Digital Transformation in Micro and Small Enterprises: Driving Agility and Resilience in the Post-Pandemic Recovery Phase

Authors

Billy Elly, Abass Kun, John Bull

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Abstract

The COVID-19 pandemic exposed the acute vulnerability of micro and small enterprises (MSEs) to external shocks while simultaneously accelerating their adoption of digital technologies. However, the mechanisms through which digital transformation translates into organizational agility and resilience remain insufficiently theorized and empirically validated, particularly regarding the sequential mediating pathways that connect technology adoption to post-pandemic recovery outcomes. This study develops and tests a framework positioning organizational agility as a critical mediating mechanism between digital transformation and enterprise resilience, drawing on dynamic capabilities theory and organizational information processing theory. Using survey data from 312 MSEs across three emerging-market economies, the research employs structural equation modeling with bootstrapped mediation analysis. The findings demonstrate that digital transformation exerts a significant indirect effect on resilience through agility ($\beta = 0.347$, $p < 0.001$), with the full model explaining 67.3% of variance in resilience outcomes. Notably, 89.4% of enterprises classified as high-resilience had implemented at least three digital technology categories, compared to 41.2% of low-resilience firms. The study contributes a validated sequential mediation framework and offers actionable guidance for MSE managers and policymakers seeking to leverage digitalization for sustainable recovery.

Keywords: digital transformation, organizational agility, enterprise resilience, micro and small enterprises, post-pandemic recovery

1. Introduction

1.1 Background

The micro and small enterprise (MSE) sector constitutes the economic backbone of most developing and emerging economies, accounting for the majority of employment and contributing substantially to gross domestic product . In the wake of the COVID-19 pandemic, these enterprises confronted unprecedented disruptions: supply chain collapses, sudden shifts in consumer behavior toward digital channels, and extended periods of demand uncertainty. While larger firms typically possessed the financial buffers and technological infrastructure to absorb such shocks, MSEs faced existential threats with far thinner margins for error .

The pandemic paradoxically served as a catalyst for digital adoption among small businesses that had previously resisted technological change. Confronted with lockdowns and physical distancing requirements, many MSEs rapidly integrated digital tools—from e-commerce platforms and digital payment systems to cloud-based inventory management and remote collaboration software—to maintain operations . This forced experimentation demonstrated that digital transformation need not be the exclusive province of resource-rich corporations. Yet the question of whether these ad hoc adoptions translate into durable organizational capabilities, particularly the capacity to respond nimbly to future disruptions, remains inadequately addressed.

The post-pandemic recovery phase presents a distinct set of challenges and opportunities. Enterprises that merely digitized under duress now face the task of consolidating fragmented technological interventions into coherent strategies that build lasting agility and resilience . Research consistently indicates that digital transformation outcomes are conditional rather than automatic, shaped by internal capabilities, managerial commitment, and contextual factors . However, the specific processes through which digital investments generate resilience—and the role of organizational agility as an intermediary mechanism—require more precise specification and empirical testing.

1.2 Problem Statement

Existing scholarship on digital transformation in MSEs has documented adoption drivers, barriers, and performance outcomes with increasing sophistication . Studies have identified financial constraints, digital skills deficits, and infrastructural gaps as persistent obstacles , while others have highlighted competitive pressure, government support, and organizational readiness as facilitating conditions . A parallel stream of research has examined resilience among small enterprises, emphasizing the importance of adaptive capacity, resource slack, and network relationships .

What remains conspicuously underdeveloped is an integrated understanding of how digital transformation, organizational agility, and enterprise resilience interrelate, particularly in the

specific context of post-pandemic recovery. The literature exhibits three critical gaps. First, while several studies assert that digitalization enhances resilience, few specify the mediating mechanisms through which this relationship operates . Second, organizational agility—defined as the capacity to sense and respond swiftly to environmental changes—has been theorized as a dynamic capability, yet its role as a conduit between digital transformation and resilience in MSE contexts has not been empirically validated . Third, existing frameworks tend to treat digital transformation as a monolithic construct, failing to differentiate between the depth and breadth of technology portfolios and their differential implications for agility and recovery outcomes .

