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Adaptive firm performance under uncertainty: Integrating operational efficiency, risk, digital capabilities, innovation, and entrepreneurial finance

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Abstract

PURPOSE: *The paper develops an integrative explanation of how firms, entrepreneurial ventures, employees, and investors sustain performance when uncertainty arises from market crises, technological change, cyber threats, fragmented institutions, financing constraints, and bounded rationality.* ***METHODOLOGY:*** *We conduct an integrative narrative synthesis of the six articles in this Issue and map their theoretical lenses, levels of analysis, methods, and findings into a cross-level framework, and future research directions.* ***FINDINGS:*** *We identify four interdependent domains of adaptive performance: resources and financing, human and behavioral capabilities, governance and risk architecture, and institutional and ecosystem embeddedness. Across the studies, access to finance and technology is enabling but not sufficient. Outcomes depend on how resources are converted through learning, managerial discipline, institutional connectivity, and context-appropriate risk measurement. Digitalization is simultaneously a source of efficiency and a source of cyber and organizational exposure. The studies also show that average effects conceal meaningful heterogeneity across regions, sectors, firm sizes, lifecycle stages, employee groups, and crisis types.* ***IMPLICATIONS:*** *Research should move from isolated determinants toward multilevel, longitudinal, and configurational designs. Managers and policymakers should align resources, capabilities, governance, and institutional support rather than optimize any single factor.* ***ORIGINALITY & VALUE:*** *The paper integrates employee readiness, entrepreneurial decision-making, innovation, startup financing, cybersecurity, and downside portfolio risk into a single adaptive-performance architecture and derives a focused research agenda.*

Keywords: *adaptive performance, operational efficiency, uncertainty, risk management, digital capabilities, cybersecurity, innovation, entrepreneurial finance, institutions, resilience*

INTRODUCTION

Uncertainty is not simply an external variable that impacts organizations. Instead, there are many types of uncertainty that exist, including sudden market downturns, geopolitical and economic instability, cyberattacks, technological obsolescence, financing issues, organizational fragmentation, and cognitive biases. Each type of uncertainty has different origins and levels of analysis. They all have the same effect: undermine the ability of organizations to rely upon previously existing data to transform available resources into desired results. Thus, under conditions of high levels of uncertainty, performance cannot be measured solely by a single financial metric, nor can operational efficiency be viewed as the only factor that determines whether an organization will be able to sustain operations. Operational efficiency is vital for all organizations,

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particularly for small and medium-sized enterprises (SMEs), since it directly influences liquidity, expense management, customer satisfaction, and the long-term viability of the organization.

The authors in this Issue examine other measures of organizational success such as employee readiness for digital work, product/process innovation, startup funding patterns, cybersecurity performance, perceived entrepreneurial investment success, and asset resilience during times of market downturn. Consequently, financial performance and organizational value should be viewed as protected outcomes within a broader adaptive system. Historically, the literature related to organizational adaptation and innovation has been developed independently. The resource-based view (Barney, 2001; Conner & Prahalad, 1996; Wernerfelt, 1984) and dynamic-capabilities (Teece, 2007; Teece et al., 1997) describe how firms utilize and adapt their resources. Behavioral finance (Kahneman & Tversky, 1979; Ritter, 2003; Thaler, 1985) describes deviations from rational decision-making. Competence theory (Prahalad & Hamel, 1990) describes learning and readiness. Then institutional theory (DiMaggio & Powell, 1983) and entrepreneurship ecosystems (Stam, 2015) describe external support/constraints. Finally, risk-management theory describes methods for identifying/containing risk and was grounded first by Knight (1921).

Each of these theories provides a partial explanation for organizational performance under uncertainty. They together demonstrate that performance under uncertainty depends on complementary relationships between organizational assets/resources, employee/behavioral capabilities, governance/risk-management structures, and institutional/ecosystem characteristics. Consequently, effective organizational functioning requires an integrated approach that simultaneously develops adaptive capabilities, strengthens resilience, and enables the efficient use of available resources in a dynamic and constantly changing environment.

