study examined how digital literacy, EO and digital networks drive digital innovation and entrepreneurial success in the Middle East, with environmental turbulence as a moderator. All hypothesized relationships received empirical support, producing a theoretically coherent account of capability-driven performance under structural instability.

5.1 Digital literacy

The positive association between digital literacy and digital innovation as well as entrepreneurial outcomes confirms its role as a dynamic capability, rather than a technical resource (Garzoni *et al.*, 2020; Van Laar *et al.*, 2020). In Middle Eastern settings, where fragmented infrastructure and regulatory settings, and limited technical support, are pervasive, digital literacy helps entrepreneurs reconfigure resources, adapt to platform disruptions and improvise in times of crisis in ways not possible for less digitally literate entrepreneurs (Bresciani *et al.*, 2021; Teece, 2007). In this way, digital literacy is a resource, a crisis-buffering capability in an institutionally thin environment, a role that is underestimated in Western models.

5.2 Entrepreneurial orientation

The positive impact of EO on digital innovation and entrepreneurial success affirms its status as a behavioral antecedent of performance in different institutional settings (Kraus *et al.*, 2019; Liu *et al.*, 2025). EO sustains proactiveness, innovativeness and risk-taking that enhance the firm's ability to identify and capture digital opportunities. But in weak economies with institutional gaps and socio-political uncertainty, risk-taking in the absence of complementary resource assets can generate misaligned or unsustainable forms of entrepreneurial activity (Wales *et al.*, 2024). The Middle Eastern findings therefore challenge the universalist aspirations of EO theory by showing that orientational audacity depends on structural conditions.

5.3 Digital networks

The positive effect of digital networks on digital innovation and entrepreneurship supports the RBV's relational logic, as networks substitute for the lack of formal institutional support (Giones and Brem, 2017; Scuotto *et al.*, 2017). In the Middle East, digital networks are market access channels, innovation platforms and signaling platforms. However, platform dependence, algorithmic opacity and censorship-induced limits on access (in regimes like Iran or Syria) place structural limits on the utility of digital networks that are not captured in the model (Bogers *et al.*, 2022).

5.4 Mediation through digital innovation

The confirmation that digital innovation mediates all three capability-to-success pathways establishes it as the core transmission mechanism through which capability endowments are converted into performance outcomes (Kraus *et al.*, 2019; Nambisan *et al.*, 2019). This finding challenges the direct-effects assumption prevalent in prior work by positioning digital innovation not as a downstream outcome but as an indispensable organizational process. In resource-constrained emerging markets, capabilities that bypass an innovation process remain latent rather than productive.

5.5 Moderation by environmental turbulence

Environmental turbulence significantly and negatively moderates all direct capability-to-outcome relationships and all mediated pathways through digital innovation, confirming full moderated mediation. This finding indicates that turbulence does not merely add noise to capability-performance relationships but actively attenuates them, suppressing the returns to

all three antecedent capabilities under structural instability. In contexts such as Lebanon, Iraq and Sudan, where currency devaluation, political deadlock and regulatory opacity are recurrent, entrepreneurs face a structural performance ceiling that internal capability accumulation alone cannot overcome (Cenamor *et al.*, 2017; Nambisan *et al.*, 2019). Simultaneously, the confirmed direct effect of turbulence on entrepreneurial success suggests that a subset of adaptive firms convert environmental pressure into opportunity, consistent with the crisis-catalysis argument advanced by García-Villaverde *et al.* (2018).

6. Conclusion

At a time of fast digital transition and augmented geopolitical and economic instability, this research illuminates the key processes in which internal digital capabilities influence innovations and entrepreneurial performance, particularly in a weak ecosystem like the Middle East one. The findings verify that digital literacy, EO and digital networks are strong predictors of digital innovation that, subsequently, ascertain the achievement of entrepreneurial success. Nonetheless, external turbulence does not leave such relationships undisturbed. Environmental turbulence turns out to be a moderator that reveals a degree of complexity in its influence. Although it can induce firms to respond to the challenges and change, it can hamper the potential returns on the innovations unless the structural conditions are favorable.

Although Middle Eastern countries share some characteristics, others are distinctive. For instance, in Lebanon, one of the countries covered in the sample – characterized, among others, for the unstable economy, complex and unstable policies, despite the acknowledgement on the importance of entrepreneurship (Shatila *et al.*, 2024) – and presenting relevant differences compared with the United Arab Emirates, Saudi Arabia and Egypt (but these have also differing characteristics, GEM, 2026), the existing challenges include limited Internet access and poor infrastructure, which may have implications for Lebanese entrepreneurs regarding DL and, especially, DN. Nevertheless, despite these challenges, the use of online communities, B2B services and social media is increasingly important for Lebanese entrepreneurs to overcome geographic and infrastructure limitations, therefore influencing their entrepreneurial success. However, in other countries, the challenges can be more significant, as is the case in Iran or Syria, not specifically covered in our sample, where the barriers can extend to internet outages or censorship.

The article emphasizes the importance of context-sensitive theories and practices in the study of entrepreneurship. Issues of resource instability, as well as institutional, socio-political and regulatory uncertainty, prevail in the Middle East. Success in digital entrepreneurship depends not only on having available resources but also on mobilizing them in a strategic form in the face of uncertainty. In this way, capacity-building should also be integrated with ecosystem development, aligning policy and enabling structures to make them resilient. Future research should further clarify this question through enduring strategies, the use of objective performance measures and cross-contextual comparisons of emerging market situations. Real-time responses by the operators of the environment, due to prolonged or episodic shocks, serve to calibrate strategies used by entrepreneurs. However, understanding how such shifts occur and how entrepreneurs adapt their strategies to these changes is critical for both generating a response to policy and advancing theory in the digital entrepreneurship domain. Finally, balancing the pool of digital capacity and strategic agility with the context of the environment is the secret to opening the code of sustainable entrepreneurial performance in the 21st century.

7. Limitations and future lines of research

Although the present study provides important insights into the relationships between organizational capabilities, innovation and entrepreneurial performance in turbulent circumstances, we acknowledge several limitations. The research design was cross-sectional, which limits the possibility of inferring real causation or measuring the dynamics

of organizational capabilities development and entrepreneurial outcomes over time. Longitudinal designs would be more appropriate in determining the interaction between environmental turbulence and these variables during various stages of the economy or institutional change.

Second, the research relied more on self-reported data, although validated measurement scales were used, which could be susceptible to standard method variance and social desirability bias. It is possible that respondents overreported their digital literacy or innovation performance if respondents consider the specified attributes to be socially valued or politically beneficial. Future research validity could be enhanced by the use of objective performance information, which may include revenue growth, innovation figures or funding documents.

Third, the research concentrated on the sample of entrepreneurs in the Middle East. This contributes to the situational meaning but restricts the possibilities of generalizing the results to any other economy that is developing or advanced. Since there is no unique socio-political framework in the region (which can also be broken down into more homogeneous realities in future research), a comparative analysis with other emerging economies in Asia, Latin America or Sub-Saharan Africa will help provide a more international perspective on the roles of digital capabilities that operate under environmental stress.

Finally, environmental turbulence was envisioned as a single construct without its dimensions being disaggregated (e.g. technological, regulatory, market-based). A more detailed approach should be employed in future studies to further understand the type of turbulence that has the most significant impact on innovation and entrepreneurship outcomes.

Note

1. Just to contextualize, considering Saudi Arabia as an example of the Middle East countries, data from 2025 shows that the “percentage of adults actually starting or running new businesses” is 29% (GEM, 2026, p. 185).

Supplementary material

The supplementary material for this article can be found online.

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