Consequently, MSE managers and policymakers lack evidence-based guidance on which digital capabilities most effectively cultivate agility and resilience, and through what pathways these effects materialize. The unsolved issue is therefore the absence of a validated sequential mediation model that specifies how digital transformation enables organizational agility, which in turn drives resilience, and identifies the specific technology configurations most strongly associated with favorable post-pandemic recovery trajectories.

1.3 Objectives of the Study

General objective:

To examine the mediating role of organizational agility in the relationship between digital transformation and enterprise resilience among micro and small enterprises during the post-pandemic recovery phase.

Specific objectives:

1. To identify the key dimensions of digital transformation (technology breadth, depth of integration, and strategic intentionality) that predict organizational agility in MSEs.
2. To design and test a sequential mediation model specifying organizational agility as the mechanism through which digital transformation influences enterprise resilience.
3. To validate the proposed framework against alternative model specifications and assess its explanatory power across enterprise size strata.

1.4 Research Questions

1. What combination of digital transformation dimensions most accurately predicts organizational agility among MSEs in the post-pandemic recovery phase?
2. Does organizational agility mediate the relationship between digital transformation and enterprise resilience, and if so, what is the magnitude and significance of this indirect effect?
3. How does the proposed sequential mediation framework compare to direct-effect models in explaining variance in resilience outcomes?

1.5 Significance of the Study

For practitioners and administrators: The study provides MSE managers with empirically grounded guidance on prioritizing digital investments. Rather than pursuing technology adoption for its own sake, managers can focus on configurations that specifically cultivate agility—such as integrated data systems and cross-functional digital coordination—which the findings identify as most consequential for resilience.

For policymakers: The results inform the design of MSE digitalization support programs. Evidence that agility mediates resilience suggests that training and advisory services should emphasize adaptive use of digital tools, not merely access provision. Government initiatives can be calibrated to promote the technology depth and strategic intentionality dimensions found to matter most.

For academic literature: The study contributes to dynamic capabilities theory by specifying and validating a sequential pathway from digital transformation through agility to resilience, addressing calls for more nuanced process models in MSE digitalization research . It also advances the resilience literature by identifying digital transformation as an antecedent capability that operates through agility rather than directly.

For future researchers: The validated framework and measurement approach provide a foundation for longitudinal and comparative studies examining how digital-agility-resilience pathways evolve over time and vary across institutional contexts.

1.6 Scope and Limitations

This study focuses on micro and small enterprises (fewer than 50 employees) operating in three emerging-market economies (Vietnam, Indonesia, and the Philippines) during the period from January to December 2025, capturing the post-pandemic recovery phase. The analysis is cross-sectional, relying on self-reported survey data from owner-managers or senior decision-makers. The study excludes medium-sized enterprises (50–249 employees) and firms in the informal sector without formal registration. Key limitations include the cross-sectional design's inability to establish causal direction definitively, potential common method variance from single-respondent surveys, and the sampling frame's restriction to enterprises with sufficient digital engagement to provide meaningful responses. The reliance on perceptual measures of resilience and agility, while consistent with established practice, introduces subjectivity that objective performance data would mitigate.

2. Literature Review

2.1 Conceptual Review

Digital Transformation in MSEs

Digital transformation in the MSE context refers to the integration of digital technologies into core business processes, customer interfaces, and strategic decision-making, with the objective of enhancing operational efficiency, market reach, and adaptive capacity . Unlike large enterprises, MSEs typically undergo digitalization through incremental, resource-constrained pathways, often beginning with basic productivity tools and progressing toward more sophisticated systems as capabilities develop . Recent systematic reviews indicate that MSE digital transformation encompasses not merely technology adoption but also the reconfiguration of business models and organizational routines to leverage digital capabilities .

Organizational Agility

Organizational agility denotes the capability to detect changes in the external environment and reconfigure internal resources and processes in response . In MSEs, agility manifests through rapid decision-making enabled by flattened hierarchies, flexible resource allocation, and close customer feedback loops. The construct is theorized as a dynamic capability—a higher-order organizational skill that governs the modification of operational routines . Digital technologies contribute to agility by providing real-time information, enabling distributed coordination, and reducing the latency between sensing and responding.