Therefore, this article attempts to address the following question: How do resources/funding, human/behavioral capabilities, governance/risk-management structures, and institutional/ecosystem characteristics combine to determine organizational adaptation, innovation, resilience, and performance under uncertainty? To answer this question, we present a narrative synthesis of six studies addressing accounting employees in Poland, innovation-active service SMEs in Colombia, European equity markets, ethnic entrepreneurs in Quebec, ICT startups in Albania, and corporations in the United States, Europe, and China. We are not treating these studies as tests of a single causal model. Rather, we are using the results from these studies to identify common mechanisms, complementarities, boundaries, and methodological implications.

ADAPTIVE PERFORMANCE UNDER UNCERTAINTY: AN INTEGRATIVE FRAMEWORK

We define "adaptive performance" as the capability of maintaining, protecting, or improving desired results using information about changes, utilizing resources, coordinating efforts, and recovering from disruptions. Thus, the idea of adaptive performance allows for the consideration of operational efficiency within a larger context. Operational efficiency relates to converting inputs to outputs, while adaptive performance relates to revising objectives, reconfiguring resources, preserving value, and reacting differently to various types of uncertainty.

The first area of focus is resources and financing. This includes internal and external sources of capital, leverage, tangible and intangible investments, digital infrastructure, and the size of available organizational resources. The resource-based view and dynamic-capabilities perspective distinguish between possessing resources and deploying/reconfiguring those resources for productive purposes (Barney, 2001; Teece et al., 1997). The distinction is important because financing enables action; however, it does not automatically lead to innovation, resilience, or performance.

The second area of focus is human and behavioral capabilities. Human and behavioral capabilities include professional competence, informal learning, digital readiness, founder experience, and the cognitive/emotional processes through which individuals interpret information. Competence is context-specific and develops through interactions with the work/learning environment (Billett, 2001; Salo et al., 2024; Sandberg, 2000). At the same time, judgments made under conditions of uncertainty are susceptible to heuristic-based biases, framing effects, and loss-related biases (Kahneman & Tversky, 1979). Therefore, human capability includes both the capacity to learn and the self-discipline to recognize limitations in judgment.

The third area of focus is governance and risk architecture. It includes monitoring systems, incentive alignment mechanisms, project governance processes, cybersecurity practices, and methods for assessing adverse-state exposure. Agency theory and transaction cost economics argue that resources and decisions must be supported by appropriate structures for control and coordination (Jensen & Meckling, 1976; Williamson, 1985). The articles presented in this

Issue extend that argument by illustrating how governance influences whether behavioral tendencies are translated into disciplined execution and whether operational/financial exposures are visible prior to causing losses.

The fourth area of focus is institutional/ecosystem embeddedness. Formal rules, sector-specific regulations, regional institutions, universities, governmental agencies, intermediary organizations, and entrepreneurial networks provide access to knowledge, legitimacy, capital, and protection. Institutional arrangements influence organizational choice and performance (Williamson, 2000), while entrepreneurial-ecosystem research suggests that support is relational and unevenly distributed among even geographically proximate ventures (Stam, 2015). Table 1 presents those four domains through the prism of principal theoretical lenses, core mechanisms, and illustrative evidence.

Table 1. Four domains of adaptive performance under uncertainty

Domain	Principal theoretical lenses	Core mechanism	Illustrative evidence in this Issue
Resources and financing	Resource-based view, dynamic capabilities, entrepreneurial finance	Accessing, allocating, and reconfiguring financial, tangible, and intangible resources	Funding and innovation investment, startup financing portfolios, leverage and financial flexibility
Human and behavioral capabilities	Competence theory, behavioral finance, bounded rationality	Learning, interpreting information, making decisions, and adapting behavior	Digital readiness and informal learning, cognitive biases, founder experience
Governance and risk architecture	Agency and transaction-cost perspectives, project and risk management	Coordinating execution, aligning incentives, monitoring exposure, and protecting value	PM^2 methodology, cybersecurity performance, drawdown-sensitive risk measures
Institutional and ecosystem embeddedness	Institutional theory, triple/quadruple helix, entrepreneurial ecosystems	Providing or constraining legitimacy, knowledge, finance, regulation, and intermediation	Regional and sectoral cybersecurity differences, institutional support for innovation, startup ecosystem typologies

We propose the four major conceptualizations. First, complementarity of resources (e.g., financial) is more significant than the individual existence of a particular resource. When firms do not have absorptive capacity, implementation capability, or institutional linkages to the market, financial access adds very little value. Similarly, when employees do not have the readiness or support to use digital infrastructure, it adds very little value. When risk management tools are used without being integrated into governance and decision-making processes, they add very little value.

Second, digitalization has a dual nature. On one hand, it reduces processing time and increases information availability. It also facilitates process innovations and expands the scope of organizations. On the other hand, it increases the interdependency of systems, creates cyber vulnerabilities and increases the demand for ongoing education/training and investment in security. Therefore, digital transformation should be assessed based upon its net-value proposition rather than as an unambiguous productivity enhancement.

Third, heterogeneity is substantive and not simply noise. Articles demonstrate differences between regions, industries, firm sizes, organizational lifecycles, employee groups, ecosystems, and crisis types. Therefore, averaging results may mask configurations, where the same resource/practice yields differing results. This is especially true for SMEs and startups that exhibit substantial variation in resource constraints, founder attributes and ecosystem access within the same national environment.

Fourth, performance measurements should be consistent with the current state of the world and the level of analysis. A typical market beta may mask behaviors exhibited during drawdown periods. Employee self-assessment of digital readiness is not equivalent to empirically verified competence. Perception of entrepreneurial success is not equivalent to independently audited financial performance, and innovation occurrence does not represent innovation scale. Inferential strength depends upon clarity regarding whether a study evaluates preparedness, behavior, resilience, efficiency, financial outcomes, or protection of value.

Figure 1 interprets the relationships between the main idea of uncertainty and adaptive-performance architecture.