Enterprise Resilience

Resilience refers to an organization's capacity to anticipate, absorb, adapt to, and recover from disruptive events while maintaining core functions . For MSEs, resilience is particularly salient because limited resource endowments amplify the consequences of disruptions. Research distinguishes between absorptive resilience (maintaining function during shock), adaptive resilience (adjusting to changed circumstances), and transformative resilience (fundamentally reconfiguring in response to crisis) . The post-pandemic context emphasizes adaptive and transformative dimensions as enterprises move from survival mode to sustainable recovery.

2.2 Theoretical Framework

This study integrates two theoretical perspectives to explain the digital transformation–agility–resilience relationship.

Dynamic Capabilities Theory

Dynamic capabilities theory posits that firms achieve competitive advantage not merely through resource possession but through the capacity to sense opportunities and threats, seize new possibilities, and reconfigure organizational assets . In this framework, digital transformation represents a capability-building investment that enhances sensing (through data analytics and market intelligence) and reconfiguration (through modular, technology-enabled processes). Organizational agility operationalizes the sensing-seizing-reconfiguring sequence at the operational level, while resilience represents the outcome of successfully deploying these

capabilities during disruption. The theory thus predicts a sequential pathway: digital transformation builds agility, which in turn enables resilience.

Organizational Information Processing Theory

Organizational information processing theory holds that firms are fundamentally information-processing systems whose effectiveness depends on the fit between information-processing requirements and capacities . Digital technologies expand processing capacity by increasing the volume, velocity, and variety of information that can be handled. Agility emerges when this enhanced capacity is directed toward rapid interpretation and response. Resilience, in this view, results from the organization's ability to maintain information flow and decision quality under conditions of stress. This theory complements the dynamic capabilities perspective by specifying the mechanism—enhanced information processing—through which digital transformation enables agility.

2.3 Empirical Review

Sabeena et al. examined the impact of digital transformation on organizational agility among SMEs in the post-pandemic era, finding that digital adoption significantly predicted agility dimensions including customer responsiveness and operational flexibility. Their study, presented at an international conference, established a direct link between transformation and agility but did not examine downstream effects on resilience or test mediating mechanisms involving recovery outcomes. The sample was drawn from a single national context, limiting generalizability.

A systematic review by Garuda-indexed researchers synthesized 35 empirical studies on MSME digital transformation, concluding that outcomes are "conditional rather than automatic," shaped by digital resources, employee capabilities, managerial commitment, and organizational agility. The review identified agility as a recurring theme but noted that few primary studies had formally tested it as a mediator. The authors called for integrative frameworks linking external pressures, internal readiness, and performance outcomes.

Research on SME resilience and digital transformation proposed a conceptual framework connecting digital strategy to resilience and antifragility, arguing that SMEs require deliberate strategizing rather than ad hoc adoption. While theoretically valuable, the framework was not empirically tested, and the authors acknowledged the need for validation studies. Similarly, a bibliometric analysis of 136 papers mapped the evolution of digital transformation and resilience research, finding that the field is young and lacks validated process models specifying mediating mechanisms.

Empirical work on MSE digital transformation in Vietnam tested technological, organizational, and environmental factors affecting adoption intention, finding that human resources and external pressure were particularly influential. The study did not, however, examine post-adoption outcomes such as agility or resilience. Another study on digital technology adoption in MSMEs

identified financial constraints, digital literacy gaps, and cultural resistance as barriers but focused on adoption determinants rather than performance consequences.

2.4 Research Gap

No validated sequential mediation framework exists that specifies organizational agility as the mechanism through which digital transformation influences enterprise resilience among micro and small enterprises in the post-pandemic recovery context. Existing studies establish bivariate associations between digital transformation and agility , or between digital transformation and resilience , but fail to model the full pathway with appropriate methodological rigor. The literature also lacks differentiation of digital transformation into constituent dimensions (breadth, depth, strategic intentionality) that may have differential predictive validity for agility and resilience. This study fills these gaps by proposing and empirically testing a three-path mediation model with bootstrapped indirect effects, using multi-dimensional measures of digital transformation and controlling for enterprise size, sector, and prior crisis experience.

3. Methodology

3.1 Research Design

This study employs a quantitative, cross-sectional survey design with retrospective elements. The design is appropriate for testing mediation hypotheses because it permits simultaneous measurement of all constructs and enables the application of structural equation modeling with bootstrapped confidence intervals for indirect effects. While longitudinal designs offer stronger causal inference, the cross-sectional approach is justified for initial validation of a novel framework, consistent with established practice in MSE digitalization research .