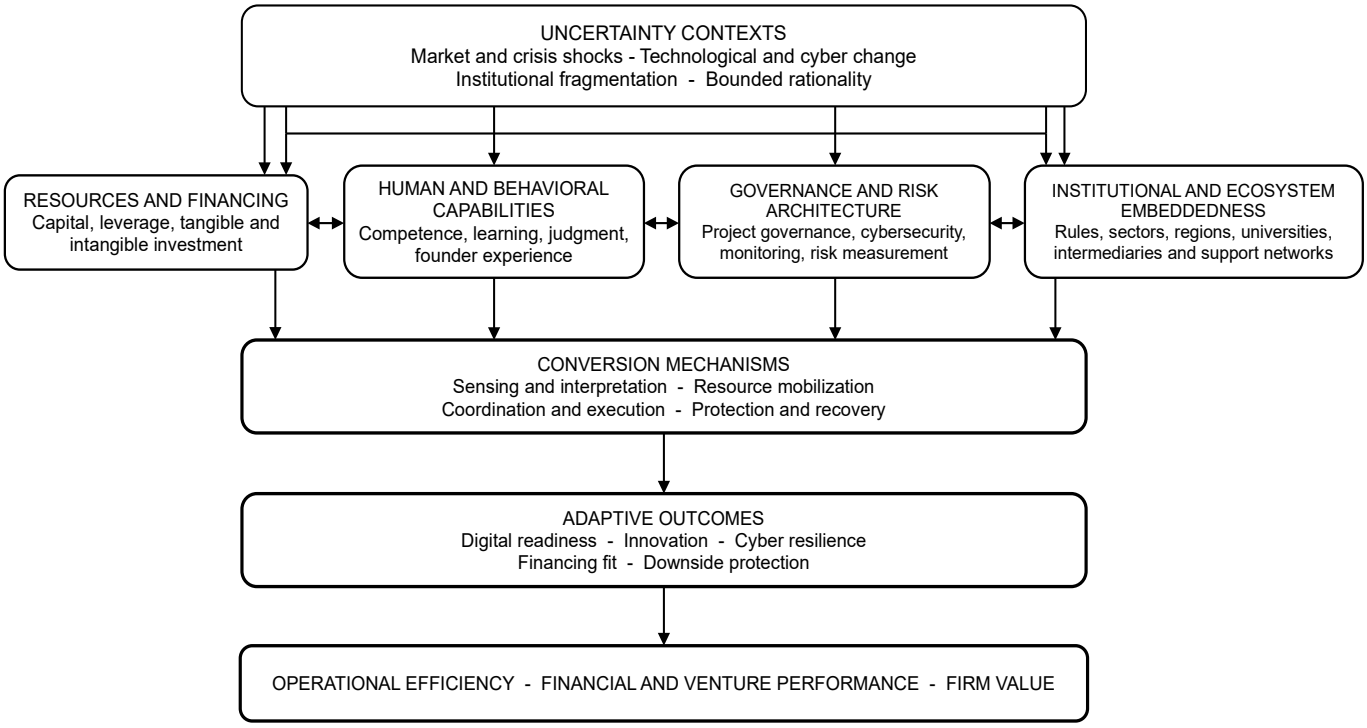

Figure 1. An adaptive-performance architecture

Methodologically, this Issue illustrates how important it is to match analytical design to this phenomenon: 1) Binary logistic regression identifies those variables that correlate with categorical cybersecurity performance and perceived digital readiness, 2) Partial least squares structural equation modeling examines composite innovation paths and behavioral-governance relationships, 3) Cluster analysis illustrates within-ecosystem heterogeneity, 4) Drawdown-based measures illustrate market behavior during adverse states. This multiplicity is an advantage, but it also creates a common disadvantage: most relationships are observational, several outcomes are self-reported or categorical and therefore, causal interpretation should be limited.

CONTRIBUTORS

Bąk et al. (2026) perceive the digital transformation to occur at the employee-organization interface. Based on survey data collected from 332 accounting department employees in Poland and using logistic regression, confirmatory factor analysis and structural equation modeling, they assess employee perceptions of their readiness for working in a digitized environment. Employee perceptions of readiness vary by gender, enterprise size, and foreign-capital participation; however, are positively correlated with workplace digitization, contact with IT specialists, and the level of informal online learning. The authors consider digital competence to be contextually dependent and not solely an individual trait: the combination of organizational infrastructure, technical support, and learning opportunities will determine whether employees feel ready to participate. Formal training as the presence of internal training could indicate existing capability gaps or a lack of alignment between employee needs and training offered.

Romero-Alvarez et al. (2026) investigate distinct routes toward innovation using micro-level data on 2,782 SMEs service sector firms that have been active in innovation in Colombia. They used two PLS-SEM models to differentiate between product innovation and process innovation. Institutional support had the largest positive association with product innovation (β = 0.416), while investment in innovation, specifically in intangible assets including training, software, and intellectual property, had the largest positive association with process innovation (β = 0.371). Both sources of funding were positively associated with both types of innovation; however, these associations had significantly lower coefficient values. Thus, this research indicates that financial assistance is an important facilitating factor, but its impact

is dependent upon how well firms convert their available funds into building-blocks to increase their capabilities through investment, and upon their ability to access institutions that provide them with knowledge, legitimacy and marketing/commercialization assistance. As the sample used in this research was comprised of firms that reported having engaged in innovation activities and the data collected was cross-sectional, the results of this research represent associations among the participating firms and do not provide evidence of causal relationships for all SMEs.

Feder-Sempach et al. (2026) transition the focus of their analysis from the operational aspects of organizations to their capacity for maintaining stability in times of turmoil in capital markets. They utilized data collected from 2004 to 2024 for 428 surviving components of the STOXX Europe 600 index and compared the traditional beta to two new betas – Expected Regret of Drawdown (ERoD) beta and Conditional Drawdown at Risk (CDaR) beta. Drawdown measures allow for the identification of those securities whose performance changes significantly during periods of turmoil in markets and identify securities with negative exposure during periods of turmoil that may be indicative of hedging or safe haven behavior. During the COVID-19 pandemic, many healthcare and technology stocks as well as firms located in certain countries demonstrated such behaviors. Conversely, the traditional beta continued to be positive and offered little insight into crisis specific behaviors. The authors, however, did not discover a clear connection between market capitalization and resilience during periods of drawdown. Additionally, this analysis recognized survivorship bias as only firms that remained within the index sample were included in the study.

Salehi et al. (2026) expand upon previous work in behavioral finance by exploring the role of heuristics-driven biases and framing biases in the context of ethnic entrepreneurial ventures. Based on survey data collected from 183 ethnic entrepreneurs in Quebec, the authors find that heuristics-driven biases and framing biases are significantly related to entrepreneurs' perceptions of their own success as ethnic entrepreneurs. In contrast, they find that contextual factors do not exhibit a significant relationship. They also find that the use of PM^2 methodology is significantly related to entrepreneurs' perceptions of their own success and that PM^2 acts as both an intervening variable and a moderating variable that links entrepreneurs' behavioral tendencies to their ability to execute projects successfully. The authors' main contribution is to demonstrate that entrepreneurs' individual judgments can be influenced by formal organizational processes such as structured planning, monitoring and governance, and that these processes may affect how entrepreneurs' intuitive decisions translate into actual outcomes for their ventures. However, since the authors evaluate entrepreneurs' perceptions of success rather than independent measures of venture success (e.g., financial performance, survival), caution is warranted when interpreting the results.

Kruja & Irimia-Diéguez (2026) investigate heterogeneity among startups operating within a single emerging economy entrepreneurial ecosystem. Using survey data collected from 111 Albanian ICT startups and k-means clustering, the authors identify three distinct profiles of startups: financially constrained, ecosystem-enabled, and ecosystem-disconnected. Ecosystem-enabled startups report having greater access to financing and achieving higher levels of performance than either financially constrained or ecosystem-disconnected start-ups. In addition, financially constrained and ecosystem-disconnected startups differ in terms of the types of financing sources they utilize (e.g., bootstrapping, crowdfunding), they do not differ in the total number of financing sources utilized. This distinction between the types of financing sources utilized and the number of financing sources utilized is theoretically valuable. They also show that prior experience in startups, firm size, and lifecycle stage can help predict which profile a particular startup will fall into. Ultimately, this research suggests that ecosystem supports are neither uniform nor automatically available to all startups and that a "one-size-fits-all" approach to supporting startups may fail to recognize the structural differences between different types of startups within the same environment.

Doś et al. (2026) examine institutional and organizational correlates of cybersecurity performance using binary logistic regression analysis on data collected from 1,211 corporations located in the United States, Europe, and China in 2022. The researchers find that corporations in China and Southern and Northern Europe are significantly less likely than corporations in the United States to achieve advanced cybersecurity performance. Corporations in Western Europe achieve comparable levels of cybersecurity performance to those achieved by corporations in the United States. Additionally, financial services and healthcare corporations perform better in terms of cybersecurity performance than corporations in other industries, and higher levels of leverage are consistently associated with lower levels of cybersecurity performance. The authors also observe a non-linear relationship between profitability and cybersecurity performance. Specifically, find that corporations with moderately profitable operations tend to make larger investments in cybersecurity than corporations with extremely profitable operations. Finally, firm size is negatively associated with cybersecurity performance in their full model. However, when the researchers examine their sectoral analyses separately, they find that

firm size is not consistently negatively associated with cybersecurity performance across all sectors. Ultimately, the authors' main contribution is to position cyber risk within an institutional and organizational risk management framework.

The studies in this Issue reinforce the editors' initial premise: operational efficiency is a key mechanism for converting inputs into outputs; however, operational efficiency cannot be considered a universal explanation for success. Input resources and financing must be converted through competence, judgment, governance, and institutional linkages. Risks must be quantified in a manner consistent with their potential impacts, and performance must be evaluated at the level where it occurs. The focus moves away from the identification of isolated determinants of success towards the development of an adaptive-performance architecture, where complementary elements and contextual factors determine whether organizations maintain or enhance value under uncertain conditions.