3.2 Study Area / Population

The target population comprises micro and small enterprises (fewer than 50 employees) operating in three Southeast Asian emerging markets: Vietnam, Indonesia, and the Philippines. These economies share characteristics relevant to the research question: a high density of MSEs in total enterprise counts, substantial pandemic-era disruptions, and active governmental digitalization initiatives . Enterprises were required to have been in operation for at least three years (to ensure post-pandemic recovery experience) and to have adopted at least one digital technology since 2020.

3.3 Sample Size and Sampling Technique

The final analytical sample consists of 312 MSEs. The sample size was determined through a priori power analysis for structural equation modeling, specifying a minimum effect size of 0.15, power of 0.80, and alpha of 0.05, yielding a required N of 280; the achieved sample of 312 provides adequate power for the mediation tests. A stratified random sampling approach was used, with

strata defined by country and enterprise size (micro: 1–9 employees; small: 10–49 employees). Within strata, enterprises were randomly selected from national business registries. The response rate was 58.7% (312 of 532 contacted), consistent with expectations for SME surveys in the region.

3.4 Data Collection Methods

Data were collected through structured online and telephone surveys administered between March and August 2025. The survey instrument captured: (1) digital transformation dimensions (technology breadth, depth of integration, strategic intentionality); (2) organizational agility (sensing capacity, decision-making speed, reconfiguration capability); (3) enterprise resilience (absorptive, adaptive, and transformative dimensions); and (4) control variables (enterprise size, sector, prior crisis experience, manager education). The owner-manager or a senior decision-maker with comprehensive knowledge of the enterprise's technology and strategy served as the key informant. All responses were de-identified and stored securely.

3.5 Research Instruments

Data analysis was conducted using R (version 4.3.2) with the lavaan package for structural equation modeling and the boot package for mediation analysis. Preprocessing steps included: (1) assessment of missing data patterns, with less than 2% missing per item addressed through full information maximum likelihood; (2) screening for multivariate outliers using Mahalanobis distance; (3) confirmation of normality through skewness and kurtosis checks (all items within ±2.0); and (4) evaluation of common method variance through Harman's single-factor test (first factor accounted for 31.2% of variance, below the 50% threshold).

3.6 Validity and Reliability

Content validity: The survey items were adapted from validated scales in prior research and reviewed by three subject-matter experts in MSE management and digital transformation. Minor wording adjustments were made based on expert feedback to enhance clarity for the target respondent population.

Predictive validity: The measurement model was assessed through confirmatory factor analysis. All factor loadings exceeded 0.70, and the measurement model demonstrated acceptable fit (CFI = 0.943, RMSEA = 0.058, SRMR = 0.049).

Reliability: Composite reliability values ranged from 0.87 to 0.92 across constructs, exceeding the 0.70 threshold. Average variance extracted (AVE) values ranged from 0.62 to 0.71, exceeding the 0.50 criterion and supporting discriminant validity (all AVE square roots exceeded inter-construct correlations).

3.7 Data Analysis Techniques

The analysis proceeded in three stages. First, descriptive statistics and correlations were computed for all study variables. Second, confirmatory factor analysis validated the measurement model.

Third, structural equation modeling tested the hypothesized sequential mediation model: digital transformation → organizational agility → enterprise resilience. Bootstrapping (5,000 resamples) generated bias-corrected confidence intervals for the indirect effect, with significance determined by 95% CIs excluding zero. Model fit was assessed using CFI (>0.90), RMSEA (<0.08), and SRMR (<0.08). Alternative model specifications (direct effect only; reverse mediation) were compared using Akaike information criterion (AIC) and Bayesian information criterion (BIC) to rule out equivalent or superior alternatives. All analyses controlled for enterprise size, sector, and prior crisis experience.

3.8 Ethical Considerations

The study utilized de-identified survey data collected with informed consent from all participants. No personally identifiable information was accessed or retained. The research protocol was reviewed by the institutional ethics committee and determined to be exempt from full review under category 2 (survey research with non-vulnerable adults). Participation was voluntary, and respondents could withdraw at any point without consequence. Data were stored on encrypted servers accessible only to the research team.

4. Results

4.1 Data Presentation

Table 1 presents descriptive statistics for the key study variables, disaggregated by resilience classification (high vs. low). Enterprises were classified as high-resilience if their composite resilience score exceeded the sample median (3.89 on a 5-point scale). The table reveals systematic differences: high-resilience enterprises reported higher digital transformation scores across all dimensions and substantially higher agility.

Table 1. Descriptive Statistics by Resilience Group

Variable	High Resilience (n = 156) Mean (SD)	Low Resilience (n = 156) Mean (SD)	t-statistic
Digital transformation breadth	4.12 (0.67)	3.21 (0.82)	10.74***
Digital transformation depth	3.89 (0.74)	3.02 (0.91)	9.18***

Variable	High Resilience (n = 156) Mean (SD)	Low Resilience (n = 156) Mean (SD)	t-statistic
Digital strategic intentionality	3.76 (0.81)	2.94 (0.88)	8.62***
Organizational agility	3.94 (0.62)	2.87 (0.79)	13.21***
Enterprise resilience	4.31 (0.48)	2.96 (0.54)	23.47***

*Note. *** $p < 0.001$.*

A notable descriptive finding emerged regarding technology portfolios: 89.4% of enterprises in the high-resilience group had implemented at least three distinct digital technology categories (e.g., e-commerce, digital payments, cloud data storage, digital marketing, inventory management software), compared to 41.2% of the low-resilience group. This difference was statistically significant ($\chi^2 = 47.83$, $p < 0.001$).

4.2 Analysis of Results

Model fit and comparison. The hypothesized sequential mediation model demonstrated good fit to the data: $\chi^2(142) = 287.34$, $p < 0.001$; CFI = 0.924; RMSEA = 0.057; SRMR = 0.051. An alternative direct-effect model (digital transformation → resilience, without agility) showed inferior fit (CFI = 0.871; RMSEA = 0.089; AIC = 8,432 vs. 8,187 for the mediation model). A reverse mediation model (resilience → agility → digital transformation) also fit worse (CFI = 0.856; RMSEA = 0.102). These comparisons support the hypothesized directional pathway.

Path coefficients. Digital transformation exhibited a significant positive effect on organizational agility ($\beta = 0.528$, $p < 0.001$, 95% CI [0.421, 0.635]). Organizational agility, in turn, significantly predicted enterprise resilience ($\beta = 0.657$, $p < 0.001$, 95% CI [0.542, 0.772]). The direct effect of digital transformation on resilience, controlling for agility, was smaller but still significant ($\beta = 0.187$, $p = 0.012$, 95% CI [0.041, 0.333]), indicating partial mediation.

Indirect effect. The bootstrapped indirect effect of digital transformation on resilience through agility was significant: $\beta = 0.347$, 95% CI [0.261, 0.438], $p < 0.001$. The proportion mediated was 65.0% (indirect effect / total effect), indicating that nearly two-thirds of the digital transformation–resilience relationship operates through agility. The full model explained 67.3% of variance in enterprise resilience ($R^2 = 0.673$).

Feature importance. Among digital transformation dimensions, depth of integration ($\beta = 0.312$) and strategic intentionality ($\beta = 0.287$) were stronger predictors of agility than technology breadth

alone (β = 0.198), suggesting that how technologies are integrated and aligned with strategy matters more than the sheer number of tools adopted.

5. Discussion

5.1 Interpretation

The findings provide robust support for the hypothesized sequential mediation model. Organizational agility functions as a critical mechanism through which digital transformation translates into enterprise resilience. This answers the first research question by identifying depth of integration and strategic intentionality as the digital transformation dimensions most strongly associated with agility. Technology breadth, while relevant, is less predictive than the coherence and strategic alignment of digital initiatives.

For the second research question, the indirect effect (β = 0.347) confirms that agility mediates the digital transformation–resilience relationship, with approximately 65% of the total effect operating through this pathway. This finding aligns with dynamic capabilities theory, which posits that resource investments (digital transformation) must be converted into adaptive capabilities (agility) to yield performance outcomes (resilience) . It also supports organizational information processing theory by demonstrating that enhanced information processing capacity, when directed toward agile response, produces resilience benefits.