FUTURE RESEARCH AGENDA

The research agenda suggested by these contributions is much more specific and, thus, much more amenable to empirical testing than simply calling for "more research." In addition, there are six primary areas of focus that should be considered as part of this agenda (Table 2).

Table 2. Future research agenda for adaptive performance under uncertainty

Priority	Core research question	Recommended designs and evidence
Cross-level causal mechanisms	In what way do institutions and ecosystems influence the governance of an organization, the behavior of employees/founders, and the resulting performance?	Longitudinal multilevel models, natural experiments, regulatory changes, matched employer-employee or firm-ecosystem data
Complementarities and configurations	What are the combinations of funding mechanisms, capabilities, governing structures, and institutional supports that will be required or sufficient to create resilience/innovation?	Configurational methods, finite-mixture or latent-class models, longitudinal typologies, interaction and complementarity tests
Perceived versus objective capability and performance	At what times do self-assessments align with demonstrated competencies, audited performances, survival, and/or actual innovation value?	Linked surveys and administrative records, digital-skill tests, objective cyber ratings, accounting and financing records
Dynamic and crisis-specific resilience	How do preventive actions, absorptive capacities, recovery efforts, and adaptive responses vary among different types of shock events (e.g., financial, cyber-related, geopolitical, technology-related)?	Event studies, panel and survival models, repeated drawdown analysis, recovery-time and persistence measures
Interdependent risk portfolios	Under what conditions do cyber-related, operational, funding, and market-related risk factors cluster together, enhance each other, and/or transfer across organizations/networks?	Network models, stress testing, copulas and tail-dependence methods, supply-chain and portfolio-level data
Net value of digitalization	At what time do the advantages of productivity and innovation outweigh the costs of implementation, training, security, and organizational restructuring?	Quasi-experimental adoption studies, cost-benefit analysis, mediation models, longitudinal productivity and security data

These priorities will also need more clearly defined boundaries. Comparisons of emerging vs. developed economies, micro and small businesses vs. larger corporations, early stage vs. growth stage ventures, and industries with varying levels of regulatory intensity and data sensitivity are all examples of how comparative studies should be differentiated. Researchers should consider factors such as gender, immigration status, language, previous entrepreneurial experience, and international capital involvement as theoretically relevant sources of access, learning and confidence for entrepreneurs and employees instead of just as control variables. Another priority is to study the transitions employees, startups, companies and assets make over time rather than just looking at their current position. An employee could transition from a low level of digital readiness to a high level of digital readiness. A startup could transition between being constrained by its environment, enabled by it, and disconnected from it. A company could transition from having strong cybersecurity

measures to weaker ones or *vice versa*. And assets that protect against a crisis today could increase loss in the event of a different crisis tomorrow. Therefore, researchers studying adaptive performance should not only look at the state an individual/organization is in but also at the transition between states.

CONCLUSION

The main finding of this Issue is that operational efficiency is not the only factor determining financial performance. Adaptive performance under uncertain circumstances is based on the integration of four areas: (1) Resource and financing, (2) Human/behavioral capabilities, (3) Governance/risk architecture, and (4) Institutional/Ecosystem embeddedness. Some combination of all four areas will be necessary in certain situations but no single area will ever be enough. Resources that are available but cannot be used effectively are wasted. Capabilities without an effective governance system may not translate into disciplined action. A governance system that does not fit well within the broader institutional structure of the organization/sector/ecosystem can lead to constraints or costs. Digitalization without learning/cybersecurity can create greater fragility. The studies also illustrate that performance is dependent upon the context of the situation and the dimensions of interest. An individual, employee, venture, etc., may seem to perform well during stable times only to respond differently to changes in the environment.

Therefore, for managers, investors, and policy makers, the key question is not which of the five domains (finance, technology, people, governance, or institutional support) should receive top priority. Rather, it is how each domain should be configured and integrated together for a given organization/sector/ecosystem/type of uncertainty. The transition – from isolated factors to integrated configurations – represents the largest shared contribution of this Issue and provides the best starting point for further investigation.

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Conflicts of interest

The authors declare no competing interests. Piotr Łasak serves as an Associate Editor of JEMI and was not involved in the decision concerning this article.

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