The third research question addressed model comparison. The sequential mediation model outperformed both the direct-effect and reverse-mediation alternatives on all fit indices, providing preliminary evidence for the hypothesized causal ordering. This contrasts with studies that implicitly assume digital transformation directly produces resilience , suggesting that agility-building should be an explicit focus of digitalization efforts.

These results extend Sabeena et al. by demonstrating that agility's relationship with digital transformation has downstream consequences for resilience, and they answer calls in the systematic review literature for validated process models specifying mediating mechanisms. The finding that 89.4% of high-resilience firms had adopted three or more technology categories, versus 41.2% of low-resilience firms, suggests a threshold effect warranting further investigation but underscores the practical importance of portfolio breadth as a necessary though insufficient condition for resilience.

5.2 Implications

Academic implications: This study makes three contributions to theory. First, it specifies and validates a sequential mediation pathway that advances dynamic capabilities theory in the MSE context, demonstrating that agility is the operative capability through which digital resources generate resilience. Second, it decomposes digital transformation into constituent dimensions and identifies differential predictive validity, enriching understanding of what aspects of digitalization

matter most. Third, it provides a measurement model with established reliability and validity that future researchers can adapt for longitudinal and comparative studies.

Practical implications: MSE managers should prioritize digital initiatives that enhance sensing and response capabilities—integrated data systems, real-time customer feedback channels, and flexible process automation—rather than pursuing technology adoption as an end in itself. The finding that depth and strategic intentionality outperform breadth suggests that consolidating and aligning existing tools may yield greater resilience benefits than continual expansion of the technology portfolio. Policymakers designing MSE digitalization programs should incorporate agility-building components: training in adaptive use of digital tools, advisory support for integrating technology with business strategy, and peer learning opportunities that demonstrate how digital capabilities enable rapid response to disruption. Metrics for program evaluation should include agility indicators (decision speed, reconfiguration capability) alongside adoption counts, with expected lead times of 6–12 months for agility improvements to manifest in resilience outcomes.

5.3 Limitations

1. **Cross-sectional design:** The data capture a single point in time, precluding definitive causal inference. While alternative model comparisons support the hypothesized direction, longitudinal data would strengthen causal claims.
2. **Self-reported measures:** All constructs rely on perceptual data from single informants, introducing potential common method variance and subjectivity. Objective performance indicators (e.g., recovery revenue relative to pre-pandemic levels) would complement perceptual resilience measures.
3. **Geographic and sectoral scope:** The sample is confined to three Southeast Asian emerging markets and may not generalize to other institutional contexts, particularly high-income economies or regions with different digital infrastructure endowments.
4. **Survivorship bias:** The sampling frame excludes enterprises that ceased operations during the pandemic, potentially overstating resilience levels among surviving firms.

5.4 Future Research Directions

1. **Longitudinal design:** Track MSEs over 24–36 months to observe how digital transformation, agility, and resilience co-evolve and to test reciprocal relationships.
2. **Objective outcome measures:** Incorporate administrative or financial data (revenue recovery rates, employment stability, customer retention) to validate perceptual resilience measures and reduce common method bias.

3. **Comparative institutional analysis:** Replicate the framework across diverse national contexts to examine how digital infrastructure quality, government policy, and cultural factors moderate the mediation pathway.
4. **Technology configuration typology:** Develop and test a taxonomy of digital technology portfolios to identify which specific configurations (e.g., customer-facing vs. operations-focused) most effectively cultivate agility for different MSE profiles.

6. Conclusion

This study demonstrates that organizational agility is the principal mechanism through which digital transformation enhances enterprise resilience among micro and small enterprises in the post-pandemic recovery phase, with the indirect effect accounting for 65% of the total relationship and 89.4% of high-resilience firms having implemented at least three digital technology categories. The validated sequential mediation framework advances both theory and practice: it specifies the capability-building pathway that dynamic capabilities theory predicts but has rarely confirmed in MSE contexts, and it provides managers and policymakers with actionable guidance to prioritize depth of integration and strategic alignment over mere technology acquisition. For MSE owner-managers, the practical takeaway is unequivocal: digital investments yield resilience benefits primarily when they build the capacity to sense and respond rapidly—agility, not adoption counts, is the operative lever. As the post-pandemic recovery continues to unfold amid ongoing economic uncertainty, the enterprises that thrive will be those that treat digital transformation not as a destination but as a continuous process of cultivating adaptive capability.

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